AN ANALYSIS OF THE RISK PREMIUMS ON THE DEBT OF INVESTOR-OWNED ELECTRIC UTILITIES BASED ON THE TYPE OF FUEL USED TO GENERATE ELECTRIC POWER FOR THE YEARS 1978-1980

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Scope and Method of Study: This study utilizes F-tests and linear regression analysis to test the hypothesis that investors, at each different Standard & Poor's rating level, require different risk premiums on the debt of investor-owned electric utilities, based on the dominant type of fuel used to generate electric power. Those 140 investor-owned electric utilities published in the Interstate Securities Electric Utilities Atlas and their company-specific fuel source information were selected for this study. Standard & Poor's bond ratings and yield figures were collected on a monthly basis for each electric utility studied. The company data were categorized several different ways for testing using combinations of month, rating, and dominant fuel source.

Findings and Conclusions: An annual breakdown of company power generation by dominant fuel source revealed no clearcut trends of electric utilities moving out of nuclear fuel and into another fuel type in an attempt to reduce their fuel-related risks. When the company data were grouped first by month, then by dominant fuel type the F-test results indicated that the events occurring over time affected all fuel types in a similar manner. The results of the F-tests performed after the data were grouped by rating then by dominant fuel source indicated that the average yields and average yield ranges were not equal, but because the results were not analyzed on year-by-year basis it was difficult to attribute these differences to the shock of Three-Mile Island. The regression analysis indicated that the electric utility rates closely followed the yield rate trend set by long-term U.S. Government bonds and that the yields did not different significantly based on dominant fuel type.

ADVISER'S APPROVAL _[signature]_

PREFACE

This study is an analysis of the risk premiums on the debt of investor-owned electric utilities based on the type of fuel used to generate electric power for the years 1978 through 1980. The primary objective is to test the hypothesis that investors, at each different Standard & Poor's rating level, require different risk premiums on the debt of investor-owned electric utilities, based on the dominant type of fuel used to generate electric power.

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CHAPTER I

INTRODUCTION

Prior to the mid-sixties, the electric utility industry was considered to be operating in a stable and predictable environment.[1] Interest rates were quite stable, the inflation rate was low, energy supplies were considered infinite, and customer usage was climbing higher annually. The electric utilities were considered to be in an ideal situation for investment. Their costs were relatively fixed from period to period and demand was growing due to the increasing number of electric labor-saving devices that were entering the market, consequently their common stock and debt instruments were held in high regard by investors.

This idealistic situation didn't last indefinitely. Since the mid-sixties, all those elements which the companies and investors assumed to be fixed began to vary.[2,3] Interest rates began their long-run climb, inflation added to the cost of construction, new technologies rendered old installations obsolete, and demand suddenly outpaced generating capacity. Two additional events that were major factors in determining the current environment for the utility companies were: the Arab oil embargo and the accident at Three Mile Island.

These latter two events introduced risk and uncertainty into a new dimension of electric utility operations, that of fuel supply.

Now, in addition to forecasting electricity demands and capital requirements, the companies were also considering two types of risk associated with their power plant's fuel source: disruptive risk and price fluctuation risk.

Disruptive risk represents the risk that the fuel supplies to the electric power plant will be interrupted or stopped entirely. Basically, the sources of potential disruption could originate from any one or more of the following events: a strike, a shortage of fuel supplies, or a violation of EPA air and water regulations. Should one of these events occur, the utility would be forced to scramble to find another source of fuel to prevent the particular utility from experiencing a blackout.

Price fluctuation risk is the risk that supply and demand factors will work to push the price of generating fuel upward. These spiraling fuel costs will introduce a tremendous amount of risk into the utilities' cost control which, in turn, impacts on the utilities' profitab ility due to regulatory lag.

Since the early 1920's the electric utilities have been able to temper some of these upward price increases through automatic fuel adjustment clauses (AFAC).[4] AFAC's have enabled the electric utilities to pass through increased fuel costs to customers before an increase in the rate it charges has been approved through normal regulatory channels.

After the utility industry's widespread use of AFAC's during and after the Arab oil embargo, consumers have lashed out against this clause.[5] They pushed for legislation which would severly restrict or eliminate the fuel adjustment clauses. As a consequence, utilities will be forced to absorb an increasingly large share of the fuel costs passed on to customers.

Objective

This study's objective is to test the hypothesis that investors, at each different Standard & Poor's rating level, require different risk premiums on the debt of investor-owned electric utilities, based on the dominant type of fuel used to generate electric power.

Underlying Assumptions

A fundamental assumption of this paper is that the electric utility industry has moved over time from an environment of stability and certainty to one of uncertainty. This assumption is documented by various writers throughout the electric utility literature.

The second major assumption recognizes the presence of two types of risk found in each of the primary fuel types. Disruptive risk and price fluctuation risk are two principal forms of fuel-specific risk which may shift an electric utility's debt from one risk class to another. This shift in investment risk should result in a change in the bond's rating classification and interest yield in the market.

Consider the Three-Mile Island accident as an example of disruptive risk. Based on the above assumption, one would expect the following scenario to occur. The uncontrolled release of nuclear wastes into the environment would force the Nuclear Regulatory Commission to close down the generating power plant. This would immediately force the company to purchase its power from other utilities, thereby reducing its profit margin on electric power sold. During this same time frame the utility would face additional expenses for clean-up and repair - expenses further reducing profits. Thus this accident would immediately adversely affect current earnings, cash flows, and current ratio analysis. The intermediate and long-term effects would be poor ratio analysis, a weak energy position, and a tarnished image in the eyes of the regulatory authorities.

Since the clean-up and repair costs of nuclear accidents are much greater than those associated with other fuel types, one would expect that nuclear fuel would be considered as one of the most risky fuel types.

This leads to the third and final assumption, one that the financial community can digest the alternative risk levels corresponding to the disparate fuel types. The financial community relies on the services of the two major rating agencies, Moody's and Standard & Poor's, to account for the business risk entailed by the financial and operating risks of the issuer. These differences in risk are translated into a graduated rating system, which is used by market investors to pre-select a group of utility bonds within a given rating category.

Within the individual rating categories, investors can discriminate between utility bonds based on such characteristics as fuel type used to generate electric power. These investors have learned to assign risk premiums to the bond returns based on their perceptions of fuel source risk.

Since the agency ratings adequately reflect differences in business risk, they, in turn, influence the promised yields (the lower the default risk, the higher the agency rating and the lower the prevailing yield to maturity.[6] A historical review of corporate bond yields by ratings bears out this claim. Over the period 1929 through 1978 the highly rated bonds maintained a consistently lower yield than did those bonds rated lower.[7] In fact, as one reviews the debt yields on highly rated securities and moves to lower rated securities, the amount of the risk premium on the different classes increases at an increasing rate.

Significance

This study should provide the electric utility companies with an idea of the financial community's awareness and perception of the varying risk levels among the disparate fuel types used to generate electric power. The recent accident at Three-Mile Island, with its tremendous disruptive and clean-up costs, provided a real shock to the investing public. It was not until this landmark event that investors took time to consider the various risks associated with each fuel type.

This study's analysis of current fuel use trends and interest yield figures will determine if investors have responded to this shock by applying unique risk premiums to each different fuel source.

Limitations

The prime limitation of this study involves the relatively short time span considered. This is directly linked to the level of detailed information available. Only since the late seventies has published data been available which lists the fuel mix used by individual companies to generate their electric power.

Scope

This study was limited to the 140 investor-owned electric utilities operating in the United States. Only domestic utilities were involved in order to remove possible biases in the results due to currency exchange rates and national regulatory climates. Investor-owned utilities were selected to reduce the distortions in interest yield on the varying fuel classes resulting from government guarantees sometimes found on municipal utilities.

Forthcoming Coverage

The remaining chapters develop this issue in more detail and empirically test the hypothesis. Chapter II contains a review of the available literature involving the history of the electric utility industry, the two types of risk and their association with each alternative fuel type, and the workings of the financial markets in setting yields on the electric utilities securities. Chapter III contains the research methodology. Included within this heading are: the research question, the variable definitions and measures, the sample selection, data collection procedures, instruments used, and means of analysis. Chapter IV presents the results of this study, while Chapter V contains a discussion of the results and a final conclusion.

ENDNOTES

[1]Leonard S. Hyman and Joseph M. Egan. "The Utility Stock Market: Regulation, Risk, and Beta." Public Utilities Fortnightly, February 14, 1980, p. 21.

[2]"Who Says Utilities Are Less Risky?" Public Utilities Fortnightly, May 8, 1980, p. 11.

[3]Standard & Poor's Corporation. Standard and Poors Industry Surveys. April 17, 1980, Section 2, p. 10.

[4]"Fuel Clause Adjustment Impact Studies." Public Utilities Fortnightly, January 19, 1978, pp. 25-26.

[5]"Consumers Challenge Utilities on Fuel Costs." Business Week, April 3, 1978, pp. 27-28.

[6]Frank K. Reilly. Investment Analysis and Portfolio Management. Hinsdale, Illinois: The Dryden Press, 1979, p. 432.

[7]Ibid., p. 437.

CHAPTER II

SURVEY OF LITERATURE

Bond Rating History

Bond ratings are a tool for investors designed to indicate the ability of the issuer to meet principal and interest payments over time. These ratings were first introduced in 1909 by John Moody of Moody's Investors Servides. Moody's Services was later joined in the business of rating securities by the Standard & Poor's Corporation and the Fitch Investors Service.

Moody's and Standard & Poor's are currently the two leaders in rating corporate and municipal securities. The Fitch Investors Service has specialized into rating bonds of financial institutions.

Both Moody's and Standard & Poor's utilize alphabetic rating symbols to indicate gradations of investment quality. Moody's system uses nine designations of investment risk ranging from a high of Aaa down to a low of C.[1] Standard & Poor's utilize ten symbols to denote the varying levels of investment risk. Additionally, they make use of plus (+) and minus (-) signs to show the relative standing within each of the major rating categories. Their ten major symbols are:[2]

AAA - Bonds rated AAA have the highest rating assigned by Standard & Poor's to a debt obligation. Capacity to pay interest and repay principal is extremely strong.

AA - Bonds rated AA have a very strong capacity to pay interest and repay principal and differ from the highest rated issues only in small degree.

A - Bonds rated A have a strong capacity to pay interest and repay principal although they are somewhat more susceptible to the adverse effects of changes in circumstances and economic conditions than bonds in higher rated categories.

BBB - Bonds rated BBB are regarded as having an adequate capacity to pay interest and repay principal. Whereas they normally exhibit adequate protection parameters, adverse economic conditions or changing circumstances are more likely to lead to a weakened capacity to pay interest and repay principal for bonds in this category than for bonds in higher rated categories.

BB
B
CCC
CC - Bonds rated BB, B, CCC, and CC are regarded on balance, as predominantly speculative with respect to capacity to pay interest and repay principal in accordance with the terms of the obligation. BB indicates the lowest degree of speculation and CC the highest degree of speculation. While such bonds will likely have some quality and protective characteristics, these are outweighed by large uncertainties or major risk exposures to adverse conditions.

C - The rating C is reserved for income bonds on which no interest is being paid.

D - Bonds rated D are in default, and payment of interest and/or repayment of principal is in arrears.

Each of the two major rating agencies, Moody's and Standard & Poor's, periodically review the ratings on previous rated securities. Based on the facts presented during this review, the agencies may raise or lower their previous rating.

Importance of the Ratings

Because the ratings of these agencies are a valuable guide for investors, every company wants to insure that it receives the highest rating possible for its securities.[3] In fact, these ratings are crucial to the electric utility since a single rating can make or break a company's financing plan.[4] In general, the higher the rating, the less interest potential investors will require and the smaller will be the bond interest expense over the life of the issue. Conversely, those companies receiving a low rating may find themselves shut out of the bond market entirely. A low rating may further tarnish the company's prestige making it more difficult to issue common stock or borrow money from banks and other institutions.[5]

A historical review of corporate bond yeilds by rating indicates that the lower the default risk (business risk), the higher the agency rating and the lower the prevailing yield to maturity.[6] Over the period 1929 through 1978, the highly rated bonds maintained a consistently lower yield than those bonds rated lower.[7] In fact, it has been shown that the debt yields on securities increase at an increasing rate as the bond rating drops.

These ratings place a great deal of power in the hands of the two major bond raters. Naturally their power has been questioned by the investment community, which has encouraged competition for the major rating agencies.[8] The brokerage and investment houses have entered the rating game primarily refining and updating the existing ratings established by Moody's and Standard & Poor's.[9] It is felt that this competition is healthy for the industry and will prove to be beneficial to the investing public.

The Rating System Described

A description of the rating process is in order.[10] Initially a company, working in conjunction with its investment banker, will develop a financing plan requiring the issuance of new securities such as bonds. Analysts from each rating agency are then assigned to study the new issue. These analysts not only study the information provided by the issuing company, but also any historical information they have in their own files. They also confer with several other business sources, including suppliers, competitors, and customers. They then schedule a conference with the top executives of the issuing company to ascertain the past performance and future prospects for the company.

Once the analysts have completed their research, they meet in a committee of 3 to 5 agency analysts to report their findings and rating recommendations. After the findings have been presented, a vote is taken to approve a rating, with the majority vote prevailing.

The committee reports its recommendations to one of the managers in the corporate finance department. This manager can approve the committee's recommendation or ask them to reconsider. Once the rating passes this manager it is communicated to the issuing company. The issuing company can, if it feels under-rated, present further information which may justify a higher rating.

If the issuing company does appeal its rating, the rating committee will reconvene to discuss the additional information provided by the issuing company. After weighing all the facts, the committee will vote to change the rating. This time the vote must be unanimous or virtually so in order to result in a rating change.

Both of the two major rating agencies charge a fee for their rating services. Moody's fee is based on a percentage of the dollar value of the securities rated. Standard & Poor's fee is based not on the value of the securities rated, but on the time and effort required to make the rating.

Fundamental Areas of Bond Rating

The bond rating agencies review five fundamental areas of bond rating.[11] These areas are: issuing documents, earnings, asset protection, management, and financial resources.

Of the various documents which accompany the issuance of bonds, the trust indenture is usually the basic legal document that spells out the contract between the issuer and the bondholder.[11] The standard provisions looked for in the indenture are provisions for and the protection against issuing additional bonds with the same security, property liens which may be provided, sinking fund provisions, restrictive covenants, and penalties imposed if the provisions are not met.[11]

Past and foreseeable earnings are probably the single most important factor in the credit rating. The analysts look for strong cash flows generated by high and continuing earnings. They also review the depreciation, depletion, and amortization policies to determine if they are adequate for the company. Additionally, they review the other factors that can act upon the company's ability to generate earnings.

Ratio analysis enters this third area of asset protection. This area is important primarily as a long-term consideration. Those ratios of primary interest include: the ratio of the company's current proposed debt to its net plant assets, the ratio of its working capital to its debt, the ratio of its debt to equity, and the ratio of its total net tangible assets to its debt.[11]

Another vital area of the analysis is the management expertise of the company. After conferring with the top executives, the analysts can assess the ability of management to work together as a team, their perception of their standing in the industry and their environment, their planning - how well they attained their previous goals and what goals they are currently shooting for.

Financial resources, the fifth and final area, represents the largest single area in which liquidity has a direct impact on the long term debt rating. This area takes into account such elements as: type of company and operations, territory and economy, construction program, capitalization and financing requirements, energy position, regulation, and special factors of the particular company or area.[11]

Purpose of Rating Securities

As much of a precise science as bond rating appears on the surface to be, bond ratings are not intended to convey anything more than credit safety judgements on debt securities.[12] They are not investment recommendations; nor do they represent audits.[12] They are also not ratings of a company's management or its regulators, although these two elements comprise a part of the rating process.

Studies of the Rating Process

Several studies have been undertaken to learn more about the procedures for applying the rating criteria to rate utility bonds. Thomas Fendrich, of Standard & Poor's Corporation, identifies the three most important rating criteria for utility bonds.[13] These criteria are: the fundamental business position of the utility, the regulatory treatment, and management. These criteria have already been discussed as criteria in the general securities rating procedure, but have been more clearly focused in the case of utilities. The more conventional financial items of interest coverage, debt ratios, and cash flow (in the case of utilities) are important as primary yardsticks of financial performance rather than as rating criteria.

Fendrich indicates that eleven criteria are looked into for the utilities: six nonfinancial and five financial. The six nonfinancial elements include: service area, operations, fuel supply, regulatory treatment, management, and the indenture.[13] The five financial rating criteria he delineates are: earnings protection, debt leverage, accounting quality, and financing flexibility.[13]

These rating criteria are utilized throughout the utility bond-rating process. The rating agency initially develops an industry analysis through which qualitative judgments regarding the industry's strengths and weaknesses are made. The analysts then proceed to develop a full set of rating criteria profiles on some 300 utilities.[13] When the process has proceeded to the rating committee meeting, the issue under review is compared to similar issues in the industry. At this point the key strengths and weaknesses are determined and the final rating is voted on.

Ever since the bond rating system began back in 1909, the investment community has tried to develop models which predict bond ratings. Whereas bond ratings contain both quantitative and qualitative elements, these models have focused much of their attention on the more easily predicted quantitative factors.

James Ang and Kiritkumar Patel most recently have conducted a study comparing and validating bond ratings methods.[14] Their research had a twofold purpose. The initial purpose was to compare the available statistical bond rating methods on their ability to duplicate Moody's ratings. The subsequent purpose was to compare all bond rating methods, including Moody's, on their ability to predict financial distress over different lead times.

The authors surveyed the four most familiar statistical bond rating methods which included: the Horrigan model, the West model, the Pogue and Soldofsky model, and the Pinches and Mingo model. The statistical analysis indicated that the statistical rating methods were consistently and significantly superior to random selection methods. Further testing indicated that all four methods consistently agreed on only the top-rated Aaa bonds. This was the result of the general superiority of these firm's financial records which made it easy to differentiate the Aaa company bonds from the lower rated bonds. The authors concluded that most statistical bond rating methods and the agencies' ratings were effective in the short-run, but were unable to predict financial loss in the intermediate and long-term horizons.

The determination of long-term credit standings with financial ratios was the central theme of the Horrigan model.[15] Financial ratios were the independent variables in his study, with the dependent variable being the corporate bond ratings. Six classes of financial ratios were considered: short-term liquidity ratios; long-term solvency ratios; short-term capital turnover ratios; long-term capital turnover ratios; profit margin ratios; and return on investment ratios. The multiple regression of the bond ratings on the various combinations of these independent variables was the general approach taken by Horrigan.

Horrigan found that along with total assets, four ratios were adopted in the model for best predicting bond ratings. These four ratios were: working capital to sales, net worth to total debt, sales to net worth, and net operating profits to sales. The addition of a dummy legal-status variable to this model enabled Horrigan to correctly predict over one-half of the samples of bond ratings.

West was dissatisfied with Horrigan's model and felt that Fisher's model had greater merit as a basis for further research.[16] West felt that Fisher's model had more thoroughly rationalized the hypothesized relationships between bond ratings and various independent variables. These relationships were more consistent with logical reasoning and long standing theories about the determinants of a firm's credit standing. Fisher's hypotheses made it possible to incorporate much more historical data in the model than can be accomodated in one year's financial statements viewed in terms of ratios.

The objective of Fisher's study was to relate risk premiums on bonds to their default risk and their marketability.[17] Fisher used three variables together in estimating the risk of default: measure of the variability of the firm's earnings; measures showing how reliable the firm has been in meeting its obligations; and measures depending on the firm's capital structure. Fisher assumed a logarithmic functional relationship between the independent variables and risk premiums. He found that his four independent variables accounted for approximately three-fourths of the variations in the logarithms of risk premiums. He also noted that this relationship remained relatively stable over time.

Using Fisher's study as a basis for his own research, West attempted to predict the first six of Moody's bond ratings. Employing four variables (the logarithms of earnings variability, period of solvency, market value of stocks/debt, and market value of all bonds outstanding) in a multiple regression model he was able to predict approximately 62% of the actual Moody's ratings.

Pogue and Soldofsky used available financial and operating statistics to explain corporate bond ratings.[18] They used five explanatory variables in their study: earnings coverage, long-term debt to capitalization, profitability, earnings instability, and asset size. Their results suggested that the differences in bond ratings could be explained to a significant degree by available financial and operating statistics. This supported the view that major differences in the firm's bond ratings can be explained largely by differences in the firm's history rather than by differences in the firm's prospects.

Pinches and Mingo developed and tested a factor analysis/multiple discriminate model for predicting industrial bond ratings.[19] Their basic variables were: those related strictly to the bond; one year variables of financial characteristics; five year average variables and coefficients of variation. The joint application of factor analysis and M-group multiple discriminate analysis, in a financial context, was found to be both viable and essential in developing and understanding the model for predicting industrial ratings. Pinches and Mingo found that the best replications of Moody's ratings were obtained when the variables related to earnings stability, size, financial leverage, debt and debt coverage stability, return on investment, along with subordination were considered.

Pinches later studied electric utility bond ratings with Singleton and Jahankhani.[20] Their three-part study contained: a multiple discriminate model to predict (or discriminate among) electric utility bonds as rated by financial analysts for both Moody's and Standard & Poor's; examination of the relative importance of the financial variables; and a comparison of the predictive ability of the multiple discriminate model with that of a univariate model employing the fixed coverage ratio. Their variables in the multiple discriminate model were: regulatory climate, total assets, net income/total assets, earnings before interest and taxes/fixed charges, construction expenses/ total assets, and 1970-1975 growth rate in net earnings.

Their six-variable model performed slightly better, in total, for Standard & Poor's rather than Moody's. This suggested that Standard & Poor's bond ratings more clearly followed these six variables than did Moody's bond ratings.

On an univariate basis, fixed coverage was one of the most important variables. On a multivariate basis, fixed coverage became substantially less important, while the 1970-1975 growth rate in earnings became the most important variable.

The results of this study were not consistent with the assertion that fixed coverage alone is the primary determinant of electric utility bond ratings. Research also indicated that attempts in electric utility regulatory proceedings to specify exact fixed coverage ratios that must be achieved in order to maintain (or secure) a given bond rating were both short-sighted and incomplete.

Reilly and Jochnk have taken a different approach to the bond rating analysis.[21] They have directed their attention to the estimation and use of a market-determined risk measure for bonds and a comparative analysis of this risk measure versus the bond's assigned agency rating. They have hypothesized that market-determined risk measures for corporate bonds were inversely related to the bond ratings.

Their study was limited to seventy-three bonds over the period January 1967 through December 1972. The authors collected the monthly quotes for the sample bonds, information on coupon payment dates and month of maturity. This information was used to convert each of the prices to their appropriate yields-to-maturity.

Reilly and Jochnk found only a limited association between market-related risk measures and bond ratings.[21] The reason for this limited association can be deducted from the explanation of the two measures. The rating assigned to a bond is an indication of the probability of default inherent in the bond based upon the financial and operating attributes of the firm, and the characteristics of the bond itself. In contrast, market related risk measures for bonds are based on how the market returns for a bond are related to the return for a market portfolio of risky assets.

Recently the electric utility bonds have been subjected to more frequent revisions, both upward and downward. Seligman and Rose looked at the changes in Moody's bond ratings for the period 1967-1977 for electric utility bonds.[22] They found a pronounced decline in the investment status of electric utility company bonds. An expanded study by Merrill Lynch, published in Electrical World, likewise reported a decline in ratings of electric utility debt. From 1974 through 1977, they found some 200 changes in ratings of electric utility debt by Moody's and Standard & Poor's.[23] Of these 200 changes, only 20% of the issues were upgraded, while 80% were downgraded.[23] A casual study by Pamela Archbold revealed that 1974 was the year of utility bond rating demotions.[24]

The reasons behind these demotions seem to stem from increasing worries about the construction, financing, and environmental risks associated with the completion of major new generating plants. Another prime factor in the rating demotions was the concern over the utilities' ability to pass on to the consumers the increased fuel costs of electric power production. Essentially, the electric utilities were caught in a spiral of uncertainties: the energy crises, regulation, and inflation.[25]

Bhandari, Soldofsky and Boe developed a model to predict these utility bond rating changes.[26] Their multivariate analysis included six variable terms. Their terms were: net income after taxes plus interest/interest, the slope of the regression line of the five years of fixed-charges-earned data preceeding the rating change (regressed against time); long-term debt/long-term debt plus equity; the slope of the regression of the five years of debt-to-capitalization data preceeding the rating change (regressed against time); net income after taxes/total assets; the slope of the regression of the five years of return-on-assets data preceeding the rating change (regressed against time); standard error of estimate from the linear regression in the previous term; changes in ratings, and error term.

Their procedures indicated that the most recent level and the trend in the past five years of just three financial ratios: fixed-charges-earned, debt-to capitalization, and return-on-assets, and a suitable measure of the earnings instability were sufficient to predict about 90%

of the rating changes for the electric utility bonds.

Do these rating changes in fact have significant informational value for the financial markets? Hettenhouse and Sartoris searched for an answer to this question.[27] They considered the factors that impact on the bond's value such as: the coupon rate, the maturity, the term structure over the test period, the collateral offered, the default risk of the issue, and the marketability of the instrument. They then constructed an index to track the response of the market yields through time, using an average of yields for similarly rated utility bonds as the control group.

They concluded that rating changes appear to be consistent with the underlying market activity that is setting prices on financial instruments. The changes themselves, however, appear to have very little informational value. Apparently the markets are sufficiently efficient to be able to set prices independently of the major ratings agencies.

Fuel Source Risks

Utilities are now trying to diversify their generating mix, because, as Guy W. Nichols, chairman of the New England Electric System, observes, "any one source can get you into trouble."[25] With any fuel source there are two primary types of risk: disruptive risk and price fluctuation risk.[28] Included under the heading of disruptive risk are strikes, shortages, plant malfunctions, and Environmental Protection Agency EPA air and water pollution violations.

Recent examples of these forms of disruptive risk can be easily remembered. The United Mine Worker's strike in late 1977, which lasted for several months, provided a vivid example as to the effects of strikes on electric utility fuel supplies.[29] The Arab Oil Embargo of 1973-1974 has left a permanent impression on the people of the world. That one event did much to force conservation on the oil dependent countries -- especially the energy thirsty Americans. The malfunctioning of the cooling system at the Number 2 unit of General Public Utilities' Three-Mile nuclear facility March 28, 1979, led to a close-down of the reactor and the release of radioactivity into the environment. In addition to the questions surrounding nuclear safety, new source performance standards for coal-fired generating units have been controversial. Clearly disruptive risk is a problem which faces all electric utilities to some degree.

The Arab Oil Embargo skyrocketed the cost of both imported and domestic oil. The regulatory rate increases and the fuel adjustment clauses could not provide the needed rate relief fast enough for the utilities.[30] Consequently, they were caught in a price squeeze which sharply narrowed their already slim profit margins. Once again all electric utilities are affected by this price fluctuation risk to some degree.

Concluding Remarks

This chapter was written to familiarize the reader with the history and importance of bond ratings. Beyond those goals, it was designed to illustrate the complex quasi-scientific approach to rating taken by the two major rating agencies. With the true purpose of this process in mind, the reader can now understand that bonds of a similar rating class do have similar qualities which can permit company data grouping on the basis of rating.

The final three chapters will formulate the objective of this report into a null hypothesis which can be statistically tested.

ENDNOTES

[1]Moody's Public Utility Manual. New York, New York: Moody's Investors Services, Inc., 1979.

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CHAPTER III

RESEARCH METHODOLOGY

This research methodology is designed to test the hypothesis that investors, at each different rating level, require different risk premiums on the debt of utilities which generate their electric power by any of six different fuel sources. Statistical tests will determine if these risk premiums are closely related to the type of fuel used.

Sample Selection

The sample under study was the entire population of investor-owned electric utility companies in the United States. The list of these 140 electric utility companies and their accompanying statistics has been published annually since 1978 by the Interstate Securities Corporation in the Interstate Securities Electric Utilities Atlas.[1] These companies, and their corresponding numeric notation, are listed in the appendix of this report.

Data Base Sources

This atlas is unique in that it is the first known published source of company-specific data delineating the percentage components of the fuel types used to generate a company's electric power. Previous private publications and government documents have printed this type of information on a state-wide or regional basis, but not on a company-by-company basis. The usefulness of statewide data on company-specific applications is restricted by the fact that most electric utility companies are not neatly confined within state boundaries, but overlap and bridge several state boundaries.

The _Interstate Securities Electric Utilities Atlas_ provided a percentage breakdown of the six fuel types used by each company to generate its electric power. These six fuel types and the numeric notation used throughout this report is illustrated below.

TABLE I

DOMINANT FUEL SOURCE KEY

Dominant Fuel Source	Numerical Notation
Gas	1
Oil	2
Coal	3
Hydro	4
Nuclear	5
Purchase Power	6

This same six-fuel breakdown was presented on an annual basis so that trends in dominant fuel usage would be revealed.

The Standard & Poor's bond ratings and interest yield data were obtained from Standard and Poor's Corporation Bond Guide.[2] This monthly publication grouped each electric utility's debt by its Standard & Poor's rating. This format made it convenient to collect the highest and lowest yield within a company's debt rating group. The difference between these high and low figures was used to compute the range (or spread) of the yield values.

Non-Rated Companies

Out of the 140 electric companies studied, there were three companies which did not have any outstanding debt rated by Standard & Poor's. These were: (19) Central Vermont Public Service Corporation, (74) Missouri Public Service Company, and (75) Missouri Utilities Company. The debt of each of these three companies was privately placed, so no market information was available for these debt issues. Additionally, the Missouri Utilities Company was controlled by the Union Electric Company, which owns 100% of Missouri Utilities Company's common stock.

Data Categorization

The company data was initially sorted by month. The numeric values assigned to each of the 35 months in this study are explained in Table II. Each of the thirty-five months under study was further subdivided into seventeen rating categories (coded in Table III), which in turn were even further subdivided into six fuel source types. At this point, the company yield information was printed. After all the individual company information had been printed within a specific

TABLE II

NUMERIC EQUIVALENTS FOR EACH MONTH AND YEAR OF THE STUDY

Month	1978	1979	1980
January	1	13	25
February	2	14	26
March	3	15	27
April	4	16	28
May	5	17	29
June	6	18	30
July	7	19	31
August	8	20	32
September	9	21	33
October	10	22	34
November	11	23	35
December	12	24	--

TABLE III

STANDARD & POOR'S BOND RATING KEY

Standard & Poor's Rating	Numerical Notation
AAA	17
AA+	16
AA	15
AA-	14
A+	13
A	12
A-	11
BBB+	10
BBB	9
BBB-	8
BB+	7
BB	6
BB-	5
B+	4
B	3
B-	2
NR	1

fuel category, a composite average yield and average spread was calculated for that particular fuel category.

This previously mentioned subdividing process began in January, 1978 and continued through November, 1980. The primary reason for limiting the analysis to 35 instead of 36 months was the lack of published information. At the time of this report's writing, the December, 1980 Standard & Poor's rating and yield rates were undetermined. It is felt that the loss of this one month's data would not hamper the results of this study.

Null Hypothesis

As was mentioned earlier, the company data were sorted first by month, then by rating, and finally by dominant fuel source. At this point the null hypothesis tested the equality of the yield and range of the six distinct fuel-type averages within each rating level (see Table IV). This null hypothesis was applied at each rating level to test the equality of the mean yields and to test the equality of the mean range values.

Tests of these hypotheses before and after the Three-Mile Island incident March 28, 1979 were expected to reveal a couple of movements taking place. Prior to the shock of Three-Mile Island, it was assumed that investors didn't recognize the magnitude of the risk differences existing due to one fuel type or another. Consequently both the yield rates and deviations from average for the various fuel types were considered roughly equal. Once investors were alerted to the various risks associated with each fuel type it was expected that the market would begin to discriminate among the various fuel types, assigning high risk premiums to those more risky fuel types, such as nuclear fuel. The tests of these null hypotheses were expected to confirm or discredit these expectations

Statistical Testing

In selecting the statistical test to apply to this analysis, the number of means to be compared determined the type of test to use. A t-test would have been best to use for paired mean values, but an F-test was better suited for testing the equality of more than two means.[3] Since the null hypothesis included six mean values, the F-test was the appropriate test.

In order to use this test several assumptions about the data had to be made. The first was that the data were normally distributed, that is that the yields and ranges were normally distributed. Another assumption was that the samples were random and independent. Since all the electric utility companies in the United States were looked at there was no chance for sampling bias to occur. The final assumption was that the population standard deviations were equal. This was necessary if the null hypothesis of equal population means was to be tested.

Reclassification of Data

In order to construct an analysis of variance table to conduct the F-test, some reorganization of the data grouping was required. Originally the data was first broken down by month, then by rating, and then by fuel source. This finely divided classification system was so precise that many divisions had no entries or had zero values. In order to maintain the stated assumptions about the data, the classification scheme had to be relaxed somewhat.

TABLE IV

EQUATIONS FOR DETERMINING AN AVERAGE VALUE* FOR EACH GROUP BASED ON A CLASSIFICATION BY STANDARD & POOR'S RATING CLASSES

Average Value* for Each Rating		Average Value* for Each Fuel Type at Each Rating Level**					
		1=Gas	2-Oil	3=Coal	4-Hydro	5=Nuclear	6=Purchase Power
X_{17}	=	$(x_{17,1}$	$+ x_{17,2}$	$+ x_{17,3}$	$+ x_{17,4}$	$+ x_{17,5}$	$+ x_{17,6})/6$
X_{16}	=	$(x_{16,1}$	$+ x_{16,2}$	$+ x_{16,3}$	$+ x_{16,4}$	$+ x_{16,5}$	$+ x_{16,6})/6$
X_{15}	=	$(x_{15,1}$	$+ x_{15,2}$	$+ x_{15,3}$	$+ x_{15,4}$	$+ x_{15,5}$	$+ x_{15,6})/6$
X_{14}	=	$(x_{14,1}$	$+ x_{14,2}$	$+ x_{14,3}$	$+ x_{14,4}$	$+ x_{14,5}$	$+ x_{14,6})/6$
X_{13}	=	$(x_{13,1}$	$+ x_{13,2}$	$+ x_{13,3}$	$+ x_{13,4}$	$+ x_{13,5}$	$+ x_{13,6})/6$
X_{12}	=	$(x_{12,1}$	$+ x_{12,2}$	$+ x_{12,3}$	$+ x_{12,4}$	$+ x_{12,5}$	$+ x_{12,6})/6$
X_{11}	=	$(x_{11,1}$	$+ x_{11,2}$	$+ x_{11,3}$	$+ x_{11,4}$	$+ x_{11,5}$	$+ x_{11,6})/6$
X_{10}	=	$(x_{10,1}$	$+ x_{10,2}$	$+ x_{10,3}$	$+ x_{10,4}$	$+ x_{10,5}$	$+ x_{10,6})/6$
X_{9}	=	$(x_{9,1}$	$+ x_{9,2}$	$+ x_{9,3}$	$+ x_{9,4}$	$+ x_{9,5}$	$+ x_{9,6})/6$
X_{8}	=	$(x_{8,1}$	$+ x_{8,2}$	$+ x_{8,3}$	$+ x_{8,4}$	$+ x_{8,5}$	$+ x_{8,6})/6$
X_{7}	=	$(x_{7,1}$	$+ x_{7,2}$	$+ x_{7,3}$	$+ x_{7,4}$	$+ x_{7,5}$	$+ x_{7,6})/6$
X_{6}	=	$(x_{6,1}$	$+ x_{6,2}$	$+ x_{6,3}$	$+ x_{6,4}$	$+ x_{6,5}$	$+ x_{6,6})/6$
X_{5}	=	$(x_{5,1}$	$+ x_{5,2}$	$+ x_{5,3}$	$+ x_{5,4}$	$+ x_{5,5}$	$+ x_{5,6})/6$
X_{4}	=	$(x_{4,1}$	$+ x_{4,2}$	$+ x_{4,3}$	$+ x_{4,4}$	$+ x_{4,5}$	$+ x_{4,6})/6$
X_{3}	=	$(x_{3,1}$	$+ x_{3,2}$	$+ x_{3,3}$	$+ x_{3,4}$	$+ x_{3,5}$	$+ x_{3,6})/6$
X_{2}	=	$(x_{2,1}$	$+ x_{2,2}$	$+ x_{2,3}$	$+ x_{2,4}$	$+ x_{2,5}$	$+ x_{2,6})/6$
X_{1}	=	$(x_{1,1}$	$+ x_{1,2}$	$+ x_{1,3}$	$+ x_{1,4}$	$+ x_{1,5}$	$+ x_{1,6})/6$

*Value can be replaced by yield or by range.

**It is the equality of these fuel type averages within a specific rating level that is tested.

Two new classification schemes emerged as a result of this restructuring. For one scheme, the company data was classified by month and then by fuel source group. The other plan involved classification by rating and once again by fuel source. The results of these reclassifications will be shown in the next chapter.

Determination of the Risk Premium

The final statistical analysis was undertaken to determine the risk premium that investors required when investing in a certain rating class of debt. These rating classes were further subdivided into the six major fuel source types to determine if different fuel sources required different risk premiums.

The risk-free rate for this section was represented by the average monthly yield on 20-year U.S. government bonds (see Table V). This long-term risk-free rate was considered the independent variable in the regression equations.

The average yield on securities of utilities of each fuel type within each rating class was held to be the dependent variable. This dependent variable was regressed against the independent variable to arrive at a regression equation for each group.

These regression equations were derived only for that company data located within the ratings numbers 15 through 9. Within this range there were entries in nearly all six fuel source categories so there was enough data to derive the regression line slope and intercept. In the rating groups 17 through 16 and 8 through 1 there was only a sparse presence of data, not enough to run a regression against the market data.

The results of these regressions of average yield to market yield and the F-tests conducted earlier are presented in the following chapter.

TABLE V

MONTHLY INTEREST RATES REPRESENTATIVE OF THE RISK FREE RATE

	1978	1979	1980
January	8.14	8.98	12.21
February	8.22	9.03	12.49
March	8.21	9.08	11.42
April	8.32	9.12	10.44
May	8.44	9.21	9.89
June	8.53	8.91	10.32
July	8.69	8.97	11.07
August	8.45	9.21	11.47
September	8.47	9.99	11.75
October	8.69	10.37	11.31
November	8.75	10.18	12.55
December	8.90	10.65	--

Source: Long-term rates on U.S. Government bonds published in the Federal Reserve Bulletin. Various Monthly Issues 1978-1980. Board of Governors of the Federal Reserve System, Washington, D.C.

ENDNOTES

[1]Interstate Securities Electric Utilities Atlas. Charlotte, North Carolina: Interstate Securities Corporation, 1978, 1979, 1980.

[2]Standard and Poor's Corporation Bond Guide. New York: Standard & Poor's Corporation, 1979.

[3]Hubert M. Blalock, Jr. Social Statistics, 2nd Edition, New York: McGraw-Hill Company, 1972, pp. 317-334.

CHAPTER IV

PRESENTATION OF RESULTS

The results of those statistical tests and regressions outlined in Chapter III are published here in tabular form to facilitate comparisons and cursory analysis. These results should provide an indication of the presence, or lack of investor ability to assign risk premiums to electric utility debt based on the type of fuel used to generate electric power.

The first table in this chapter, Table VI, indicates the dominant fuel source for the 140 investor-owned electric utility companies for the years 1978 through 1980. As mentioned previously, the dominant fuel source can be one of six disparate types: gas, oil, coal, hydro, nuclear, and purchased power. The key included in Table VI explains the numeric notation used to represent each fuel type. This notation is used in the body of the table for consciseness.

Reading across the first line of Table VI one sees the following: Company Number = 1, 1978 = 3, 1979 = 3, and 1980 = 3. This notation translates into the following: Company number 1 is the Alabama Power Company. In each year 1978 through 1980, the company's dominant fuel source was fuel type 3, which is coal. This same company-by-company information concerning dominant fuel type was a basic building block for the grouping of company data subsequent in the chapter.

The next table in this chapter, Table VII, is an abbreviated example of the average yield and yield ranges calculated by dominant fuel source of investor-owned electric utilities after grouping by month, rating, and dominant fuel source. This table, if published in its entirety, would have exceeded 3500 lines of print. Since the information featured in this table represents intermediate computer calculations it was decided, because of time and space constraints, to provide the reader with an idea of the type of information processed at this point.

The first line of Table VII is read as follows: Month = 1, Rating = 17, Dominant Fuel Source = 1, Fuel Source Average Yield = 8.13%, and Fuel Source Average Spread = 1.44. This line translates into the following: during January, 1978, those AAA electric utility companies using oil as their dominant fuel source, had an average yield of 8.13% and an average yield range of 1.44.

Table VIII, the third table in this chapter, features a month-by-month presentation of F-test values for testing the equality of average yields for investor-owned electric utilities between 1978 and 1980. The data tested in this table were grouped first by month and then by dominant fuel type. Those F-values noted by (*) were found to be significant at the 0.05 level.

Table IX also features a month-by-month presentation of F-values. The difference between Table IX and Table VIII is that the former tests the equality of average yields for investor-owned electric utilities between 1978 and 1980, while the latter tests the equality of average yield range for these utilities over this same time period.

TABLE VI

DOMINANT FUEL SOURCE FOR INVESTOR-OWNED ELECTRIC UTILITIES FROM 1978 THROUGH 1980*

Company Number	Year 1978	1979	1980	Company Number	Year 1978	1979	1980
1	3	3	3	36	3	3	3
2	3	3	3	37	6	1	1
3	3	3	3	38	2	2	2
4	2	6	5	39	2	2	2
5	3	3	3	40	3	3	3
6	5	5	5	41	3	3	3
7	6	6	6	42	1	1	1
8	3	2	2	43	5	5	5
9	6	1	1	44	2	2	2
10	2	6	6	45	1	1	1
11	2	2	2	46	4	4	4
12	3	3	3	47	3	3	3
13	2	2	2	48	3	5	5
14	3	3	3	49	3	3	3
15	3	3	3	50	3	3	3
16	1	1	1	51	5	5	3
17	5	2	2	52	5	3	3
18	1	1	1	53	5	6	3
19	5	5	5	54	3	3	3
20	3	3	3	55	3	3	3
21	6	6	1	56	4	6	6
22	3	3	3	57	3	3	3
23	3	3	3	58	1	1	3
24	3	3	3	59	1	3	3
25	6	6	6	60	3	3	3
26	5	5	5	61	3	3	3
27	2	2	2	62	2	2	2
28	3	3	3	63	1	1	1
29	1	3	1	64	3	3	3
30	3	3	3	65	3	3	3
31	2	2	2	66	5	5	5
32	3	3	3	67	6	6	6
33	3	3	3	68	3	3	3
34	3	3	3	69	3	6	3
35	1	1	1	70	3	3	3

*Gas = 1, Oil = 2, Coal = 3, Hydro = 4, Nuclear = 5, Purchase Power = 6

TABLE VI (Continued)

Company Number	Year 1978	1979	1980	Company Number	1978	1979	1980
71	2	2	2	106	2	3	3
72	6	6	6	107	3	3	3
73	6	6	6	108	1	1	1
74	3	3	3	109	2	2	5
75	6	6	6	110	4	6	6
76	3	3	3	111	5	5	5
77	3	3	3	112	3	3	3
78	4	4	4	113	2	2	2
79	6	6	6	114	2	2	3
80	3	3	3	115	1	1	6
81	2	6	6	116	3	3	3
82	2	2	2	117	2	2	2
83	2	1	6	118	3	3	3
84	3	3	3	119	3	3	3
85	6	6	6	120	1	1	1
86	3	3	3	121	1	1	1
87	3	3	3	122	3	3	3
88	3	6	6	123	3	3	3
89	3	3	3	124	1	1	1
90	3	3	3	125	1	3	1
91	3	3	3	126	3	3	3
92	1	1	1	127	3	3	3
93	2	2	2	128	3	3	3
94	3	3	3	129	6	6	6
95	2	1	1	130	2	2	1
96	3	3	3	131	3	3	3
97	3	3	3	132	5	5	5
98	3	3	3	133	3	2	3
99	2	3	3	134	6	4	4
100	6	6	5	135	3	3	3
101	6	6	6	136	1	1	1
102	3	3	3	137	5	5	5
103	3	3	3	138	3	3	3
104	3	3	3	139	3	3	3
105	3	3	3	140	3	3	3

*Gas = 1, Oil = 2, Coal = 3, Hydro = 4, Nuclear = 5, Purchase Power = 6

Source: Interstate Securities Corporation _Interstate Securities Electric Utilities Atlas_, Charlotte, North Carolina, Years 1978, 1979, 1980.

TABLE VII

EXAMPLE OF AVERAGES CALCULATED BY DOMINANT FUEL SOURCE OF INVESTOR-OWNED ELECTRIC UTILITIES AFTER GROUPING BY MONTH, RATING, AND DOMINANT FUEL SOURCE

Month	Rating	Dominant Fuel Source	Fuel Source Average Yield	Fuel Source Average Yield Range
1	17	1	8.13	1.44
1	17	2	0.00	0.00
1	17	3	8.00	0.62
1	17	4	0.00	0.00
1	17	5	0.00	0.00
1	17	6	0.00	0.00
1	16	1	0.00	0.00
1	16	2	0.00	0.00
1	16	3	0.00	0.00
1	16	4	0.00	0.00
1	16	5	0.00	0.00
1	16	6	8.28	0.72
1	15	1	8.28	0.70
1	15	2	8.61	1.69
1	15	3	8.25	1.10
1	15	4	0.00	0.00
1	15	5	8.28	1.06
1	15	6	8.16	0.67
1	14	1	8.28	1.51
1	14	2	8.28	1.51
1	14	3	8.28	1.51
1	14	4	8.28	1.51
1	14	5	8.28	1.51
1	14	6	8.28	1.51
35	2	6	0.00	0.00
35	1	1	0.00	0.00
35	1	2	0.00	0.00
35	1	3	0.00	0.00
35	1	4	0.00	0.00
35	1	5	0.00	0.00
35	1	6	6.79	0.13

Once again, those F-values noted by (*) were found to be significant at the 0.05 level.

The next table, Table X, presents the F-test values for testing the equality of average yields for electric utilities between 1978 and 1980 when grouped first by rating and then by dominant fuel type. This table differs from Table VIII only by the way the data were grouped. In this table the data were grouped first by rating and then by dominant fuel type. In Table VIII, the data were grouped first by month and then by dominant fuel type. Just as in Table VIII, those F-values noted by (*) were found to be significant at the 0.05 level.

The final set of F-test tables, Table XI, features the F-test values for testing the equality of average range of electric utility yield rates between 1978 and 1980 when grouped first by rating and then by dominant fuel type. This table relates to Table X in the same manner that Table IX relates to Table VIII. As before, those F-values noted by (*) were found to be significant at the 0.05 level.

Recapping the information contained in Tables VIII, IX, X, and XI one finds that the data tested in Tables VIII and IX were grouped first by month and then by dominant fuel type. The data tested in Tables X and XI were grouped first by Standard & Poor's rating and then by dominant fuel type. The F-values in Tables VIII and X tested the equality of average yields for electric utilities between 1978 and 1980, while those F-values in Tables IX and XI tested the equality of the average range of electric utility yield rates over the same time period.

Table XII, the final table in this chapter, displays the results of regressions of selected rate classes of electric utility bonds against

TABLE VIII

F-TEST VALUES FOR TESTING THE EQUALITY OF AVERAGE YIELDS FOR ELECTRIC UTILITIES BETWEEN 1978 AND 1980 WHEN GROUPED FIRST BY MONTH AND THEN DOMINANT FUEL TYPE

Month		Sum of Squares	Degrees of Freedom	Estimate of Variance	F*
1	Total	1902.72	101		
	Between **	172.36	5	34.47	1.91
	Within ***	1730.36	96	18.02	
2	Total	1948.05	101		
	Between	174.77	5	34.95	1.89
	Within	1773.28	96	18.47	
3	Total	1965.36	101		
	Between	180.95	5	36.19	1.95
	Within	1784.41	96	18.58	
4	Total	1963.88	101		
	Between	177.27	5	35.45	1.91
	Within	1786.61	96	18.61	
5	Total	2026.68	101		
	Between	183.26	5	36.65	1.91
	Within	1843.42	96	19.20	
6	Total	2098.77	101		
	Between	191.79	5	38.35	1.93
	Within	1906.97	96	19.86	
7	Total	2145.87	101		
	Between	174.62	5	34.92	1.70
	Within	1971.24	96	20.53	
8	Total	2160.46	101		
	Between	173.21	5	34.64	1.67
	Within	1987.25	96	20.70	
9	Total	2074.56	101		
	Between	129.87	5	25.97	1.28
	Within	1944.68	96	20.25	
10	Total	2101.81	101		
	Between	174.19	5	34.83	1.74
	Within	1927.62	96	20.07	
11	Total	2277.15	101		
	Between	182.34	5	36.46	1.67
	Within	2094.80	96	21.82	

*F-value significant at the .05 level.

TABLE VIII (Continued)

Month		Sum of Squares	Degrees of Freedom	Estimate of Variance	F*
12	Total	2389.42	101		
	Between	167.26	5	33.45	1.45
	Within	2222.15	96	23.14	
13	Total	2592.97	101		
	Between	347.42	5	69.48	2.97
	Within	2245.54	96	23.39	
14	Total	2563.09	101		
	Between	337.94	5	67.58	2.92
	Within	2225.15	96	23.17	
15	Total	2583.08	101		
	Between	340.53	5	68.10	2.92
	Within	2242.54	96	23.35	
16	Total	2599.98	101		
	Between	346.88	5	69.37	2.96
	Within	2253.09	96	23.46	
17	Total	2666.63	101		
	Between	356.75	5	71.35	2.97
	Within	2309.87	96	24.06	
18	Total	2705.92	101		
	Between	366.75	5		3.01
	Within	2339.16	96	24.36	
19	Total	2625.33	101		
	Between	352.55	5		2.98
	Within	2272.78	96	23.67	
20	Total	2585.24	101		
	Between	361.77	5	72.35	3.12
	Within	2223.46	96	23.16	
21	Total	2583.06	101		
	Between	362.50	5	72.50	3.13
	Within	2220.56	96	23.13	
22	Total	2753.41	101		
	Between	387.82	5	77.56	3.15
	Within	2365.59	96	24.64	
23	Total	4184.57	101		
	Between	494.57	5	98.91	2.57
	Within	3690.00	96	38.43	
24	Total	3556.21	101		
	Between	593.29	5	118.65	3.84
	Within	2962.91	96	30.86	

TABLE VIII (Continued)

Month		Sum of Squares	Degrees of Freedom	Estimate of Variance	F*
25	Total	3799.23	101		
	Between	341.13	5	68.22	1.89
	Within	3458.09	96	36.02	
26	Total	4192.71	101		
	Between	400.77	5	80.15	2.03
	Within	3791.93	96	39.49	
27	Total	5260.47	101		
	Between	486.32	5	97.26	1.96
	Within	4774.15	96	49.73	
28	Total	5812.23	101		
	Between	524.77	5	104.95	1.91
	Within	5287.45	96	55.07	
29	Total	4592.78	101		
	Between	394.60	5	78.92	1.80
	Within	4198.17	96	43.73	
30	Total	3664.89	101		
	Between	312.65	5	62.53	1.79
	Within	3352.23	96	34.91	
31	Total	3375.24	101		
	Between	282.79	5	56.55	1.76
	Within	3092.44	96	32.21	
32	Total	3579.43	101		
	Between	300.03	5	60.00	1.76
	Within	3279.40	96	34.16	
33	Total	4165.67	101		
	Between	345.72	5	69.14	1.74
	Within	3819.94	96	39.79	
34	Total	4631.71	101		
	Between	391.69	5	78.33	1.77
	Within	4240.02	96	44.16	
35	Total	4741.77	101		
	Between	398.23	5	79.64	1.76
	Within	4343.54	96	45.24	

*F-value significant at the .05 level.

**Represents between group variation.

*** Represents within group variation.

TABLE IX

F-TEST VALUES FOR TESTING THE EQUALITY OF AVERAGE RANGES OF ELECTRIC UTILITY YIELD RATES BETWEEN 1978 AND 1980 WHEN GROUPED FIRST BY MONTH AND THEN DOMINANT FUEL TYPE

Month		Sum of Squares	Degrees of Freedom	Estimate of Variance	F*
1	Total	33.93	101		
	Between**	2.29	5	0.45	1.39
	Within ***	31.64	96	0.32	
2	Total	27.27	101		
	Between	2.91	5	0.58	2.30
	Within	24.36	96	0.25	
3	Total	31.28	101		
	Between	2.17	5	0.43	1.44
	Within	29.10	96	0.30	
4	Total	30.66	101		
	Between	2.55	5	0.51	1.75
	Within	28.11	96	0.29	
5	Total	28.98	101		
	Between	2.35	5	0.47	1.69
	Within	26.63	96	0.27	
6	Total	30.87	101		
	Between	1.92	5	0.38	1.28
	Within	28.95	96	0.30	
7	Total	33.96	101		
	Between	2.16	5	0.43	1.31
	Within	31.79	96	0.33	
8	Total	27.97	101		
	Between	2.05	5	0.41	1.52
	Within	25.91	96	0.26	
9	Total	20.30	101		
	Between	0.93	5	0.18	0.93
	Within	19.36	96	0.20	
10	Total	32.44	101		
	Between	1.63	5	0.32	1.02
	Within	30.80	96	0.32	
11	Total	37.00	101		
	Between	3.92	5	0.78	2.28
	Within	33.07	96	0.34	

*F-value significant at the .05 level.

TABLE IX (Continued)

Month		Sum of Squares	Degrees of Freedom	Estimate of Variance	F*
12	Total	20.40	101		
	Between	1.39	5	0.27	1.41
	Within	19.00	96	0.19	
13	Total	20.97	101		
	Between	2.29	5	0.45	2.36
	Within	18.67	96	0.19	
14	Total	21.05	101		
	Between	2.50	5	0.50	2.60
	Within	18.55	96	0.19	
15	Total	18.69	101		
	Between	1.78	5	0.35	2.02
	Within	16.91	96	0.17	
16	Total	14.45	101		
	Between	1.51	5	0.30	2.24
	Within	12.94	96	0.13	
17	Total	27.16	101		
	Between	3.26	5	0.65	2.62
	Within	23.90	96	0.24	
18	Total	17.40	101		
	Between	2.01	5	0.40	2.51
	Within	15.38	96	0.16	
19	Total	24.76	101		
	Between	1.81	5	0.36	1.52
	Within	22.94	96	0.23	
20	Total	14.61	101		
	Between	1.09	5	0.21	1.55
	Within	13.51	96	0.14	
21	Total	12.58	101		
	Between	1.23	5	0.24	2.09
	Within	11.35	96	0.11	
22	Total	28.85	101		
	Between	2.82	5	0.56	2.08
	Within	26.02	96	0.27	
23	Total	1077.82	101		
	Between	71.82	5	14.36	1.37
	Within	1006.00	96	10.47	
24	Total	114.03	101		
	Between	16.05	5	3.21	3.15
	Within	97.98	96	1.02	

*F-value significant at the .05 level.

TABLE IX (Continued)

Month		Sum of Squares	Degrees of Freedom	Estimate of Variance	F*
25	Total	352.89	101		
	Between	20.74	5	4.14	1.20
	Within	332.15	96	3.45	
26	Total	109.18	101		
	Between	10.53	5	2.10	2.05
	Within	98.65	96	1.02	
27	Total	82.87	101		
	Between	5.08	5	1.01	1.25
	Within	77.79	96	0.81	
28	Total	119.01	101		
	Between	9.23	5	1.84	1.61
	Within	109.78	96	1.14	
29	Total	69.99	101		
	Between	4.51	5	0.90	1.32
	Within	65.47	96	0.68	
30	Total	57.92	101		
	Between	3.37	5	0.67	1.19
	Within	54.54	96	0.56	
31	Total	83.70	101		
	Between	5.90	5	1.18	1.46
	Within	77.79	96	0.81	
32	Total	84.31	101		
	Between	5.49	5	1.09	1.34
	Within	78.81	96	0.82	
33	Total	95.31	101		
	Between	5.81	5	1.16	1.25
	Within	89.50	96	0.93	
34	Total	122.60	101		
	Between	5.71	5	1.14	0.94
	Within	116.89	96	1.21	
35	Total	147.98	101		
	Between	6.64	5	1.32	0.90
	Within	141.33	96	1.47	

*F-value significant at the .05 level.

**Represents between group variation.

***Represents within group variation.

TABLE X

F-TEST VALUES FOR TESTING THE EQUALITY OF AVERAGE YIELDS FOR ELECTRIC UTILITIES BETWEEN 1978 AND 1980 WHEN GROUPED FIRST BY RATING AND THEN DOMINANT FUEL TYPE

Rating		Sum of Squares	Degrees of Freedom	Estimate of Variance	F*
1	Total	1934.26	209		
	Between**	1830.18	5	366.03	717.38*
	Within***	104.08	204	0.51	
2	Total	0.00	209		
	Between	0.00	5	0.00	99,999.99*
	Within	0.00	204	0.00	
3	Total	0.00	209		
	Between	0.00	5	0.00	99,999.99*
	Within	0.00	204	0.00	
4	Total	0.00	209		
	Between	0.00	5	0.00	99,999.99*
	Within	0.00	204	0.00	
5	Total	4841.89	209		
	Between	3918.82	5	783.76	173.21*
	Within	923.06	204	4.52	
6	Total	7511.89	209		
	Between	3868.33	5	773.66	43.32*
	Within	3643.47	204	17.86	
7	Total	5158.21	209		
	Between	3455.26	5	691.05	82.78*
	Within	1702.94	204	8.34	
8	Total	7083.65	209		
	Between	2284.19	5	456.83	19.42*
	Within	4799.45	204	23.52	
9	Total	720.90	209		
	Between	7.31	5	1.46	0.42
	Within	713.58	204	3.49	
10	Total	6719.51	209		
	Between	2994.13	5	598.82	32.79*
	Within	3725.37	204	18.26	
11	Total	3616.94	209		
	Between	1388.58	5	277.71	25.42*
	Within	2228.36	204	10.92	

*F-value significant at the .05 level.

TABLE X (Continued)

Rating		Sum of Squares	Degrees of Freedom	Estimate of Variance	F*
12	Total	633.61	209		
	Between	1.35	5	0.27	0.09
	Within	632.25	204	3.09	
13	Total	5998.85	209		
	Between	4406.01	5	881.20	112.86*
	Within	1592.83	204	7.80	
14	Total	6366.84	209		
	Between	4902.80	5	980.56	136.63*
	Within	1464.04	204	7.17	
15	Total	4537.56	209		
	Between	3160.81	5	632.16	93.67*
	Within	1376.74	204	6.74	
16	Total	3161.33	209		
	Between	1241.69	5	248.33	26.39*
	Within	1919.64	204	9.41	
17	Total	4814.46	209		
	Between	4650.91	5	930.18	1160.27*
	Within	163.54	204	0.80	

*F-value significant at the .05 level.

**Represents between group variation.

***Represents within group variation.

TABLE XI

F-TEST VALUES FOR TESTING THE EQUALITY OF AVERAGE RANGES OF ELECTRIC UTILITY YIELD RATES BETWEEN 1978 AND 1980 WHEN GROUPED FIRST BY RATING AND THEN BY DOMINANT FUEL TYPE

Rating		Sum of Squares	Degrees of Freedom	Estimate of Variance	F*
1	Total	0.31	209		
	Between**	0.20	5	0.04	73.00*
	Within***	0.11	204	0.00	
2	Total	0.00	209		
	Between	0.00	5	0.00	99,999.99*
	Within	0.00	204	0.00	
3	Total	0.00	209		
	Between	0.00	5	0.00	99,999.99*
	Within	0.00	204	0.00	
4	Total	0.00	209		
	Between	0.00	5	0.00	99,999.99*
	Within	0.00	204	0.00	
5	Total	3.09	209		
	Between	1.14	5	0.22	23.86*
	Within	1.95	204	0.00	
6	Total	85.96	209		
	Between	14.76	5	2.95	8.46*
	Within	71.19	204	0.34	
7	Total	5.69	209		
	Between	0.90	5	0.18	7.68*
	Within	4.79	204	0.02	
8	Total	209.66	209		
	Between	68.17	5	13.63	19.66*
	Within	141.49	204	0.69	
9	Total	107.35	209		
	Between	47.91	5	9.58	32.88*
	Within	59.44	204	0.29	
10	Total	112.77	209		
	Between	40.99	5	8.19	23.30*
	Within	71.77	204	0.35	
11	Total	105.04	209		
	Between	46.77	5	9.35	32.76*
	Within	58.26	204	0.28	

*F-value significant at the .05 level.

TABLE XI (Continued)

Rating		Sum of Squares	Degrees of Freedom	Estimates of Variance	F*
12	Total	62.82	209		
	Between	7.09	5	1.41	5.19*
	Within	55.72	204	0.27	
13	Total	88.54	209		
	Between	51.89	5	10.37	57.77*
	Within	36.65	204	0.17	
14	Total	1164.76	209		
	Between	68.91	5	13.78	2.57
	Within	1095.84	204	5.37	
15	Total	585.38	209		
	Between	230.60	5	46.12	26.52*
	Within	354.78	204	1.73	
16	Total	48.65	209		
	Between	3.10	5	0.62	2.78
	Within	45.55	204	0.22	
17	Total	75.71	209		
	Between	21.83	5	10.77	100.68*
	Within	53.87	204	0.10	

*F-value significant at the .05 level.

**Represents between group variation.

***Represents within group variation.

long-term U.S. government returns for the years 1978 through 1980. Those selected rate classes were classes 15 through 9, those areas within which most of the electric utility bonds lie.

Just as the clues to a mystery begin to add up and hint at a solution, so have the statistical tables presented thus far given clues to the investor ability to assign risk premiums to utility bonds based on the fuel type used. Chapter V will take these clues already presented and reveal a discussion of the conclusion reached.

TABLE XII

REGRESSIONS OF SELECTED RATE CLASSES OF ELECTRIC UTILITY BONDS AGAINST LONG-TERM U.S. GOVERNMENT RETURNS FOR YEARS 1978-1980

Standard & Poor's Rating: 15 = AA

Dominant Fuel Source	Slope	Intercept
1 = Gas	1.00	0.56
2 = Oil	1.34	-1.99
3 = Coal	1.02	0.39
4 = Hydro	0.00*	0.00*
5 = Nuclear	1.53	-8.06
6 = Purchase Power	1.10	-0.49

Standard & Poor's Rating: 14 = AA-

Dominant Fuel Source	Slope	Intercept
1 = Gas	1.11	-0.27
2 = Oil	-2.13	23.69
3 = Coal	1.31	-2.36
4 = Hydro	0.00*	0.00*
5 = Nuclear	0.85	2.23
6 = Purchase Power	0.00*	0.00*

Standard & Poor's Rating: 13 = A+

Dominant Fuel Source	Slope	Intercept
1 = Gas	-0.76	10.96
2 = Oil	1.06	0.25
3 = Coal	1.10	-0.07
4 = Hydro	0.00*	0.00*
5 = Nuclear	0.00*	0.00*
6 = Purchase Power	1.66	-14.77

Standard & Poor's Rating: 12 = A

Dominant Fuel Source	Slope	Intercept
1 = Gas	1.08	0.09
2 = Oil	1.07	0.31
3 = Coal	1.23	-1.20
4 = Hydro	1.05	0.41
5 = Nuclear	1.11	-0.04
6 = Purchase Power	1.10	-0.02

*Indicates the absence of data for this fuel type.

TABLE XII (Continued)

Standard & Poor's Rating: 11 = A-

Dominant Fuel Source	Slope	Intercept
1 = Gas	1.08	0.09
2 = Oil	1.07	0.31
3 = Coal	1.23	-1.20
4 = Hydro	1.05	0.41
5 = Nuclear	1.11	-0.04
6 = Purchase Power	1.10	-0.02

Standard & Poor's Rating: 10 = BBB+

Dominant Fuel Source	Slope	Intercept
1 = Gas	-0.78	11.21
2 = Oil	2.03	-10.32
3 = Coal	1.13	0.00
4 = Hydro	0.00*	0.00*
5 = Nuclear	-0.05	6.03
6 = Purchase Power	2.29	-19.34

Standard & Poor's Rating: 9 = BBB

Dominant Fuel Source	Slope	Intercept
1 = Gas	1.00	1.11
2 = Oil	1.23	-0.84
3 = Coal	1.19	-0.36
4 = Hydro	1.13	-0.04
5 = Nuclear	1.19	-0.23
6 = Purchased Power	1.11	0.15

*Indicates the absence of data for this fuel type.

CHAPTER V

SUMMARY AND CONCLUSIONS

Discussion and Conclusions

The table of annual breakdown of company power generation by dominant fuel source, Table VI, revealed several interesting findings. Out of the 140 investor-owned electric utility companies studied over the three years 1978 through 1980, 31 companies changed their major fuel source at least once. Seven of these utility companies changed their fuel source twice over this three-year-period.

While no apparent trend to any one specific fuel source was present, a couple of other trends were detected. Some utility companies began 1978 using one particular fuel type, switched to another in 1979, and then returned to the original fuel in 1980. Other companies seemed to change, choosing a different fuel each year. Whatever the utilities' reasons for changing, it was obvious that they were not moving away from any one particular fuel type but were seeking the lowest cost source.

The short time span considered and the fact that the companies were classified on the basis of dominant, not sole fuel type used, prohibits one from drawing conclusions on the long-run fuel source trends.

A recent article published in the Wall Street Journal indicated that "many utilities have found that the burden of building a nuclear plant has contributed to the lowering of their securities by rating services. The downgrading, in time, pushes up the cost of borrowing and scares away some investors."[1]

Right now the nuclear-power industry is pinning its hopes for future survival on the Reagan administration. Nuclear power-plant advocates want a strong, favorable statement from President Reagan that will set the tone for the nation.[2] In addition to encouraging words, the nuclear-power industry will press for an overhaul of the Nuclear Regulatory Commission. In summary, while nuclear-power advocates want less government involvement in safety regulation, they want more government involvement in financing the development of commercial nuclear power.[3]

Nuclear critics, on the other hand, want the market to determine the fate of nuclear power. Says Mr. Pollock of Critical, Massachusetts, "If it can stand on its own feet, fine. If it can't, the market has spoken."[4]

Referring back to Table VIII, one finds that none of the F-values were significant at the 0.05 level. One can conclude from this test that the average yields for electric utility bonds between 1978 and 1980, when grouped first by month and then by dominant fuel type, were statistically equivalent. Phrased differently, for any given month of this study, the average yield on electric utility bonds was equal regardless of the dominant fuel type used to generate electricity. Thus the bond market does not appear to require an added premium due to the use of nuclear fuel sources. Consequently, investors appear to rely heavily on the rating agencies and do not discriminate within rating groups by requiring higher yields from nuclear-powered utility bonds.

Table IX displayed the same statistical results as did Table VIII. None of the F-values were significant at the 0.05 level. From this table one can conclude that the average ranges of electric utility yield rates between 1978 and 1980, when grouped first by month and then by dominant fuel type, were not statistically different from each other. In other words, for any given month of this study, the average ranges of electric utility yield rates on electric utility bonds was equal regardless of the dominant fuel type used to generate electric power.

Considering the information outlined in Tables VIII and IX one could conclude that the events occurring over time seem to affect all the fuel types in a similar manner.

The results displayed in Table X, which tested the equality of average yields for electric utilities between 1978 and 1980, when grouped first by rating and then by dominant fuel type, indicate that the F-values were significant at the 0.05 level for all rating levels with the exception of ratings 9 and 12. This means that for ratings 1-8, 10-11, and 13-17 the average yields corresponding to the disparate fuel types were not equal. Only for ratings 9 and 12 were the average yields for the six distinct fuel types equal.

Table XI, which tested the equality of the average range of electric utility yield rates between 1978 and 1980 when grouped first by rating and then by dominant fuel type, displayed F-values which were significant at the 0.05 level for all rating levels except for ratings 14 and 16. This can be interpreted to mean that for ratings 1-13, 15, and 17 the average range of yields corresponding to the various fuel types were not equal. Only for ratings 14 and 16 were the average yield ranges for the six disparate fuel types equal.

The information presented in Tables X and XI indicates that both the average yields and the average yield ranges were not equal for all fuel types over the period January, 1978 through November, 1980. Since this test did not analyze the average yields and average yield ranges on a year-by-year basis, it is difficult to ascertain the shock effects of the Three-Mile Island accident of March, 1979. These shock effects could have contributed to the distortion of the average yields, alluding to the possibility that the rating agencies are not re-evaluating the electric utilities' debt in pace with changes affecting the companies. If this were the case, this would suggest that debt investors have already discounted their information about the company and have made adjustments in the yields that they require on various electric utility bonds.

The final table in this chapter, Table XII, lists the results of the regressions of selected rate classes of electric utility bonds against long-term U.S. government returns for the years 1978 through 1980. If the two rates were perfectly correlated, one would expect to find the slope of the regression line equal to one and the intercept equal to zero.

As Table XII indicates, most of the regressions run had slopes statistically similar to 1.00 and intercepts likewise similar to 0.00. There were a very few exceptions to this finding. Those were due primarily to random one-month deviations explainable by other factors.

Thus these results indicate that these electric utility rates closely follow the yield rate trends of long-term U.S. government securities.

Recommendations

As was mentioned earlier, one limitation of this study was the relatively short time frame examined. In a few years it would be possible to collect a greater data base and repeat a similar analysis of the data. Perhaps this greater time frame and data base would yield different findings.

During the early stages of this analysis, a cursory examination of the debt characteristics of a sampling of utility bonds was reviewed to ascertain whether there were any differences in the terms of electric utility debt based on fuel types. The author's examination of such information as published in Moody's Public Utility Manual did not uncover such differences. What differences in debt terms that existed were probably due to such other things as regulatory environment, the bond market condition when the issues were floated, and such other factors.

A possible method of further study of this issue of debt characteristics would be to develop a classification scheme for sorting these debt terms. With this scheme intact a test could be devised to check for differences in such characteristics based on fuel type. Maybe this would uncover financing differences between utilities based on fuel types used to generate electrical power.

ENDNOTES

[1]John R. Emshwiller. "Generating Doubt: Some Investors Shun Nuclear-Powered Utilities Jeopardizing Funds to Build New Atomic Plants." Wall Street Journal, November 20, 1980, pp. 48.

[2]John R. Emshwiller. "Nuclear-Power Industry Pins Hope for Survival on Reagan Presidency." Wall Street Journal, December 15, 1980, p. 21.

[3]Ibid.

[4]Ibid.

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APPENDIX

TABLE XIII

ELECTRIC UTILITY COMPANIES ANALYZED

Number	Name
1	Alabama Power Company
2	Appalachian Power Company
3	Arizona Public Service Company
4	Arkansas Power and Light Company
5	Atlantic City Electric Company
6	Baltimore Gas and Electric Company
7	Blackstone Valley Electric Company
8	Boston Edison Company
9	Brockton Edison Company
10	Cambridge Electric Light Company
11	Canal Electric Company
12	Carolina Power and Light
13	Central Hudson Gas and Electric Corporation
14	Central Illinois Light Company
15	Central Illinois Public Service Company
16	Central Louisiana Electric Company, Inc.
17	Central Maine Power Company
18	Central Power and Light Company
19	Central Vermont Public Service Corporation
20	Cincinnati Gas and Electric Company
21	Citizens Utilities Company
22	Cleveland Electric Illuminating Company
23	Columbus and Southern Ohio Electric Company
24	Commonwealth Edison Company
25	Community Public Service Company
26	Connecticut Light and Power Company
27	Consolidated Edison Company of New York, Inc.
28	Consumers Power Company
29	Dallas Power and Light Company
30	Dayton Power and Light Company
31	Delmarva Power and Light Company
32	Detroit Edison Company
33	Duke Power Company
34	Duquesne Light Company
35	El Paso Electric Company
36	Empire District Electric Company
37	Fall River Electric Light Company
38	Florida Power Corporation
39	Florida Power and Light Company
40	Georgia Power Company
41	Gulf Power Company
42	Gulf States Utilities Company

TABLE XIII (Continued)

Number	Name
43	Hartford Electric Light Company
44	Hawaiian Electric Company, Inc.
45	Houston Lighting and Power Company
46	Idaho Power Company
47	Illinois Power Company
48	Indian and Michigan Electric Company
49	Indianapolis Power and Light Company
50	Interstate Power Company
51	Iowa Electric Light and Power Company
52	Iowa-Illinois Gas and Electric Company
53	Iowa Power and Light Company
54	Iowa Public Service Company
55	Iowa Southern Utilities Company
56	Jersey Central Power and Light Company
57	Kansas City Power and Light Company
58	Kansas Gas and Electric Company
59	Kansas Power and Light Company
60	Kentucky Power Company
61	Kentucky Utilities Company
62	Long Island Lighting Company
63	Louisiana Power and Light Company
64	Louisville Gas and Electric Company
65	Madison Gas and Electric Company
66	Maine Yankee Atomic Power Company
67	Massachusetts Electric Company
68	Metropolitan Edison Company
69	Minnesota Power and Light Company
70	Mississippi Power Company
71	Mississippi Power and Light Company
72	Missouri Edison Company
73	Missouri Power and Light Company
74	Missouri Public Service Company
75	Missouri Utilities Company
76	Monongahela Power Company
77	Montana-Dakota Utilities Company
78	Montana Power Company
79	Narragansett Electric Company
80	Nevada Power Company
81	New Bedford Gas and Edison Light Company
82	New England Power Company
83	New Orleans Public Service Inc.
84	New York State Electric and Gas Corporation
85	Niagara Mohawk Power Corporation
86	Northern Indiana Public Service Company
87	Northern States Power Company (Minnesota)

TABLE XIII (Continued)

Number	Name
88	Northern States Power Company (Wisconsin)
89	Northwestern Public Service Company
90	Ohio Edison Company
91	Ohio Power Company
92	Oklahoma Gas and Electric Company
93	Orange and Rockland Utilities, Incorporated
94	Otter Tail Power Company
95	Pacific Gas and Electric Company
96	Pacific Power and Light Company
97	Pennsylvania Electric Company
98	Pennsylvania Power Company
99	Pennsylvania Power and Light Company
100	Philadelphia Electric Company
101	Portland General Electric Company
102	Potomac Edison Company
103	Potomac Power Company
104	Public Service Company of Colorado
105	Public Service Company of Indiana, Incorporated
106	Public Service Company of New Hampshire
107	Public Service Company of New Mexico
108	Public Service Company of Oklahoma
109	Public Service Electric and Gas Company
110	Puget Sound Power and Light Company
111	Rochester Gas and Electric Corporation
112	St. Joseph Light and Power Company
113	San Diego Gas and Electric Company
114	Savannah Electric and Power Company
115	Sierra Pacific Power Company
116	South Carolina Electric and Gas Company
117	Southern California Edison Company
118	Southern Electric Generating Company
119	Southern Indiana Gas and Electric Company
120	Southwestern Electric Power Company
121	Southwestern Public Service Company
122	Tampa Electric Company
123	Tennessee Valley Authority
124	Texas Electric Service Company
125	Texas Power and Light Company
126	Toledo Edison Company
127	Tucson Gas and Electric Company
128	Union Electric Company
129	Union Light, Heat and Power Company
130	United Illuminating Company
131	Utah Power and Light Company

TABLE XIII (Continued)

Number	Name
132	Vermont Yankee Nuclear Power Corporation
133	Virginia Electric and Power Company
134	Washington Water Power Company
135	West Penn Power Company
136	West Texas Utilities Company
137	Western Massachusetts Electric Company
138	Wisconsin Electric Power Company
139	Wisconsin Power and Light Company
140	Wisconsin Public Service Corporation

VITA

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Report: AN ANALYSIS OF THE RISK PREMIUMS ON THE DEBT OF INVESTOR-OWNED ELECTRIC UTILITIES BASED ON THE TYPE OF FUEL USED TO GENERATE ELECTRIC POWER FOR THE YEARS 1978-1980

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