Table 8 The Sample of Publicly-Traded Cable Service Companies				
	Cable Service Revenue (as a % of Total 1993 Revenue)	*Dividends*	*1993 Net Worth ($000s)*	*1993 Net Income ($000s)*
Adelphia Communications Corporation	95.0%	None	-868,614	-176,795
Cablevision Systems Corporation	95.0%	None	-1,503,244	-246,782
Century Communications Corporation	87.6%	3% Stock Paid in December 1993	-68,906	-37,791
Comcast Corporation	81.9%	$0.023 Cash Paid in June 1994	-870,531	-859,225
Jones Intercable, Inc.	86.0%	None	31,649	-56,790
Jones Spacelink, Inc.	81.4%	None	6,988	-13,412
TCA Cable TV, Inc.	89.5%	$0.11 Cash Paid in July 1994	90,251	20,449
Tele-Communications, Inc.	91.0%	None	2,112,180	-9,000

2. The Commission's Concerns About the Use of Cable Equity Betas Turn Out To Be Unwarranted

The Commission raised several concerns about the use of cable stock betas in its Cost-of-Service Order. As a result of these concerns, the Commission generally dismissed evidence that relied on these betas. If truly necessary, this would be an extremely unfortunate result, because data from traded securities for companies in the industry in question provide by far the best evidence from which to infer the cost of capital.[39] Fortunately, an examination of the Commission's concerns reveals that they do *not* turn out to warrant disregard of evidence from the cable industry

[39] For example, it is our understanding that in the 1990 Telco Represcription Order (Cost-of-Service Order, Attachment D at ¶ 28), the Commission gave the greatest weight to the cost of equity estimate for the Regional Bell Holding Companies (RBHCs) in determining a reasonable zone for the cost of equity for interstate access service. We endorse a policy of primary reliance on evidence from publicly traded companies in the industry in question, and strongly urge use of the same policy for cable companies.

itself. It does turn out to be possible to make valid use of information from publicly traded companies in the business of providing regulated cable service.

a. Concern About Cable Betas Based on Closely Held Nature of Cable Stocks

The Commission raised a concern that the closely-held nature of cable stocks may bias the betas upward, or even render them useless.[40] Part of this concern was based on the Commission's observation that specific high betas appeared to correspond to high insider holdings. A problem with this comparison is that it does not control for differences in the amount of debt. The high equity betas cited by the Commission are, in most cases, accompanied by high debt levels. It turns out that once adjusted for capital structure differences, the betas for the cable companies are well in line with each other and rather stable over time.

Table 9 presents equity betas for the sample of cable service companies from 1987 through April 1994. Table 10 presents the same equity betas restated (*i.e.*, "relevered") to a 50 percent debt-to-value capital structure.

First, we note that the relevered equity betas in Table 10 are generally stable over time, although there is a pattern of increasing betas in 1993 and 1994, addressed later in this report. Second, with betas adjusted for capital structure, many of the aberrations cited by the Commission disappear. The betas for these companies are all well in line with each other. Consider Adelphia: Adelphia has approximately 74 holders of record.[41] At a 50 percent debt-to-value ratio, the April 1994 equity

---

[40] At ¶ 176 of the Cost-of-Service Order the Commission states, "As we note in Attachment D, The high betas of some cable equity issues reflect the closely-held nature of the stock. We believe that the historic pattern of fluctuations in cable stock prices is not purely the outcome of the changing risk-and-return assessments of market investors, but instead reflects in large measure insider decisions regarding cable stocks."

[41] 1993 Adelphia Annual Report.

beta for Adelphia is 1.20, considerably lower than the 2.37 beta calculated at its estimated market capital structure of over 80 percent debt, and even lower than the overall average for the sample of cable companies.

Table 9

Equity Betas for Cable Service Companies

	1987	1988	1989	1990	1991	1992	1993	1994
Adelphia	NA	NA	NA	NA	1.58	1.80	2.15	2.37
Cablevision	NA	NA	NA	NA	1.52	1.75	1.91	1.99
Century	NA	NA	NA	NA	1.90	2.09	2.35	2.31
Comcast A	0.93	1.04	1.08	1.26	1.21	1.52	1.63	1.55
Comcast Special	NA	NA	NA	NA	1.25	1.63	1.70	1.64
Jones Intercable	1.34	1.40	1.47	1.38	1.26	1.38	1.67	1.69
Jones Intercable A	1.69	1.83	1.75	1.65	1.56	1.82	2.05	1.91
Jones Spacelink	1.55	1.47	2.09	2.32	2.15	2.36	2.26	2.34
TCA Cable	0.85	0.89	0.88	0.99	0.85	0.89	0.92	0.89
Tele-Comm. A	1.20	1.33	1.31	1.48	1.40	1.68	1.78	1.79
Tele-Comm. B	1.04	1.15	1.16	1.34	1.23	1.33	1.48	1.49
Avg. Cable TV	1.23	1.30	1.39	1.49	1.45	1.66	1.81	1.82

Source: The Brattle Group.

Note: Betas are estimated using Compuserve stock price data for the 60 months prior to and including December of that year except for 1994, which is estimated for the 60 months prior to and including April 1994.

Table 10

Equity Betas of Cable Service Companies Adjusted to Hypothetical 50% Debt-to-Value Capital Structure

	1987	1988	1989	1990	1991	1992	1993	1994
Adelphia	NA	NA	NA	NA	1.06	1.07	1.13	1.20
Cablevision	NA	NA	NA	NA	1.27	1.32	1.44	1.48
Century	NA	NA	NA	NA	1.95	2.00	2.19	2.16
Comcast A	1.33	1.28	1.28	1.41	1.36	1.51	1.73	1.66
Comcast Special	NA	NA	NA	NA	1.40	1.60	1.80	1.74
Jones Intercable	1.41	1.48	1.50	1.31	1.21	1.27	1.47	1.49
Jones Intercable A	1.70	1.85	1.73	1.51	1.42	1.56	1.73	1.63
Jones Spacelink	1.48	1.39	1.72	1.65	1.49	1.42	1.34	1.38
TCA Cable	1.31	1.39	1.32	1.44	1.24	1.28	1.31	1.27
Tele-Comm. A	1.25	1.38	1.37	1.47	1.41	1.66	1.82	1.83
Tele-Comm. B	1.13	1.22	1.24	1.35	1.27	1.37	1.56	1.57
Avg. Cable TV	1.37	1.43	1.45	1.45	1.37	1.46	1.59	1.58

Source: The Brattle Group.

Note: Betas are estimated using Compuserve stock price data for the 60 months prior to and including December of that year except for 1994, which is estimated for the 60 months prior to and including April 1994.

Cablevision, cited by the Commission, is controlled by a single shareholder, and insiders own 19 percent of Class A and 55 percent of Class B shares.[42] There is no established market for the Class B shares, so the beta we report is only for the class A shares. The April 1994 stock beta for Cablevision is 1.99. Adjusted to a 50 percent debt-to-value ratio, the equity beta is 1.48. Again, this value is slightly lower than the cable sample average.

Jones Spacelink and Jones Intercable were also cited by the Commission as having equity betas which may be biased because of the large holdings by insiders.[43] Just as with the previous companies, once leverage has been taken into account, the equity betas are close to the sample average. The cable equity betas for Jones Intercable common stock, Jones Intercable Class A and Jones SpaceLink Class A, adjusted to a 50 percent debt-to-value ratio, are 1.49, 1.63 and 1.38 respectively. The average leverage-adjusted beta for the sample of cable companies is 1.58.

Thus, the leverage-adjusted equity betas, which allow for intertemporal and cross-sectional comparisons, do not suggest a wide variation in the equity betas for cable companies. These data do not seem to support a claim that large insider holdings of cable stocks affects the equity beta.

The Commission also was concerned that for closely-held companies, buy/sell decisions by insiders can affect the stock price, "magnifying the underlying business and financial risks of the companies."[44] There are two reasons this concern turns out to be unwarranted, one based on the kinds of trades that would be necessary to produce such a bias, and the second on a well-documented bias in the opposite direction in betas for closely held companies.

---

[42] Cost-of-Service Order, Attachment D, at ¶ 25.

[43] *Ibid.*

[44] Cost-of-Service Order, Attachment D, at ¶ 26.

First, beta is based on analysis of 60 months of correlations of a stock's returns with the market's returns. For a particular subset of trades to magnify beta, they would have to be (a) frequent; (b) large enough to materially affect the price, and (c) timed in a way that repeatedly happened to exaggerate the tendency for the stock to move in the same direction as the market moved. This combination seems, at the very best, extremely unlikely.

For example, the Value Line reports cited by the Commission[45] track insider decisions to buy, sell, or exercise options but they do not indicate the size of the transaction. Of the eight publicly traded companies in our sample, only three of them are covered in Value Line. Value Line indicates that for these stocks, insiders have made decisions to buy, sell or exercise options in various months over the past year.[46] However, the number of insider decisions were relatively small and not very frequent. Cablevision, for example, had no insider decisions from December 1993 to April 1994. For the three months prior to that, there was an average of slightly greater than two decisions to exercise options and three decisions to sell. Comcast had a sporadic pattern of insider decisions over the past year, with only two instances of decisions by insiders to sell over the entire year, and six months with an average of slightly less than two insider decisions per month to exercise options. Tele-Communications, Inc. has had no insider decisions since October of 1993. In short, while insiders do buy and sell stock, it seems extremely unlikely that such trades have the frequency, size, and market correlation necessary to magnify beta.

The second, and well documented, concern about cable stocks being closely-held is that cable stocks may not be traded frequently as a result. If insiders hold a large fraction of the stock and the rest is held by institutional investors and others, the stock may not be traded often. Insiders and institutional investors tend to hold onto

---

[45] Cost-of-Service Order, Attachment D, at ¶ 26.

[46] *Value Line Investment Survey*, Edition 2, June 24, 1994.

their shares for extended periods of time. This so-called "thin trading problem" can create problems in the estimation of beta. Scholes and Williams (1977) and Dimson (1979)[47] studied this problem and concluded that when shares are traded infrequently, beta estimates can be *downward*-biased.

Dimson recommended alternative estimating procedures to the conventional method which eliminates the bias. The procedures are described in Appendix B. The results are summarized in Table 11. The beta estimates are *higher* using the Dimson procedure, as predicted.

---

[47] *See* Elroy Dimson, "Risk Measurement When Shares are Subject to Infrequent Trading", *Journal of Financial Economics*, Vol. 7, 1979, pages 197-226, and Myron Scholes and Joseph Williams, "Estimating Betas from Nonsynchronous Data", *Journal of Financial Economics*, Vol. 5, 1977, pages 309-327.

Table 11

Cable Company Equity Betas Adjusted for Thin Trading Bias

	Beta 59 Months To Dec 1993	Beta 59 Months To April 1994
Adelphia	1.91	2.30
Cablevision	3.53	3.70
Century	3.42	3.44
Comcast A	1.84	1.98
Camcast Special	2.00	2.17
Jones Intercable	2.52	2.53
Jones Intercable A	3.07	2.94
Jones Spacelink	2.96	2.94
TCA Cable	2.40	2.46
Tele.-Comm. A	2.06	2.17
Tele.-Comm. B	2.00	2.13
Avg. Cable TV	2.52	2.61

Source: The Brattle Group.

Note: Betas are estimated using Compuserve stock price data.

We conclude that if the closely-held nature of cable stocks has any effect on cable betas, it is potentially to bias the estimates *downward*. However, we make no adjustment for this effect in our calculations.

b. Concerns About Cable Betas Based on a View that Cable Companies Have Historically Had Monopoly Power

The Commission also raises the concern that cable betas reflect investor expectations for monopoly profits.[48] Table 8 above shows the net income for our sample of cable companies. For what it is worth, only one of the eight companies made profits in 1993. Moreover, even if these companies were making monopoly profits as the Commission fears, the loss in revenue associated with cable regulation will *increase* the operating leverage of the companies. An increase in operating leverage, all else equal, will increase the business risk of the company and subsequently the stock beta. Thus, a move from expectations for monopoly profit levels to competitive profit levels, were that the case, would only indicate that cable stocks in the future will be *more* volatile, and, if anything, that the betas would *increase* as a result.

c. The Cable Equity Betas Measured Today are Likely to Be Conservative Estimates of the True Betas

Finally, the Commission is concerned that since the beta estimates of cable companies are based on historic data, they are not indicative of the risks facing cable companies in the future.[49] Specifically the Commission notes that the last five years have been replete with unique events, and hence, that betas measured over this time period may not be representative of the future. The beta history of cable companies presented in Table 10 does not support this concern. The equity betas

---

[48] Cost-of-Service Order at ¶ 176.

[49] Cost-of-Service Order, Attachment D, at ¶ 27.

presented there are all adjusted to the same leverage ratio. This facilitates intertemporal beta comparisons. The constant-leverage betas are relatively stable over time. Moreover, the equity betas for 1987 rely on data for the previous 60 months. Thus, the estimates cover a period of almost 10 years. These results suggest that historical forecasts of beta are good predictors of forward-looking betas for cable companies. If anything, the historic betas appear to be underestimates of investors' future expectations of the risks of cable companies.

We tested for recent changes in beta to see if the upward trend observed in the 60-month betas in Tables 9 and 10 was an aberration or indicative of investor's risk perceptions of the cable industry. We estimated 24-month and 52-week betas for December 1993 and April 1994. The results are summarized in Table 12. These data suggest that the risk of these companies is trending up. Contrary to the Commission's belief that cable stock betas should be adjusted downward to be representative of forward-looking betas, these data suggest the opposite. Historic equity betas would need to be adjusted upward to be representative of the risks facing cable companies in the future. Using the current 60-month stock beta, therefore, will produce a conservative estimate of the cost of equity for cable companies.

Table 12

60–Month, 24–Month and 52–Week Equity Betas for Cable Service Companies

	December 1993			April 1994		
	(60 months)	(24 months)	(52 weeks)	(60 months)	(24 months)	(52 weeks)
Adelphia	2.15	4.17	3.46	2.37	4.89	5.12
Cablevision	1.91	2.42	2.43	1.99	2.44	2.27
Century	2.35	3.51	2.29	2.31	2.86	2.30
Comcast A	1.63	4.29	2.69	1.55	3.06	2.81
Comcast Special	1.70	3.88	2.62	1.64	2.95	3.17
Jones Intercable	1.67	4.30	2.36	1.69	2.71	2.65
Jones Intercable A	2.05	4.50	2.54	1.91	2.70	2.59
Jones Spacelink	2.26	2.69	3.59	2.34	2.52	6.02
TCA Cable	0.92	1.78	1.06	0.89	1.83	1.01
Tele-Comm. A	1.78	1.73	2.35	1.79	1.78	3.08
Tele-Comm. B	1.48	1.87	2.73	1.49	1.81	2.72
Avg. Cable TV	1.81	3.20	2.56	1.82	2.69	3.25

Source: The Brattle Group.

Note: Betas are estimated using Compuserve stock price data for the 60 months, 24 months, and 52 weeks prior to and including December 1993 and April 1994.

It is not surprising to see equity betas of our sample of cable companies increasing. As described in Section III, the onset of regulation and an increasingly competitive environment are contributing to increased business risk for regulated cable service. To the extent that regulation reduces the cash flows cable service companies would otherwise have had, the consequent increase in operating leverage increases the risk of those companies. For regulators then to fail to acknowledge that increased risk, would be a "Catch-22" indeed.

3. Cable Company Cost of Capital Estimates

We estimated CAPM and ECAPM cost of equity models for the sample of cable companies as of April 1994. The results are summarized in Table 13 below and shown in detail in Tables B-7 and B-8 in Appendix B. The average all-equity cost of capital for the sample of cable companies was also adjusted to a 50 percent debt-to-value ratio.

Table 13
Average Risk-Positioning Cost of Equity Estimates
Cable Company Sample
April 1994

	CAPM (%)	*ECAPM (%)*
Cost of Equity (At observed Capital Structure)	20.4	18.8
All-equity cost of capital	13.6	13.1
Cost of Equity (At Hypothetical 50% Debt-to-Value Capital Structure)	18.6	17.6

The average cost of equity estimated for the sample of cable companies *exceeds* the estimates of the cost of equity for both the non-dividend and dividend paying companies in the S&P 400. However, since the cable companies are highly leveraged, a better comparison is to look at the all-equity results. The average all-equity cost of capital for cable companies is slightly lower than the all-equity cost

of capital estimates for the non-dividend paying companies in the S&P 400 presented in Table 5, but exceeds the average all-equity cost of capital for the dividend paying companies. Referring back to the all-equity cost of capital estimates by quartile reported in Table 2, we observe that the average all-equity cost of capital for the cable companies falls squarely within the risk positioning range of the third quartile of the S&P 400.[50] That is, the prediction that the cable industry would display the above-average risk associated with non-dividend paying stocks was confirmed. Finally, the cost of equity for the cable companies adjusted to the hypothetical capital structure of 50 percent debt is between 17.5 percent and 18.5 percent. As we see from Tables 1 and 13, the levered cost of equity estimate for cable is well at the top of the range of risk positioning cost of equity estimates for the fourth quartile of the dividend paying companies in the S&P 400. These estimates are even further above the 12 percent to 15 percent range recommended by the Commission in the Cost-of-Service Order.

Based on these estimates alone, a conservative estimate of the cost of equity for cable companies is 17.5 percent at a hypothetical capital structure of 50 percent debt. The all-equity cost of capital then is conservatively estimated at 13.0 percent. These estimates do not reflect any consideration for the special circumstances facing many cable companies such as illiquidity associated with privately-held companies and very small size.

---

[50] The need to adjust for leverage is illustrated by the observation that the all-equity cost of capital for the sample of cable companies falls within the third quartile of the S&P 400 dividend paying companies. However, the cost of equity for cable companies estimated at a hypothetical 50 percent debt-to-value capital structure falls into the fourth quartile of the cost of equity estimates of the S&P 400 dividend paying companies. We note that the cost of equity estimates of the fourth quartile could be unstable as capital structure changes over time, whereas basing the results on an all-equity cost of capital eliminates the need to adjust for leverage.

C. TELECOMMUNICATION COMPANIES

We also examined companies in the telephone exchange business. These companies are the seven RBHCs.[51] The companies derive substantial portions of their revenues from local exchange/toll services.

We estimated CAPM and ECAPM cost of equity models for the sample of telecommunication companies as of April 1994. The models are those used for the S&P 400 and we describe them in detail in Appendix B. The results are summarized in Table 14 below and shown in detail in Tables B-9 and B-10 in Appendix B. The average all-equity cost of capital estimate for the sample of telephone companies was also adjusted to a 50 percent debt-to-value ratio.

Table 14
Average Risk-Positioning Cost of Equity Estimates
Telecommunications Company Sample
April 1994

	CAPM (%)	*ECAPM (%)*
Cost of Equity (At observed Capital Structure)	11.7	12.1
All-equity cost of capital	10.8	11.1
Cost of Equity (At Hypothetical 50% Debt-to-Value Capital Structure)	13.0	13.7

The average cost of equity estimates for the telecommunications company sample are lower across the board than the cost of equity estimates for the cable company sample, as summarized in Table 14. The average all-equity cost of capital estimates for the RBHCs are 2 to 3 percentage points *lower* than the all-equity cost of capital estimates for the sample of cable companies. This is evidence in support of the claim that the business risk of cable companies *exceeds* that of telecommunication

[51] The seven RBHCs are Ameritech, Bell Atlantic, Bell South, NYNEX, Pacific Telesis, Southwestern Bell, and US West.

companies. The average cost of equity for telecommunication companies levered to a hypothetical capital structure of 50 percent debt results in cost of equity estimates 4 to 6 percentage points *lower* than that for the sample of cable companies.

Relative to the dividend paying companies in the S&P 400, the telecommunication companies have risk positioning cost of equity estimates *below* the overall average and comparable to the estimates of those in the first quartile. Similar results hold when we eliminate the effect of leverage. Referring back to Table 6, we observe that the average all-equity cost of capital estimates for the telecommunication company sample is well within the range of the estimates for the first quartile of the S&P 400 dividend paying companies. The all-equity cost of capital for the telecommunication companies is well below the average all-equity cost of capital for the non-dividend paying companies of the S&P 400, approximately 14.6 percent to 15.0 percent (as shown in Table 5). Thus, the business risk of the RBHCs appears to be in the range of the first or second quartile of the S&P 400 dividend paying companies and well below that of the non-dividend paying companies.

V. CONCLUSIONS

Estimation of the cost of capital for cable television turns out to be a much harder task than regulators normally must face. The most widely used estimation method in rate regulation, the Discounted Cash Flow approach, makes no sense for cable companies because most of the available publicly traded sample companies pay no dividends. Moreover, since the DCF approach contains *no* adjustment for relative risk, picking a group of allegedly comparable companies based merely on intuition and subjectivity is highly likely to lead to an arbitrary and capricious outcome.

The goal of this report has been to assist the Commission to resolve these problems by broadening the focus to methods that *can* be used when stocks pay no dividends.

We rely on what is literally the textbook model of the cost of capital, the Capital Asset Pricing Model, and on a variant of it, based on empirical research, that produces somewhat lower estimates for cable companies. We also consider the cost of capital for benchmark groups the Commission has considered, the S&P 400 by quartile and the Regional Bell Holding Companies.

Our results show that on average, the no-dividend stocks in the S&P 400 are indeed riskier and have higher costs of capital than those that pay dividends. For S&P 400 stocks that do pay dividends, we show that DCF methods produce somewhat *higher* estimates of the cost of capital than the CAPM approaches do.

We also address directly the concerns the Commission raised about use of the CAPM in the cable context. For example, the CAPM risk measures ("betas") for cable companies turn out to be stable over time and insensitive to whether the company is broadly or closely held once we control for differences in capital structure. That is, additional debt creates additional financial risk for equityholders, so the only way to get an "apples to apples" comparison of the betas of different companies is to restate them at a constant debt ratio. Once this is done, the pattern that was of concern to the Commission disappears.

We address other concerns as well. Thus, there is no obvious mechanism by which trades of a closely held stock by "insiders" could magnify betas, and the evidence that does exist contradicts the possibility. To the contrary, a closely held company is likely to be associated with thin trading, which biases betas *downward.* Similarly, whether or not it were true that cable companies had enjoyed a degree of monopoly profits before regulation, the cash flow cuts that regulation engenders will increase the companies' operating leverage and hence their cost of capital in the future. In fact, there may be evidence of this phenomenon in the recent upturn in the values of constant-debt-ratio cable betas. In any case, the evidence is clear that

once we control for capital structure, use of standard 60-month betas is likely to underestimate the current cost of capital.

In short, it turns out that none of the Commission's concerns warrant a disregard of the best evidence that exists on an industry's cost of capital (and the kind of evidence the Commission has primarily relied on elsewhere), analysis of the securities of companies actually in the industry.

That evidence suggests that the regulatory weighted-average cost of capital of cable television is 13 percent, well above the 11.25 percent adopted by the Commission on an interim basis. This weighted-average cost of capital is squarely within the range of that of the third quartile of the dividend paying companies in the S&P 400, and well above that of the RBHCs. (The publicly traded cable companies seem to be somewhat less risky than the no-dividend stocks in the S&P 400, which have a weighted-average cost of capital of about 14 percent.) Moreover, there are numerous cable companies that are not publicly traded, and investors in untraded companies require a "liquidity premium" that cannot be quantified with currently available financial models. Therefore, a weighted-average cost of capital of 13 percent would be a conservative value to adopt for the cable industry generally.

APPENDIX A

QUALIFICATIONS OF A. LAWRENCE KOLBE

APPENDIX A

QUALIFICATIONS OF A. LAWRENCE KOLBE

Lawrence Kolbe is a Principal of The Brattle Group, an economic, management and environmental consulting firm located in Cambridge, Massachusetts. Before co-founding The Brattle Group, he was a Director of Putnam, Hayes & Bartlett, and before that, he was a Vice President of Charles River Associates (CRA). Before joining CRA, he was an Air Force officer assigned to the Office of the Secretary of Defense and earlier to Headquarters, USAF.

His work has included extensive research in financial economics, especially as it applies to rate regulation, project or asset valuation, and the decisions of regulated firms. Clients for this work include the California Public Utilities Commission, the Consumer Advocate in a Newfoundland proceeding, the Edison Electric Institute, the Electric Power Research Institute, the Interstate Natural Gas Association of America, the Newfoundland Federation of Municipalities, the Nova Scotia Board of Commissioners of Public Utilities, the U.S. Department of Energy, the U.S. Department of State, the Town of Labrador City, and a number of private firms, many in rate-regulated industries.

He is the coauthor of two books and has published a number of articles. He is coauthor of a report filed with the British Office of Fair Trading, in London, and he has been an expert witness in proceedings before the International Bureau of the Permanent Court of Arbitration in The Hague, the Iran - United States Claims Tribunal in The Hague, U.S. District Courts in Colorado, New Jersey, Oklahoma and Texas, a commercial arbitration tribunal in Australia, a commercial arbitration tribunal held in London concerning a dispute in Australia, and the Minerals Management Service of the U.S. Department of the Interior; in U.S. federal regulatory proceedings before the Postal Rate Commission, the U.S. Federal Communications Commission, the U.S. Federal Energy Regulatory Commission and the U.S. Federal Maritime Commission; and in state or provincial regulatory proceedings in Alaska, Arkansas, California, Maine, Massachusetts, Michigan, Montana, Newfoundland, Nova Scotia, Ohio and Virginia.

He holds a B.S. in International Affairs (Economics) from the U.S. Air Force Academy and a Ph.D. in Economics from the Massachusetts Institute of Technology.

Additional information on his qualifications follows.

HONORS AND AWARDS

Sears Foundation National Merit Scholarship, 1963 (declined).

Fairchild Award, U.S. Air Force Academy, 1968 (for standing first in his class, academically).

HONORS AND AWARDS (continued)

National Science Foundation Graduate Fellowship in economics, MIT, 1968-1971.

Joint Service Commendation Medal, 1975

PROFESSIONAL AFFILIATIONS

American Economic Association

American Finance Association

The Econometric Society

Referee for *The Rand Journal of Economics*, *Land Economics*, *The Journal of Industrial Economics*

RECENT PAPERS AND PUBLICATIONS

"Banking on NUG Reliability" (with Sarah Johnson and Johannes P. Pfeifenberger). *Public Utilities Fortnightly*, May 15, 1994.

"Purchased Power: Risky Business?" (with Sarah Johnson, Johannes P. Pfeifenberger and David W. Weinstein). *The Electricity Journal*, forthcoming.

"Financial and Discount Rate Issues for Strategic Management of Environmental Costs" (with Stewart C. Myers). *Air and Waste Management Association*, forthcoming.

"Section 712 Issues: Risk Identification, Allocation and Compensation." Paper presented to National Association of Regulatory Utility Commissioners (July 1993) and published in *Presentations and Papers from the National Seminars on Public Utility Commission Implementation of the Energy Policy Act of 1992*. Columbus, OH: National Regulatory Research Institute, December 1993.

"Purchased Power Risks and Rewards" (with Sarah Johnson and Johannes P. Pfeifenberger). *TBG* report prepared for Edison Electric Institute, November 1993.

"Rate Base Issues in Cable Television Cost-of-Service Regulation" (with Susan E. Vitka). *TBG* Report filed in Federal Communications Commission Docket No. 93-215, August 1993.

RECENT PAPERS AND PUBLICATIONS (continued)

"Rate of Return Issues in Cable Television Cost-of-Service Regulation" (with Lynda S. Borucki). *TBG* Report filed in Federal Communications Commission Docket No. 93-215, August 1993.

"The Failure of Competition in the Credit Card Market: Comment" (with Stephen H. Kalos, Carlos Lapuerta and Stewart C. Myers). Working paper in progress.

"How to Value a Lost Opportunity: Measurement of Damages with or without Hindsight" (with William B. Tye and Stephen H. Kalos). Working paper in progress.

"Event Study of the Effects on Pacific Gas & Electric's Debt of the Guarantee of Pacific Gas Transmission's Debt" (with Lynda S. Borucki). *TBG* report prepared for Pacific Gas & Electric Company, May 1993.

"It's Time for a Market-Based Approach to DSM" (with M. Alexis Maniatis, Johannes P. Pfeifenberger and David M. Weinstein). *The Electricity Journal* 6, 42-52 (May 1993).

Regulatory Risk: Economic Principles and Applications to Natural Gas Pipelines and Other Industries (with William B. Tye and Stewart C. Myers). Boston: Kluwer Academic Publishers (1993).

"EPA's 'BEN' Model: A Change for the Better?" (with Kenneth T. Wise and M. Alexis Maniatis), *Toxics Law Reporter* 7, 1125-1129 (February 24, 1993).

"CATALYST: A Group Process for Strategic Decision Making: Facilitators' Guidebook" EPRI TR-100583. (With P.G. Abrahamson, A. Cohn, P.A. Morris and D. M. Murphy). Palo Alto, CA: Electric Power Research Institute (September 1992).

"Who Pays for Prudence Risk?" (with William B. Tye), *Public Utilities Fortnightly* (August 1, 1992).

"Types of Risk that Utilities Face," *TBG* report prepared for Niagara Mohawk Power Corporation, May 7, 1992.

"EPA's 'BEN' Model: Challenging Excessive Penalty Calculations" (with Kenneth T. Wise, Paul R. Ammann and Scott M. DuBoff), *Toxics Law Reporter* 6, 1492-1496 (May 6, 1992).

"Optimal Time Structures for Rates in Regulated Industries" (with William B. Tye). *Transportation Practitioners Journal* 59, 176-199 (Winter 1992).

RECENT PAPERS AND PUBLICATIONS (continued)

"How to Value a Lost Opportunity: Defining, Proving and Measuring Damages from Market Foreclosure" (with William B. Tye and Stephen H. Kalos), Working paper in progress.

"Environmental Cleanup Liabilities" (with William B. Tye), *Public Utilities Fortnightly* (January 1, 1992).

"The Fair Allowed Rate of Return with Regulatory Risk" (with William B. Tye), *Research in Law and Economics* 15, 129-169 (1992).

"Risk of the Interstate Natural Gas Pipeline Industry" (with Stewart C. Myers and William B. Tye), Washington, DC: Interstate Natural Gas Association of America (October 1991).

"The *Duquesne* Opinion: How Much '*Hope*' Is There for Investors in Regulated Firms?" (with William B. Tye). *Yale Journal on Regulation*, Winter 1991.

"How Far Back Should Prudence Tests Reach?" (with William W. Hogan). *Public Utilities Fortnightly* (January 15, 1991).

"Practical Implications of the Supreme Court's *Duquesne* Opinion for Regulated Industries" (with William B. Tye). *Public Utilities Fortnightly* (August 30, 1990).

"Evaluating Demand-Side Options" (with Matthew P. O'Loughlin and Stephen W. Chapel) Palo Alto, CA: Electric Power Research Institute.

"Financial Constraints and Electric Utility Capital Requirements," (with Matthew P. O'Loughlin) *Proceedings of the 1989 EPRI Utility Strategic Issues Forum.* Palo Alto, CA: Electric Power Research Institute.

"When Choosing R&D Projects, Go with the Long Shot" (with Peter A. Morris and Elizabeth Olmstead Teisberg). *Research Technology Management* (January-February 1991).

"EPRI PRISM Interim Report: Parcel/Message Delivery Services" (with Richard W. Hodges), PHB report prepared for the Electric Power Research Institute, RP-2801-2 (June 1989).

"Capital Requirements for the U.S. Investor-Owned Electric Utility Industry, 1985-2005" EPRI P-5830. (PHB report with Sarah K. Johnson and Matthew P. O'Loughlin). Palo Alto, CA: Electric Power Research Institute (June 1988).

RECENT PAPERS AND PUBLICATIONS (continued)

"Are Regulatory Risks Excessive? A Test of the Modern Balance between Risk and Reward for Electric Utility Shareholders" (PHB report with Matthew P. O'Loughlin). Division of Coal and Electric Policy, U.S. Department of Energy (May 1986).

"Cash Flow Risk, the Cost of Capital, and the Fair Allowed Rate of Return." Working paper in progress.

"Determining the Cost of Capital for Utility Investments" (with Robert A. Lincoln and James A. Read, Jr.). In *Energy Markets in the Longer-Term: Planning under Uncertainty*. A.S. Kydes and D.M. Geraghty, ed. North-Holland: Elsevier Science Publishers, 1985.

"How Can Regulated Rates -- and Companies -- Survive Competition?" *Public Utilities Fortnightly* 115 (4 April 1985).

"Inflation and Rate of Return Regulation" (with Stewart C. Myers and William B. Tye). In *Research in Transportation Economics*, Volume II. Greenwich, CT: JAI Press, Inc., 1985.

"Annual Capital Charges That Will Survive Competition." Prepared for the 11th Annual Rate Symposium, The Institute for Study of Regulation. February 1985.

The Cost of Capital: Estimating the Rate of Return for Public Utilities (with James A. Read and George R. Hall). Cambridge, MA: The MIT Press, 1984.

"Conditions for Investor and Customer Indifference to Transitions Among Regulatory Treatments of Deferred Income Taxes" (with William B. Tye and Miriam Alexander Baker). *The Rand* (formerly *Bell*) *Journal of Economics* (Fall 1984).

"The Cost of Capital and Investment Strategy" (with Robert A. Lincoln). *Management Review* (May 1984).

"Regulation and Capital Formation in the Oil Pipeline Industry" (with Stewart C. Myers and William B. Tye). *Transportation Journal* (Spring 1984).

"Regulatory Treatment of Deferred Income Taxes Resulting from Accelerated Depreciation by Motor Carriers" (with William B. Tye and Miriam Alexander Baker). *Transportation Journal* (Spring 1984).

RECENT PAPERS AND PUBLICATIONS (continued)

"The Economics of Midstream Switches in Regulatory Treatments of Deferred Income Taxes Resulting from Accelerated Depreciation" (with William B. Tye and Miriam Alexander Baker). *ICC Practitioners' Journal* (November-December 1983).

"Selection of Discount Rates for Project Evaluations." Prepared for the 27th AACE Meeting. June 1983.

"What Rate of Return Makes Your Energy Investment Worthwhile?" (with Robert A. Lincoln). *Power* (April 1983).

"Inflation-Driven Rate Shocks: The Problem and Possible Solutions." *Public Utilities Fortnightly* 111 (17 February 1983).

"Inflation and Utility Finances: Problems and Possible Solutions." Presented at the NARUC Biennial Regulatory Information Conference. September 1982.

"A Model of Capital Market Interactions with Utility Strategic Decisionmaking." Presented at the IMACS World Conference on Systems Simulation and Scientific Computation. August 1982.

"Marginal Cost Pricing with Inflation" (with William R. Hughes). Delivered to the IAEE Conference on International Energy Issues. June 1981.

"The Economics of Revenue Need Standards in Motor Carrier General Increase Proceedings" (with William B. Tye and Miriam Alexander Baker). *Transportation Journal* (Summer 1981).

"Flow-Through Versus Normalization of Deferred Income Taxes for Motor Carriers" (with William B. Tye and Miriam Alexander Baker). *Motor Freight Controller* (December 1980).

CRA Reports (Often Written with Others)

"Evaluating the Effects of Time and Risk on Investment Choices: A Comparison of Finance Theory and Decision Analysis" (with Applied Decision Analysis, Inc.). Published by the Electric Power Research Institute. January 1987.

"The 'Abandonment Value' of Shorter Leadtimes" (with Applied Decision Analysis, Inc.). June 1985.

"Rate Shock and Power Plant Phase-In: Discussion Paper of Generic Issues." Published by the Edison Electric Institute. December 1984.