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OBSERVATIONS ON THE EMPIRICAL CAPITAL ASSET PRICING MODEL IN ESTIMATING A PUBLIC UTILITY'S COST OF EQUITY CAPITAL

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ABSTRACT

The literature of the Capital Asset Pricing Model describes a fundamental bias in its empirical application. The most notable problem is that the Empirical Capital Asset Pricing Model produces betas which overestimate the returns of high-beta stocks and underestimate the returns of low-beta stocks. This has proven problematic in estimating public utilities' stocks expected returns in regulatory proceedings. The literature prescribes the use of a shift parameter, alpha, to correct for this bias. This dissertation aims to find the value of alpha and its statistical significance. In contrast to the literature, the following empirical analysis discovers that alpha is statistically insignificant. Diagnostics of this paradox conclude that alpha is not significant in a variety of applications. The probable cause of the literature's error is autocorrelation and data choice.

CHAPTER ONE

INTRODUCTION

I. The Reason for Regulating Utilities

Public Utilities, like the gas and electric service, are natural monopolies. They achieve greater returns to scale, i.e., lower per unit costs, as output increases. This is what causes the utility to become a natural monopoly. Customers and the companies themselves are best served by one producer. This avoids unnecessary duplication of productive resources that have more socially desirable uses in other industries. The result gives creates a conundrum that pits two of the economics profession's desired aims against each other; the competitive determination of prices in the marketplace and the efficient use of resources.

The history of public utility regulation in the United States begins with the establishment of the Interstate Commerce Commission in 1887.[1] The purpose was to regulate the rates that the railroads charged to shippers in a more equitable manner. Until that time,

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[1] Phillips, Charles F., Jr., "Chapter 4 : Independent Regulatory Commissions," The Regulation of Public Utilities, (Arlington, VA: Public Utilities Reports, Inc., 1993), p. 132.

the prices that shippers charged to individuals wishing their service was monopolistic. This gave the railroads the opportunity to charge any rate they wished. As other industries began to show the characteristics of decreasing costs, the legislative response was to expand coverage to limit monopoly power. Congress enacted a series of laws to protect the marketplace from anticompetitive behavior. The body of this legislation became known as antitrust law with the aim of protecting competition and stopping monopolies at their inception. The Sherman, Patman, and Robinson Acts aimed to capture the spirit of this goal at the turn of the Twentieth Century.

Most regulation of public utilities is the domain of state and local levels of government. A few federal bodies have the authority to set rates for those utilities engaged in interstate commerce. They include telecommunications, the transmission of electricity, and the transportation of natural gas. The goal of all regulatory commissions is to establish rates that are fair, equitable, and mimic what rates would be if competition existed in these industries. James C. Bonbright summed the purpose of public utility regulation when he stated:

> "Regulation, it is said is a substitute for competition. Hence its objective should be

to compel a regulated enterprise, despite its possession of complete or partial monopoly, to charge rates approximating those which it would charge if free from regulation but subject to the market forces of competition. In short, regulation should be not only a substitute for competition, but a closely imitative substitute."[2]

In essence, regulation is a correction for the failure of free markets to correct for the "problem" of a natural monopoly. However, natural monopoly is not the only necessary precondition for regulation. The industry must also provide an essential and necessary service to the market and to the community which it serves. These industries provide the basic infrastructure for modern industrial economies, like the United States, to function. As part of the social contract in which society grants public utilities exemption from some antitrust legislation, they assume the obligation to serve all who request their service. Regulation provides customers the least cost protection from monopoly power and the investor owned utility the opportunity to recover all costs associated with providing that service.

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[2] Bonbright, J.C., Principles of Public Utility Rates, (New York: Columbia University Press, 1966), p.93.

A. The Form of Utility Regulation

The responsibility of establishing rates falls under the purview of legislatively empowered authorities. State regulatory commissions provide the bulk of such ratemaking. In a rate proceeding known as a rate case, the commission undertakes two tasks. The first is to determine the overall revenue required to cover the entire cost of service. The second objective is to develop the proper structure of rates that establishes equity between the company and the ratepayers, and equity among ratepayers.[3] The subject of this paper focuses on one element of the first objective, specifically the cost of equity capital.

The revenue requirement or cost of service includes all elements necessary for the utility to provide service to its customers. This includes all operation and maintenance costs, depreciation of assets, taxes, and a fair rate of return on the ratebase as determined by the commission. The last component is the most contentious of all.[4]

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[3] Morin, Roger A., "Chapter 1: Rate of Return Regulation," Regulatory Finance: Utilities' Cost of Capital, (Arlington, VA: Public Utilities Reports, Inc., 1993), pp. 1-32.

[4] Ibid.

B. Determination of a Fair Rate of Return

Unfortunately no golden rule exists that establishes the appropriate rate of return that any given company may earn. However, the Supreme Court has defined the legal principles for such determination in two landmark cases to guide regulators in determining what constitutes a fair rate of return. The Court outlines them in *Bluefield Waterworks & Improvement Co. v. Public Service Commission of West Virginia* (262 U.S. 679, 1923)[5] and *Federal Power Commission v. Hope Natural Gas Company* (320 U.S. 291, 1944)[6]. The aim of both these decisions is to ameliorate conflicts between aggressive, pro-consumer commissions and commissions friendly to the utilities.

In the *Bluefield* case, the Supreme Court creates the standard which commissions must use to determine just and reasonable rates. The Court states:

> A public utility is entitled to such rates as will permit it to earn a return on the value of property which it employs for the convenience of the public equal to that generally being made at the same time and in the same general part of the country on investments in other business undertakings which are attended by corresponding risks and uncertainties. The return should be

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[5] *Bluefield Water Works & Improvement Company v. Public Service Commission*, 262 U.S. 679(1923), 165n, 203n, 258n, 370n, 412n, 413n, 414n, 613n.

[6] *Federal Power Commission v. Hope Natural Gas Company*, 320 U.S. 591 (1944), 203n, 204n, 302n, 304n, 358n, 359n, 412n, 431n, 531n, 533n.

> reasonable, sufficient to assure confidence in the financial soundness of the utility, and should be adequate, under efficient and economical management, to maintain and support its credit and enable it to raise money necessary for the proper discharge of its public duties.[7]

The *Hope* case further elaborates upon the standards that commissions must utilize to adjudicate a reasonable allowed return. The Court restates its original rulings in the *Bluefield* case and recognizes the need to allow for revenues that also cover capital costs associated with the provision of service. The Court states:

> From the investor or company point of view it is important that there be enough revenue not only for operating expenses but also allow for the capital costs of the business. These include service on the debt and dividends on the stock. By that standard the return to the equity owner should be commensurate with returns on investments in other investments in other enterprises having corresponding risks. That return, moreover, should be sufficient to assure confidence in the financial integrity of the enterprise, so as to maintain its credit and attract capital.[8]

The decisions of the Court in the *Bluefield* and *Hope* cases create the standards for commissions to follow to determine fair and reasonable, allowed rates of return. First, they create a standard of capital attraction. Second, they promote a standard of

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[7] *Bluefield*, ibid.

[8] *Hope Natural Gas*, ibid.

comparable earnings corresponding to comparable risks. Last, they seek a standard to maintain the financial integrity of the regulated enterprise.

C. The Economic Reasons for Regulation

These standards have a very fundamental economic logic inherit in them. An opportunity cost exists for those who provide capital to finance the development of utility companies. The opportunity cost that investors forgo is the expected return they would earn in ventures with comparable risks. As such, bondholders and shareholders must have the opportunity to earn a similar return on like investments. Going further, a utility must have the opportunity to maintain its credit worthiness to allow it access to capital markets for future investment. With these goals in mind, a regulated company should earn a return sufficient to assure confidence in its financial health, maintain its credit, and continue to attract funds at reasonable terms.

Several other cases sharpen the criteria further. The Court states in *Federal Power Commission v. Memphis Light, Gas & Water Division* (411 U.S. 458, 1973)[9] and

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[9] *Memphis Light & Gas Water Division, In re,* 411 U.S. 458 (1973), 413n.

the *Permian Basin Rate Cases* (390 U.S. 747, 1968)[10] the goals of *Bluefield* and the end-result doctrine of the *Hope* case. The *Permian Basin Rate Cases* adds emphasis to the regulator's mission that a rate of return order shall:

> ...reasonably be expected to maintain financial integrity, attract necessary capital, and fairly compensate investors for the risks they have assumed...[11]

The *Duquesne Light Company et al. v. David M. Barasch et al.* (488 U.S. 299, 1989)[12] restates the standards set forth in the *Bluefield* and *Hope* cases, but also adds more guidelines in determining rates for regulated public utilities. In *Duquesne,* the Court recognizes regulatory risk as risk which a utility assumes. As such, commissions must compensate companies for it in rate of return judgments.

The *Hope* case creates the end-result doctrine. By this, the Court gives less weight to the methodology a given commission chooses. Instead, the *Hope* decision places the emphasis of ratemaking on achieving results that are equitable to both ratepayers and shareholders. As such, the Court does not bind the regulator to a

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[10] *Permian Basin Area Rate Cases,* 390 U.S. 747 (1968), 728n.

[11] *Permian Basin Area Rate Cases,* ibid.

[12] *Duquesne Light Company v. Barasch,* 488 U.S. 299 (1989), 413n.

outcome must provide a fair result. This ruling provides a zone of comfort to regulators given the empirical difficulties and theoretical assumptions that circumscribe most financial models of the cost of capital calculation. As the name implies, the outcome is the goal which is to replicate competition and not to subvert it.[13]

II. Methods for Calculating the Cost of Equity

While the legal and economic conception of what comprises the substance of a fair rate of return is concrete, the actual determination of it is suspect and controversial.[14] Rancorous debate often emerges among experts about the proper use of accepted methods. Likewise, witnesses argue about what constitutes a fair rate of return given specious data. In addition, they question the variety of assumptions an analyst may make about the firm and associated market conditions. However, analysts typically make their judgments based on the following financial models; Comparable Earnings, Discounted Cash Flow (DCF) Analysis, Risk Premium, and the Capital Asset Pricing Model (CAPM).

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[13] Morin, Roger A., "Chapter 1: Rate of Return Regulation," Regulatory Finance: Utilities' Cost of Capital, (Arlington, VA: Public Utilities Reports, Inc., 1993), pp. 9-11.

[14] Morin, pp. 28-30.

A. The Comparable Earnings Method

Until the mid-1960's, analysts relied solely on the Comparable Earnings method. Analysts chose a group of unregulated companies that in their judgment possessed the same level of risk as the utility in question. From the calculation of the return on common equity of these firms, experts determined a fair rate of return. Early, the comparable earnings method proved controversial as analysts would debate what essentially were the characteristics of the chosen sample that made them "comparable." Experts found themselves arguing over whether to use book equity or market equity. Again, witnesses debated about the appropriate time period over which to consider returns. Finally, they squabbled over what adjustments one needed to make to determine a fair rate of return. The major roadblock to successful application of the comparable earnings method was a proper measurement of risk.[15]

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[15] Morin, Roger A., "Chapter 16: Comparable Earnings," pp. 393-408.

B. The Risk Premium Method

Starting in the mid-1960's through the mid-1970's, analysts began to apply principles gathered from modern finance theory to develop more accurate measurements of the fair cost of capital. The most basic method utilized is the risk premium model. This tool rests on the premise that the return on equity is more costly or expensive than a less risky or risk-free instrument. As such, all an analyst needs to do is find the difference appropriate for the utility in question and use that to determine the rate of return on common equity. The most common method is to take the difference of the historical return on book equity for the regulated company, and subtract the yield on some long-term bond. Next, the analyst simply adds this difference of premium to the risk-free rate to determine the rate of return. Analysts soon found themselves engaged in disputes about what the appropriate risk-free rate, the length of time used to calculate the risk premium, and the stability of the risk premium.[16]

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[16] Morin, Roger A., "Chapter 11: Risk Premium," pp. 269-300.

C. The Discounted Cash Flow Method

The most ubiquitous method of rate of return analysis is the Discounted Cash Flow (DCF) Analysis. The DCF theory holds that the value of a financial asset derives from its ability to generate future income streams. The fundamental notion is that the security's price reflects all of its future income discounted by its cost of capital. The price also represents the marginal investor's valuation of the future cash flows. In the mathematical form, one expresses the DCF model as[17]:

$$P = \Sigma \left(\frac{D+g}{1+k} \right)^t$$

Which simplifies to:

$$k = \frac{D}{p} + g$$

Where:

P - current price of the security in question

D - current dividend of the security in question

g - growth rate of dividends

k - cost of equity capital

The DCF method has the advantage of mechanically producing a cost of capital when all the assumptions of the model hold true. As such, analysts found themselves debating what adjustments, if any,

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[17] Morin, Roger A., "Chapter 4: Discounted Cash Flow Concepts," pp. 99-132.

regulators must make to determine a fair rate of return.

D. The Capital Asset Pricing Model

The other tool that analysts have at their disposal is the Capital Asset Pricing Model (CAPM). The financial theory underlying it states that investors face two types of risk, systematic and unsystematic risk. Unsystematic risk is the risk that an investor assumes when he purchases one security. Systematic risk is the risk that an investor faces in the entire marketplace of securities. As such, investors can diversify for unsystematic risk by diversifying their investment portfolios. The CAPM method utilizes a measure of risk of an individual security called beta that measures the differential risk of a given security relative to the market risk. Mathematically, one can represent the CAPM as[18]:

$$k = R_f + \beta(R_m - R_f)$$

[18] Thompson, Howard E., "Chapter 4; Traditional Models: CAPM and Risk Analysis," Regulatory Finance : Financial Foundations of Rate of Return Regulation, (Boston: Kluwer Academic Publishers, 1991), pp. 43-56.

Where:

k - required return

R_f - risk-free rate

R_m - required return of the overall market

B - security's beta risk measure

Like the DCF method, the CAPM also gives analysts the opportunity to determine mechanically a fair rate of return. However, such crass empiricism has led to much debate about the appropriate expected market return. Likewise, analysts debate about which risk-free rate controls for all risk in the market. Further, they argue about whether the estimated beta accurately reflects the implicit risk of the asset in question.

All of the aforementioned financial models have their individual shortcomings. As such, most analysts in regulatory proceedings chose to use them in tandem to produce an estimate of the fair rate of return. Given the nature of the regulatory environment, any misjudgment on the behalf of either ratepayers or the regulated entity can seriously affect the return a company earns. To compensate all parties, regulators have at their disposal the legislative authority to adjust rates to maintain the goal of regulation; fair and reasonable rates.

III. Correction of the CAPM

Analysts primarily rely on the DCF model to make cost of common equity judgments. Typically they then utilize the CAPM as a check on the DCF. Since the DCF produces a result that reflects the desires of the marginal investor, one must perform some adjustments to reflect more accurately the "true" return on equity. The bulk of the return on equity literature suggests various ways to adjust the DCF to provide these adjustments. DCF adjustment theories are quite broad and numerous. However, the body of literature about adjustments to the CAPM is quite small.

A. Areas of Correction of the CAPM

The literature falls into two broad categories; size-adjusted CAPM's and empirically adjusted CAPM's. The size-adjusted CAPM's rely primarily on the theoretical and empirical work of Eugene Fama and Kenneth French (1992).[19] Fama and French take the

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[19] Fama, Eugene F., and Kenneth R. French, "The Cross-Section of Expected Stock Returns," Journal of Finance, Volume 48, Number 2, June 1992, pp. 427-465.

market capitalization of a stock in question as an important determinant of stock returns. They find that it makes the CAPM a more effective estimator of expected returns. The broadest and most complete empirical work in this area comes from Roger Ibbotson's Stock, Bonds, Bills and Inflation Yearbook, published annually.[20] It provides basis point adjustments across all sizes and classes of equity assets. Analysts throughout the financial community whether public utility economists, portfolio managers, financial advisors, stockbrokers, or financial journalists, rely upon Ibbotson's work when studying stocks. Ibboston Associates publishes it annually, most libraries or investment firms subscribe to it, and it carries acceptance in the investment community.

The other vein of CAPM adjustments follows the work Black, Jensen, and Scholes (1972)[21] and Litzenberger, Ramaswamy and Sosin (1980)[22]. In broad

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[20] Ibbotson, Roger, "Chapter 8: Estimating the Cost of Capital or Discount Rate," Stocks, Bonds, Bills, and Inflation 1997 Yearbook, (Chicago: Ibbotson Associates, 1997), pp. 140-161.

[21] Black, Fischer, Michael Jensen, and Myron Scholes, "The Capital Asset Pricing Model: Some Empirical Tests," Studies in the Theory of Capital Markets, edited by Michael C. Jensen, (New York: Praeger, 1972), pp. 79-121.

[22] Litzenberger, Robert, Krishna Ramaswamy, and Howard Sosin, "On the CAPM Approach to the Estimation of A Public Utility's Cost of Capital," Journal of Finance, Volume 35, Number 2, May 1980, pp. 369-387.

terms, this approach empirically recognizes that the CAPM overestimates the return on equity for high-beta stocks and underestimates the return for low-beta stocks. As such, it seeks to find a shift parameter that "flattens" the CAPM's Market Return Line to control for this inherit bias. The literature in this area has less definition and more controversy.

B. The Empirical Capital Asset Pricing Model

Since the works of Fama and French and Ibbotson carry a lot of weight among utility analysts, they offer fewer possibilities for extension or criticism. Financial economists have conducted little work on finding an empirical correction for the CAPM. The only serious academic works in this field of the estimation of the cost of common equity are the separate works of Litzenberger *et al* and Roger A. Morin. The Litzenberger *et al* is rather old, dating from 1980. While the analysis of Morin is newer, it has less acceptance among utility and financial economists. The method that this dissertation will explore is the empirically adjusted CAPM.

C. Reasons for Correcting the CAPM

The overriding question one must ask is why is finding a more accurate empirical CAPM important for return on equity estimation of public utilities. This inquiry requires three responses. The first issue one must address is whether a stable adjustment to the CAPM exists. The second is then what is the size of that adjustment. The reason for finding out the answer to both of these questions is that the ECAPM will provide analysts with another tool with which to make return on equity estimates of utilities. The third reason follows from the second. The coming deregulation of utility services requires more accurate, longer-term estimates of cost of common equity.

D. Restructuring of the Utility Industry

Financial analysts have always had many tools at their disposal to make cost of capital judgments. However, as the industry becomes more competitive, the number of rate cases that public utility commissions review will decrease. As such, analysts must provide more accurate estimates of the "true" cost of common equity. Most restructuring proposals call for use of performance based ratemaking or deadband regulation. The current test case in performance based regulation is for San Diego Gas & Electric in California. The California Public Utility Commission has given the company a bandwidth inside its return on equity may fall. If the return increases beyond the top end of the bandwidth, San Diego Gas & Electric must provide customers with a refund, called a ratepayer dividend, reflected in lower rates. Likewise, if the return on equity should fall below the lower end of the bandwidth, then the company may raise its rates to cover any losses. The other piece of this regulatory compact is that the California Commission promised San Diego Gas & Electric a five year moratorium on rate cases.[23]

E. Performance Based Ratemaking

Performance based ratemaking has two pitfalls that require more precise estimates of the cost of capital. Performance based ratemaking regimes have rate case moratoria as part of their prescription. Exceedingly generous or decidedly stingy allowed rates of return can have lasting consequences. A deadband that errs on the low side of the true cost of equity will subsidize ratepayers at the expense of the company's

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[23] Performance-Based Regulation, "1995 Statistical Report & Five Year Forecast, 1995 Annual Report of the Enova Corporation, pp. 8-11.

stockholders. Future rate case will require commissions to award utilities higher rates of return, since such a result will increase the company's cost of capital. In the opposite case, a deadband that errs on the high side of the true cost of equity will serve to transfer wealth from ratepayers to shareholders of the company. Given, the long period of most proposed rate moratoria, this solution is just as undesirable.[24] With this in mind, one can readily see the attraction of having more perfected tools of financial analysis like the Empirical CAPM.

IV. Conclusion

The previous discussion identifies two threads in the public utility economics. First, the utility industry is preparing for major restructuring. The ultimate aim of which is to introduce competition among companies to reduce or eliminate cost of service regulation. The new regimen of performance based regulation exists as a legal "bridge" to more competitive markets. The goals of this new paradigm

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[24] Navarro, Peter, "The Simple Analytics of Performance-Based Ratemaking: A Guide for the PBR Regulator," Yale Journal on Regulation, Volume 13, Number 1, (New Haven, CT: Yale University Press, 1996), pp. 105-161.

are to lower costs, to promote energy efficiency, to price efficiently, and to improve service quality. Since the performance based ratemaking scheme is relatively new, little empirical evidence exists to show how firms respond under it.[25] The first thread is broad and overreaching.

The second thread is more sublime and follows from the first. To implement performance based ratemaking, regulators must adopt a cost of common equity deadband that promotes the goals of cost reduction, pricing efficiency, and service quality. Estimates of the longer-term return on equity must have a higher degree of accuracy and durability than they now possess. The academic literature presents many of the shortcomings of the Discounted Cash Flow method and the size-adjusted Capital Asset Pricing Model. The literature prescribes appropriate adjustments to the cost of common equity for their use in rate proceedings. However, the literature on the Empirical CAPM is thin. The coming restructuring requires a more accurate and robust Empirical CAPM.

Here, the two threads intertwine. The broad perspective is industry-wide restructuring and

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[25] Hill, Lawrence J., "Incentives Under Performance Based Regulation," <u>A Primer on Incentive Regulation for Electric Utilities</u>, (Oak Ridge, TN: Oak Ridge National Laboratory, 1995), pp. 25-34.

deregulation which form the "weave" of the regulatory "tapestry." The need for accurate longer-term estimates of the cost of capital will determine the success of restructuring. Accurate estimates of the cost of common equity require more empirically sound models such as the Empirical CAPM. This forms the "woof" of the regulatory "tapestry."

CHAPTER TWO

LITERATURE REVIEW

I. Introduction

The literature surrounding the Capital Asset Pricing Model (CAPM) falls into three broad schools of economic thought. The first is the Fischer Black school which, generally speaking, regards the CAPM as imperfect but correctable with adjustments to beta. The second school of thought is the Fama and French school which regards the CAPM as useless. This school posits that variables other than beta provide more accurate assessments of risk. Both the Fischer Black school and the Fama and French school are more academic in nature and focus on generalities about the CAPM applied to all securities. The third school of thought is the Litzenberger school which takes the above mentioned academic critiques and applies them specifically to cost of capital estimation for public utilities. Together, these three schools provide the basis of criticism that states that the basic CAPM underestimates the returns for public utilities.

A. The Fischer Black School Defined

The Fischer Black school holds that the CAPM has inherit empirical bias against low beta securities. The first is the work of Sharpe, Linter and Black which establishes the theoretical underpinnings of the CAPM. Their research establishes the basic mathematical form of the CAPM as an extension of risk premium analysis. Unlike risk premium analysis, the CAPM assesses risk relative to other securities in the market. The second is the work of Robert S. Hamada which frames the CAPM with a few assumptions. When these assumptions hold, they allow the CAPM to more accurately measure the risk of a given security.

The third study is the work of Louis K. C. Chan and Josef Lakonishok that uses a practitioner's approach to rebut the great body of work of the Fama and French school. Chan and Lakoninshok base their approach on the fact that a great deal of portfolio managers use beta in their investment decisions. They further note that many financial analysts regard beta as one of the most important contributions of the academic financial community. The fourth thread of the Fischer Black school is the work of Fischer Black himself. Black poses his own rebuttal of Eugene Fama and Kenneth French. He simply argues that Fama and French are wrong. Black does this by updating the work of Black, Jensen, and Scholes and Miller and Scholes. He finds that the bias against low beta stocks is more significant now than it was previously. The latest work in the Fischer Black school is the analysis of Kevin Grundy and Burton Malkiel. They also take issue with the Fama and French school. Grundy and Malkiel find that beta is a useful measure of the downside risk of low beta stocks in bear markets.

B. The Fama and French School Defined

The Fama and French school of thought centers on the work of Eugene Fama and Kenneth French. Fama and French study cross-sectional variation of average stock returns. They find that market capitalization and book-to-market equity ratios contribute more to the estimation of the return on equity than beta. Fama and French discover that when one controls for size or book-to-market equity that the relationship between beta and returns is statistically indeterminate. This indicates that beta has no predictive power in determining the cost of common equity. Others in this camp include Reinganum and Lakoninshok who examine the relationship between dividend yields and market returns.

C. The Litzenberger School Defined

The third school of thought is the Litzenberger school which applies the lessons of the other two schools specifically to the public utility industry. The first study of the use of the CAPM in regulatory proceedings is the work of William Breen and Eugene Lerner. They find the use of beta wanting. They note that the empirical estimates of beta are unstable at best. The second body of knowledge is the work of Eugene Brigham and Roy Crum. They discuss the numerous problems associated with the model and its use as an estimator of the cost of capital in regulatory proceedings. Brigham and Crum's criticisms are both academic and procedural. They find the model's assumptions unrealistic, the choice of the risk-free rate unsettling, estimates of the market premium controversial, and generally unstable betas.

The third study is the work of John Glister and Charles Linke. Their rebuttal of Brigham and Crum argues against the instability of the betas of public utilities. Rather than discarding the CAPM, Glister and Linke suggest operating under the assumption that the betas of public utilities are stable. They make this assumption based on the premise that utility stocks are more conservative assets. The fourth article is the summation of the efforts of Richard

Pettway. Like Glister and Linke, Pettway argues that the instability of beta is not an issue in estimating utilities' cost of equity. Empirically, Pettway finds that market shocks have caused the instability in betas. Thus, those betas estimated in periods of relative market calm produce betas which have predictive value in rate cases.

Robert Litzenberger, Krishna Ramaswamy, and Howard Sosin attempt to develop a grand unification theory on how to correct the CAPM for the estimation of the return of common equity of public utilities. Litzenberger *et al* acknowledge the various possible effects whether they are from dividend yields, taxation, unlimited borrowing, firm size, etc., and try to apply them all to correct the CAPM. They note that low betas possess an inherit bias in the estimation of the cost of capital which creates a systematic skewness. Their cure for the problem is to adjust beta with a shift parameter, alpha. It shifts beta closer to unity. The aim of the alpha shift parameter is to account for all of the possible influences upon beta's instability and inaccuracy.

The last work in the Litzenberger school is the update of Litzenberger *et al*'s measurement of alpha by Roger Morin. Morin uses Litzenberger *et al*'s methodology to update the alpha estimate. He assumes that all of the other variables to explain returns such as book-to-market ratios, skewness, firm size, and dividend policy serve to obfuscate the analysis. Instead, Morin lumps them all into one category and uses alpha to explain them. The results of his analysis show that the CAPM is flatter than other empirical methods describe. Morin demonstrates that unadjusted betas understate the true cost of capital of public utilities.

II. The Fischer Black School of Thought

A. Theoretical Development of the CAPM

Through a series of articles, Sharpe (1964)[1], Linter (1965)[2], and Black (1972)[3] construct a mathematical theory of asset returns known as the Capital Asset Pricing Model (CAPM). The model began as an extension of risk premium analysis, the predominant theory of finance at the time. The first CAPM theory, also known as the Sharpe-Linter-Black Model, explains

[1] Sharpe, William, "Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk," Journal of Finance, (September 1964), pp. 425-442.

[2] Linter, J., "Security Prices, Risk, and Maximal Gains from Diversification," Journal of Finance, (December 1965), pp. 587-615.

[3] Black, Fischer, "Capital Market Equilibrium with Restricted Borrowing," Journal of Business, Volume 45 (July 1972), pp. 444-455.

the relationship between two types of risk; systematic risk and unsystematic risk. The systematic risk is the risk of any given security or asset. The unsystematic or market risk is the risk associated with the whole market of capital assets. The appeal of the CAPM is its presentation of a simple, measurable relationship between risk and expected return. It describes the expected return of an asset or security as the sum of the return on a risk free asset and a premium for risk. One assesses risk solely as the sensitivity of a given asset to the movements of a broad market index. The risk premium depends exclusively on this sensitivity and on the spread between the expected rate of return on the broad index and the risk-free rate. The appeal of the CAPM is its simplicity. Mathematically, the Sharpe-Linter-Black CAPM is:

$$R_m = R_f + \beta(R_m - R_f)$$

Where:

R_i - the expected return of the security

R_f - the risk free return

B - sensitivity of the security

R_m - the expected return to the market

B. Underlying Assumptions of the CAPM

Robert S. Hamada (1969) in his article entitled, "Portfolio Analysis, Market Equilibrium, and Corporation Finance," frames the CAPM by adding a few underlying assumptions[4]. He posits that for the CAPM to predict returns accurately for a given security, then one must assume that capital markets are perfect. This implies that information is available to all, no taxes or transaction costs exist, and assets are infinitely divisible. Further, one must assume that investors are risk averse and maximize the expected utility of their wealth at the end of their planning horizon. Third, the planning horizon is the same for all investors, and they make their portfolio decisions at the same time. Fourth, all investors have identical estimates of expected rates of return. Fifth, one must

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[4] Hamada, Robert S., "Portfolio Analysis, Market Equilibrium and Corporate Finance," Journal of Finance, Volume 24, Number 1, (March 1969), pp. 13-31.

assume that expected bankruptcy or default risk and the risks of interest rate and purchasing power fluctuation are negligible. Sixth, one must presuppose that dividend policy has no effect on the market value of a firm's cost of capital. Last, one must ignore future investment opportunities that exist at rates of return greater than the firm's current cost of capital.

C. A Practitioner's Approach to the CAPM

Louis K.C. Chan and Josef Lakonishok (1993) take a practitioner's approach to rebut Fama and French's dismissal of the CAPM[5]. In their 1993 article, they examine portfolio managers' use of beta to make investment decisions. They state that many professionals regard the concept of beta as the single most important contribution of academic researchers to the financial community. They start their discourse by asking the simple question: is there sufficient evidence to bury beta? Further, they assert that the question adds urgency when one considers the dramatic acceptance of beta in portfolio management in the past decade. Portfolio managers are now using optimization techniques to find more efficient portfolios. Chan and Lakonishok note that the trend is growing. Technology

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[5] Chan, Louis K.C., and Josef Lakonishok, "Are the Reports of Beta's Death Premature?," Journal of Portfolio Management, (Summer 1993), pp. 51-62.

has advanced in such a way to optimize portfolios from thousands of asset choices. Chan and Lakonishok find it ironic that the industry should accept beta for twenty years with thin empirical evidence only to discover academics discarding it. Indeed, they think that beta may emerge in the future as an important measure of risk.

Chan and Lakonishok warn that numerous reasons exist as to why returns may bear little relation to betas. They note that Roll and Ross emphasize the problems associated with testing the relationship between return and beta when one cannot observe the true market portfolio. They do not dispute that a fundamental difficulty exists with current tests of the CAPM. However, their approach is more pragmatic. They focus on the practical use of the CAPM. Their standard approach is to utilize some broad-based proxy for the market index, calculate beta with respect to this proxy, and relate future returns to these betas. Since Fama and French find no association between returns and betas, Chan and Lakonishok focus on that conclusion. As such, they exclude all the debate about which other variables one should include in the CAPM. The variables Chan and Lakonishok ignore are market capitalization, book-to-market ratios, etc. They focus exclusively on beta. They note that while it is true that other variables may help explain returns, no firm guidelines exist as to which variables one should include.

D. Betas Are Still Biased

Fischer Black (1993) also takes issue with the findings of Fama and French in his treatise entitled, "Beta and Return: Announcements of the 'Death' of Beta Seem Premature."[6] Black attributes Fama and French's dismissal of the CAPM to the wrong interpretation of their own results. He cites studies by Black, Jensen, and Scholes (1972) and Miller and Scholes (1972). These authors found that during the period of 1931 through 1965 low-beta stocks performed better than the CAPM predicts while high-beta stocks did worse. The above authors found that the estimated slope of the line relating average return and risk is flatter than the CAPM predicts. Further, they find that if one chooses his data carefully, one can find a period of two decades where the risk-return line is essentially flat. Black states that the results of Fama and French are more than likely the result of data-mining or statistically loaded arguments.

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[6] Black, Fischer, "Beta and Return: Announcements of the 'Death' of Beta Seem Premature," Journal of Portfolio Management, (Fall 1993), pp. 8-18.

Black describes a market phenomenon he calls the "beta effect" where borrowing restrictions have higher than expected returns. He states that many investors who can borrow, and who deduct the interest they pay from their income taxes, are nonetheless reluctant to borrow. Those who accept market risk will bid up the prices of high-beta stocks. This makes low-beta stocks more attractive and high-beta stocks unattractive to investors who have low-beta portfolios or who are unwilling to borrow. Evidence of this exists in the market's reaction to a change in a firm's leverage position. An offer to exchange debt for equity generally causes the firm's stock price to rise, while an offer of equity for debt causes the stock price to decrease.

Black chooses to update his previous study with Jensen and Scholes (1972) to rebut Fama and French. In doing so, he finds that high-beta stocks have lower returns accented by negative alphas. Likewise, the low-beta stocks have higher than expected returns with positive alphas. Black stands by the original assertion that he and others have made previously. He states that the CAPM will continue to overestimate the returns of high-beta stocks and underestimate the returns of low-beta stocks. Black caps his argument with Fama and French by posing a more intuitive logic rather than an empirical demonstration. If the relationship between risk and return is essentially flat, then the market underprices low-beta stocks. As such, a wise fund or portfolio manager would do well to purchase low-beta assets. This way one minimizes risk and maximizes return.

E. Beta is a Robust Measure of Downside Risk

Kevin Grundy and Burton G. Malkiel (1996) follow Fischer Black's latest rebuttal (1993) of Fama and French's conclusions and find beta to be a serviceable measure of downside risk, *ex ante.*[7] Using statistical methods similar to Fama and French, Grundy and Malkiel find that while beta shows little predictive power in bull markets, it does help to find low risk assets in bear markets. As such, they view the death of beta as an illusion if one places it in the correct context.

[7] Grundy, Kevin and Burton G. Malkiel, "Reports of Beta's Death Have Been Greatly Exaggerated," Journal of Portfolio Management, (Spring 1996), pp. 36-44.

III. The Fama and French School of Thought

Eugene F. Fama and Kenneth R. French in their 1992 treatise entitled, "The Cross-Section of Expected Stock Returns," all but declare that the CAPM is dead.[9] They take two easily measured variables, size and book-to-market equity and empirically demonstrate that they combine to capture the cross-sectional variation in average stock returns associated with market betas. Further, they show that when tests allow for variation in beta unrelated to size, then the relation between market betas and average returns is nonexistant. This questions the empirical validity of beta as an explanatory variable of returns. Fama and French's results concur with the studies of Reinganum (1981) and Lakoninshok (1986) which also illustrate that beta alone does not explain average market returns. Their conclusions are simple. Beta does not help explain cross-section average stock returns. Fama and French empirically demonstrate that size and book-to-market ratios are more useful predictors of returns than beta.

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[9] Fama, Eugene and Kenneth French, "The Cross-Section of Expected Stock Returns," Journal of Finance, Volume 48, Number 2, pp. 427-465.

IV. The Litzenberger School of Thought

A. The CAPM as a Measure of the Cost of Capital

In their 1972 article "On the Use of Beta in Regulatory Proceedings," William J. Breen and Eugene M. Lerner undertook the first critical examination of the CAPM to estimate the return on equity of public utilities.[9] Their study explores the use of beta in regulatory proceedings and finds its use wanting. They note that the empirical estimates of betas are unstable. The estimates range for any given firm from very positive to very negative. Breen and Lerner attribute this to three factors; the estimating equation utilized, the choice of market index, and the specific time period selected to derive beta. They assert that these unstable betas are a result of changes in managerial decisions. As a result they develop an empirical and theoretical construct that checks the validity of estimated betas as representative of "true" betas. Breen and Lerner conclude that if the CAPM provides the underlying framework for the valuation of firms in regulatory proceedings, then financial analysts must conduct more

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[9] Breen, William J., and Eugene M. Lerner, "On the Use of Beta in Regulatory Proceedings," Bell Journal of Economics and Management Science, (Autumn 1972), pp. 612-621.

research. This research must examine the relationship between individual corporate activities and the risk associated with the individual firm. They also assert that given the nature of public utilities that regulatory decisions may have underlying influence on the betas of utility stocks. This hypothesis has a strange familiarity in the conclusions of the *Bluefield Waterworks* decision that ruled that regulatory risk is a risk that commissions must consider in their decisions.

B. Problems with the CAPM in Regulation

Eugene F. Brigham and Roy L. Crum (1977) in their article, "On the Use of the CAPM in Public Utility Rate Cases," write of the numerous problems associated with the model.[10] First, the model has unrealistic assumptions. Second, disagreement exists among academics over the choice of the appropriate risk-free interest rate. Third, one cannot measure the market risk premium accurately. Fourth, not only is an individual stock's beta unstable, but no one knows how to estimate a stock's future beta coefficient. In addition, Brigham and Crum state that the dividend policy of a given corporation affects the asset's

[10] Brigham, Eugene F., and Roy L. Crum, "On the Use of the CAPM in Public Utility Rate Cases," Financial Management, (Summer 1977), pp. 7-15.

price. In other words, dividend yields influence betas.

Brigham and Crum conclude that the CAPM probably produces downward-biased betas resulting in lower cost of capital estimates. Calculated beta coefficients will tend to decline whenever a company's fundamental risk position changes. This is true even if the market as a whole is rising while investors expect moderate or deteriorating earning prospects. Thus, betas can measure risk in the exactly the opposite direction from actual market and firm conditions. Brigham and Crum then cite the examples of Penn Central, W. T. Grant, and Franklin National Bank, three of the largest bankruptcies in history. They note that these firms had declining betas and poor earnings forecasts prior to bankruptcy. Bankruptcy should have served to raise their risk, hence their betas. Similarly, the electric and telephone utilities' betas remained constant or even declined from 1964 to 1975 when the industries fundamental risks increased. At the same time, analysts were downgrading the companies' stocks and bonds from "widow and orphan stocks" to assets that pose a significant degree of risk. The implication of Brigham and Crum is that the use of the CAPM in utility cost of capital estimation is unclear. Historical betas do not necessarily reflect the risks inherent in utility equity due to their bias on the past.

C. Exercise Caution When Using the CAPM in Regulation

John E. Glister, Jr. and Charles M. Linke quickly counter Brigham and Crum. In their 1978 article, "More on the Estimation of Beta for Public Utilities: Biases Resulting from Structural Shifts in True Beta," Glister and Linke present two discrepancies of opinion on the instability of estimated betas.[12] First, they argue that a size and closure rate discrepancy occurs between a firm's true beta and its regressed beta. This difference usually follows a structural shift in the firm's systematic risk. This discrepancy is a function of the correlation between changes in returns due to changes in true beta or changes in returns due to all other causes. Glister and Linke note that Brigham and Crum fail to acknowledge this correlation effect. Likewise, they note that Brigham and Crum overlook the "arithmetic phenomenon" of a declining beta while risk for the firm is increasing. Brigham and Crum assume that this is not unique to the CAPM. Glister and Linke take issue with Brigham and Crum's empirical support

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[12] Glister, John E., and Charles M. Linke, "More on the Estimation of Beta for Public Utilities: Biases Resulting from Structural Shifts in True Beta," Financial Management, (Autumn 1978), pp. 60-65.

for the "arithmetic phenomenon" by their choice of firms approaching financial embarrassment. Glister and Linke offer an alternate explanation for the declining estimated betas for companies approaching bankruptcy. They contend that the phenomenon of falling betas was simply a reflection of investors' expectations of lower earnings. Glister and Linke also view Brigham and Crum's application of the misleading beta to public utilities as inappropriate for purposes of simplicity. They question the notion of using a complex calculation to find a stable beta instead of simply assuming a stable betas for utility stocks. All in all, Glister and Linke do agree with Brigham and Crum. They concur that one must exercise a great deal of caution when estimating betas for calculation of the return on equity.

D. Assumption of Stable Betas

Richard H. Pettway undertakes an empirical examination of the CAPM in his 1978 study entitled, "On the Use of Beta in Regulatory Proceedings: an Empirical Examination."[12] Pettway notes that the CAPM has become a way to estimate the return on equity that investors

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[12] Pettway, Richard H., "On the Use of Beta in Regulatory Proceedings: An Empirical Examination," Bell Journal of Economics, Volume 9, Number 1, (Spring 1978), pp. 239-248.

anticipate. As a forecast of the equity portion of the cost of capital, the CAPM does not require structural stability of beta. However, one must assume that it exists, or else the model is useless. Through his empirical work, Pettway comes to three conclusions. First, periods exist when the estimated parameters of the CAPM showed a strong resilience. They made good estimators of future observed values. Second, some periods during severe energy shocks caused disruption in the ability to make stable estimates. The result is unstable estimates and poor predictions of future returns. Third, after the period of instability, the estimated parameters return to their previous stability. Pettway concludes that a fundamental problem exists when using historical data to forecast future returns. He notes that no reliable test exists to demonstrate if such *ex post* parameters make effective *ex ante* estimators. However, if markets are free from substantial shocks and disruptions, then the *ex post* betas are reliable. Consequently, Pettway concludes that when one uses historical data one must consider such possibilities.

E. The Litzenberger CAPM

The boldest critique of the pure or theoretical CAPM comes from an article entitled, "On the CAPM Approach to the Estimation of A Public Utility's Cost of Equity Capital," by Robert Litzenberger, Krishna Ramaswamy, and Howard Sosin (1980).[13] Litzenberger *et al* identify a prevailing assumption in CAPM estimates that the betas are strictly proportional to market returns. As previously noted, the empirical literature does not support this presupposition. The empirical literature supports a (non-proportional) linear relationship between risk premia and market betas with a positive intercept. Their survey of the literature finds that other factors besides beta have profound influence on returns including systematic skewness and dividend yields. They find that the work of others so overwhelming that they state:

> "The version of the CAPM that should be employed in estimating a public utility's cost of equity capital cannot be conclusively demonstrated by theoretical arguments."[14]

By this statement, they imply that a positive theory of the valuation of risky assets cannot rely exclusively

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[13] Litzenberger, Robert, Krishna Ramaswamy, and Howard Sosin, "On the CAPM Approach to the Estimation of a Public Utility's Cost of Equity Capital," Journal of Finance, Volume 35, Number 2, (May 1980), pp. 369-387.

[14] Ibid.

on the validity of its assumptions, but it must also rely on the accuracy of its *a priori* predictions. Litzenberger *et al* demonstrate empirically that risk premia behave in direct proportion to some market index beta. However, they produce downward biased predictions of the cost of equity when betas are less than unity. They note that the cause may be the high dividend yields of utility stocks relative to the weighted yield of market index stocks.

Litzenberger *et al* have performed studies of the relationship between dividends and returns to find that, besides beta, dividends have a strong, positive association with cost of equity capital estimates. Further study indicates that the relationship between this estimate of returns and dividend yields is nonlinear in nature. In addition, their conclusions about market skewness indicate that the effect is unstable, hence a capricious determinant of future returns. In computing beta, Litzenberger *et al* suggest following the theoretical advice of Blume (1971) by adjusting historical betas towards unity. The underlying thesis of this argument is that in the long run all returns converge to the market return, *ceteris paribus*. In addition, adjusted betas make better forecasters of future returns. Litzenberger *et al* opt for two types of adjustment to beta; global and Bayesian. The global adjustment applies the same shift to each beta equally, while the Bayesian adjusts each beta according to its own unique variance. Their study concludes that utilities generally have residual standard deviations that are smaller than most industrial firms. Hence, the Bayesian adjustment does not have the same predictive ability that the global adjustment procedure does. They find that the global adjustment has a more profound *a priori* effect that warrants further investigation.

F. Morin's Empirical CAPM

Roger A. Morin (1994) counters Fama and French's thesis with a paraphrasing of Mark Twain's quip, "The reports of the death of the CAPM have been greatly exaggerated."[15] He dismisses Fama and French's argument by pointing out that they used realized returns rather than expected returns. Morin recognizes that the CAPM remains a valuable theory in the estimation of the return on equity in public utility rate cases. Therefore, he embarks on an effort to give the model some regulatory credibility. Using the

[15] Morin, Roger A., "Chapter 13: CAPM Extensions," Regulatory Finance: Utilities' Cost of Capital, (Arlington, VA: Public Utilities Reports, Inc., 1994), pp. 321-342.

methodology of Litzenberger, Ramaswamy, and Sosin (1980) as a basis, Morin assumes that the various correction variables suggested by others (i.e., firm size, dividend policy, skewness, debt-to-equity ratios) serve to obfuscate the analysis. Morin offers to lump them all into one explanatory variable that he uses as a shift parameter of the raw beta. The result of this shift parameter is to flatten the CAPM and its graphical counterpart, the Market Return Line (MRL). As the previous literature indicates, the CAPM has an empirical bias against firms with betas less than unity and those that pay high dividends. Likewise, the CAPM empirically overestimates the returns of betas greater than unity and those with small dividends. To test his hypothesis, Morin separates securities from the Center for Research of Security Prices into forty-two portfolios based on betas and dividend yields and regressed them on the following equation:

$$R_i = R_f + \alpha(R_m - R_f) + (1-\alpha)\beta_i(R_m - R_f)$$

Where:

R_i - Portfolio Risk Return

R_f - Risk Free Return

α - Alpha Shift Parameter

B_i - Beta of the Given Portfolio

R_m - Market Risk Return

Morin proceeds to test the hypothesis that alpha is not equal to zero. If alpha were zero, then the CAPM would not show a bias against low beta and high dividend stocks.[16] One must note that Morin uses portfolios that describe the market as a whole. He includes over 450 companies in his analysis, most of which are not public utilities. His shift parameter is a global one to describe all stocks and is not unique to utilities.

V. Conclusion

As the above body of literature demonstrates, a general dissatisfaction has existed with the results

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[16] Morin, Roger A., "Appendix B: Rebuttal Testimony of Roger A. Morin," In the Matter of the Commission's Examination of the Rates and Charges of the Mountain States Telephone and Telegraph Company, Arizona Corporation Commission, Docket No. E-1051-88-146, (March 28, 1989), pp. 1-28.

produced by the theoretical CAPM since its introduction. The criticism is widespread. Whether it attempts to reconcile the bias of beta or it dismisses the CAPM outright, all agree that the CAPM produces biased results. Two dominant trends emerge from the preceding discussion in the areas of estimation bias and underestimation of risk. All give some credence to the idea that the CAPM produces biased betas. Likewise, they acknowledge that the CAPM understates the returns for stocks with betas less than unity. In addition, the literature indicates that high dividend stocks have betas that do not fully account for their returns. Further, beta does not fully measure risk related to the market capitalization of a given security. Beta also does not completely describe the relationship between book-to-market ratios and returns on equity.

The previous discussion makes little mention of alpha as a way to correct for the bias against low beta stocks. The first authors to address this issue are Litzenberger *et al* and their case is compelling. Black tends to concur; however, his discussion of alpha is more superficial. Although he previously addressed the topic of an alpha shift parameter, it has the appearance of an afterthought. Morin concurs with the results produced by Litzenberger *et al* and uses them as a basis to update their efforts. All of the others do not give the idea of a shift parameter, such as alpha, much thought as a solution to the empirical bias of the CAPM. However, the use of the alpha shift variable emerges as a solution to the bias produced by more traditional methods of beta estimation.

Last, no serious scholarly work has materialized to develop the alpha shift parameter further. The work of Morin appears as an appendix to support rate of return testimony he filed with the Arizona Public Service Commission.[17] However, one must allow Morin the benefit of the doubt. He replicates the results in his book Regulatory Finance.[18] The last exclusively academic research on the size and statistical significance of alpha is the work of Litzenberger *et al*.[19] It stands to this day as the only work on the subject of developing a global adjustment to betas to account for the biases of the traditional CAPM. Nevertheless, both Litzenberger *et al* and Morin find global shift alphas that apply to betas. Given the unique characteristic of utility stocks as income assets, their alphas may not truly represent the bias

[17] Ibid.

[18] Morin, Roger A., "Chapter 13: CAPM Extensions," ibid.

[19] Litzenberger, ibid.

against accurate return on equity estimates. For ratemaking purposes, a more precise alpha may result by directly estimating the alpha for a group of utility stocks. Given the minimal amount of discussion of alpha in the literature of the CAPM, an alpha unique to utilities may exist. Because of its application to utility regulation, it has potentially significant policy implications. Further, it is possible to test for that alpha empirically.

CHAPTER THREE

RESEARCH METHODOLOGY

I. The Problem Defined

The previous literary discussion illustrates that the Capital Asset Pricing Model (CAPM) has many serious empirical shortcomings in estimating the expected return on equity of utilities. As noted, the simple CAPM produces betas that have inherit biases against low beta stocks and those yielding high dividends. The result is to estimate a cost of common equity that differs from the true cost. Likewise, beta does not fully account for risk associated with market capitalization, firm size, and book-to-market ratios. Further, the literature has little discussion of the use of the alpha shift parameter to correct the model's empirical shortcomings. In addition, the academic literature surrounding the empirical CAPM is out of date. Finally, this particular branch of CAPM theory draws general inferences related to all stocks. It does not focus exclusively on the issue of the underestimation of returns to public utilities' securities. All in all, CAPM theory in its present form does not serve the function as an accurate measure in the current, deregulated, less-frequent regulatory environment.

A. Beta is a Biased Estimator

Beta is a biased estimator of risk as Fischer Black makes clear. Unadjusted betas produce biases in the estimation of expected returns. The nature of the empirical process derives raw betas that understate the returns of low beta stocks and overestimate the returns of high beta stocks. Since utilities fall into the former category, the use of the CAPM as a measure of the cost of capital can cause shareholders to receive less compensation for the risk they assume. In the longer-term, inadequate returns will discourage capital investment for infrastructure development. Morin further asserts that beta has a bias against stocks that pay high dividend yields. Once again, the investors who hold the equities of public utilities receive earnings that are less than they should for securities of comparable risk. This can hamper any given utility's ability to attract capital for future investments in plant to serve its customers. As illustrated, beta is a biased estimator of expected risk.

B. Beta Does Not Fully Measure Risk

Beta does not fully account for risk that any firm possesses based on unique characteristics of the firm in question. As Fama and French discover, the CAPM and beta do not adequately measure the risk associated with the market capitalization of smaller companies. The general tendency of beta is to understate the true cost of equity for firms with smaller market capitalization. With no adjustment to account for this possibility, shareholders of smaller utilities will either subsidize ratepayers or will cease investment. Litzenberger *et al* raise the issue of beta as a skewed estimator of risk which underreports the risk of small firms and those with low betas. Another possibility is the issue raised by Breen and Lerner that beta has an inherit bias that does not account for regulatory risk. In order to account for the underestimation of risk associated with raw betas, one must adjust them.

C. Scant Academic Discussion of Alpha

In the literature, little discussion exists about the alpha shift parameter as a means to account for the biases inherit in beta. Black does acknowledge that the CAPM should produce results that are flatter than the ordinary model predicts. However, he develops an alpha that is merely additive rather than rebalancing the CAPM to capture the possible causes of the skewness of the unadjusted CAPM. Litzenberger *et al* are the only authors that view the alpha shift parameter as a viable solution to the skewness of beta. The results of Litzenberger *et al* demonstrate that the use of alpha to correct the CAPM produces more robust estimates of the cost of capital for public utilities. Morin's reworking of the efforts of Litzenberger *et al* serves to confirm this. In the vast academic literature of the CAPM, only the last two address the adjustment of beta with an alpha shift in the estimation of the return on common equity for public utilities.

D. All Studies of Alpha are Out of Date

The last exclusively academic research on the use of alpha to adjust the betas is the aforementioned analysis of Litzenberger *et al.* Given that they conducted this research almost two decades ago, the empirical results are out of date. The data they analyzed were security prices that end in the late 1970's. The utility industry has undergone two major changes which have had an impact upon the risks associated with holding these securities. The first is the vertical divestiture in the natural gas industry. Federal Energy Regulatory Commission (FERC) no longer regulates wellhead gas prices. Although FERC still regulates the rates charged for the interstate transportation of natural gas, it is far more limited and FERC performs this function more at an arm's length. Many shippers and pipelines negotiate their rates directly. Consequently, pipeline rate cases are infrequent, and FERC limits them to regulation of the rates of return that the pipelines earn. The only traditional regulation remains with the states which establish the rates that local gas distribution companies (LDC's) charge. The second emerging trend is the move toward deregulation of the retail utility business which ultimately aims to offer more retail customers the choice of their gas and electricity suppliers. Although the work of Morin is more recent, it relies upon data drawn from a period of time before this industry-wide restructuring. The need to more accurately account for the cost of future capital needs of utilities and to cope with less frequent rate cases requires a more precise and timely measurement of alpha.

E. Restructuring Requires a Precise Estimate

The current restructuring of the industry and the movement of the utility industry toward competition necessitate an estimate of the return on equity which produces a robust, long-term estimate of the cost of capital. The aim of the newer performance based ratemaking is to reduce costs to ratepayers by conducting fewer regulatory proceedings. The current paradigm of cost of service regulation allows utility companies to seek rate adjustments to cover revenue shortfalls to avoid financial peril. The major crux of restructuring is to force the market to regulate rates in the off years. As such, regulators, customers and utilities need more accurate long-term estimates of the true cost of capital. In order for the empirical CAPM to have any value in a performance based rate making regimen, it must have long-term stability.

F. Transparency is Necessary

Other policy considerations exist that influence the methodologies suitable for measuring the cost of capital in ratemaking as well. The primary *modus operandi* of any regulatory model is transparency. Whether it is the setting of the rates of public utilities or limiting the tailpipe emissions of dangerous "greenhouse" gases, both the regulators and the regulated entities deserve a process that all concerned will understand. In the case of ratemaking, the goal of transparency requires tools that estimate the cost of capital with minimal complexity. The CAPM is a simple model to do such an estimate. However, both the regulator and the firm must understand its limitations and make adjustments, like the alpha shift, that more fully account for the biases inherit in the CAPM. The alpha adjustment is a simple change to the CAPM that an analyst can easily explain to all stakeholders in a rate proceeding and it is easy to replicate.

G. The Empirical CAPM is Simple

The appeal of the empirical CAPM is its simplicity. All one needs to do is take a risk free rate of return and add it to a calculated risk premium for an individual firm. This characteristic is especially true in utility rate cases. An analyst must testify to a regulatory commission about a required rate of return to attract the necessary capital to provide a fair rate of return. Complex and esoteric discussions about minute adjustments to the CAPM serve to overwhelm regulators. A brief discussion of the inadequacies of the CAPM followed with a concise adjustment to the CAPM will aid all involved.

A plausible explanation of the CAPM's statistical imperfections may lie with its assumptions. Most glaring among them is the assumption of homogeneous dividend policies for all firms. As Litzenberger *et al* establish, this assumption has led to a downward bias in cost of equity estimates. An appropriate analysis of the CAPM as it applies to high dividend stocks like public utilities would relax this assumption to allow for inclusion of a "dividend effect."

The rule of parsimony requires that should an analyst make any empirical adjustments to the CAPM, then one must keep them to a minimum. As such, the argument of Fama and French regarding the use of other variables falls short of achieving this end. Indeed, one might even consider ignoring them outright. Otherwise, the result is an unfortunate subsidization of ratepayers by the company or *vice versa*. However, one must make some adjustment.

Following Litzenberger *et al* and Morin's lead the logical step is to conduct an analysis and synthesis that globally adjusts the returns of utilities to minimize their variances and remove any instability associated with any given parameter. This catch-all adjustment takes into account the variety of influences upon any given security to eliminate any multicollinearity that those variables may have on one another. At this point the issue devolves into three straight-forward questions:

- What is size of this alpha adjustment?
- Is alpha statistically significant?
- Is alpha statistically robust?

II. Methodology

A. Introduction

The purpose of this analysis is to determine whether the Empirical Capital Asset Pricing Model (ECAPM) is a useful predictor of the cost of capital for electric and gas utilities in the emerging regulatory environment. The unique characteristic of the ECAPM is that it attempts to envelop all of the shortcomings that the previous discussion illustrates. The ECAPM uses the alpha shift parameter as a "catch-all" for the plausible causes of the bias inherit in raw betas. For the model to be useful as an estimator of the return on common equity in utility rate-making, one must assess its statistical stability.

One cannot estimate alpha directly. The estimation of alpha requires a two step regression. The first step is the regression of the raw beta using the Sharp-Linter-Black CAPM. The second step to estimate alpha involves using the raw beta to derive alpha. The equation which one utilizes is the formula developed by both Litzenberger *et al* and Morin. Then, one can obtain an estimate of the alpha shift parameter.

B. Estimation of the Raw Beta

The raw beta is a measure of the sensitivity of the utility portfolio relative to the market portfolio. To calculate the utility portfolio beta, one must regress the returns of the utility portfolio as the dependent variable relative to the returns of the market portfolio. With the CAPM developed by Sharp, Linter, and Black, the only step necessary is to find an estimate of beta. The CAPM in the theoretical form is as follows:

$$R_i = R_f + \beta_i (R_m - R_f) + \varepsilon_i \qquad (1)$$

Where:

R_i - Return of the Utility Portfolio

R_f - Risk Free Return

B_i - Raw Beta of the Utility Portfolio

R_m - Return of the Market Portfolio

ε_i - Error term

One can estimate the raw beta by using any simple regression technique. The key in this step is to find the covariance between the utility index and the market index to later estimate alpha and test the raw beta for statistical significance.

C. The Estimation of Alpha

Since one cannot estimate alpha directly, the ECAPM developed by Litzenberger *et al* and Morin must undergo a transformation for empirical convenience. In its theoretical form, the ECAPM is as follows:

$$R_i = R_f + \alpha(R_m - R_f) + (1 - \alpha)\beta_{raw}(R_m - R_f) + \varepsilon_i \quad (2)$$

Where:

R_i - Return of the Utility Portfolio

R_f - Risk Free Return

α - Alpha Shift Parameter

R_m - Return of the Market Portfolio

B_{raw} - Raw beta of the Utility Portfolio

ε_i - error term

However, equation (2) requires some modification before one may estimate its parameters. The first step is to isolate the risk return of the utility portfolio in equation (1). Therefore equation (1) becomes:

$$(R_i - R_f) = a_i + b_i(R_m - R_f) + \varepsilon_i \quad (3)$$

Using equation (2) as a guide, the parameters for estimation in equation (3) are as follows:

$$a_i = \alpha(R_m - R_f) \qquad (4)$$

$$b_i = (1-\alpha) B_{raw} \qquad (5)$$

The next step is to estimate the parameters of equation (3) to find the values of a_i and b_i. The last step is to test the values of a_i and b_i for significance. Then, using the raw beta from the previous regression allows one to estimate alpha.

D. Finding the Alphas for All Industry Segments

The final step is to perform the regression and calculation of alpha for the three data sets. Given the possibility that differences may exist among the LDC's, the electric companies, and the combined utilities, a prudent step is to include the results of any possible beta bias for each industry.

The selected data sets represent all three segments of the utility industry. The Dow-Jones Utility Index and the Standard & Poor's Utility Index represent the industry overall. Given the recent increase in mergers and alliances that pair electric companies with gas utilities, the need exists for an alpha to account for any biases that affect utilities overall. The convergence of gas and electric companies and the move toward competition between the two has given rise to finding any bias that might exist. However, some companies will chose to remain dedicated to the lines of business in which they began. Therefore, the analysis must consider the differences in alpha that may exist for the gas and electric industries on their own. As such, the Moody's Gas Companies Index will provide a estimate of the alpha for gas companies. Likewise the Moody's Electric Companies will establish the alpha for electric only companies. These three regressions will examine if any such differences do exist.

III. The Data Set

The calculation of beta and alpha require three sets of data. The first is a portfolio that represents the market return rate that accounts for systematic risk. The second is a portfolio of individual securities that represent the public utility industry as a whole. The third data series is the risk free rate. These three data series allow one to estimate both beta and the alpha shift parameter.

A. The Standards for Data Set Selection

Each set of data must meet three criteria for their use in this analysis. First, the data must have general acceptance as appropriate representatives of the various components of the CAPM. Second, the data must be readily available from reliable sources. This gives the analysis more credibility. Finally, the data series must possess statistical stability. All data must meet these standards.

It is necessary to replicate the empirical correction to the CAPM in regulatory proceedings. Therefore, it is appropriate to choose data that commissioners, regulatory staffs, investors, and financial analysts use in assessing the returns on common equity. The data should be readily available and acceptable to all to satisfy the regulatory requirement of transparency. In addition, the choice of market indices and utilities that comprise a representative cross section of the industry should fit these conditions.

B. The Choice of the Market Portfolio

The first choice of data involves the selection of a portfolio that represents the returns of the market as a whole. In the literature of the CAPM, the choice of a market index is the subject of controversy. However, some consensus emerges as to how to select an index. The criteria are twofold; the index must have general acceptance and have the property of ready availability. Litzenberger *et al* use NYSE Composite Index. However, the Standard & Poor's 500 Index also fits this criterion. In addition, as companies merge with other companies, leave the indices, offer share-splits and any other possible disturbance to share prices, Standard & Poor's adjusts its index to account for these possibilities. The purpose is to maintain the statistical stability of these indices. Therefore, the S&P 500 fits the statistical stability requirement.

B. The Choice of a Utility Portfolio

The choice of a utility portfolio is far more difficult. In their analysis, Litzenberger *et al* and Morin divide all stocks listed on the New York Stock Exchange into ten portfolios. However, Litzenberger *et al* leave open the possibility that any portfolio will allow one to make at least a crude point estimate of alpha. The use of a utility portfolio will more fully correct for any bias beta that it may cause to the industry. Like the choice of a market portfolio, the utility portfolio must have general acceptance and ready availability. The possibility of constructing a portfolio has the potential for "data-mining" through the careful selection of a given handful of companies. This violates the condition of general acceptance.

However, several utility indices do exist which fairly represent the industry as a whole. Indices that fit this criterion are the Dow-Jones Utilities Index, the Moody's Electric Index, the Moody's Gas Companies Index, and the Standard & Poor's Utilities Index. To satisfy the criterion of availability, the Wall Street Journal publishes the Dow-Jones Utilities Index daily. Moody's publishes the Moody's Electric and Gas Companies indices monthly. Standard & Poor's provides monthly measurements of its Utility Index. Further, Dow-Jones, Moody's and Standard & Poor's adjust their indices as other companies acquire index components, companies offer stock-splits, and any other occurrence that might adversely affect share prices. They do this to maintain statistical stability. So all of these indices satisfy all three requirements for the utility portfolio data set.

C. The Choice of a Risk Free Rate Data Set

The choice of a risk free rate of return is the subject of some controversy among financial theorists regarding the CAPM. Some economists argue that the appropriate risk free rate of return is the yield of 90-Day Treasury Bills while others contend that longer term bonds serve to forecast a more long-term return on common equity.[1] As such, one cannot meet the general acceptance criterion for the risk free rate of return. When one considers the requirement that the risk free rate have statistical stability, yields on 90-Day T-Bills vary more widely than the longer term U.S. Bonds. However, some analysts do come to a consensus around using long-term U.S. Treasury bonds which vary less than short term debt instruments. In this sense, the statistical stability criterion trumps the general acceptance requirement because of the need to produce statistically robust alphas and betas. The proxy that this study will use for the risk free rate is the Monthly Ten-Year Composite as reported in the Federal Reserve Statistical Release publication known as H15. Since the Federal Reserve releases this data weekly to all who wish to have it, this meets the criterion of ready availability. The Federal Reserve 10-Year Composite yield of U.S. Treasury bonds meets two of the three criteria required for this analysis.

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[1] Ibbotson, Roger, "Chapter 8: Estimating the Cost of Capital or Discount Rate," Stocks, Bonds, Bills, and Inflation 1997 Yearbook, (Ibbotson Associates: Chicago, 1997), pp.150-153.

The literature supports the use of long-term Treasury bonds as the risk-free rate. Brigham and Gapenski (1985) note that long-term Treasury bonds have several characteristics that make them superior to Treasury bills. First, capital market rates include a real rate (between two and four percent) and an inflation premium. This premium accounts for the market's expectation of future inflation rates that the returns on equities must pay. Since common stocks are long-term securities, investors hold them for long investment horizon. A longer maturity Treasury bond will also have the same long-term focus as common stocks. Last, Treasury bill rates are subject to more random disturbances than Treasury bonds due to their central role in monetary policy. All in all, long-term Treasury bonds will produce more statistically robust estimates of alpha and beta.[2]

E. The Length of the Time Series Data

The next question about choice of data is the length of the time series. Litzenberger *et al* suggest that using sixty months of price data is sufficient to calculate beta. Likewise, the financial literature

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[2] Brigham, Eugene F., and Louis C. Gapenski, "Chapter 7A: Estimating the Cost of Equity in Practice," Financial Management: Theory and Practice, Fourth Edition, (New York: The Dryden Press, 1985), pp. 279-281.

suggests that both Value Line and Merrill Lynch use sixty months of data to calculate their betas.[3] To satisfy the requirement of general acceptance, this analysis will use sixty months of data.

F. The Use of the Data

Using the above mentioned data sets, the analysis will begin with an estimate of the alpha for the electric utility industry. The second regression will attempt to find the alpha for the natural gas utility industry. The last analysis will find the alpha for the utility industry as a whole.

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[3] Statman, Meir, "Betas Compared : Merill Lynch vs, Value Line," Journal of Portfolio Management, Winter 1981, pp. 41-44.

CHAPTER FOUR

ANALYSIS

The previous chapter established the method by which one estimates the alpha shift-parameter in the Empirical Capital Asset Pricing Model (CAPM). As stated in the previous chapter, the Empirical CAPM is:

$$(R_i - R_f) = a_i + b_i(R_m - R_f) + \varepsilon_i$$

Where:

R_i - Return for the Index Portfolio

R_f - Risk Free Return

R_m - Return for Market Portfolio

ε_i - Error Value

$a_i = \alpha(R_m - R_f)$

$b_i = (1-\alpha)B_{raw}$

The analysis will find estimates of a_i, b_i, and B_{raw} to determine the empirical bias of the CAPM.

I. Summary of the Methodology

The statistical analysis consists of a two-stage regression process. The first statistical analysis involves using the SAS statistical software package to estimate the raw betas of the Moody's Electric Index, the Moody's Local Distribution Companies (Gas Utilities), and the Dow-Jones Utility Index. The first step of which is to estimate both the raw alpha and raw beta of the given portfolios. The total annual rates of return of the Standard & Poor's 500 (S&P 500) is the independent variable. The total annual rates of return of the various utility indices are the dependent variables. The next step is to test the hypothesis that raw alpha and raw beta are equal to zero; that is to test the null hypothesis.

The second stage involves finding the *a* and *b* parameters identified in Chapter Three. The data series of the various indices require adjustment to complete the study. Each needs a conversion from index values to annual rates of return to effectively compare their returns to those of the market index. The hypothesis to test regarding *a* and *b* is if either is statistically significant.

II. Electric Utilities' Alpha

The first analysis is of the electric industry. The reason for analyzing the electric industry separately is determine if a separate alpha exists for that industry. The first regression uses the annual returns of the Standard and Poor's 500 as the independent variable and the annual returns of the Moody's Electric Index as the dependent variable. The SAS AUTOREG procedure begins with an Ordinary Least Squares regression. This yields a raw beta of 0.838984 and an alpha of -0.087198 for the electric industry. The Durbin-Watson statistic is 0.1965 indicating autocorrelation.[1] Since the Durbin-Watson shows the presence of autocorrelation, it is necessary to have SAS correct for this bias. The data has autocorrelation with one lagged period.

Having adjusted for the autocorrelation problem, the data is ready for another estimate of the parameters. The Maximum Likelihood method derives a more accurate measure of the raw beta, and it yields a beta of 0.565482 and an intercept of -0.058762. The estimate of the intercept is negative and statistically insignificant. Table 1 shows the results.[2]

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[1] Appendix A reports the results of the Ordinary Least Squares analysis which includes these statistics.

[2] Appendix A contains the SAS output to support this table.

Table 1.--Electrics' Total Returns

Analysis of Variance

SSE	0.12	DF	57
MSE	0	Root MSE	0.05
Reg R^2	0.18	Total R^2	0.89
Durbin-Watson	1.61		

Variable	DF	B Value	Std Error	t Ratio	Prob
Intercept	1	-0.06	0.06	-0.96	0.34
SPDELTA	1	0.57	0.16	3.44	0
A(1)	1	-0.91	0.06	-16.35	0

Variable	DF	B Value	Std Error	t Ratio	Prob
Intercept	1	-0.06	0.06	-0.96	0.34
SPDELTA	1	0.57	0.16	3.49	0

The next step is to find the *a* and *b* estimates to determine the value of alpha. The independent variable is the annual return for the Standard & Poor's 500 less the yield of a ten-year Treasury Bond. The dependent variable is the annual return of Moody's Electric Index less the yield of a ten-year Treasury Bond. The results of the SAS Ordinary Least Squares analysis are a beta of 0.859561 and an intercept of -0.099795.[3] The

[3] Appendix A contains the Ordinary Least Squares

beta is statistically significant, but the intercept is not. However, the Durbin-Watson statistic is 0.1981 indicating autocorrelation. The SAS AUTOREG procedure corrects for this by finding a correlation with this first period lag.

Having adjusted for the autocorrelation problem, the data is ready for another estimate of the parameters. The Maximum Likelihood method derives a more accurate measure of the raw beta, and it yields a beta of 0.609533 and an intercept of -0.093321. The estimate of the intercept is negative and statistically insignificant. Table 2 shows the results.[4]

Table 2.--Electrics' Risk Premium

Analysis of Variance			
SSE	0.12	DF	57
MSE	0	Root MSE	0.05
Reg R^2	0.2	Total R^2	0.89
Durbin-Watson	1.61		

analysis from which these statistics come.

[4] Appendix A contains the SAS output to support this table.

Table 2.--Continued

Variable	DF	B Value	Std Error	t Ratio	Prob
Intercept	1	-0.09	0.06	-1.63	0.11
SPLESS	1	0.61	0.16	3.76	0
A(1)	1	-0.9	0.06	-16.06	0

Variable	DF	B Value	Std Error	t Ratio	Prob
Intercept	1	-0.09	0.06	-1.64	0.11
SPLESS	1	0.61	0.16	3.82	0

The intercept is the estimate of the *a* parameter through which one indirectly measures alpha. Since the *a* parameter is statistically insignificant, the null hypothesis stands. Alpha is not statistically different from zero in the electric industry. A statistically insignificant alpha is inconsistent with the literature of the CAPM.

III. Local Distribution Companies' Alpha

The second analysis is of the local distribution companies (LDC's) of the natural gas industry. The reason for analyzing the LDC's separately is to determine if a separate alpha exists for that industry. Unlike the electric companies, the LDC's have experienced a measure of competition and restructuring since the beginning of this decade. The first regression uses the annual returns of the S&P 500 as the independent variable and the annual returns of the Moody's LDC Index as the dependent variable. The SAS AUTOREG procedure begins with an Ordinary Least Squares regression. This yields a raw beta of 0.661066 and an intercept of -0.012822 for the LDC industry. The Durbin-Watson statistic is 0.2103 indicating autocorrelation.[5] Since the Durbin-Watson shows the presence of autocorrelation, it is necessary to have SAS correct for this bias. As is the case with the electric industry, the data require correction for autocorrelation. The data has autocorrelation with the first, the ninth, and the tenth lagged periods.

Having adjusted for the autocorrelation problem, the data is ready for another estimate of the parameters. The Maximum Likelihood method derives a more accurate measure of the raw beta, and it yields a beta of 0.355608 and an intercept of 0.017167. The estimate of the intercept is statistically insignificant. Table 3 shows the results.[6]

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[5] Appendix A contains the Ordinary Least Squares analysis that produces these statistics.

[6] Appendix A contains the SAS output to support this table.

Table 3.--Local Distribution Companies' Total Returns

Analysis of Variance

SSE	0.09	DF	55
MSE	0	Root MSE	0.04
Reg R^2	0.11	Total R^2	0.9
	Durbin-Watson	2.11	

Variable	DF	B Value	Std Error	t Ratio	Prob
Intercept	1	0.02	0.04	0.49	0.63
SPDELTA	1	0.36	0.14	2.49	0.02
A(1)	1	-0.89	0.05	-16.66	0
A(9)	1	-0.42	0.13	-3.18	0
A(10)	1	0.49	0.13	3.87	0

Variable	DF	B Value	Std Error	t Ratio	Prob
Intercept	1	0.02	0.03	0.49	0.62
SPDELTA	1	0.36	0.14	2.57	0.01

The next step is to find the *a* and *b* estimates to determine the value of alpha. The independent variable is the annual return of the S&P 500 less the yield of a ten-year Treasury Bond. The dependent variable is the annual return of the Moody's LDC Index less the yield of a ten-year Treasury Bond. The results of the SAS Ordinary Least Squares analysis are a beta of 0.685063 and an intercept of -0.038253.[7] The beta is statistically significant, but the intercept is not. However, the Durbin-Watson statistic is 0.2111 indicating autocorrelation. The SAS AUTOREG procedure corrects for this by finding a correlation with the first, ninth, and tenth period lags.

Having adjusted for the autocorrelation problem, the data is ready for another estimate of the parameters. The Maximum Likelihood method derives a more accurate measure of the raw beta, and it yields a beta of 0.386694 and an intercept of -0.106921. The estimate of the intercept is statistically insignificant. Table 4 shows the results.[8]

Table 4.--Local Distribution Companies' Risk Premium

Analysis of Variance			
SSE	0.1	DF	55
MSE	0	Root MSE	0.04
Reg R^2	0.13	Total R^2	0.9
Durbin-Watson	2.1		

[7] Appendix A contains the Ordinary Least Squares analysis which produced these statistics.

[8] Appendix A contains the SAS output to support this table.

Table 4.--Continued

Variable	DF	B Value	Std Error	t Ratio	Prob
Intercept	1	-0.03	0.03	-0.99	0.33
SPLESS	1	0.39	0.14	2.72	0.01
A(1)	1	-0.89	0.05	-16.62	0
A(9)	1	-0.4	0.13	-3.05	0
A(10)	1	0.48	0.13	3.75	0

Variable	DF	B Value	Std Error	t Ratio	Prob
Intercept	1	-0.03	0.03	-1	0.32
SPLESS	1	0.39	0.14	2.81	0.01

The intercept is the estimate of the *a* parameter by which one indirectly measures alpha. Since the *a* parameter is statistically insignificant, the null hypothesis stands. Alpha is negative and not statistically different from zero in the natural gas distribution industry. Like the electric industry, the statistically insignificant alpha is contrary to the literature surrounding the CAPM.

IV. Combination Utilities' Alpha

The third analysis is of the overall utility industry. The reason for analyzing a utility index separately is determine if a separate alpha exists for the converged companies. The first regression uses the annual returns of the S&P 500 as the independent variable and the annual returns of the Dow-Jones Utility Index as the dependent variable. The SAS AUTOREG procedure begins with an Ordinary Least Squares regression. This yields a raw beta of 0.919748 and an alpha of -0.099718 for the utility industry. The Durbin-Watson statistic is 0.2666 indicating autocorrelation.[9] Since the Durbin-Watson shows the presence of autocorrelation, it is necessary to have SAS correct for this bias. The data has autocorrelation with one lagged period.

Having adjusted for the autocorrelation problem, the data is ready for another estimate of the parameters. The Maximum Likelihood method derives a more accurate measure of the raw beta. It yields a beta of 0.518260 and an intercept of -0.059372. Once again, the estimate of the intercept is statistically insignificant. Table 5 shows the results.[10]

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[9] Appendix A contains the Ordinary Least Squares analysis which produces these statistics.

[10] Appendix A contains the SAS output to support this table.

Table 5.--Combination Utilities' Total Returns

Analysis of Variance

SSE	0.14	DF	57
MSE	0	Root MSE	0.05
Reg R^2	0.14	Total R^2	0.87
Durbin-Watson	1.78		

Variable	DF	B Value	Std Error	t Ratio	Prob
Intercept	1	-0.06	0.06	-1.06	0.3
SPDELTA	1	0.52	0.18	2.93	0
A(1)	1	-0.89	0.06	-14.75	0

Variable	DF	B Value	Std Error	t Ratio	Prob
Intercept	1	-0.06	0.06	-1.06	0.29
SPDELTA	1	0.52	0.17	3.03	0

The next step is to find the *a* and *b* estimates to determine the value of alpha. The independent variable is the annual return for the S&P 500 less the yield of a ten-year Treasury Bond. The dependent variable is the annual return of Dow-Jones Utility Index less the yield of a ten-year Treasury Bond. The results of the SAS Ordinary Least Squares analysis are a beta of 0.946449 and an intercept of -0.106921. The beta and the intercept are statistically significant. However, the Durbin-Watson statistic is 0.2111 indicating autocorrelation.[11] The SAS AUTOREG procedure corrects for this by finding a correlation with the first period lags.

Having adjusted for the autocorrelation problem, the data is ready for another estimate of the parameters. The Maximum Likelihood method derives a more accurate measure of the raw beta, and it yields a beta of 0.569174 and an intercept of -0.097563. The estimate of the intercept is statistically insignificant. Table 6 shows the results.[12]

Table 6.--Combination Utilities' Risk Premium

Analysis of Variance			
SSE	0.14	DF	57
MSE	0	Root MSE	0.05
Reg R^2	0.17	Total R^2	0.88
Durbin-Watson	1.77		

[11] Appendix A contains the Ordinary Least Squares analysis which produces these statistics.

[12] Appendix A contains the SAS output to support this table.

Table 6.--Continued

Variable	DF	B Value	Std Error	t Ratio	Prob
Intercept	1	-0.1	0.05	-1.9	0.06
SPLESS	1	0.57	0.18	3.25	0
A(1)	1	-0.88	0.06	-14.53	0

Variable	DF	B Value	Std Error	t Ratio	Prob
Intercept	1	-0.1	0.05	-1.9	0.06
SPLESS	1	0.57	0.17	3.38	0

The intercept is the estimate of the *a* parameter by which one indirectly measures alpha. Since the *a* parameter is statistically insignificant, the null hypothesis stands. Alpha is not statistically different from zero in the overall utility industry. Like the electric and gas utilities individually, the alpha of the combination utilities is not statistically significant in contrast to the literature of the CAPM.

V. Conclusion

In stark contrast to the body of literature surrounding the empirical CAPM, the alpha shift parameter does not appear to exist for the utility industry. From the empirical evidence previously presented, the empirical bias in the Capital Asset Pricing Model (CAPM) does not exist. While the analysis acknowledges an alpha, it is negative and not statistically significant. This is true whether one examines the electric industry, the regulated distribution of natural gas, or the utility industry overall. Table 7 summarizes the results of the analysis.[13]

Table 7.--Summary of Results

Industry	Beta	Significant	Alpha	Significant
Electric	0.61	Yes	-0.03	No
Natural Gas	0.39	Yes	-0.11	No
Consolidated	0.57	Yes	-0.1	No

The conclusions of this analysis are a paradox of the accepted opinions on the empirical shortcomings of the CAPM. Fischer Black maintains that the CAPM has an even larger bias than he originally estimated in his previous work.[14] Likewise, Litzenberger *et al* and Morin[15] conclude that alpha is significant and estimate its value.[16] The only school of thought that these results do not contradict is the work of Fama and

[13] Tables A, B, and C present the data from which these conclusions come.

[14] Black, *ibid.*

[15] Morin, *ibid.*

[16] Litzenberger, Ramaswamy, and Sosin, *ibid.*

French.[17] These conclusions may buttress their argument that beta is not a sufficient measure of risk when one controls risk for the market capitalization of the security in question. The results of the previous study may be "correct" if beta offers little predictive power.

The results are inconsistent with the literature surrounding the CAPM. As demonstrated in Chapter Two, the literature states that the CAPM has an empirical bias. Although no way exists to ennumerate all of the possible causes of this result, one can list several causes. The possible reasons may have some association with the choice of methodology or data to derive the industry betas for the selected studies. One possible explanation is that the period from which the data come, 1991 to 1996, is an incongruity. A second possibility is the length of the time series inspected. Another possibility is that the lack of a statistically significant alpha is unique to the utility industry and does not exist in others. A fourth explanation flows from the third. It is possible that the nature of administered prices in a regulatory environment has an impact on the security prices. This impact precludes

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[17] Fama and French, *ibid.*

the ordinary empirical inconsistencies that the CAPM has for industries that have no price regulation.

A fifth possible cause for this inconsistency, which is also a result of the industries studied, is the so-called "Dividend Effect." The majority of returns for public utility stocks are dividends rather than capital gains. Historically, investors have come to expect dividend income from them. Since the CAPM excludes dividend income from the calculation of betas, the model may estimate an insignificant alpha. A sixth possible reason is the difference in the length of the time periods to calculate returns. This analysis used annual returns and long-term Treasury Bond yields. Litzenberger *et al* and Morin used monthly stock returns and 90-Day T-Bill yields as data. A final and more troubling explanation is that the previous analyses did not test for statistical problems like autocorrelation, and they did not adjust their results to account for them. Consequently, any of these possible explanations, or combinations of them, may account for the inconsistent results.

CHAPTER FIVE

EXPLORING THE PARADOX

With the given set of data, the results of Chapter Four show that that the Capital Asset Pricing Model (CAPM) has no empirical bias. Indeed, none of the alphas analyzed were statistically significant. The preceding statistical analysis suggests that the empirical bias of the CAPM is a mirage. At least this is true of the recent past if one accepts the previous investigation as sacrosanct. This position, however, is a hasty and quixotic one to assume. The former analysis is in conflict with the literature outlined in Chapter Two. The discrepancy may be the consequence of poor research methods, faulty conclusions, or differences in methods and assumptions between this study and the work of Litzenberger[1] *et al* and Morin.[2] A variety of plausible explanations exist that might explain the inconsistencies. Whether this study has erred or the previous work requires reconsideration, it is wise to attempt to reconcile the differences between the two.

The possible explanations are as follows, but this list is not exhaustive or all inclusive. One potential

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[1] Litzenberger, Ramaswamy, and Sosin, *ibid.*
[2] Morin, *ibid.*

reason is the choice of the time period for the analysis. A second, related reason is the length of the data series examined. Third, a viable cause of the inconsistency is that the absence of a bias is industry specific. Related to this explanation is the possibility that the inconsistency is due to the nature of the price regulation inherit in the utility industry. A fifth potential cause for the difference is the exclusion of dividend yields in the estimation of beta. A sixth possibility is the use of a long-term risk-free rate. A seventh possible reason is lax statistical methodology of the previous empirical work.

The prudent course to follow is to test each of the above stated hypotheses using the methodology outlined in Chapter Three. This allows for the opportunity to test the validity of the investigation of Chapter Four. Concomitantly, it tests the arguments established in Chapter Two. Scholastic integrity requires one to rectify the inconsistency between the results of Chapter Four and the body of literature surrounding the empirical CAPM. The aim of the current chapter is to diagnose the causes of this paradox and reconcile them. Further, this chapter will explore whether this dissertation is in error or if the literature of the CAPM is.

I. Time Period

Both the gas and electric utility industries have experienced two very profound institutional shocks during the time frame under inspection. Between 1992 and 1996, both industries have restructured and have moved towards competition. During this time, the Federal Energy Regulatory Commission (FERC) has implemented two decisions that aim to restructure the industries and introduce competition to them. Indeed, FERC Order 436 has had the effect of driving the Moody's Local Distribution Company (LDC) index down in 1994. Likewise, FERC Order 888 caused reverses in the Moody's Electric index in 1996. Such institutional disturbances have the effect of contaminating the data.

A. The Period of 1987 to 1991

A logical solution to eliminate the effects of FERC ordered restructuring is to choose a time period that precedes both decisions. As a check on this scenario, this study analyzes the five years preceding the data set used in chapter Four. This study attempts to find the alpha for the time period 1987 to 1991. These fall outside the bounds of the previous work and the implementation of FERC Orders 436 and 888. Table 8 illustrates the results of using the five years of data prior to the previous data set.[3]

Table 8.--Summary of 1987 to 1991 Data						
Industry	Beta	Prob	Sig	Alpha	Prob	Sig
Electric	0.31	0.01	Yes	-0.01	0.83	No
Natural Gas	0.36	0	Yes	-0.02	0.7	No
Consolidated	0.42	0	Yes	-0.06	0.2	No

Like the previous analysis in Chapter Four, the alphas are not statistically significant. What is notable is that the risk of LDC stocks has changed little in ten years as measured by the beta. The beta of the period of 1987 to 1991 is 0.36. In contrast, the beta of the later period is 0.39. Whether this is an indication that the natural gas industry has already adjusted to the risk of restructuring is a question worth examining. Even more notable than that is the change in the betas in both the electric industry and the utility industry overall. In the period 1987 to 1991, the beta for the electric industry is 0.31. In contrast, the beta of the 1992 to 1996 period is 0.61. The statistics imply that the market has recognized that restructuring and competition will make the electric utilities more risky. This also serves to

[3] Appendix B contains the SAS analysis that supports this table.

confirm beta as a measure of risk, and that it has adjusted to changes in the industry. The results from the Dow-Jones Utility Index conform to this observation, moving from a beta of 0.42 in 1987 to 1991, to a beta of 0.57 in 1992 to 1996.

That the alphas are negative and not significant in either time period eliminates restructuring and competition as the cause of the statistical insignificance of alpha in the utility industry. Likewise, the increase in the betas for the electric industry and the combined utilities is a recognition of the fact that many utilities have reorganized as holding companies. This reorganization has separated traditional utility operations from those ventures associated with energy marketing and movement toward competition with other utility companies. The increased betas due to this exposure to competition reflects this reorganization.

B. The Period of 1961 to 1965

Another possibility is that the current time frame is not representative of the returns for the industry. Another one might prove otherwise. As a check on the possibility that both of the time periods of 1992 to 1996 and 1987 to 1991 are statistical anomalies, an examination of a more distant time period is appropriate. The selected period for study is 1961 to 1965. This is an era in the utility industry that has no extraneous events to disturb stock returns, (i.e., the Energy Crisis of 1970's). Moody's LDC and electric indices have data that go back to the 1960's. However, the Dow-Jones Utility Index is not available. Fortunately, Standard & Poor's produces its own Utility Index which is a substitute for the Dow-Jones Index. Table 9 illustrates the results of the analysis outlined in Chapters Three and Four using data from the period 1961 to 1965.[4]

Table 9.--Summary of 1961 to 1965 Data

Industry	Beta	Prob	Sig	Alpha	Prob	Sig
Electric	0.81	0	Yes	-0.39	0.11	No
Natural Gas	0.89	0	Yes	-0.66	0.05	Yes
Consolidated	0.82	0	Yes	-0.3	0.05	Yes

The analysis of Utility Returns in the 1960's produces results different from those of Chapter Four. The *a* coefficients for the LDC's and the Consolidated Companies have a measure of statistical significance. However, they imply *negative* alphas which also contradict the literature surrounding the empirical CAPM. One must consider these results in the light of

[4] Appendix C contains the SAS analysis that supports this table.

their application in the area of cost of capital estimation for public utility stocks. The implication of the *a* estimates is that one can determine the cost of equity with the CAPM by first *decreasing* the results by the amount of the *a*. In the case of the LDC's, the CAPM overestimates the returns of common equity by approximately sixty basis points. Likewise, the CAPM overstates the returns for the S&P Utility Index companies by approximately thirty basis points. Given that in any given trading day a stock price can vary by as much as those estimates, the alpha estimates are probably not significant.

II. Length of the Data Set

Another possible cause of the disparity between the results in Chapter Four and the Litzenberger *et al* and the Morin studies is the difference in the time periods examined. Litzenberger *et al* examines a much broader, fifty-year period from 1928 to 1978. Likewise, Morin analyzes a time series that begins in 1928 and ends in 1990. During this time, the country has experienced the Great Depression, World War II, the Cold War, the collapse of Bretton Woods, the Energy Crisis, and two stock market crashes. Such institutional shocks can have the effect of contaminating data for useful empirical study. In contrast, the study in Chapter Four only examines the past five years.

The effect of the longer time period studied by Litzenberger *et al* may produce the empirical bias in the CAPM. This masks a larger consideration though. The fundamental question exists whether a fifty-year time span can accurately reflect the expected future risks in the near term. The longer data series may account for risks that no longer exist in the market. Indeed, extraneous disturbances, whether they are from wars or supply shocks, can cause variations in betas that would have absolutely no impact on the current risk of utility stocks. Likewise, a longer time series may not account for the risk to which the market currently has exposure. If the longer data set masks the current risk, it is the work of Litzenberger *et al* and Morin that needs questioning. In sum, the empirical bias of beta may be a result of Litzenberger *et al* and Morin's use of a very long time series and not an inaccurate specification of risk by beta.

III. Peculiar to the Industry

A possible cause of the insignificant alphas is that they are the result of conditions specific to the industry. In other words, alpha does not exist for the utility industry and the CAPM does not produce a biased empirical estimate of the expected return of common equity. This is a hypothesis worth examining. Good candidate industries for this study are ones that have similar characteristics to the utility industry. Such aspects include conservative and established enterprises, large capital needs, and no price regulation. Representative industries that fit these criteria are transportation, finance, and insurance. Using the same methodology as outlined in Chapter 3, the study analyzes the industries. Table 10 illustrates the results.[5]

Table 10.--Unregulated Industries

Industry	Beta	Prob	Sig	Alpha	Prob	Sig
Transportation	0.94	0	Yes	-0.26	0.43	No
Finance	1.23	0	Yes	-0.14	0.71	No
Insurance	0.83	0	Yes	-0.06	0.91	No

[5] Appendix D contains the SAS analysis that supports this table.

The results conform to the conclusions established in Chapter Four. These unregulated industries do not show the empirical bias which the CAPM literature addresses. This suggests that the literature itself is either dated or inaccurate. Even more so, one must note that the probabilities of insignificant a parameters are quite high. The fact that none of the a parameters of the unregulated industries have any statistical significance and are negative is both informative and enlightening. The smallest probability that the null hypothesis holds true is in the transportation industry. Compared to the results of Chapter Four, the alphas of the unregulated industries are even more statistically insignificant than the alphas of the utility industry. This warrants further examination of other unregulated industries to find if their alphas are insignificant as well.

IV. The Nature of Regulated Industries

Public utilities are industries with administered prices for the services they sell and regulated returns on their shareholders' equity. Ordinary market forces do not entirely determine the returns afforded to the stockholders of utilities. Despite deregulation and the movement towards competition, this is still true. As such, the possibility exists that the regulatory process itself causes the alphas of utilities stocks to be insignificant. Instances exist that illustrate that regulators ignore generally accepted financial principles to achieve politically popular rate settlements. This nuance of the regulatory environment may remove any statistical significance of alpha. A reasonable test of such a hypothesis is to find the alpha of one or more unregulated industries.

The outcome the investigation of the previous section (Section III) appears to refute this possibility. If one examines the results of Table 10, then one will see that regulation does not remove the statistical significance of alpha. In the transportation, finance, and insurance industries, alpha is not statistically significant. This suggests that regulation is not the cause of insignificant alphas.

V. The Dividend Effect

Investors receive equity income in two forms: capital gains and dividends. The calculation of beta for the use of measuring risk in the CAPM utilizes only capital gains. The exclusion of dividends is a possible cause of the alphas statistical insignificance. The study in Chapter Four estimates betas by comparing the annual growth rates in the utility indices and regresses them on the annual growth rates in the Standard & Poor's 500 (S&P 500) Index. This is consistent with the literature, but it only measures the growth in utility stocks' share prices. However, capital appreciation is a small portion of the total returns to utility stocks. Since another description of utility stocks is that they are the "widows and orphans" stocks, a prudent analysis will include examination of dividend income as well. Investors in utility stocks have an interest in dividend income rather than capital appreciation. Given that most utilities have dividend payout ratios of between sixty and eighty percent, excluding this stream of income when calculating beta may cause alpha's statistical insignificance. This is especially telling when one considers that the dividend payout ratios of the typical S&P 500 company is twenty to thirty percent. The status of utility stocks as income equities may contribute to the insignificance of alpha.

If one contrasts this study with the methodology of Litzenberger *et al* and Morin, the possibility that dividend income has an impact on the statistically significance of alpha becomes a real one. Litzenberger *et al* and Morin examine portfolios of over fifteen hundred different stocks representing all industries. These stocks typically have lower payout ratios than utility stocks. Since most of the returns measured in the CAPM literature focus on capital gains, the statistical bias of the CAPM may be the result of measuring capital gains and not dividend income. This opens the possibility that both this study and the literature are correct about the statistical significance of alpha.

VI. Use of Long-term Interest Rates

Litzenberger *et al* used the 90-Day Treasury Bill yield for the risk-free rate. The yields on short-term securities are far more unstable and have a greater variance than longer-term Treasury Bonds.[6] The advantage of using long-term bond yields is that they are more stable and absorb the effects of other market risks such as inflation. Likewise, Litzenberger *et al* and Morin used monthly returns on stock portfolios to calculate their alphas. In contrast, the analysis in

[6] Brigham and Gapenski prefer to use long-term T-Bonds for this reason. Brigham and Gapenski, *ibid.*

Chapter Four uses annual stock returns reported monthly. This allows for a greater fit with the returns of the longer-term risk-free securities. A reasonable analysis, using the same data for the study in Chapter Four adjusted to calculate monthly returns rather than annual returns, is prudent. Table 11 shows the results of using the methodology outlined in Chapter Three applied to monthly return data and 90-Day T-Bill yield for the risk-free rate.[7]

Table 11.--Summary of Monthly Return Data

Industry	Beta	Prob	Sig	Alpha	Prob	Sig
Electric	6.7	0.25	No	-2.56	0.22	No
Natural Gas	5.59	0.32	No	-2.33	0.25	No
Consolidated	6.05	0.08	No	-1.35	0.27	No

The previous analysis produces more curious results. All of the alphas and betas estimated with monthly return data are statistically insignificant. Even a cursory examination of the beta parameters yields unrealistic returns. The implication of betas greater than unity suggests that utility stocks are more risky than the market as a whole. Given the excess size of the estimates in Table 11, one can discard the use of monthly returns to calculate beta

[7] Appendix E contains the SAS analysis that supports this table.

and alpha with great impunity. This suggests that the choice of data studied causes the empirical bias in the CAPM.

Autocorrelation is not a problem with monthly returns. Unlike all other statistical analyses conducted in this dissertation, the one which uses monthly returns to estimate beta does not have an autocorrelation problem. This conclusion raises the possibility of an empirical mirage once again. Given that Litzenberger *et al* utilized monthly rather than annual returns, the paradox outlined at the beginning of this chapter may simply be the result of their choice of using monthly returns rather than annual returns.

VII. Potential Problems in the Original Study

Litzenberger *et al* and Morin did not test for autocorrelation. At least they made no indication that such statistical problems exist. With the exception of the monthly returns, all of the diagnostic regressions presented in this chapter had some form of autoregression or statistical instability. The SAS software detected it and made corrections. It is conceivable that the software analysis package that

Litzenberger *et al* used for their study lacked diagnostic tools like those available now. Indeed, Savin and White (1977)[8] derived the critical values of the Durbin-Watson Statistic at the same time Litzenberger *et al* conducted their study. It is conceivable that SAS had yet to incorporate tests for autocorrelation at that time. As a result, an empirical bias may have appeared where one does not necessarily exist. As Chapter Four demonstrated, correcting for autocorrelation eliminates the statistical significance of alpha. Table 12 compares the results of the analysis of Chapter Four before and after correction for autocorrelation.

Table 12.--Comparison of Alphas Before and After Correcting for Autocorrelation

	Before		After	
Industry	Alpha	Sig	Alpha	Sig
Electric	-0.1	Yes	-0.09	No
Natural Gas	-0.04	Yes	-0.03	No
Consolidated	-0.11	Yes	-0.1	No

[8] Savin, E. and K. White, "The Durbin-Watson Test for Serial Correlation with Extreme Sample Sizes or Many Regressors," Econometrica, Volume 45, (1977), pp. 1989-1996.

It is conceivable that the use of random portfolios in the Litzenberger *et al* and Morin studies produced the empirical bias of the CAPM. Litzenberger *et al* and Morin calculated the alpha terms of stock portfolios with only one common characteristic, the value of their beta. This use of beta segregated portfolios raises some suspicion because it assumes that beta measures all the risk of a group of securities. Litzenberger *et al* and Morin group their securities into these portfolios assuming that similar betas imply similar risks. As a result, very diverse industries can appear in the same portfolio. This indicates that the fundamentals of those industries are similar which, of course, is contrary to the facts. Fama and French showed that if one were to include just one other determinant of risk (i.e., market capitalization), then beta loses all predictive and statistical significance. Perhaps, this dissertation's findings are more consistent with Fama and French than the work of Litzenberger *et al* and Morin.

VIII. Conclusion

This chapter has the aim of providing plausible reasons why the results of Chapter Four conflict with the literature surrounding the Empirical CAPM. The goal of the chapter is to find if the CAPM truly has an empirical bias for which alpha can correct as the literature claims. Likewise, its goal is to disprove the hypothesis raised by the results of Chapter Four Namely, alpha is not statistically significant. In this regard, the analysis presented supports statistically insignificant alphas. The basic question that this chapter has attempted to ask is if the CAPM has a fundamental empirical bias. The explanations fall into two neat categories; those that support the thesis that alpha is not significant, and those that say that alpha is statistically significant. Ironically, another way to state that is those hypotheses this dissertation tested, and those that it did not. Table 13 summarizes the conclusions that each of the preceding sections found. Table 13 shows the possibilities that support the literature which claims significant alphas, or this dissertation which claims insignificant alphas.

Table 13.--Is Alpha Significant or Insignificant ?		
Cause	Litzenberger & Morin	This Study
Time Period Analyzed	No	No
Length of Time Series Data	No	No
Peculiar to Utilities	No	Yes
Peculiar to Regulation	No	Yes
Dividend Effect	Yes	No
Long-term Risk Free Rate	No	Yes
Correcting for Autocorrelation	No	Yes

Table 13 requires some explanation of what it wishes to demonstrate. Table 13 compares all the possible causes of the discrepancy of the results this dissertation produces and what the body of literature says about the empirical application of the CAPM. The literature, of course, states that beta has an empirical bias and alpha has a measure of statistical significance. The work that demonstrates this the most is the analyses of Litzenberger *et al* and Morin. This study has found that alpha is statistically insignificant. One must note that two possible causes produce indeterminate results. The choice of the period examined and the length of time analyzed both produce results that support the possibility that alpha could be either significant or insignificant.

A. Alpha is statistically insignificant.

Those hypotheses that support the notion that alpha is not statistically significant are numerous. First, the idea that the specific block of time chosen for this dissertation is an anomaly does not prove true. Tests of three different time spans confirm this hypothesis. Second, the use of long-term Treasury Bonds as the risk-free rate removes the possibility of an empirical bias. Short-term returns prove to be too statistically unstable for use as the risk free rate in calculation of betas. Third, the idea that insignificant alphas are peculiar to the utility industry does not bear fruit either. The other industries tested demonstrate the lack of an empirical bias. Fourth, the idea that insignificant alphas arise from the result of regulation also holds little sway. This is true because alpha does not appear statistically significant in the other industries tested. All of these explanations do not suggest that one can make sweeping generalities about the CAPM from the industries examined. However, they provide direction for further exploration. This is especially important if the CAPM is to continue to be a useful tool in measuring the cost of capital for public utilities.

B. Alpha is statistically significant.

The other hypotheses fall into the category of possible explanations that support a significant alpha, but as noted, they remain untested. The full accounting of the cost of equity may reveal itself through the inclusion of dividend income to find both alpha and beta. This has the potential to produce biased betas. The unique status of utility stocks as high income stocks rather than growth equities may cause the alpha to be insignificant. Without entirely reproducing the study of Litzenberger *et al*, one can merely speculate on the possible causes of it finding a significant alpha. Good scholarship dictates that one explore the possibility that the original study did not perform all of its appropriate diagnoses of time series data. Of course, the possibility remains that the original concept Litzenberger *et al* and Morin tested has flaws. Their method may have produced this statistical bias which in reality is a mirage. Based on the results present here, this may be the case. As such, it merits further inquiry.

C. Alpha is statistically indeterminate.

The possibility exists that one cannot precisely determine the statistical significance of alpha.

Table 14.--Is Alpha Statistically Indeterminate?	
Cause	Outcome
Time Period Analyzed	Yes
Length of Time Series Data	Yes
Peculiar to Utilities	No
Peculiar to Regulation	Nc
Dividend Effect	No
Long-term Risk Free Rate	No
Correcting for Autocorrelation	No

Table 14 illustrates the possible causes that can indicate that both this study and the work of Litzenberger *et al* and Morin are correct. In other words, the choice of the period analyzed and the length of time examined can produce results that will make alpha both statistically significant and insignificant. This extends from a larger debate about what data one should use when empirically applying the CAPM. Litzenberger *et al* and Morin chose time series that were fifty years in length. This study examined only five years of historical data. The question of the appropriate length of time series data is still controversial in the financial literature. It is easy for one to say that the most appropriate empirical method to chose is the one the produces the best least unbiased estimate of alpha. However, the best method to chose is the empirical method that produces the best estimate of the expected cost of equity capital. Therefore, the issue remains unresolved as to whether the literature is correct or this study provides new direction on the empirical application of the CAPM.

D. Summary Remarks

Ultimately, the reason for addressing the previous issues is to test the validity of the CAPM as a measure of the cost of equity capital of public utility stocks. Given the evolution of industry restructuring and the movement towards competition, the assessment of the cost of capital that mirrors competitive markets is of great importance. The assessment of the return on equity requires more accurate tools. The question now becomes one that begs the effectiveness of the empirical CAPM. The work of Chapters Four and Five casts doubt on the reported empirical bias of the CAPM. Placing these findings into the regulatory realm gives regulators the opportunity to ignore the body of literature about the CAPM's inherit empirical biases.

CHAPTER SIX

THE CONCLUSION

Chapter One begins this dissertation by recognizing the changes within the utility industry, deregulation and the movement towards competition. In this light, this dissertation presupposes a need for capital pricing models that will more accurately assess the cost of equity for public utilities. Chapter Two outlines the literature of the Capital Asset Pricing Model (CAPM) and its application to utilities' cost of capital. The literature notes that the CAPM is theoretically sound. However, its empirical application has limits due to an inherit statistical bias. This bias leads to underestimates of the return on common equity. Chapter Three establishes the methodology of this dissertation. The methodology aims to test the validity of the CAPM literature and it claims of biased betas. The results of Chapter Four cast doubt on the literature's notion of biased betas and statistically significant alphas. Chapter Five is an addition that seeks to validate the findings of Chapter Four. Further, it attempts to reconcile them with the literature of the CAPM. Chapter Four and Five focus on responding to the questions that Chapter Three poses. They ask:

- What is the size of alpha?
- Is alpha statistically significant?
- Is alpha statistically robust?

I. Three Questions

Chapter Three, the methodology outline, begins by posing three questions which this dissertation aimed to answer. The first question is what is the size of the alpha adjustment. The second question asks if alpha is statistically significant. The third one questions whether alpha is statistically robust. The literature of the Capital Asset Pricing Model (CAPM), outlined in Chapter Two, states that the answer to the first question is that alpha is a positive value between zero and one. Likewise, it states that alpha is statistically significant and statistically robust. Because of the literature, one has anticipated that the value of this dissertation would be answering these three questions.

In the case of the electric industry, the answers to these three questions are the complete opposite of what the literature of the CAPM says they should be. Alpha is negative for the electric utilities. Alpha is not statistically significant. Alpha is not statistically robust.

The case of the local distribution companies (LDC) of natural gas, like the electric utilities, contradicts the literature of the CAPM. Alpha is negative for LDC's. Alpha is not statistically significant. Therefore, one must conclude that it is zero. Further, the alpha of the LDC's is not statistically robust.

Also in stark contrast to the literature of the CAPM, the combination utilities show the same results as the others. The alpha value is negative. Alpha is not statistically significant. By extension, it is not statistically robust.

The answers to these three questions from Chapter Three for all three types of utilities are negative, no, and no. However, one can stop the analysis at the negative response to the second question. Since alpha is not statistically significant, this dissertation had to explore the possibility that the methodology and data outlined in Chapters Three and Four were in error. The goal of Chapter Five was to address the possible causes of the paradox between the literature and the results from Chapter Four. The analysis of Chapter

Five concurs with the proposition that alpha is equal to zero.

II. Serendipitous Findings

The analyses of Chapters Four and Five produce two conclusions about the Empirical CAPM and its application to the cost of capital of public utilities. Both of these findings were not the primary goal of this dissertation, but their discovery is useful in estimating public utilities' cost of capital. As such, they have value from the perspective of both regulatory and financial economics. First, beta accounts for risk associated with owning public utility stocks. Second, the increased risk measured by beta includes exposure from unregulated affiliates of public utilities.

Beta accounts for the risk associated with public utility stocks. Chapter Five notes that both the electric utilities and the combined utility companies have experienced an increase in their betas from 1987 to 1996. The most logical explanation is that the market has adjusted to the increased risk associated with the coming deregulation of the utility business and the convergence of gas and electricity. As Chapter Five noted, the electric utilities and the combined companies have had a doubling of their betas over the past ten years.

The increased risk measured by beta includes exposure from unregulated affiliates of public utilities. Starting in 1996, many utilities reorganized themselves as holding companies to prepare themselves for deregulation and competition. One of the effects of this reorganization is the formation of unregulated marketing subsidiaries. Since the state commissions or the Federal Energy Regulatory Commission activities do not regulate these divisions, the risk associated with responding to market pressures has increased. Logically, this increases the cost of capital as returns become more uncertain. Regulators must recognize that this increased cost of capital is due to nontraditional utility functions. As such, regulators need to adjust their rate of return judgments to account for them.

III. Generalizations

This dissertation has produced five conclusions that are within the scope of its original goal of testing the validity of the Empirical CAPM. First, when calculating the betas of stocks one must check for autocorrelation. Second, one must use only current data within a short time period to calculate betas. Third, one must use long-term government bond yields for the risk-free rate of return when estimating betas. Fourth, the CAPM is a clumsy tool for the estimation of public utilities cost of capital, but it still has use in measuring risk. Last, alpha is statistically insignificant, but one must continue checking for it.

When estimating betas, one must check for autocorrelation. All of the time periods and industries tested have a measure of autocorrelation. The problem manifests itself when one uses annual rates of return and long-term risk-free rates. Fortunately, statistical analysis software such as SAS can correct for this problem. Without correcting for autocorrelation, the CAPM produces an empirical bias that underestimates the cost of equity capital for public utility stocks.

When calculating betas, the choice of a short time series such as five years eliminates the empirical bias of the CAPM. As this dissertation has shown, the bias may be the result of an inordinately long set of time series data. Litzenberger *et al* and Morin use time series that span fifty years. As this dissertation has demonstrated, shorter time spans of five years do not produce empirical biases in the CAPM. Likewise, shorter time series produce betas that more closely replicate current market conditions. Longer data series rely on information that may have no bearing on future expectations of utilities' stock returns.

One must use long-term government bond yields as the risk-free rate when estimating betas. The analysis in this dissertation demonstrates that the use of 90-Day T-Bill yields as the risk-free rate produces unstable and biased betas. The use of the short-term yields produces biased betas that led to Litzenberger *et al* and Morin's conclusions. The combination of annual rates of return and long-term interest rates produces statistically robust and unbiased betas. These unbiased betas provide more accurate measures of the risk associated with the security under scrutiny.

The CAPM remains a useful tool in measuring the risk associated with public utility stocks, yet it is a clumsy one in its empirical application. The theoretical foundations of the CAPM remain intact. It is not the function of this dissertation to challenge them, nor does anything undertaken here imply their undoing. The aim of this dissertation was to test its application in the estimation of risk associated with public utility stocks. Likewise, it tests the empirical application of the CAPM and the bias that the literature purports to exist. In sum, the CAPM is on sound theoretical ground in the assessment of risk. It is when one uses the CAPM that one must take care to acknowledge its empirical limits in a regulatory setting.

While alpha is statistically insignificant in the data analyzed here, one must consider the possibility that alpha may be statistically significant in the future. Since this dissertation examined time series data, the possibility that future betas will have biases still exists. Therefore, when one estimates betas, one must test to see if alpha is statistically significant in the future. This purpose is to foreclose the possibility of biased betas. This has application to the empirical use of the CAPM both inside and outside the utility industry. As shown previously, the alphas of unregulated industries are insignificant. Therefore, continued testing for alpha is prudent in estimating risk.

IV. Terminus

This dissertation is about two things: utilities' cost of common equity and the CAPM. The evidence presented above casts doubt on the Empirical CAPM as a measure of the returns on equity. However, this statement does not aim to dismiss capital asset pricing theory completely. The CAPM has a valuable place in the measurement of public utilities' cost of common equity. Regulators and analysts alike need to continue to use it for its analytical value. Since a goal of this dissertation is to find more robust measures for a more competitive market, then one knows that the Empirical CAPM method is not a useful tool.

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APPENDIX A

SAS OUTPUT FOR UTILITIES (1992-1996)

OBS	MONTH	SPDELTA	DJDELTA	ELEDELTA	LDCDELTA	TBOND	SPLESS	DJLESS	ELELESS	LDCLESS
1	Jan-92	0.2783	0.0176	0.1648	0.1677	0.0776	0.2007	-0.0600	0.0872	0.0901
2	Feb-92	0.1389	-0.0336	0.1005	0.1356	0.0777	0.0612	-0.1113	0.0228	0.0579
3	Mar-92	0.0942	-0.0532	0.0687	0.0792	0.0797	0.0145	-0.1329	-0.0110	-0.0005
4	Apr-92	0.0742	0.0050	0.1102	0.1165	0.0803	-0.0061	-0.0753	0.0299	0.0362
5	May-92	0.0974	0.0079	0.1362	0.1247	0.0781	0.0193	-0.0702	0.0581	0.0466
6	Jun-92	0.0793	0.0724	0.1327	0.2379	0.0765	0.0028	-0.0041	0.0562	0.1614
7	Jul-92	0.0916	0.1171	0.1422	0.2007	0.0726	0.0190	0.0445	0.0696	0.1281
8	Aug-92	0.0733	0.0517	0.0844	0.2091	0.0725	0.0008	-0.0208	0.0119	0.1366
9	Sep-92	0.0808	0.0365	0.0465	0.1636	0.0710	0.0098	-0.0345	-0.0245	0.0926
10	Oct-92	0.0662	0.0191	0.0270	0.1087	0.0741	-0.0079	-0.0550	-0.0471	0.0346
11	Nov-92	0.0957	-0.0006	0.0027	0.0889	0.0748	0.0209	-0.0754	-0.0721	0.0141
12	Dec-92	0.1213	-0.0227	-0.0206	0.1164	0.0726	0.0487	-0.0953	-0.0932	0.0438
13	Jan-93	0.0460	0.0771	0.0634	0.1372	0.0725	-0.0265	0.0046	-0.0091	0.0647
14	Feb-93	0.0706	0.1680	0.1487	0.2197	0.0698	0.0008	0.0982	0.0789	0.1499
15	Mar-93	0.1051	0.1744	0.1563	0.3012	0.0702	0.0349	0.1042	0.0861	0.2310
16	Apr-93	0.0876	0.1340	0.1079	0.1949	0.0701	0.0175	0.0639	0.0378	0.1248
17	May-93	0.0734	0.1167	0.0899	0.1636	0.0701	0.0033	0.0466	0.0198	0.0935
18	Jun-93	0.0975	0.1594	0.1204	0.1262	0.0668	0.0307	0.0926	0.0536	0.0594
19	Jul-93	0.0777	0.1091	0.0927	0.1514	0.0656	0.0121	0.0435	0.0271	0.0858
20	Aug-93	0.0866	0.1709	0.1458	0.1284	0.0623	0.0243	0.1086	0.0835	0.0661
21	Sep-93	0.0974	0.1325	0.1213	0.1084	0.0627	0.0347	0.0698	0.0586	0.0457
22	Oct-93	0.1246	0.0937	0.1136	0.1442	0.0623	0.0623	0.0314	0.0513	0.0819
23	Nov-93	0.0947	0.0304	0.0436	0.1035	0.0651	0.0296	-0.0347	-0.0215	0.0384
24	Dec-93	0.0696	0.0375	0.0400	0.1100	0.0654	0.0042	-0.0279	-0.0254	0.0446
25	Jan-94	0.0868	-0.0026	-0.0130	0.0845	0.0637	0.0231	-0.0663	-0.0767	0.0208

OBS	MONTH	SPDELTA	DJDELTA	ELEDELTA	LDCDELTA	TBOND	SPLESS	DJLESS	ELELESS	LDCLESS
26	Feb-94	0.0676	-0.1237	-0.1292	-0.0172	0.0682	-0.0006	-0.1919	-0.1974	-0.0854
27	Mar-94	0.0303	-0.1872	-0.1664	-0.0592	0.0725	-0.0422	-0.2597	-0.2389	-0.1317
28	Apr-94	0.0094	-0.1670	-0.1521	-0.0429	0.0745	-0.0651	-0.2415	-0.2266	-0.1174
29	May-94	0.0127	-0.2194	-0.2038	-0.0864	0.0759	-0.0632	-0.2953	-0.2797	-0.1623
30	Jun-94	0.0151	-0.2762	-0.2543	-0.1364	0.0774	-0.0623	-0.3536	-0.3317	-0.2138
31	Jul-94	0.0092	-0.2544	-0.2339	-0.1532	0.0746	-0.0654	-0.3290	-0.3085	-0.2278
32	Aug-94	0.0223	-0.2624	-0.2462	-0.1616	0.0761	-0.0538	-0.3385	-0.3223	-0.2377
33	Sep-94	0.0168	-0.2736	-0.2657	-0.1622	0.0800	-0.0632	-0.3536	-0.3457	-0.2422
34	Oct-94	-0.0002	-0.2466	-0.2595	-0.1405	0.0809	-0.0811	-0.3275	-0.3404	-0.2214
35	Nov-94	-0.0041	-0.2033	-0.2094	-0.1700	0.0808	-0.0849	-0.2841	-0.2902	-0.2508
36	Dec-94	-0.0231	-0.2084	-0.2127	-0.1759	0.0799	-0.1030	-0.2883	-0.2926	-0.2558
37	Jan-95	-0.0164	-0.1455	-0.1297	-0.1594	0.0780	-0.0944	-0.2235	-0.2077	-0.2374
38	Feb-95	0.0219	-0.0786	-0.0728	-0.0962	0.0758	-0.0539	-0.1544	-0.1486	-0.1720
39	Mar-95	0.0633	-0.0440	-0.0559	-0.0748	0.0755	-0.0122	-0.1195	-0.1314	-0.1503
40	Apr-95	0.1357	-0.0245	-0.0361	-0.0430	0.0745	0.0612	-0.0990	-0.1106	-0.1175
41	May-95	0.1617	0.1094	0.1027	-0.0310	0.0677	0.0940	0.0417	0.0350	-0.0987
42	Jun-95	0.1858	0.1406	0.1498	0.0265	0.0670	0.1188	0.0736	0.0828	-0.0405
43	Jul-95	0.2348	0.0944	0.0968	-0.0082	0.0691	0.1657	0.0253	0.0277	-0.0773
44	Aug-95	0.2044	0.0697	0.0860	0.0330	0.0674	0.1370	0.0023	0.0186	-0.0344
45	Sep-95	0.2394	0.1809	0.2019	0.0785	0.0663	0.1731	0.1146	0.1356	0.0122
46	Oct-95	0.2568	0.1828	0.2148	0.0684	0.0641	0.1927	0.1187	0.1507	0.0043
47	Nov-95	0.2918	0.2019	0.1974	0.2186	0.0623	0.2295	0.1396	0.1351	0.1563
48	Dec-95	0.3501	0.2417	0.2372	0.2283	0.0603	0.2898	0.1814	0.1769	0.1680
49	Jan-96	0.3530	0.1954	0.1757	0.2107	0.0609	0.2921	0.1345	0.1148	0.1498
50	Feb-96	0.3260	0.1315	0.1304	0.1717	0.0659	0.2601	0.0656	0.0645	0.1058

OBS	MONTH	SPDELTA	DJDELTA	ELEDELTA	LDCDELTA	TBOND	SPLESS	DJLESS	ELELESS	LDCLESS
51	Mar-96	0.3077	0.1338	0.1209	0.1391	0.0684	0.2393	0.0654	0.0525	0.0707
52	Apr-96	0.2818	0.0802	0.0350	0.1040	0.0706	0.2112	0.0096	-0.0356	0.0334
53	May-96	0.2734	0.0263	0.0153	0.1452	0.0717	0.2017	-0.0454	-0.0564	0.0735
54	Jun-96	0.2395	0.0902	0.0347	0.1607	0.0703	0.1692	0.0199	-0.0356	0.0904
55	Jul-96	0.1370	0.0056	-0.0514	0.1184	0.0707	0.0663	-0.0651	-0.1221	0.0477
56	Aug-96	0.1635	0.0594	-0.0254	0.1829	0.0726	0.0909	-0.0132	-0.0980	0.1103
57	Sep-96	0.1853	0.0121	-0.0735	0.0767	0.0704	0.1149	-0.0583	-0.1439	0.0063
58	Oct-96	0.2015	0.0568	-0.0362	0.1237	0.0671	0.1344	-0.0103	-0.1033	0.0566
59	Nov-96	0.2678	0.0922	0.0125	0.1194	0.0643	0.2035	0.0279	-0.0518	0.0551
60	Dec-96	0.2053	0.0316	-0.0483	0.0686	0.0673	0.1380	-0.0357	-0.1156	0.0013

Electricity- Total Returns

Autoreg Procedure

Dependent Variable = ELEDELTA

Ordinary Least Squares Estimates

SSE	0.677378	DFE	58
MSE	0.011679	Root MSE	0.108069
SBC	-90.5709	AIC	-94.7596
Reg Rsq	0.3820	Total Rsq	0.3820
Durbin-Watson	0.1965		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.087198	0.0226	-3.851	0.0003
SPDELTA	1	0.838984	0.1401	5.987	0.0001

Autoreg Procedure

Estimates of Autocorrelations

Lag	Covariance	Correlation	-1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1
0	0.01129	1.000000	|******************** |
1	0.01003	0.888395	|****************** |
2	0.008543	0.756670	|*************** |
3	0.007664	0.678896	|************** |
4	0.006452	0.571467	|*********** |
5	0.004898	0.433849	|********* |
6	0.003698	0.327541	|******* |
7	0.002663	0.235900	|***** |
8	0.00134	0.118657	|** |
9	0.000323	0.028571	|* |
10	-0.00052	-0.045933	| *| |
11	-0.00158	-0.139523	| ***| |
12	-0.00236	-0.209022	| ****| |

Backward Elimination of Autoregressive Terms

Lag	Estimate	t-Ratio	Prob
10	0.009924	0.0443	0.9648
6	0.020065	0.0896	0.9290

Electricity- Total Returns

Autoreg Procedure

12	-0.045203	-0.3250	0.7466
4	0.080867	0.3908	0.6976
7	-0.129636	-0.8534	0.3975
8	0.113798	0.7758	0.4415
9	-0.061272	-0.5755	0.5674
11	0.075929	1.1736	0.2458
2	0.341697	1.8619	0.0681
3	-0.155641	-1.3578	0.1801
5	0.109646	1.4957	0.1403

Preliminary MSE = 0.002379

Estimates of the Autoregressive Parameters

Lag	Coefficient	Std Error	t Ratio
1	-0.88839455	0.060807	-14.610

Electricity- Total Returns

Autoreg Procedure

Maximum Likelihood Estimates

SSE	0.121842	DFE	57
MSE	0.002138	Root MSE	0.046234
SBC	-187.674	AIC	-193.957
Reg Rsq	0.1763	Total Rsq	0.8888
Durbin-Watson	1.6092		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.058762	0.0614	-0.956	0.3429
SPDELTA	1	0.565482	0.1644	3.440	0.0011
A(1)	1	-0.907291	0.0555	-16.354	0.0001

Autoregressive parameters assumed given.

Electricity- Total Returns

Autoreg Procedure

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.058762	0.0613	-0.959	0.3419
SPDELTA	1	0.565482	0.1619	3.494	0.0009

Gas- Total Returns

Autoreg Procedure

Dependent Variable = LDCDELTA

Ordinary Least Squares Estimates

SSE	0.63935	DFE	58
MSE	0.011023	Root MSE	0.104992
SBC	-94.0376	AIC	-98.2263
Reg Rsq	0.2890	Total Rsq	0.2890
Durbin-Watson	0.2103		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.012822	0.0220	-0.583	0.5622
SPDELTA	1	0.661066	0.1361	4.856	0.0001

Gas- Total Returns

Autoreg Procedure

Estimates of Autocorrelations

```
Lag  Covariance  Correlation -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1

  0    0.010656     1.000000 |                    |********************|
  1    0.009511     0.892524 |                    |******************  |
  2    0.008698     0.816263 |                    |****************    |
  3    0.007621     0.715177 |                    |**************      |
  4     0.00687     0.644675 |                    |*************       |
  5     0.00657     0.616581 |                    |************        |
  6    0.006346     0.595504 |                    |************        |
  7    0.006002     0.563236 |                    |***********         |
  8    0.005502     0.516342 |                    |**********          |
  9    0.004851     0.455241 |                    |*********           |
 10    0.003539     0.332160 |                    |*******             |
 11    0.002535     0.237911 |                    |*****               |
 12    0.001294     0.121464 |                    |**                  |
```

Backward Elimination of Autoregressive Terms

Lag	Estimate	t-Ratio	Prob
8	-0.028398	-0.1568	0.8761
11	-0.045392	-0.2516	0.8024

Gas- Total Returns

Autoreg Procedure

7	0.083851	0.5126	0.6106
6	-0.082708	-0.5616	0.5770
4	0.076964	0.4676	0.6421
12	0.121178	1.1307	0.2635
2	-0.229345	-1.4376	0.1566
3	0.145838	1.1227	0.2666
5	-0.131956	-1.5546	0.1259

Preliminary MSE = 0.001917

Estimates of the Autoregressive Parameters

Lag	Coefficient	Std Error	t Ratio
1	-0.89387229	0.066783	-13.385
9	-0.29709204	0.131843	-2.253
10	0.33992906	0.126810	2.681

Gas- Total Returns

Autoreg Procedure

Expected Autocorrelations

Lag	Autocorr
0	1.0000
1	0.8935
2	0.7976
3	0.7112
4	0.6333
5	0.5629
6	0.4992
7	0.4414
8	0.3889
9	0.3410
10	0.2303

Gas- Total Returns

Autoreg Procedure

Maximum Likelihood Estimates

SSE	0.094106	DFE	55
MSE	0.001711	Root MSE	0.041365
SBC	-192.377	AIC	-202.848
Reg Rsq	0.1069	Total Rsq	0.8954
Durbin-Watson	2.1071		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	0.017167	0.0351	0.489	0.6268
SPDELTA	1	0.355608	0.1426	2.494	0.0157
A(1)	1	-0.887116	0.0532	-16.662	0.0001
A(9)	1	-0.415907	0.1309	-3.177	0.0024
A(10)	1	0.489900	0.1268	3.865	0.0003

Gas- Total Returns

Autoreg Procedure

Expected Autocorrelations

Lag	Autocorr
0	1.0000
1	0.8908
2	0.7912
3	0.6999
4	0.6161
5	0.5388
6	0.4673
7	0.4007
8	0.3384
9	0.2797
10	0.1287

Autoregressive parameters assumed given.

Gas- Total Returns

Autoreg Procedure

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	0.017167	0.0348	0.493	0.6242
SPDELTA	1	0.355608	0.1386	2.566	0.0131

Dow Jones Utility Composite- Total Returns

Autoreg Procedure

Dependent Variable = DJDELTA

Ordinary Least Squares Estimates

SSE	0.600828	DFE	58
MSE	0.010359	Root MSE	0.10178
SBC	-97.7662	AIC	-101.955
Reg Rsq	0.4558	Total Rsq	0.4558
Durbin-Watson	0.2666		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.099718	0.0213	-4.676	0.0001
SPDELTA	1	0.919748	0.1320	6.969	0.0001

Dow Jones Utility Composite- Total Returns

Autoreg Procedure

Estimates of Autocorrelations

```
Lag  Covariance  Correlation -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1

  0    0.010014     1.000000 |                    |********************|
  1    0.008491     0.847960 |                    |*****************   |
  2    0.007051     0.704175 |                    |**************      |
  3    0.006209     0.620058 |                    |************        |
  4    0.005216     0.520894 |                    |**********          |
  5    0.003593     0.358839 |                    |*******             |
  6    0.002711     0.270719 |                    |*****               |
  7    0.002035     0.203212 |                    |****                |
  8    0.000569     0.056839 |                    |*                   |
  9    -0.00041    -0.040970 |                   *|                    |
 10    -0.00107    -0.107204 |                  **|                    |
 11    -0.00227    -0.226729 |               *****|                    |
 12    -0.00366    -0.365513 |             *******|                    |
```

Backward Elimination of Autoregressive Terms

Lag	Estimate	t-Ratio	Prob
3	0.033582	0.1688	0.8667
10	-0.056067	-0.3029	0.7633

Dow Jones Utility Composite- Total Returns

Autoreg Procedure

12	0.063084	0.4445	0.6587
6	-0.112614	-0.6321	0.5303
2	0.147493	1.0230	0.3113
9	-0.233581	-1.6533	0.1044
11	0.126754	1.4425	0.1552
4	-0.203013	-1.4802	0.1447
5	0.146649	1.3575	0.1803
7	-0.255344	-1.9735	0.0535
8	0.120450	1.7078	0.0932

Preliminary MSE = 0.002814

Estimates of the Autoregressive Parameters

Lag	Coefficient	Std Error	t Ratio
1	-0.84796027	0.070208	-12.078

Dow Jones Utility Composite- Total Returns

Autoreg Procedure

Maximum Likelihood Estimates

SSE	0.138216	DFE	57
MSE	0.002425	Root MSE	0.049243
SBC	-180.305	AIC	-186.588
Reg Rsq	0.1388	Total Rsq	0.8748
Durbin-Watson	1.7777		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.059372	0.0563	-1.055	0.2958
SPDELTA	1	0.518260	0.1769	2.930	0.0049
A(1)	1	-0.885914	0.0601	-14.748	0.0001

Autoregressive parameters assumed given.

Dow Jones Utility Composite- Total Returns

Autoreg Procedure

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.059372	0.0560	-1.061	0.2932
SPDELTA	1	0.518260	0.1710	3.031	0.0037

Electricity- Risk Premium

Autoreg Procedure

Dependent Variable = ELELESS

Ordinary Least Squares Estimates

SSE	0.680265	DFE	58
MSE	0.011729	Root MSE	0.108299
SBC	-90.3158	AIC	-94.5044
Reg Rsq	0.4083	Total Rsq	0.4083
Durbin-Watson	0.1981		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.099795	0.0159	-6.264	0.0001
SPLESS	1	0.859561	0.1359	6.327	0.0001

Electricity- Risk Premium

Autoreg Procedure

Estimates of Autocorrelations

Lag	Covariance	Correlation	-1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1
0	0.011338	1.000000	| |********************|
1	0.010062	0.887496	| |****************** |
2	0.008559	0.754886	| |*************** |
3	0.007681	0.677479	| |************** |
4	0.006475	0.571067	| |*********** |
5	0.004924	0.434266	| |********* |
6	0.003736	0.329555	| |******* |
7	0.002716	0.239530	| |***** |
8	0.001396	0.123168	| |** |
9	0.000389	0.034336	| |* |
10	-0.00044	-0.038840	| *| |
11	-0.0015	-0.132122	| ***| |
12	-0.00229	-0.202317	| ****| |

Backward Elimination of Autoregressive Terms

Lag	Estimate	t-Ratio	Prob
10	0.010278	0.0459	0.9636
6	0.014837	0.0663	0.9475

Electricity- Risk Premium

Autoreg Procedure

12	-0.042247	-0.3038	0.7626
4	0.076519	0.3696	0.7133
7	-0.132834	-0.8754	0.3855
8	0.115286	0.7873	0.4347
9	-0.062421	-0.5872	0.5596
11	0.075594	1.1655	0.2490
2	0.345428	1.8828	0.0651
3	-0.154361	-1.3481	0.1832
5	0.107666	1.4624	0.1492

Preliminary MSE = 0.002408

Estimates of the Autoregressive Parameters

Lag	Coefficient	Std Error	t Ratio
1	-0.88749625	0.061036	-14.540

Electricity- Risk Premium

Autoreg Procedure

Maximum Likelihood Estimates

SSE	0.124177	DFE	57
MSE	0.002179	Root MSE	0.046675
SBC	-186.559	AIC	-192.842
Reg Rsq	0.2041	Total Rsq	0.8920
Durbin-Watson	1.6103		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.093321	0.0571	-1.634	0.1077
SPLESS	1	0.609533	0.1622	3.758	0.0004
A(1)	1	-0.904937	0.0563	-16.062	0.0001

Autoregressive parameters assumed given.

Electricity- Risk Premium

Autoreg Procedure

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.093321	0.0568	-1.643	0.1059
SPLESS	1	0.609533	0.1594	3.824	0.0003

Gas- Risk Premium

Autoreg Procedure

Dependent Variable = LDCLESS

Ordinary Least Squares Estimates

SSE	0.644647	DFE	58
MSE	0.011115	Root MSE	0.105426
SBC	-93.5425	AIC	-97.7312
Reg Rsq	0.3163	Total Rsq	0.3163
Durbin-Watson	0.2111		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.038253	0.0155	-2.467	0.0166
SPLESS	1	0.685063	0.1323	5.180	0.0001

Gas- Risk Premium

Autoreg Procedure

Estimates of Autocorrelations

```
Lag  Covariance  Correlation -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1

  0    0.010744     1.000000 |                    |********************|
  1    0.009584     0.892019 |                    |******************  |
  2    0.008756     0.814992 |                    |****************    |
  3    0.007667     0.713589 |                    |**************      |
  4    0.006908     0.642923 |                    |*************       |
  5    0.006604     0.614618 |                    |************        |
  6    0.006394     0.595130 |                    |************        |
  7    0.006055     0.563569 |                    |***********         |
  8    0.005557     0.517251 |                    |**********          |
  9    0.004902     0.456237 |                    |*********           |
 10    0.003589     0.334079 |                    |*******             |
 11    0.002575     0.239700 |                    |*****               |
 12     0.00132     0.122877 |                    |**                  |
```

Backward Elimination of Autoregressive Terms

Lag	Estimate	t-Ratio	Prob
8	-0.021515	-0.1187	0.9060
11	-0.049597	-0.2754	0.7842

Gas- Risk Premium

Autoreg Procedure

7	0.080253	0.4904	0.6261
4	0.094351	0.5557	0.5809
6	-0.077156	-0.5386	0.5925
12	0.125804	1.1725	0.2465
2	-0.226344	-1.4120	0.1639
3	0.143670	1.1042	0.2745
5	-0.129563	-1.5244	0.1332

Preliminary MSE = 0.00195

Estimates of the Autoregressive Parameters

Lag	Coefficient	Std Error	t Ratio
1	-0.89330812	0.067119	-13.309
9	-0.29230673	0.132138	-2.212
10	0.33422418	0.127086	2.630

Gas- Risk Premium

Autoreg Procedure

Expected Autocorrelations

Lag	Autocorr
0	1.0000
1	0.8929
2	0.7967
3	0.7100
4	0.6320
5	0.5616
6	0.4980
7	0.4404
8	0.3882
9	0.3406
10	0.2311

Gas- Risk Premium

Autoreg Procedure

Maximum Likelihood Estimates

SSE	0.096505	DFE	55
MSE	0.001755	Root MSE	0.041888
SBC	-191.017	AIC	-201.489
Reg Rsq	0.1254	Total Rsq	0.8976
Durbin-Watson	2.1026		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.030605	0.0308	-0.993	0.3252
SPLESS	1	0.386694	0.1420	2.724	0.0086
A(1)	1	-0.886831	0.0534	-16.619	0.0001
A(9)	1	-0.402343	0.1317	-3.054	0.0035
A(10)	1	0.477649	0.1276	3.745	0.0004

Gas- Risk Premium

Autoreg Procedure

Expected Autocorrelations

Lag	Autocorr
0	1.0000
1	0.8909
2	0.7909
3	0.6990
4	0.6144
5	0.5360
6	0.4631
7	0.3950
8	0.3310
9	0.2704
10	0.1206

Autoregressive parameters assumed given.

Gas- Risk Premium

Autoreg Procedure

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.030605	0.0307	-0.996	0.3237
SPLESS	1	0.386694	0.1377	2.808	0.0069

Dow Jones Utility Composite- Risk Premium

Autoreg Procedure

Dependent Variable = DJLESS

Ordinary Least Squares Estimates

SSE	0.602836	DFE	58
MSE	0.010394	Root MSE	0.10195
SBC	-97.566	AIC	-101.755
Reg Rsq	0.4857	Total Rsq	0.4857
Durbin-Watson	0.2694		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.106921	0.0150	-7.129	0.0001
SPLESS	1	0.946449	0.1279	7.400	0.0001

Dow Jones Utility Composite- Risk Premium

Autoreg Procedure

Estimates of Autocorrelations

Lag	Covariance	Correlation	-1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1
0	0.010047	1.000000	|********************|
1	0.008494	0.845428	|***************** |
2	0.007035	0.700147	|************** |
3	0.006195	0.616590	|************ |
4	0.005213	0.518838	|********** |
5	0.003593	0.357589	|******* |
6	0.002729	0.271660	|***** |
7	0.002078	0.206860	|**** |
8	0.000629	0.062595	|* |
9	-0.00033	-0.032485	*|
10	-0.00096	-0.095579	**|
11	-0.00215	-0.214000	****|
12	-0.00355	-0.353671	*******|

Backward Elimination of Autoregressive Terms

Lag	Estimate	t-Ratio	Prob
3	0.032577	0.1640	0.8705
10	-0.060400	-0.3264	0.7456

Dow Jones Utility Composite- Risk Premium

Autoreg Procedure

12	0.067967	0.4789	0.6342
6	-0.113176	-0.6349	0.5284
2	0.147591	1.0238	0.3108
9	-0.234085	-1.6553	0.1040
11	0.125187	1.4207	0.1614
4	-0.203645	-1.4844	0.1436
5	0.145334	1.3432	0.1848
7	-0.253301	-1.9548	0.0557
8	0.117310	1.6466	0.1052

Preliminary MSE = 0.002866

Estimates of the Autoregressive Parameters

Lag	Coefficient	Std Error	t Ratio
1	-0.84542767	0.070742	-11.951

Dow Jones Utility Composite- Risk Premium

Autoreg Procedure

Maximum Likelihood Estimates

SSE	0.141278	DFE	57
MSE	0.002479	Root MSE	0.049785
SBC	-179.005	AIC	-185.288
Reg Rsq	0.1667	Total Rsq	0.8795
Durbin-Watson	1.7739		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.097563	0.0513	-1.900	0.0625
SPLESS	1	0.569174	0.1751	3.251	0.0019
A(1)	1	-0.884060	0.0609	-14.526	0.0001

Autoregressive parameters assumed given.

Dow Jones Utility Composite- Risk Premium

Autoreg Procedure

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.097563	0.0513	-1.903	0.0621
SPLESS	1	0.569174	0.1686	3.376	0.0013

APPENDIX B

SAS OUTPUT FOR UTILITIES (1987-1991)

OBS	MONTH	SPDELTA	DJDELTA	ELEDELTA	LDCDELTA	TBOND	SPLESS	DJLESS	ELELESS	LDCLESS
1	Jan-87	0.27041	0.27025	0.26293	0.22777	0.0778	0.19261	0.19245	0.18513	0.14997
2	Feb-87	0.28031	0.17834	0.11535	0.18278	0.0763	0.20401	0.10204	0.03905	0.10648
3	Mar-87	0.25915	0.09787	0.04101	0.10587	0.0795	0.17965	0.01837	-0.03849	0.02637
4	Apr-87	0.21555	0.13723	0.04764	-0.02736	0.0859	0.12965	0.05133	-0.03826	-0.11326
5	May-87	0.21216	0.03818	-0.01506	-0.07528	0.0880	0.12416	-0.04982	-0.10306	-0.16328
6	Jun-87	0.22870	0.02899	-0.03113	-0.04335	0.0877	0.14100	-0.05871	-0.11883	-0.13105
7	Jul-87	0.29101	-0.01152	-0.12743	-0.07335	0.0907	0.20031	-0.10222	-0.21813	-0.16405
8	Aug-87	0.34449	-0.05343	-0.15916	-0.07787	0.0936	0.25089	-0.14703	-0.25276	-0.17147
9	Sep-87	0.33739	-0.01382	-0.08524	-0.06283	0.0992	0.23819	-0.11302	-0.18444	-0.16203
10	Oct-87	0.18029	-0.12827	-0.16314	-0.15600	0.0926	0.08769	-0.22087	-0.25574	-0.24860
11	Nov-87	-0.00041	-0.17504	-0.18383	-0.15671	0.0931	-0.09351	-0.26814	-0.27693	-0.24981
12	Dec-87	-0.03057	-0.15014	-0.17086	-0.15007	0.0920	-0.12257	-0.24214	-0.26286	-0.24207
13	Jan-88	-0.05293	-0.15441	-0.16415	-0.12040	0.0852	-0.13813	-0.23961	-0.24935	-0.20560
14	Feb-88	-0.08117	-0.16089	-0.15184	-0.09908	0.0854	-0.16657	-0.24629	-0.23724	-0.18448
15	Mar-88	-0.09162	-0.19380	-0.16091	-0.13015	0.0901	-0.18172	-0.28390	-0.25101	-0.22025
16	Apr-88	-0.09229	-0.16468	-0.14426	-0.03857	0.0929	-0.18519	-0.25758	-0.23716	-0.13147
17	May-88	-0.11415	-0.10429	-0.07628	0.01418	0.0952	-0.20935	-0.19949	-0.17148	-0.08102
18	Jun-88	-0.10186	-0.12059	-0.08457	-0.00687	0.0917	-0.19356	-0.21229	-0.17627	-0.09857
19	Jul-88	-0.13222	-0.09346	-0.05789	0.02406	0.0947	-0.22692	-0.18816	-0.15259	-0.07064
20	Aug-88	-0.19945	-0.13855	-0.08887	-0.06665	0.0950	-0.29445	-0.23355	-0.18387	-0.16165
21	Sep-88	-0.15908	-0.07824	-0.03685	0.02192	0.0917	-0.25078	-0.16994	-0.12855	-0.06978
22	Oct-88	-0.00999	0.02564	0.02978	0.11364	0.0889	-0.09889	-0.06326	-0.05912	0.02474
23	Nov-88	0.10612	0.05598	0.03499	0.12511	0.0923	0.01382	-0.03632	-0.05731	0.03281
24	Dec-88	0.14730	0.06397	0.07110	0.12311	0.0918	0.05550	-0.02783	-0.02070	0.03131
25	Jan-89	0.13932	0.00500	0.00360	0.05109	0.0903	0.04902	-0.08530	-0.08670	-0.03921

OBS	MONTH	SPDELTA	DJDELTA	ELEDELTA	LDCDELTA	TBOND	SPLESS	DJLESS	ELELESS	LDCLESS
26	Feb-89	0.13909	-0.00452	-0.00568	0.00553	0.0935	0.04559	-0.09802	-0.09918	-0.08797
27	Mar-89	0.10162	0.07325	0.03592	0.08329	0.0929	0.00872	-0.01965	-0.05698	-0.00961
28	Apr-89	0.15118	0.12641	0.11828	0.12649	0.0918	0.05938	0.03461	0.02648	0.03469
29	May-89	0.22569	0.13645	0.12440	0.12582	0.0878	0.13789	0.04865	0.03660	0.03802
30	Jun-89	0.19579	0.15812	0.14833	0.11457	0.0821	0.11369	0.07602	0.06623	0.03247
31	Jul-89	0.23337	0.20973	0.21355	0.16400	0.0801	0.15327	0.12963	0.13345	0.08390
32	Aug-89	0.31437	0.21600	0.18105	0.24112	0.0841	0.23027	0.13190	0.09695	0.15702
33	Sep-89	0.29590	0.19076	0.15100	0.20885	0.0847	0.21120	0.10606	0.06630	0.12415
34	Oct-89	0.25234	0.17070	0.14765	0.22016	0.0810	0.17134	0.08970	0.06665	0.13916
35	Nov-89	0.25535	0.21160	0.19745	0.26247	0.0808	0.17455	0.13080	0.11665	0.18167
36	Dec-89	0.26076	0.26176	0.21379	0.34912	0.0816	0.17916	0.18016	0.13219	0.26752
37	Jan-90	0.19121	0.17113	0.13242	0.22880	0.0865	0.10471	0.08463	0.04592	0.14230
38	Feb-90	0.12398	0.20485	0.17032	0.24441	0.0876	0.03638	0.11725	0.08272	0.15681
39	Mar-90	0.15634	0.16644	0.15835	0.18599	0.0889	0.06744	0.07754	0.06945	0.09709
40	Apr-90	0.11869	0.05660	0.05064	0.09081	0.0924	0.02629	-0.03580	-0.04176	-0.00159
41	May-90	0.11580	0.05489	0.03971	0.09872	0.0883	0.02750	-0.03341	-0.04859	0.01042
42	Jun-90	0.11335	0.00148	0.01124	0.07237	0.0864	0.02695	-0.08492	-0.07516	-0.01403
43	Jul-90	0.08475	-0.05059	-0.03193	-0.01144	0.0860	-0.00125	-0.13659	-0.11793	-0.09744
44	Aug-90	-0.04573	-0.10847	-0.07740	-0.03788	0.0920	-0.13773	-0.20047	-0.16940	-0.12988
45	Sep-90	-0.09182	-0.08142	-0.08142	-0.00864	0.0914	-0.18322	-0.17282	-0.17282	-0.10004
46	Oct-90	-0.11595	-0.02696	-0.01488	0.01599	0.0898	-0.20575	-0.11676	-0.10468	-0.07381
47	Nov-90	-0.07322	-0.05700	-0.02338	-0.02200	0.0858	-0.15902	-0.14280	-0.10918	-0.10780
48	Dec-90	-0.05694	-0.10781	-0.03877	-0.06997	0.0844	-0.14134	-0.19221	-0.12317	-0.15437
49	Jan-91	-0.04259	-0.07561	-0.00214	-0.01665	0.0837	-0.12629	-0.15931	-0.08584	-0.10035
50	Feb-91	0.09626	-0.03449	0.03587	-0.00267	0.0841	0.01216	-0.11859	-0.04823	-0.08677

OBS	MONTH	SPDELTA	DJDELTA	ELEDELTA	LDCDELTA	TBOND	SPLESS	DJLESS	ELELESS	LDCLESS
51	Mar-91	0.09992	0.011739	0.07903	0.02428	0.0844	0.01552	-0.07266	-0.00537	-0.060123
52	Apr-91	0.12272	0.034074	0.13531	0.07615	0.0837	0.03902	-0.04963	0.05161	-0.007553
53	May-91	0.07920	0.001798	0.08005	0.08156	0.0845	-0.00530	-0.08270	-0.00445	-0.002940
54	Jun-91	0.04967	-0.062568	0.05947	0.03696	0.0860	-0.03633	-0.14857	-0.02653	-0.049039
55	Jul-91	0.05611	-0.039236	0.09587	0.12979	0.0850	-0.02889	-0.12424	0.01087	0.044788
56	Aug-91	0.17732	0.074950	0.21830	0.16245	0.0818	0.09552	-0.00685	0.13650	0.080652
57	Sep-91	0.22761	0.071763	0.27089	0.15353	0.0790	0.14861	-0.00724	0.19189	0.074533
58	Oct-91	0.25970	0.012800	0.17093	0.14407	0.0791	0.18060	-0.06630	0.09183	0.064974
59	Nov-91	0.22402	0.031779	0.18231	0.14072	0.0789	0.14512	-0.04712	0.10341	0.061815
60	Dec-91	0.18178	0.078445	0.22289	0.14202	0.0730	0.10878	0.00545	0.14989	0.069017

Autoreg Procedure

Dependent Variable = ELEDELTA

Ordinary Least Squares Estimates

SSE	0.623262	DFE	58
MSE	0.010746	Root MSE	0.103662
SBC	-95.5667	AIC	-99.7554
Reg Rsq	0.3182	Total Rsq	0.3182
Durbin-Watson	0.2519		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.017538	0.0167	-1.049	0.2984
SPDELTA	1	0.486707	0.0935	5.203	0.0001

Autoreg Procedure

Estimates of Autocorrelations

Lag	Covariance	Correlation	Plot (-1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1)
0	0.010388	1.000000	|********************|
1	0.008702	0.837730	|***************** |
2	0.007375	0.709966	|************** |
3	0.006636	0.638853	|************* |
4	0.005165	0.497233	|********** |
5	0.003975	0.382700	|******** |
6	0.002638	0.253953	|***** |
7	0.002059	0.198187	|**** |
8	0.001677	0.161399	|*** |
9	0.000645	0.062067	|* |
10	0.000377	0.036258	|* |
11	-0.00002	-0.002141	| |
12	-0.00077	-0.074357	*| |

Backward Elimination of Autoregressive Terms

Lag	Estimate	t-Ratio	Prob
11	0.046726	0.2366	0.8140
8	-0.092931	-0.4795	0.6338

Autoreg Procedure

9	0.090632	0.5673	0.5732
10	-0.055623	-0.4348	0.6656
12	0.078644	1.0227	0.3114
2	0.180401	1.0255	0.3100
5	-0.139164	-0.8373	0.4062
7	-0.208593	-1.5527	0.1264
6	0.116770	1.1321	0.2626
4	0.245023	1.8743	0.0662
3	-0.088907	-0.8637	0.3914

Preliminary MSE = 0.003098

Estimates of the Autoregressive Parameters

Lag	Coefficient	Std Error	t Ratio
1	-0.83772979	0.072331	-11.582

Autoreg Procedure

Maximum Likelihood Estimates

SSE	0.143441	DFE	57
MSE	0.002517	Root MSE	0.050165
SBC	-177.887	AIC	-184.17
Reg Rsq	0.1142	Total Rsq	0.8431
Durbin-Watson	1.9019		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	0.044812	0.0645	0.695	0.4899
SPDELTA	1	0.299218	0.1192	2.510	0.0149
A(1)	1	-0.906851	0.0597	-15.183	0.0001

Autoregressive parameters assumed given.

Autoreg Procedure

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	0.044812	0.0623	0.720	0.4746
SPDELTA	1	0.299218	0.1104	2.710	0.0089

Autoreg Procedure

Dependent Variable = LDCDELTA

Ordinary Least Squares Estimates

SSE	0.612531	DFE	58
MSE	0.010561	Root MSE	0.102766
SBC	-96.6087	AIC	-100.797
Reg Rsq	0.2580	Total Rsq	0.2580
Durbin-Watson	0.2461		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	0.013181	0.0166	0.795	0.4296
SPDELTA	1	0.416389	0.0927	4.490	0.0001

Autoreg Procedure

Estimates of Autocorrelations

Lag	Covariance	Correlation	-1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1
0	0.010209	1.000000	| |********************|
1	0.008842	0.866154	| |***************** |
2	0.007543	0.738865	| |*************** |
3	0.006368	0.623740	| |************ |
4	0.005049	0.494535	| |********** |
5	0.003822	0.374381	| |******* |
6	0.002364	0.231604	| |***** |
7	0.001105	0.108227	| |** |
8	0.000272	0.026625	| |* |
9	-0.00055	-0.054096	| *| |
10	-0.0007	-0.068580	| *| |
11	-0.00105	-0.102437	| **| |
12	-0.00166	-0.162210	| ***| |

Backward Elimination of Autoregressive Terms

Lag	Estimate	t-Ratio	Prob
11	-0.018630	-0.0946	0.9251
2	0.035789	0.1911	0.8493

Autoreg Procedure

4	0.035183	0.1909	0.8494
5	-0.027540	-0.1762	0.8609
3	-0.055496	-0.4597	0.6477
7	0.101340	0.5724	0.5696
8	-0.084555	-0.5584	0.5790
9	0.164095	1.1295	0.2638
10	-0.188650	-1.6693	0.1009
12	0.049063	0.7100	0.4807
6	0.107773	1.5272	0.1323

Preliminary MSE = 0.00255

Estimates of the Autoregressive Parameters

Lag	Coefficient	Std Error	t Ratio
1	-0.86615392	0.066197	-13.084

Autoreg Procedure

Maximum Likelihood Estimates

SSE	0.141591	DFE	57
MSE	0.002484	Root MSE	0.04984
SBC	-178.94	AIC	-185.223
Reg Rsq	0.1492	Total Rsq	0.8285
Durbin-Watson	1.8425		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	0.037179	0.0491	0.757	0.4519
SPDELTA	1	0.344607	0.1146	3.006	0.0039
A(1)	1	-0.875411	0.0644	-13.593	0.0001

Autoregressive parameters assumed given.

Autoreg Procedure

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	0.037179	0.0486	0.765	0.4473
SPDELTA	1	0.344607	0.1090	3.160	0.0025

Autoreg Procedure

Dependent Variable = DJDELTA

Ordinary Least Squares Estimates

SSE	0.400288	DFE	58
MSE	0.006902	Root MSE	0.083075
SBC	-122.134	AIC	-126.322
Reg Rsq	0.5412	Total Rsq	0.5412
Durbin-Watson	0.3657		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.045737	0.0134	-3.414	0.0012
SPDELTA	1	0.620069	0.0750	8.272	0.0001

Autoreg Procedure

Estimates of Autocorrelations

```
Lag  Covariance  Correlation -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1

  0    0.006671     1.000000 |                    |********************|
  1    0.005267     0.789510 |                    |****************    |
  2    0.004078     0.611221 |                    |************        |
  3    0.003359     0.503552 |                    |**********          |
  4     0.00227     0.340224 |                    |*******             |
  5    0.001753     0.262805 |                    |*****               |
  6    0.001075     0.161155 |                    |***                 |
  7    0.000902     0.135129 |                    |***                 |
  8    0.000853     0.127933 |                    |***                 |
  9    0.000223     0.033462 |                    |*                   |
 10    0.000111     0.016579 |                    |                    |
 11    -0.00039    -0.058487 |                   *|                    |
 12    -0.00117    -0.175201 |                ****|                    |
```

Backward Elimination of Autoregressive Terms

Lag	Estimate	t-Ratio	Prob
8	-0.053141	-0.2508	0.8031

Autoreg Procedure

11	0.069342	0.3730	0.7108
9	0.120973	0.8033	0.4257
10	-0.052289	-0.4519	0.6533
2	0.250144	1.4034	0.1667
5	-0.235861	-1.3999	0.1676
6	0.167929	1.1563	0.2529
7	-0.095709	-0.9950	0.3242
3	-0.171939	-1.1997	0.2355
4	0.051221	0.5392	0.5919
12	0.129467	1.6120	0.1126

Preliminary MSE = 0.002513

Estimates of the Autoregressive Parameters

Lag	Coefficient	Std Error	t Ratio
1	-0.78950990	0.081292	-9.712

Autoreg Procedure

Maximum Likelihood Estimates

SSE	0.126924	DFE	57
MSE	0.002227	Root MSE	0.047188
SBC	-185.572	AIC	-191.855
Reg Rsq	0.2173	Total Rsq	0.8545
Durbin-Watson	1.8792		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.004661	0.0436	-0.107	0.9152
SPDELTA	1	0.409385	0.1120	3.655	0.0006
A(1)	1	-0.865517	0.0689	-12.560	0.0001

Autoregressive parameters assumed given.

Autoreg Procedure

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.004661	0.0432	-0.108	0.9144
SPDELTA	1	0.409385	0.1029	3.977	0.0002

Autoreg Procedure

Dependent Variable = ELELESS

Ordinary Least Squares Estimates

SSE	0.642176	DFE	58
MSE	0.011072	Root MSE	0.105224
SBC	-93.773	AIC	-97.9617
Reg Rsq	0.3395	Total Rsq	0.3395
Durbin-Watson	0.2507		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.062701	0.0137	-4.573	0.0001
SPLESS	1	0.510011	0.0934	5.460	0.0001

Autoreg Procedure

Estimates of Autocorrelations

```
Lag  Covariance  Correlation -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1

  0    0.010703     1.000000 |                    |********************|
  1    0.008969     0.837999 |                    |*****************   |
  2    0.007573     0.707571 |                    |**************      |
  3    0.006779     0.633357 |                    |*************       |
  4    0.005234     0.489047 |                    |**********          |
  5    0.003984     0.372201 |                    |*******             |
  6    0.002623     0.245044 |                    |*****               |
  7    0.002046     0.191173 |                    |****                |
  8     0.00167     0.156043 |                    |***                 |
  9     0.00065     0.060744 |                    |*                   |
 10    0.000386     0.036050 |                    |*                   |
 11    -0.00001    -0.001194 |                    |                    |
 12    -0.00077    -0.072133 |                   *|                    |
```

Backward Elimination of Autoregressive Terms

Lag	Estimate	t-Ratio	Prob
11	0.046627	0.2352	0.8151
8	-0.086437	-0.4432	0.6597

Autoreg Procedure

9	0.083908	0.5252	0.6019
10	-0.050974	-0.3996	0.6912
12	0.078418	1.0265	0.3096
2	0.188501	1.0664	0.2913
5	-0.134148	-0.8024	0.4259
7	-0.213779	-1.5932	0.1171
6	0.108291	1.0526	0.2972
4	0.248760	1.9047	0.0621
3	-0.080932	-0.7886	0.4336

Preliminary MSE = 0.003187

Estimates of the Autoregressive Parameters

Lag	Coefficient	Std Error	t Ratio
1	-0.83799890	0.072276	-11.594

Autoreg Procedure

Maximum Likelihood Estimates

SSE	0.146533	DFE	57
MSE	0.002571	Root MSE	0.050703
SBC	-176.577	AIC	-182.86
Reg Rsq	0.1230	Total Rsq	0.8493
Durbin-Watson	1.8744		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.013806	0.0646	-0.214	0.8315
SPLESS	1	0.313516	0.1202	2.608	0.0116
A(1)	1	-0.909722	0.0592	-15.359	0.0001

Autoregressive parameters assumed given.

Autoreg Procedure

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.013806	0.0630	-0.219	0.8273
SPLESS	1	0.313516	0.1109	2.827	0.0065

Autoreg Procedure

Dependent Variable = LDCLESS

Ordinary Least Squares Estimates

SSE	0.62727	DFE	58
MSE	0.010815	Root MSE	0.103995
SBC	-95.1821	AIC	-99.3708
Reg Rsq	0.2778	Total Rsq	0.2778
Durbin-Watson	0.2448		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.038032	0.0136	-2.806	0.0068
SPLESS	1	0.436058	0.0923	4.723	0.0001

Autoreg Procedure

Estimates of Autocorrelations

```
Lag  Covariance  Correlation -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1

  0    0.010454     1.000000 |                    |********************|
  1    0.009055     0.866127 |                    |*****************   |
  2    0.007711     0.737611 |                    |***************     |
  3    0.006489     0.620669 |                    |************        |
  4    0.005107     0.488464 |                    |**********          |
  5    0.003819     0.365275 |                    |*******             |
  6    0.002318     0.221684 |                    |****                |
  7    0.001041     0.099621 |                    |**                  |
  8    0.000197     0.018858 |                    |                    |
  9    -0.00062    -0.059608 |                   *|                    |
 10    -0.00075    -0.071812 |                   *|                    |
 11    -0.00106    -0.101100 |                  **|                    |
 12    -0.00167    -0.159533 |                 ***|                    |
```

Backward Elimination of Autoregressive Terms

Lag	Estimate	t-Ratio	Prob
2	0.026629	0.1354	0.8929
4	0.035897	0.1917	0.8488

Autoreg Procedure

5	-0.024613	-0.1549	0.8776
11	-0.045684	-0.2515	0.8025
3	-0.052556	-0.4355	0.6651
7	0.094504	0.5329	0.5964
8	-0.082086	-0.5419	0.5902
9	0.160819	1.1062	0.2736
10	-0.192874	-1.7113	0.0928
12	0.047894	0.6964	0.4891
6	0.109271	1.5555	0.1255

Preliminary MSE = 0.002612

Estimates of the Autoregressive Parameters

Lag	Coefficient	Std Error	t Ratio
1	-0.86612749	0.066203	-13.083

Autoreg Procedure

Maximum Likelihood Estimates

SSE	0.144177	DFE	57
MSE	0.002529	Root MSE	0.050293
SBC	-177.84	AIC	-184.123
Reg Rsq	0.1589	Total Rsq	0.8340
Durbin-Watson	1.8289		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.018825	0.0480	-0.392	0.6964
SPLESS	1	0.358478	0.1153	3.110	0.0029
A(1)	1	-0.877252	0.0642	-13.656	0.0001

Autoregressive parameters assumed given.

Autoreg Procedure

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.018825	0.0478	-0.394	0.6951
SPLESS	1	0.358478	0.1093	3.280	0.0018

Autoreg Procedure

Dependent Variable = DJLESS

Ordinary Least Squares Estimates

SSE	0.406517	DFE	58
MSE	0.007009	Root MSE	0.083719
SBC	-121.207	AIC	-125.396
Reg Rsq	0.5556	Total Rsq	0.5556
Durbin-Watson	0.3656		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.079076	0.0109	-7.248	0.0001
SPLESS	1	0.632855	0.0743	8.515	0.0001

Autoreg Procedure

Estimates of Autocorrelations

```
Lag  Covariance  Correlation -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1

  0    0.006775     1.000000 |                    |********************|
  1    0.005348     0.789374 |                    |****************    |
  2    0.004122     0.608452 |                    |************        |
  3    0.003373     0.497765 |                    |**********          |
  4    0.002244     0.331217 |                    |*******             |
  5    0.001694     0.249964 |                    |*****               |
  6    0.001014     0.149632 |                    |***                 |
  7    0.000853     0.125845 |                    |***                 |
  8    0.000815     0.120273 |                    |**                  |
  9    0.000199     0.029417 |                    |*                   |
 10    0.000091     0.013367 |                    |                    |
 11     -0.0004    -0.059496 |                   *|                    |
 12    -0.00118    -0.174523 |                 ***|                    |
```

Backward Elimination of Autoregressive Terms

Lag	Estimate	t-Ratio	Prob
8	-0.049031	-0.2304	0.8188

Autoreg Procedure

11	0.066181	0.3561	0.7234
9	0.117549	0.7792	0.4397
10	-0.049823	-0.4303	0.6689
2	0.251642	1.4079	0.1654
5	-0.226797	-1.3402	0.1861
6	0.168508	1.1592	0.2517
7	-0.096442	-1.0078	0.3181
3	-0.170770	-1.1907	0.2390
4	0.058270	0.6169	0.5399
12	0.128011	1.5925	0.1169

Preliminary MSE = 0.002554

Estimates of the Autoregressive Parameters

Lag	Coefficient	Std Error	t Ratio
1	-0.78937403	0.081315	-9.708

Autoreg Procedure

Maximum Likelihood Estimates

SSE	0.128754	DFE	57
MSE	0.002259	Root MSE	0.047527
SBC	-184.701	AIC	-190.984
Reg Rsq	0.2263	Total Rsq	0.8592
Durbin-Watson	1.8587		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.055096	0.0422	-1.305	0.1972
SPLESS	1	0.420364	0.1124	3.740	0.0004
A(1)	1	-0.867312	0.0687	-12.628	0.0001

Autoregressive parameters assumed given.

Autoreg Procedure

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.055096	0.0421	-1.307	0.1963
SPLESS	1	0.420364	0.1030	4.083	0.0001

APPENDIX C

SAS OUTPUT FOR UTILITIES (1961-1965)

OBS	MONTH	SPDELTA	DJDELTA	ELEDELTA	LDCDELTA	TBOND	SPLESS	DJLESS	ELELESS	LDCLESS
1	Jan-61	.	.	.	.	4.04	.	.	.	.
2	Feb-61	8.55	6.88	0.57	8.50	3.92	8.67	7.00	0.69	8.62
3	Mar-61	5.08	2.57	2.81	1.30	3.97	5.03	2.52	2.76	1.25
4	Apr-61	1.58	1.84	-0.71	9.35	3.91	1.64	1.90	-0.65	9.41
5	May-61	2.31	0.47	4.49	-1.64	3.97	2.25	0.41	4.43	-1.70
6	Jun-61	-5.83	-6.85	-11.51	-10.22	4.04	-5.90	-6.92	-11.58	-10.29
7	Jul-61	2.59	0.34	3.74	1.28	4.04	2.59	0.34	3.74	1.28
8	Aug-61	2.77	2.04	2.19	-1.37	4.10	2.71	1.98	2.13	-1.43
9	Sep-61	2.75	2.08	8.51	11.50	4.03	2.82	2.15	8.58	11.57
10	Oct-61	3.85	7.65	7.46	-1.26	4.00	3.88	7.68	7.49	-1.23
11	Nov-61	1.58	4.97	1.86	2.05	4.04	1.54	4.93	1.82	2.01
12	Dec-61	-1.84	-8.36	-14.55	-11.24	4.15	-1.95	-8.47	-14.66	-11.35
13	Jan-62	-10.64	-13.23	-11.06	-5.80	4.19	-10.68	-13.27	-11.10	-5.84
14	Feb-62	-2.71	-4.40	0.04	-5.68	4.14	-2.66	-4.35	0.09	-5.63
15	Mar-62	-3.33	-1.43	-2.23	-4.37	3.98	-3.17	-1.27	-2.07	-4.21
16	Apr-62	-6.25	-4.99	-3.29	-9.33	3.94	-6.21	-4.95	-3.25	-9.29
17	May-62	-8.65	-9.33	-14.76	-10.11	3.93	-8.64	-9.32	-14.75	-10.10
18	Jun-62	-9.94	-7.49	-2.80	-4.80	4.01	-10.02	-7.57	-2.88	-4.88
19	Jul-62	2.28	2.17	4.42	4.88	4.12	2.17	2.06	4.31	4.77
20	Aug-62	-0.73	-0.33	-2.42	-5.32	4.01	-0.62	-0.22	-2.31	-5.21
21	Sep-62	-0.10	-1.50	-4.68	-5.57	3.98	-0.07	-1.47	-4.65	-5.54
22	Oct-62	-3.63	-4.87	-5.48	-3.29	3.95	-3.60	-4.84	-5.45	-3.26
23	Nov-62	1.87	-0.86	2.12	2.18	3.96	1.86	-0.87	2.11	2.17
24	Dec-62	2.85	5.73	8.00	4.42	3.95	2.86	5.74	8.01	4.43
25	Jan-63	6.87	9.46	10.61	7.18	3.98	6.84	9.43	10.58	7.15

OBS	MONTH	SPDELTA	DJDELTA	ELEDELTA	LDCDELTA	TBOND	SPLESS	DJLESS	ELELESS	LDCLESS
26	Feb-63	-0.31	-0.47	-5.59	0.56	4.00	-0.33	-0.49	-5.61	0.54
27	Mar-63	-0.45	-2.38	0.39	-2.40	4.01	-0.46	-2.39	0.38	-2.41
28	Apr-63	7.61	3.02	4.17	4.86	4.05	7.57	2.98	4.13	4.82
29	May-63	10.31	10.13	12.87	11.96	4.06	10.30	10.12	12.86	11.95
30	Jun-63	14.68	10.31	5.31	9.96	4.07	14.67	10.30	5.30	9.95
31	Jul-63	-4.79	-5.52	-8.13	-11.99	4.07	-4.79	-5.52	-8.13	-11.99
32	Aug-63	0.05	0.73	2.58	2.48	4.08	0.04	0.72	2.57	2.47
33	Sep-63	4.31	0.91	0.91	3.98	4.10	4.29	0.89	0.89	3.96
34	Oct-63	4.42	0.05	-2.19	5.82	4.15	4.37	0.00	-2.24	5.77
35	Nov-63	-9.07	-5.49	-9.25	-13.75	4.14	-9.06	-5.48	-9.24	-13.74
36	Dec-63	-2.54	-3.38	-2.80	-2.42	4.17	-2.57	-3.41	-2.83	-2.45
37	Jan-64	-0.90	-2.79	-4.89	-4.26	4.21	-0.94	-2.83	-4.93	-4.30
38	Feb-64	-0.11	-1.28	3.22	-0.32	4.24	-0.14	-1.31	3.19	-0.35
39	Mar-64	2.59	0.52	-2.65	1.70	4.24	2.59	0.52	-2.65	1.70
40	Apr-64	-3.73	-1.29	-0.68	-4.38	4.23	-3.72	-1.28	-0.67	-4.37
41	May-64	-1.18	-1.42	-0.73	-2.07	4.22	-1.17	-1.41	-0.72	-2.06
42	Jun-64	-0.63	1.57	2.93	1.64	4.19	-0.60	1.60	2.96	1.67
43	Jul-64	6.04	4.85	4.89	3.55	4.21	6.02	4.83	4.87	3.53
44	Aug-64	-4.96	-2.21	-5.06	-0.92	4.23	-4.98	-2.23	-5.08	-0.94
45	Sep-64	-1.03	0.51	4.10	0.53	4.21	-1.01	0.53	4.12	0.55
46	Oct-64	1.69	4.51	5.11	-0.60	4.21	1.69	4.51	5.11	-0.60
47	Nov-64	1.46	2.85	2.41	2.97	4.22	1.45	2.84	2.40	2.96
48	Dec-64	-4.45	-1.68	-1.75	-0.43	4.23	-4.46	-1.69	-1.76	-0.44
49	Jan-65	-0.55	-0.30	1.84	4.44	4.22	-0.54	-0.29	1.85	4.45
50	Feb-65	-0.56	1.84	-0.78	-1.57	4.24	-0.58	1.82	-0.80	-1.59

OBS	MONTH	SPDELTA	DJDELTA	ELEDELTA	LDCDELTA	TBOND	SPLESS	DJLESS	ELELESS	LDCLESS
51	Mar-65	-1.90	0.54	1.25	-4.78	4.22	-1.88	0.56	1.27	-4.76
52	Apr-65	-0.14	-0.41	-0.27	-0.20	4.22	-0.14	-0.41	-0.27	-0.20
53	May-65	0.55	0.40	-1.43	-2.53	4.23	0.54	0.39	-1.44	-2.54
54	Jun-65	-4.62	-5.49	-5.17	-0.84	4.23	-4.62	-5.49	-5.17	-0.84
55	Jul-65	-3.95	-3.60	-4.76	-3.87	4.24	-3.96	-3.61	-4.77	-3.88
56	Aug-65	3.45	-1.11	0.54	0.09	4.28	3.41	-1.15	0.50	0.05
57	Sep-65	1.68	0.62	-0.35	0.55	4.33	1.63	0.57	-0.40	0.50
58	Oct-65	0.55	-1.06	-0.96	-0.68	4.33	0.55	-1.06	-0.96	-0.68
59	Nov-65	0.14	-1.40	-2.65	-1.41	4.41	0.06	-1.48	-2.73	-1.49
60	Dec-65	1.40	-1.58	-0.78	-0.56	4.50	1.31	-1.67	-0.87	-0.65

Autoreg Procedure

Dependent Variable = ELEDELTA

Ordinary Least Squares Estimates

SSE	831.8323	DFE	57
MSE	14.59355	Root MSE	3.82015
SBC	331.7093	AIC	327.5543
Reg Rsq	0.5294	Total Rsq	0.5294
Durbin-Watson	1.9712		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.515125	0.4975	-1.035	0.3048
SPDELTA	1	0.847378	0.1058	8.008	0.0001

Autoreg Procedure

Estimates of Autocorrelations

Lag	Covariance	Correlation	-1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1
0	14.09885	1.000000	|********************|
1	-0.13605	-0.009650	|
2	-0.85399	-0.060572	*|
3	-2.42426	-0.171947	***|
4	2.291394	0.162523	|***
5	2.181173	0.154706	|***
6	-0.1634	-0.011590	|
7	-2.9188	-0.207024	****|
8	-2.00884	-0.142482	***|
9	3.180983	0.225620	|*****
10	-0.18414	-0.013061	|
11	0.068682	0.004871	|
12	-7.39051	-0.524193	**********|

Backward Elimination of Autoregressive Terms

Lag	Estimate	t-Ratio	Prob
6	-0.007538	-0.0579	0.9541
1	-0.020429	-0.1562	0.8766

Autoreg Procedure

5	-0.027890	-0.2188	0.8278
11	-0.031090	-0.2435	0.8086
2	0.031785	0.2589	0.7968
3	0.051094	0.4141	0.6806
4	-0.067454	-0.5570	0.5800
10	0.068375	0.5864	0.5602
8	0.065932	0.5709	0.5705
7	0.124308	1.0848	0.2828
9	-0.139614	-1.2137	0.2301

Preliminary MSE = 10.2248

Estimates of the Autoregressive Parameters

Lag	Coefficient	Std Error	t Ratio
12	0.52419253	0.113800	4.606

Autoreg Procedure

Expected Autocorrelations

Lag	Autocorr
0	1.0000
1	0.0000
2	0.0000
3	0.0000
4	0.0000
5	0.0000
6	0.0000
7	0.0000
8	0.0000
9	0.0000
10	0.0000
11	0.0000
12	-0.5242

Autoreg Procedure

Maximum Likelihood Estimates

SSE	457.2781	DFE	56
MSE	8.165681	Root MSE	2.857566
SBC	307.8913	AIC	301.6587
Reg Rsq	0.5867	Total Rsq	0.7413
Durbin-Watson	1.9138		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.391913	0.2425	-1.616	0.1117
SPDELTA	1	0.816067	0.0919	8.877	0.0001
A(12)	1	0.678639	0.0888	7.644	0.0001

Autoreg Procedure

Expected Autocorrelations

Lag	Autocorr
0	1.0000
1	0.0000
2	0.0000
3	0.0000
4	0.0000
5	0.0000
6	0.0000
7	0.0000
8	0.0000
9	0.0000
10	0.0000
11	0.0000
12	-0.6786

Autoregressive parameters assumed given.

Autoreg Procedure

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.391913	0.2425	-1.616	0.1117
SPDELTA	1	0.816067	0.0915	8.915	0.0001

Autoreg Procedure

Dependent Variable = LDCDELTA

Ordinary Least Squares Estimates

SSE	682.8672	DFE	57
MSE	11.98013	Root MSE	3.461232
SBC	320.0668	AIC	315.9118
Reg Rsq	0.6191	Total Rsq	0.6191
Durbin-Watson	2.4688		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.645787	0.4507	-1.433	0.1574
SPDELTA	1	0.922940	0.0959	9.626	0.0001

Autoreg Procedure

Estimates of Autocorrelations

```
Lag  Covariance  Correlation -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1

  0    11.57402     1.000000 |                    |********************|
  1    -2.73854    -0.236611 |               *****|                    |
  2    0.179823     0.015537 |                    |                    |
  3    -3.27225    -0.282724 |              ******|                    |
  4    1.459843     0.126131 |                    |***                 |
  5    2.308696     0.199472 |                    |****                |
  6    -0.27784    -0.024005 |                    |                    |
  7    -0.11079    -0.009572 |                    |                    |
  8    -2.16538    -0.187090 |                ****|                    |
  9    1.789276     0.154594 |                    |***                 |
 10    1.110492     0.095947 |                    |**                  |
 11    -0.73538    -0.063537 |                   *|                    |
 12    -2.96306    -0.256010 |               *****|                    |
```

Backward Elimination of Autoregressive Terms

Lag	Estimate	t-Ratio	Prob
9	-0.007687	-0.0509	0.9596
2	0.015334	0.1056	0.9163

Autoreg Procedure

4	-0.029262	-0.2023	0.8405
6	-0.053323	-0.3707	0.7125
8	0.069900	0.4995	0.6197
10	-0.097803	-0.7353	0.4656
7	-0.093576	-0.7461	0.4590
11	0.145217	1.1637	0.2498
12	0.233343	1.9234	0.0598
5	-0.236919	-1.9177	0.0604
1	0.232274	1.8507	0.0696

Preliminary MSE = 10.64888

Estimates of the Autoregressive Parameters

Lag	Coefficient	Std Error	t Ratio
3	0.28272379	0.128179	2.206

Autoreg Procedure

Expected Autocorrelations

Lag	Autocorr
0	1.0000
1	0.0000
2	0.0000
3	-0.2827

Maximum Likelihood Estimates

SSE	619.2542	DFE	56
MSE	11.05811	Root MSE	3.325374
SBC	318.6809	AIC	312.4483
Reg Rsq	0.6527	Total Rsq	0.6546
Durbin-Watson	2.4487		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.662731	0.3342	-1.983	0.0523
SPDELTA	1	0.892451	0.0870	10.256	0.0001
A(3)	1	0.311334	0.1266	2.460	0.0170

Autoreg Procedure

Expected Autocorrelations

Lag	Autocorr
0	1.0000
1	0.0000
2	0.0000
3	-0.3113

Autoregressive parameters assumed given.

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.662731	0.3342	-1.983	0.0523
SPDELTA	1	0.892451	0.0870	10.258	0.0001

Autoreg Procedure

Dependent Variable = DJDELTA

Ordinary Least Squares Estimates

SSE	280.7778	DFE	57
MSE	4.925926	Root MSE	2.219443
SBC	267.6314	AIC	263.4763
Reg Rsq	0.7674	Total Rsq	0.7674
Durbin-Watson	1.5162		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.377718	0.2890	-1.307	0.1965
SPDELTA	1	0.843113	0.0615	13.714	0.0001

Autoreg Procedure

Estimates of Autocorrelations

```
Lag  Covariance  Correlation -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1

  0    4.758945     1.000000 |                    |********************|
  1    1.103075     0.231790 |                    |*****               |
  2    -0.30347    -0.063769 |                   *|                    |
  3    -0.43968    -0.092391 |                  **|                    |
  4    0.354682     0.074530 |                    |*                   |
  5    0.696231     0.146299 |                    |***                 |
  6    0.403764     0.084843 |                    |**                  |
  7    -0.04377    -0.009198 |                    |                    |
  8    -0.56324    -0.118353 |                  **|                    |
  9    -0.14701    -0.030891 |                   *|                    |
 10    -0.16062    -0.033751 |                   *|                    |
 11    -0.14934    -0.031382 |                   *|                    |
 12    -2.12979    -0.447535 |           *********|                    |
```

Backward Elimination of Autoregressive Terms

Lag	Estimate	t-Ratio	Prob
9	0.003869	0.0285	0.9774

Autoreg Procedure

4	-0.045198	-0.3376	0.7372
3	0.037784	0.2940	0.7700
7	-0.054642	-0.4169	0.6786
8	0.055280	0.4553	0.6509
6	-0.073506	-0.5896	0.5581
11	-0.098237	-0.7841	0.4366
10	0.089129	0.7461	0.4589
5	-0.113073	-0.9598	0.3415
2	0.136599	1.1388	0.2598
1	-0.217960	-1.8628	0.0678

Preliminary MSE = 3.805788

Estimates of the Autoregressive Parameters

Lag	Coefficient	Std Error	t Ratio
12	0.44753490	0.119501	3.745

Autoreg Procedure

Expected Autocorrelations

Lag	Autocorr
0	1.0000
1	0.0000
2	0.0000
3	0.0000
4	0.0000
5	0.0000
6	0.0000
7	0.0000
8	0.0000
9	0.0000
10	0.0000
11	0.0000
12	-0.4475

Dow Jones Utility Composite- Total Returns

12:32 Tuesday, August 18, 1998

Autoreg Procedure

Maximum Likelihood Estimates

SSE	175.9406	DFE	56
MSE	3.141797	Root MSE	1.772511
SBC	250.4668	AIC	244.2342
Reg Rsq	0.7880	Total Rsq	0.8543
Durbin-Watson	1.6001		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.301691	0.1535	-1.966	0.0543
SPDELTA	1	0.821064	0.0573	14.323	0.0001
A(12)	1	0.640464	0.1012	6.329	0.0001

Autoreg Procedure

Expected Autocorrelations

Lag	Autocorr
0	1.0000
1	0.0000
2	0.0000
3	0.0000
4	0.0000
5	0.0000
6	0.0000
7	0.0000
8	0.0000
9	0.0000
10	0.0000
11	0.0000
12	-0.6405

Autoreg Procedure

Autoregressive parameters assumed given.

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.301691	0.1534	-1.967	0.0542
SPDELTA	1	0.821064	0.0569	14.426	0.0001

Autoreg Procedure

Dependent Variable = ELELESS

Ordinary Least Squares Estimates

SSE	832.3858	DFE	57
MSE	14.60326	Root MSE	3.821421
SBC	331.7486	AIC	327.5935
Reg Rsq	0.5300	Total Rsq	0.5300
Durbin-Watson	1.9709		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.516453	0.4976	-1.038	0.3037
SPLESS	1	0.848758	0.1059	8.017	0.0001

Autoreg Procedure

Estimates of Autocorrelations

```
Lag  Covariance  Correlation -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1

  0    14.10823     1.000000 |                    |********************|
  1    -0.13364    -0.009473 |                    |                    |
  2    -0.85143    -0.060350 |                   *|                    |
  3    -2.42151    -0.171638 |                 ***|                    |
  4    2.294693     0.162649 |                    |***                 |
  5    2.180182     0.154533 |                    |***                 |
  6    -0.15803    -0.011201 |                    |                    |
  7    -2.90666    -0.206026 |                ****|                    |
  8    -2.01155    -0.142580 |                 ***|                    |
  9    3.186327     0.225849 |                    |*****               |
 10    -0.19034    -0.013492 |                    |                    |
 11    0.065208     0.004622 |                    |                    |
 12    -7.39394    -0.524087 |          **********|                    |
```

Backward Elimination of Autoregressive Terms

Lag	Estimate	t-Ratio	Prob
6	-0.008401	-0.0645	0.9488
1	-0.020767	-0.1588	0.8745

Autoreg Procedure

5	-0.028176	-0.2211	0.8260
11	-0.030830	-0.2415	0.8102
2	0.031924	0.2600	0.7959
3	0.050804	0.4117	0.6823
4	-0.067744	-0.5593	0.5784
10	0.068503	0.5875	0.5594
8	0.065957	0.5711	0.5704
7	0.123393	1.0767	0.2864
9	-0.140020	-1.2173	0.2287

Preliminary MSE = 10.23316

Estimates of the Autoregressive Parameters

Lag	Coefficient	Std Error	t Ratio
12	0.52408714	0.113808	4.605

Autoreg Procedure

Expected Autocorrelations

Lag	Autocorr
0	1.0000
1	0.0000
2	0.0000
3	0.0000
4	0.0000
5	0.0000
6	0.0000
7	0.0000
8	0.0000
9	0.0000
10	0.0000
11	0.0000
12	-0.5241

Autoreg Procedure

Maximum Likelihood Estimates

SSE	457.5646	DFE	56
MSE	8.170796	Root MSE	2.85846
SBC	307.932	AIC	301.6994
Reg Rsq	0.5882	Total Rsq	0.7416
Durbin-Watson	1.9144		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.393043	0.2426	-1.620	0.1108
SPLESS	1	0.817310	0.0918	8.905	0.0001
A(12)	1	0.678762	0.0888	7.645	0.0001

Autoreg Procedure

Expected Autocorrelations

Lag	Autocorr
0	1.0000
1	0.0000
2	0.0000
3	0.0000
4	0.0000
5	0.0000
6	0.0000
7	0.0000
8	0.0000
9	0.0000
10	0.0000
11	0.0000
12	-0.6788

Autoregressive parameters assumed given.

Autoreg Procedure

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.393043	0.2426	-1.620	0.1108
SPLESS	1	0.817310	0.0914	8.944	0.0001

Autoreg Procedure

Dependent Variable = LDCLESS

Ordinary Least Squares Estimates

SSE	683.0635	DFE	57
MSE	11.98357	Root MSE	3.461729
SBC	320.0838	AIC	315.9287
Reg Rsq	0.6195	Total Rsq	0.6195
Durbin-Watson	2.4695		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.646485	0.4508	-1.434	0.1570
SPLESS	1	0.923915	0.0959	9.634	0.0001

Autoreg Procedure

Estimates of Autocorrelations

Lag	Covariance	Correlation	-1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1
0	11.57735	1.000000	|********************|
1	-2.74385	-0.237001	*****|
2	0.185123	0.015990	|
3	-3.26966	-0.282419	******|
4	1.458339	0.125965	|***
5	2.307709	0.199330	|****
6	-0.28007	-0.024192	|
7	-0.10621	-0.009174	|
8	-2.16729	-0.187201	****|
9	1.795943	0.155126	|***
10	1.103807	0.095342	|**
11	-0.73669	-0.063632	*|
12	-2.96196	-0.255841	*****|

Backward Elimination of Autoregressive Terms

Lag	Estimate	t-Ratio	Prob
9	-0.008341	-0.0552	0.9562
2	0.015162	0.1044	0.9173

Autoreg Procedure

4	-0.029173	-0.2017	0.8410
6	-0.053626	-0.3728	0.7110
8	0.070198	0.5017	0.6181
10	-0.097497	-0.7329	0.4670
7	-0.093680	-0.7470	0.4585
11	0.145453	1.1656	0.2491
12	0.233248	1.9223	0.0599
5	-0.236884	-1.9174	0.0605
1	0.232545	1.8528	0.0693

Preliminary MSE = 10.65393

Estimates of the Autoregressive Parameters

Lag	Coefficient	Std Error	t Ratio
3	0.28241913	0.128191	2.203

Autoreg Procedure

Expected Autocorrelations

Lag	Autocorr
0	1.0000
1	0.0000
2	0.0000
3	-0.2824

Maximum Likelihood Estimates

SSE	619.5416	DFE	56
MSE	11.06324	Root MSE	3.326145
SBC	318.7079	AIC	312.4753
Reg Rsq	0.6524	Total Rsq	0.6549
Durbin-Watson	2.4495		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.663587	0.3344	-1.985	0.0521
SPLESS	1	0.893254	0.0871	10.251	0.0001
A(3)	1	0.311141	0.1266	2.458	0.0171

Autoreg Procedure

Expected Autocorrelations

Lag	Autocorr
0	1.0000
1	0.0000
2	0.0000
3	-0.3111

Autoregressive parameters assumed given.

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.663587	0.3343	-1.985	0.0521
SPLESS	1	0.893254	0.0871	10.253	0.0001

Autoreg Procedure

Dependent Variable = DJLESS

Ordinary Least Squares Estimates

SSE	281.4375	DFE	57
MSE	4.9375	Root MSE	2.222049
SBC	267.7698	AIC	263.6148
Reg Rsq	0.7676	Total Rsq	0.7676
Durbin-Watson	1.5180		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.379101	0.2894	-1.310	0.1954
SPLESS	1	0.844717	0.0616	13.722	0.0001

Autoreg Procedure

Estimates of Autocorrelations

```
Lag  Covariance  Correlation -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1

  0    4.770127     1.000000 |                    |********************|
  1    1.100975     0.230806 |                    |*****               |
  2    -0.30047    -0.062989 |                   *|                    |
  3    -0.44025    -0.092292 |                  **|                    |
  4    0.359737     0.075415 |                    |**                  |
  5    0.699358     0.146612 |                    |***                 |
  6      0.4069     0.085302 |                    |**                  |
  7     -0.0407    -0.008532 |                    |                    |
  8    -0.57094    -0.119691 |                  **|                    |
  9    -0.14325    -0.030031 |                   *|                    |
 10    -0.16264    -0.034095 |                   *|                    |
 11    -0.14621    -0.030650 |                   *|                    |
 12    -2.13525    -0.447629 |           *********|                    |
```

Backward Elimination of Autoregressive Terms

Lag	Estimate	t-Ratio	Prob
9	0.002460	0.0182	0.9856

Autoreg Procedure

4	-0.045612	-0.3409	0.7348
3	0.037531	0.2921	0.7715
7	-0.055308	-0.4223	0.6747
8	0.056249	0.4632	0.6452
6	-0.074442	-0.5971	0.5531
11	-0.098652	-0.7877	0.4345
10	0.089581	0.7497	0.4568
5	-0.113678	-0.9647	0.3391
2	0.135493	1.1295	0.2637
1	-0.217290	-1.8568	0.0687

Preliminary MSE = 3.814328

Estimates of the Autoregressive Parameters

Lag	Coefficient	Std Error	t Ratio
12	0.44762919	0.119495	3.746

Autoreg Procedure

Expected Autocorrelations

Lag	Autocorr
0	1.0000
1	0.0000
2	0.0000
3	0.0000
4	0.0000
5	0.0000
6	0.0000
7	0.0000
8	0.0000
9	0.0000
10	0.0000
11	0.0000
12	-0.4476

Autoreg Procedure

Maximum Likelihood Estimates

SSE	176.3072	DFE	56
MSE	3.148343	Root MSE	1.774357
SBC	250.5947	AIC	244.3621
Reg Rsq	0.7889	Total Rsq	0.8544
Durbin-Watson	1.6034		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.302817	0.1536	-1.972	0.0536
SPLESS	1	0.822502	0.0573	14.360	0.0001
A(12)	1	0.640659	0.1012	6.330	0.0001

Autoreg Procedure

Expected Autocorrelations

Lag	Autocorr
0	1.0000
1	0.0000
2	0.0000
3	0.0000
4	0.0000
5	0.0000
6	0.0000
7	0.0000
8	0.0000
9	0.0000
10	0.0000
11	0.0000
12	-0.6407

Autoreg Procedure

Autoregressive parameters assumed given.

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.302817	0.1535	-1.972	0.0535
SPLESS	1	0.822502	0.0569	14.464	0.0001

APPENDIX D

SAS OUTPUT FOR UNREGULATED INDUSTRIES

OBS	MONTH	SPDELTA	TRANDELT	FINDELTA	INSDELTA	TBOND	SPLESS	TRANLESS	FINLESS	INSLESS
1	Jan-92	.	.	.	.	7.76	.	.	.	.
2	Feb-92	-13.94	-12.18	-24.35	-24.83	7.77	-13.95	-12.19	-24.36	-24.84
3	Mar-92	-4.47	0.59	-4.02	-4.30	7.97	-4.67	0.39	-4.22	-4.50
4	Apr-92	-2.00	-3.46	-7.61	-5.54	8.03	-2.06	-3.52	-7.67	-5.60
5	May-92	2.32	-0.71	5.86	6.90	7.81	2.54	-0.49	6.08	7.12
6	Jun-92	-1.81	-9.78	-2.34	4.85	7.65	-1.65	-9.62	-2.18	5.01
7	Jul-92	1.23	-1.84	5.40	7.45	7.26	1.62	-1.45	5.79	7.84
8	Aug-92	-1.83	-4.77	-7.38	4.58	7.25	-1.82	-4.76	-7.37	4.59
9	Sep-92	0.75	0.65	-1.60	0.41	7.10	0.90	0.80	-1.45	0.56
10	Oct-92	-1.46	-5.36	3.48	7.22	7.41	-1.77	-5.67	3.17	6.91
11	Nov-92	2.95	7.18	6.27	-2.92	7.48	2.88	7.11	6.20	-2.99
12	Dec-92	2.56	4.86	6.29	2.10	7.26	2.78	5.08	6.51	2.32
13	Jan-93	-7.53	-6.22	-7.79	-7.29	7.25	-7.52	-6.21	-7.78	-7.28
14	Feb-93	2.46	-1.00	4.56	11.73	6.98	2.73	-0.73	4.83	12.00
15	Mar-93	3.45	-0.46	4.93	3.29	7.02	3.41	-0.50	4.89	3.25
16	Apr-93	-1.75	4.79	1.46	3.76	7.01	-1.74	4.80	1.47	3.77
17	May-93	-1.42	-4.95	-9.51	-1.41	7.01	-1.42	-4.95	-9.51	-1.41
18	Jun-93	2.41	1.21	2.09	-4.12	6.68	2.74	1.54	2.42	-3.79
19	Jul-93	-1.98	4.06	1.98	-1.41	6.56	-1.86	4.18	2.10	-1.29
20	Aug-93	0.89	11.00	4.56	4.81	6.23	1.22	11.33	4.89	5.14
21	Sep-93	1.08	-1.70	4.63	1.98	6.27	1.04	-1.74	4.59	1.94
22	Oct-93	2.72	0.07	-5.26	-14.57	6.23	2.76	0.11	-5.22	-14.53
23	Nov-93	-2.99	-4.17	-15.26	-10.35	6.51	-3.27	-4.45	-15.54	-10.63
24	Dec-93	-2.51	-1.95	-3.51	-5.52	6.54	-2.54	-1.98	-3.54	-5.55
25	Jan-94	1.72	1.08	-2.51	-1.88	6.37	1.89	1.25	-2.34	-1.71

OBS	MONTH	SPDELTA	TRANDELT	FINDELTA	INSDELTA	TBOND	SPLESS	TRANLESS	FINLESS	INSLESS
26	Feb-94	-1.92	-2.69	-4.53	-3.45	6.82	-2.37	-3.14	-4.98	-3.90
27	Mar-94	-3.73	-4.16	-6.70	-5.76	7.25	-4.16	-4.59	-7.13	-6.19
28	Apr-94	-2.09	-10.48	0.31	-2.14	7.45	-2.29	-10.68	0.11	-2.34
29	May-94	0.33	-0.53	6.14	4.01	7.59	0.19	-0.67	6.00	3.87
30	Jun-94	0.24	4.48	2.28	2.63	7.74	0.09	4.33	2.13	2.48
31	Jul-94	-0.59	-3.11	-7.77	-6.53	7.46	-0.31	-2.83	-7.49	-6.25
32	Aug-94	1.31	-6.01	-0.43	-4.26	7.61	1.16	-6.16	-0.58	-4.41
33	Sep-94	-0.55	-1.89	-3.57	-3.42	8.00	-0.94	-2.28	-3.96	-3.81
34	Oct-94	-1.70	-4.37	-2.71	2.10	8.09	-1.79	-4.46	-2.80	2.01
35	Nov-94	-0.39	-4.55	5.11	6.71	8.08	-0.38	-4.54	5.12	6.72
36	Dec-94	-1.90	-3.49	-3.23	2.76	7.99	-1.81	-3.40	-3.14	2.85
37	Jan-95	0.67	1.69	2.01	5.30	7.80	0.86	1.88	2.20	5.49
38	Feb-95	3.83	3.26	6.71	3.56	7.58	4.05	3.48	6.93	3.78
39	Mar-95	4.14	6.92	3.82	7.15	7.55	4.17	6.95	3.85	7.18
40	Apr-95	7.24	9.56	3.41	1.66	7.45	7.34	9.66	3.51	1.76
41	May-95	2.60	0.69	3.04	0.89	6.77	3.28	1.37	3.72	1.57
42	Jun-95	2.41	0.41	0.76	-0.08	6.70	2.48	0.48	0.83	-0.01
43	Jul-95	4.90	11.48	4.46	1.28	6.91	4.69	11.27	4.25	1.07
44	Aug-95	-3.04	3.25	0.42	3.34	6.74	-2.87	3.42	0.59	3.51
45	Sep-95	3.50	8.10	11.49	14.08	6.63	3.61	8.21	11.60	14.19
46	Oct-95	1.74	1.80	9.54	5.40	6.41	1.96	2.02	9.76	5.62
47	Nov-95	3.50	6.03	3.29	1.10	6.23	3.68	6.21	3.47	1.28
48	Dec-95	5.83	5.10	7.26	2.28	6.03	6.03	5.30	7.46	2.48
49	Jan-96	0.29	-9.36	-5.97	-4.77	6.09	0.23	-9.42	-6.03	-4.83
50	Feb-96	-2.70	2.56	1.97	0.93	6.59	-3.20	2.06	1.47	0.43

OBS	MONTH	SPDELTA	TRANDELT	FINDELTA	INSDELTA	TBOND	SPLESS	TRANLESS	FINLESS	INSLESS
51	Mar-96	-1.83	-0.53	-1.10	-5.40	6.84	-2.08	-0.78	-1.35	-5.65
52	Apr-96	-2.59	-4.94	-6.45	-5.92	7.06	-2.81	-5.16	-6.67	-6.14
53	May-96	-0.84	4.86	-6.04	-4.43	7.17	-0.95	4.75	-6.15	-4.54
54	Jun-96	-3.39	-4.70	-2.69	1.10	7.03	-3.25	-4.56	-2.55	1.24
55	Jul-96	-10.25	-16.49	-5.18	-1.28	7.07	-10.29	-16.53	-5.22	-1.32
56	Aug-96	2.65	-0.76	4.40	0.22	7.26	2.46	-0.95	4.21	0.03
57	Sep-96	2.18	-3.29	-6.97	-9.06	7.04	2.40	-3.07	-6.75	-8.84
58	Oct-96	1.62	5.29	4.11	4.83	6.71	1.95	5.62	4.44	5.16
59	Nov-96	6.63	1.45	9.84	7.21	6.43	6.91	1.73	10.12	7.49
60	Dec-96	-6.25	-0.44	-3.10	-4.03	6.73	-6.55	-0.74	-3.40	-4.33

Autoreg Procedure

Dependent Variable = TRANDELT

Ordinary Least Squares Estimates

SSE	1021.44	DFE	57
MSE	17.92	Root MSE	4.233203
SBC	343.8243	AIC	339.6692
Reg Rsq	0.4284	Total Rsq	0.4284
Durbin-Watson	1.8129		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.353767	0.5514	-0.642	0.5237
SPDELTA	1	0.965443	0.1477	6.535	0.0001

Autoreg Procedure

Estimates of Autocorrelations

```
Lag  Covariance  Correlation -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1

  0    17.31255     1.000000 |                    |********************|
  1    1.297563     0.074949 |                    |*                   |
  2    -1.57204    -0.090804 |                  **|                    |
  3    0.512604     0.029609 |                    |*                   |
  4    0.342647     0.019792 |                    |                    |
  5    -2.44261    -0.141089 |                 ***|                    |
  6    -0.97731    -0.056451 |                   *|                    |
  7    2.931823     0.169347 |                    |***                 |
  8    0.591834     0.034185 |                    |*                   |
  9    -1.96042    -0.113237 |                  **|                    |
 10    0.554553     0.032032 |                    |*                   |
 11    -2.75143    -0.158927 |                 ***|                    |
 12    -7.14021    -0.412430 |            ********|                    |
```

Backward Elimination of Autoregressive Terms

Lag	Estimate	t-Ratio	Prob
3	0.012948	0.0951	0.9247
10	-0.016744	-0.1255	0.9007

Autoreg Procedure

1	-0.016513	-0.1232	0.9025
8	-0.035676	-0.2781	0.7821
4	-0.037008	-0.2863	0.7758
2	0.063317	0.4961	0.6220
5	0.066751	0.5297	0.5986
9	0.102261	0.8287	0.4111
6	0.108670	0.8788	0.3835
7	-0.117515	-0.9554	0.3436
11	0.128739	1.0556	0.2958

Preliminary MSE = 14.36771

Estimates of the Autoregressive Parameters

Lag	Coefficient	Std Error	t Ratio
12	0.41242973	0.121736	3.388

Autoreg Procedure

Expected Autocorrelations

Lag	Autocorr
0	1.0000
1	0.0000
2	0.0000
3	0.0000
4	0.0000
5	0.0000
6	0.0000
7	0.0000
8	0.0000
9	0.0000
10	0.0000
11	0.0000
12	-0.4124

Autoreg Procedure

Maximum Likelihood Estimates

SSE	725.6372	DFE	56
MSE	12.95781	Root MSE	3.599695
SBC	332.0506	AIC	325.818
Reg Rsq	0.4287	Total Rsq	0.5939
Durbin-Watson	1.8399		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.263340	0.3276	-0.804	0.4248
SPDELTA	1	0.943375	0.1464	6.442	0.0001
A(12)	1	0.549948	0.1311	4.194	0.0001

Autoreg Procedure

Expected Autocorrelations

Lag	Autocorr
0	1.0000
1	0.0000
2	0.0000
3	0.0000
4	0.0000
5	0.0000
6	0.0000
7	0.0000
8	0.0000
9	0.0000
10	0.0000
11	0.0000
12	-0.5499

Autoregressive parameters assumed given.

Autoreg Procedure

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.263340	0.3273	-0.804	0.4245
SPDELTA	1	0.943375	0.1455	6.482	0.0001

Autoreg Procedure

Dependent Variable = FINDELTA

Ordinary Least Squares Estimates

SSE	1135.982	DFE	57
MSE	19.9295	Root MSE	4.464247
SBC	350.095	AIC	345.9399
Reg Rsq	0.5205	Total Rsq	0.5205
Durbin-Watson	1.6732		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.114468	0.5815	-0.197	0.8446
SPDELTA	1	1.225536	0.1558	7.867	0.0001

Autoreg Procedure

Estimates of Autocorrelations

```
Lag  Covariance  Correlation -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1

  0    19.25393     1.000000 |                    |********************|
  1    2.527615     0.131278 |                    |***                 |
  2    -2.88581    -0.149881 |                 ***|                    |
  3    -4.97663    -0.258474 |               *****|                    |
  4    -0.38882    -0.020195 |                    |                    |
  5    1.299383     0.067487 |                    |*                   |
  6    -1.09323    -0.056780 |                   *|                    |
  7    -3.69692    -0.192008 |                ****|                    |
  8    2.124256     0.110328 |                    |**                  |
  9     5.61408     0.291581 |                    |******              |
 10    1.139227     0.059169 |                    |*                   |
 11    -3.19231    -0.165800 |                 ***|                    |
 12    -6.69489    -0.347716 |             *******|                    |
```

Backward Elimination of Autoregressive Terms

Lag	Estimate	t-Ratio	Prob
5	0.002658	0.0182	0.9855
4	0.034836	0.2416	0.8102

Autoreg Procedure

11	0.043356	0.3107	0.7574
6	0.050599	0.3673	0.7150
2	0.063425	0.4830	0.6312
1	-0.083336	-0.6283	0.5327
10	0.071373	0.5426	0.5898
8	-0.117097	-0.9381	0.3525
7	0.150210	1.2187	0.2283
3	0.176145	1.3779	0.1739
9	-0.216146	-1.6941	0.0959

Preliminary MSE = 16.92601

Estimates of the Autoregressive Parameters

Lag	Coefficient	Std Error	t Ratio
12	0.34771568	0.125292	2.775

Autoreg Procedure

Expected Autocorrelations

Lag	Autocorr
0	1.0000
1	0.0000
2	0.0000
3	0.0000
4	0.0000
5	0.0000
6	0.0000
7	0.0000
8	0.0000
9	0.0000
10	0.0000
11	0.0000
12	-0.3477

Autoreg Procedure

Maximum Likelihood Estimates

SSE	917.1122	DFE	56
MSE	16.377	Root MSE	4.046851
SBC	344.1331	AIC	337.9005
Reg Rsq	0.5146	Total Rsq	0.6129
Durbin-Watson	1.8172		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.138624	0.3911	-0.354	0.7243
SPDELTA	1	1.231919	0.1602	7.691	0.0001
A(12)	1	0.440439	0.1365	3.228	0.0021

Autoreg Procedure

Expected Autocorrelations

Lag	Autocorr
0	1.0000
1	0.0000
2	0.0000
3	0.0000
4	0.0000
5	0.0000
6	0.0000
7	0.0000
8	0.0000
9	0.0000
10	0.0000
11	0.0000
12	-0.4404

Autoregressive parameters assumed given.

Autoreg Procedure

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.138624	0.3911	-0.354	0.7243
SPDELTA	1	1.231919	0.1599	7.705	0.0001

Autoreg Procedure

Dependent Variable = INSDELTA

Ordinary Least Squares Estimates

SSE	1702.163	DFE	57
MSE	29.86251	Root MSE	5.46466
SBC	373.9548	AIC	369.7997
Reg Rsq	0.2673	Total Rsq	0.2673
Durbin-Watson	1.4140		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.011903	0.7118	-0.017	0.9867
SPDELTA	1	0.869548	0.1907	4.560	0.0001

Autoreg Procedure

Estimates of Autocorrelations

Lag	Covariance	Correlation	-1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1
0	28.85022	1.000000	|********************|
1	7.069775	0.245051	|***** |
2	-0.31539	-0.010932	| |
3	-5.61688	-0.194691	****| |
4	-0.35933	-0.012455	| |
5	-0.48093	-0.016670	| |
6	-2.2917	-0.079434	**| |
7	-1.32916	-0.046071	*| |
8	-2.31034	-0.080080	**| |
9	7.646223	0.265032	|***** |
10	4.390246	0.152174	|*** |
11	-0.03046	-0.001056	| |
12	-12.073	-0.418471	********| |

Backward Elimination of Autoregressive Terms

Lag	Estimate	t-Ratio	Prob
11	-0.000843	-0.0058	0.9954
2	0.003455	0.0250	0.9802

Autoreg Procedure

10	-0.029212	-0.2180	0.8284
7	-0.037556	-0.2839	0.7777
4	-0.051695	-0.3943	0.6951
5	0.037990	0.3052	0.7615
6	0.080186	0.6561	0.5147
3	0.081796	0.6799	0.4996
8	0.133075	1.1173	0.2689
9	-0.212628	-1.7978	0.0778

Preliminary MSE = 22.07182

Estimates of the Autoregressive Parameters

Lag	Coefficient	Std Error	t Ratio
1	-0.24460942	0.117941	-2.074
12	0.41821243	0.117941	3.546

Autoreg Procedure

Expected Autocorrelations

Lag	Autocorr
0	1.0000
1	0.3016
2	0.0909
3	0.0274
4	0.0082
5	0.0024
6	0.0004
7	-0.0009
8	-0.0037
9	-0.0124
10	-0.0411
11	-0.1362
12	-0.4515

Autoreg Procedure

Maximum Likelihood Estimates

SSE	1113.869	DFE	55
MSE	20.25217	Root MSE	4.500241
SBC	361.4654	AIC	353.1553
Reg Rsq	0.2609	Total Rsq	0.5205
Durbin-Watson	1.8369		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.059823	0.4994	-0.120	0.9051
SPDELTA	1	0.817995	0.1884	4.341	0.0001
A(1)	1	-0.243360	0.0996	-2.443	0.0178
A(12)	1	0.524361	0.1111	4.719	0.0001

Autoreg Procedure

Expected Autocorrelations

Lag	Autocorr
0	1.0000
1	0.3478
2	0.1210
3	0.0420
4	0.0145
5	0.0047
6	0.0008
7	-0.0023
8	-0.0082
9	-0.0240
10	-0.0693
11	-0.1993
12	-0.5729

Autoregressive parameters assumed given.

Autoreg Procedure

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.059823	0.4993	-0.120	0.9051
SPDELTA	1	0.817995	0.1856	4.406	0.0001

Autoreg Procedure

Dependent Variable = TRANLESS

Ordinary Least Squares Estimates

SSE	1021.352	DFE	57
MSE	17.91845	Root MSE	4.233019
SBC	343.8192	AIC	339.6641
Reg Rsq	0.4403	Total Rsq	0.4403
Durbin-Watson	1.8120		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.353232	0.5513	-0.641	0.5243
SPLESS	1	0.964806	0.1441	6.697	0.0001

Autoreg Procedure

Estimates of Autocorrelations

Lag	Covariance	Correlation	-1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1
0	17.31105	1.000000	|********************|
1	1.306343	0.075463	|** |
2	-1.55755	-0.089974	**| |
3	0.510695	0.029501	|* |
4	0.354774	0.020494	| |
5	-2.42795	-0.140254	***| |
6	-0.97188	-0.056142	*| |
7	2.9237	0.168892	|*** |
8	0.581585	0.033596	|* |
9	-1.96404	-0.113456	**| |
10	0.53323	0.030803	|* |
11	-2.75316	-0.159041	***| |
12	-7.14125	-0.412526	********| |

Backward Elimination of Autoregressive Terms

Lag	Estimate	t-Ratio	Prob
3	0.013271	0.0975	0.9228
10	-0.016072	-0.1205	0.9046

Autoreg Procedure

1	-0.016921	-0.1263	0.9001
8	-0.035415	-0.2760	0.7837
4	-0.037630	-0.2912	0.7721
2	0.062968	0.4934	0.6239
5	0.065974	0.5236	0.6028
9	0.102489	0.8306	0.4100
6	0.108161	0.8747	0.3857
7	-0.117456	-0.9551	0.3438
11	0.128643	1.0548	0.2961

Preliminary MSE = 14.3651

Estimates of the Autoregressive Parameters

Lag	Coefficient	Std Error	t Ratio
12	0.41252562	0.121730	3.389

Autoreg Procedure

Expected Autocorrelations

Lag	Autocorr
0	1.0000
1	0.0000
2	0.0000
3	0.0000
4	0.0000
5	0.0000
6	0.0000
7	0.0000
8	0.0000
9	0.0000
10	0.0000
11	0.0000
12	-0.4125

Autoreg Procedure

Maximum Likelihood Estimates

SSE	725.7371	DFE	56
MSE	12.95959	Root MSE	3.599943
SBC	332.0529	AIC	325.8203
Reg Rsq	0.4392	Total Rsq	0.6023
Durbin-Watson	1.8394		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.262364	0.3278	-0.800	0.4269
SPLESS	1	0.944862	0.1436	6.579	0.0001
A(12)	1	0.549638	0.1311	4.191	0.0001

Autoreg Procedure

Expected Autocorrelations

Lag	Autocorr
0	1.0000
1	0.0000
2	0.0000
3	0.0000
4	0.0000
5	0.0000
6	0.0000
7	0.0000
8	0.0000
9	0.0000
10	0.0000
11	0.0000
12	-0.5496

Autoregressive parameters assumed given.

Autoreg Procedure

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.262364	0.3276	-0.801	0.4266
SPLESS	1	0.944862	0.1427	6.622	0.0001

Autoreg Procedure

Dependent Variable = FINLESS

Ordinary Least Squares Estimates

SSE	1134.517	DFE	57
MSE	19.90381	Root MSE	4.461369
SBC	350.0189	AIC	345.8638
Reg Rsq	0.5326	Total Rsq	0.5326
Durbin-Watson	1.6759		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.118590	0.5810	-0.204	0.8390
SPLESS	1	1.223795	0.1518	8.059	0.0001

Autoreg Procedure

Estimates of Autocorrelations

```
Lag  Covariance  Correlation -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1

  0    19.22911     1.000000 |                    |********************|
  1    2.490068     0.129495 |                    |***                 |
  2    -2.90085    -0.150857 |                 ***|                    |
  3    -4.99315    -0.259666 |               *****|                    |
  4    -0.42609    -0.022158 |                    |                    |
  5    1.350679     0.070241 |                    |*                   |
  6    -1.09392    -0.056889 |                   *|                    |
  7    -3.74041    -0.194518 |                ****|                    |
  8    2.137343     0.111151 |                    |**                  |
  9    5.592383     0.290829 |                    |******              |
 10    1.135066     0.059029 |                    |*                   |
 11    -3.17872    -0.165308 |                 ***|                    |
 12    -6.68269    -0.347530 |             *******|                    |
```

Backward Elimination of Autoregressive Terms

Lag	Estimate	t-Ratio	Prob
5	-0.000494	-0.0034	0.9973
4	0.039286	0.2720	0.7868

Autoreg Procedure

11	0.042573	0.3053	0.7615
6	0.052422	0.3804	0.7054
2	0.062936	0.4793	0.6338
1	-0.081802	-0.6169	0.5401
10	0.072779	0.5532	0.5825
8	-0.118730	-0.9520	0.3455
7	0.152575	1.2380	0.2212
3	0.177698	1.3903	0.1701
9	-0.215090	-1.6847	0.0977

Preliminary MSE = 16.90668

Estimates of the Autoregressive Parameters

Lag	Coefficient	Std Error	t Ratio
12	0.34752976	0.125301	2.774

Autoreg Procedure

Expected Autocorrelations

Lag	Autocorr
0	1.0000
1	0.0000
2	0.0000
3	0.0000
4	0.0000
5	0.0000
6	0.0000
7	0.0000
8	0.0000
9	0.0000
10	0.0000
11	0.0000
12	-0.3475

Autoreg Procedure

Maximum Likelihood Estimates

SSE	915.5132	DFE	56
MSE	16.34845	Root MSE	4.043322
SBC	344.0411	AIC	337.8085
Reg Rsq	0.5253	Total Rsq	0.6228
Durbin-Watson	1.8222		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.143541	0.3907	-0.367	0.7147
SPLESS	1	1.231852	0.1569	7.852	0.0001
A(12)	1	0.441273	0.1367	3.229	0.0021

Autoreg Procedure

Expected Autocorrelations

Lag	Autocorr
0	1.0000
1	0.0000
2	0.0000
3	0.0000
4	0.0000
5	0.0000
6	0.0000
7	0.0000
8	0.0000
9	0.0000
10	0.0000
11	0.0000
12	-0.4413

Autoregressive parameters assumed given.

Autoreg Procedure

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.143541	0.3907	-0.367	0.7147
SPLESS	1	1.231852	0.1565	7.871	0.0001

Autoreg Procedure

Dependent Variable = INSLESS

Ordinary Least Squares Estimates

SSE	1704.559	DFE	57
MSE	29.90454	Root MSE	5.468504
SBC	374.0377	AIC	369.8827
Reg Rsq	0.2836	Total Rsq	0.2836
Durbin-Watson	1.4160		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.008071	0.7122	-0.011	0.9910
SPLESS	1	0.884185	0.1861	4.750	0.0001

Autoreg Procedure

Estimates of Autocorrelations

```
Lag  Covariance  Correlation -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1

  0    28.89082     1.000000 |                    |********************|
  1    7.094701     0.245569 |                    |*****               |
  2     -0.3918    -0.013561 |                    |                    |
  3     -5.6199    -0.194522 |                ****|                    |
  4    -0.37704    -0.013050 |                    |                    |
  5    -0.51594    -0.017858 |                    |                    |
  6    -2.29855    -0.079560 |                  **|                    |
  7    -1.29213    -0.044725 |                   *|                    |
  8    -2.24161    -0.077589 |                  **|                    |
  9    7.638092     0.264378 |                    |*****               |
 10    4.459182     0.154346 |                    |***                 |
 11    -0.01721    -0.000596 |                    |                    |
 12    -12.0812    -0.418168 |            ********|                    |
```

Backward Elimination of Autoregressive Terms

Lag	Estimate	t-Ratio	Prob
11	-0.002579	-0.0178	0.9859
2	0.005772	0.0418	0.9669

Autoreg Procedure

10	-0.031212	-0.2329	0.8169
7	-0.038907	-0.2938	0.7702
4	-0.051981	-0.3962	0.6937
5	0.038141	0.3063	0.7607
6	0.080703	0.6600	0.5122
3	0.081294	0.6753	0.5025
8	0.130845	1.0977	0.2773
9	-0.211372	-1.7872	0.0795

Preliminary MSE = 22.10014

Estimates of the Autoregressive Parameters

Lag	Coefficient	Std Error	t Ratio
1	-0.24532030	0.117933	-2.080
12	0.41802186	0.117933	3.545

Autoreg Procedure

Expected Autocorrelations

Lag	Autocorr
0	1.0000
1	0.3024
2	0.0914
3	0.0276
4	0.0083
5	0.0024
6	0.0004
7	-0.0009
8	-0.0037
9	-0.0125
10	-0.0413
11	-0.1365
12	-0.4515

Autoreg Procedure

Maximum Likelihood Estimates

SSE	1115.478	DFE	55
MSE	20.28142	Root MSE	4.503489
SBC	361.5404	AIC	353.2303
Reg Rsq	0.2719	Total Rsq	0.5312
Durbin-Watson	1.8378		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.057389	0.5008	-0.115	0.9092
SPLESS	1	0.827457	0.1856	4.459	0.0001
A(1)	1	-0.244984	0.0997	-2.457	0.0172
A(12)	1	0.523485	0.1113	4.703	0.0001

Autoreg Procedure

Expected Autocorrelations

Lag	Autocorr
0	1.0000
1	0.3498
2	0.1224
3	0.0428
4	0.0149
5	0.0049
6	0.0008
7	-0.0024
8	-0.0084
9	-0.0244
10	-0.0700
11	-0.2003
12	-0.5726

Autoregressive parameters assumed given.

Autoreg Procedure

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.057389	0.5008	-0.115	0.9092
SPLESS	1	0.827457	0.1826	4.532	0.0001

APPENDIX E

SAS OUTPUT FOR UTILITIES (MONTHLY RETURNS)

OBS	MONTH	SPDELTA	DJDELTA	ELEDELTA	LDCDELTA	TBILL	SPLESS	DJLESS	ELELESS	LDCLESS
1	Jan-92	7.10	-6.97	-5.66	0.40	3.84	0.31	6.78	-7.29	-5.97
2	Feb-92	-0.85	-2.26	-1.99	-1.51	3.84	0.31	-1.16	-2.58	-2.31
3	Mar-92	-1.26	0.00	-1.05	-3.33	4.05	0.33	-1.59	-0.33	-1.38
4	Apr-92	0.01	2.65	3.01	5.29	3.81	0.31	-0.30	2.34	2.69
5	May-92	1.82	1.13	0.86	3.22	3.66	0.30	1.52	0.83	0.56
6	Jun-92	-1.58	-1.09	-1.37	6.48	3.70	0.30	-1.88	-1.39	-1.68
7	Jul-92	1.66	6.76	5.12	1.45	3.28	0.27	1.39	6.49	4.85
8	Aug-92	0.69	-2.83	-2.35	1.57	3.14	0.26	0.44	-3.09	-2.60
9	Sep-92	0.13	0.71	0.25	0.00	2.97	0.24	-0.11	0.47	0.01
10	Oct-92	-1.43	-0.20	-0.86	-3.34	3.10	0.25	-1.68	-0.45	-1.11
11	Nov-92	2.51	-0.65	0.31	-0.83	3.14	0.26	2.25	-0.91	0.05
12	Dec-92	3.03	1.06	2.08	2.16	3.25	0.27	2.76	0.79	1.82
13	Jan-93	-0.09	2.52	2.42	2.28	3.06	0.25	-0.35	2.27	2.17
14	Feb-93	1.49	5.99	5.87	5.64	2.95	0.24	1.24	5.75	5.63
15	Mar-93	1.92	0.55	-0.39	3.13	2.97	0.24	1.67	0.31	-0.64
16	Apr-93	-1.57	-0.88	-1.31	-3.31	2.89	0.24	-1.81	-1.12	-1.54
17	May-93	0.49	-0.42	-0.78	0.51	2.96	0.24	0.25	-0.66	-1.02
18	Jun-93	0.63	2.70	1.38	3.05	3.10	0.25	0.38	2.44	1.13
19	Jul-93	-0.17	2.13	2.52	3.73	3.05	0.25	-0.42	1.88	2.27
20	Aug-93	1.53	2.58	2.40	-0.47	3.05	0.25	1.28	2.33	2.15
21	Sep-93	1.13	-2.60	-1.88	-1.77	2.96	0.24	0.88	-2.84	-2.13
22	Oct-93	1.01	-3.61	-1.54	-0.21	3.04	0.25	0.76	-3.86	-1.79
23	Nov-93	-0.22	-6.40	-6.00	-4.36	3.12	0.26	-0.47	-6.66	-6.25
24	Dec-93	0.66	1.75	1.73	2.77	3.08	0.25	0.41	1.50	1.48
25	Jan-94	1.51	-1.43	-2.79	-0.08	3.02	0.25	1.26	-1.68	-3.04

OBS	MONTH	SPDELTA	DJDELTA	ELEDELTA	LDCDELTA	TBILL	SPLESS	DJLESS	ELELESS	LDCLESS
26	Feb-94	-0.30	-6.88	-6.59	-4.27	3.21	0.26	-0.56	-7.15	-6.86
27	Mar-94	-1.65	-6.73	-4.65	-1.28	3.52	0.29	-1.94	-7.02	-4.94
28	Apr-94	-3.57	1.58	0.39	-1.64	3.74	0.31	-3.88	1.27	0.09
29	May-94	0.82	-6.68	-6.82	-4.05	4.19	0.34	0.48	-7.02	-7.17
30	Jun-94	0.87	-4.78	-5.05	-2.59	4.18	0.34	0.53	-5.12	-5.39
31	Jul-94	-0.75	5.21	5.32	1.71	4.39	0.36	-1.11	4.85	4.96
32	Aug-94	2.84	1.48	0.76	-1.45	4.50	0.37	2.48	1.11	0.39
33	Sep-94	0.59	-4.08	-4.43	-1.84	4.64	0.38	0.21	-4.45	-4.81
34	Oct-94	-0.67	-0.03	-0.70	2.37	4.96	0.40	-1.08	-0.44	-1.10
35	Nov-94	-0.60	-1.02	0.35	-7.65	5.25	0.43	-1.03	-1.45	-0.08
36	Dec-94	-1.26	1.10	1.32	2.04	5.64	0.46	-1.72	0.64	0.86
37	Jan-95	2.21	6.39	7.45	1.92	5.81	0.47	1.74	5.92	6.97
38	Feb-95	3.58	0.41	-0.48	2.93	5.80	0.47	3.11	-0.06	-0.95
39	Mar-95	2.33	-3.23	-2.91	1.06	5.73	0.47	1.86	-3.69	-3.38
40	Apr-95	2.99	3.65	2.50	1.75	5.67	0.46	2.53	3.19	2.04
41	May-95	3.13	6.13	6.59	-2.85	5.70	0.46	2.67	5.67	6.13
42	Jun-95	2.97	-2.11	-0.99	3.19	5.50	0.45	2.52	-2.55	-1.44
43	Jul-95	3.34	0.95	0.46	-1.73	5.47	0.44	2.90	0.50	0.02
44	Aug-95	0.31	-0.80	-0.23	2.65	5.41	0.44	-0.13	-1.24	-0.67
45	Sep-95	3.52	5.90	5.77	2.48	5.26	0.43	3.09	5.47	5.34
46	Oct-95	0.72	0.12	0.36	1.41	5.30	0.43	0.29	-0.31	-0.07
47	Nov-95	2.16	0.58	-1.09	5.34	5.35	0.44	1.73	0.15	-1.52
48	Dec-95	3.20	4.45	4.69	2.85	5.16	0.42	2.78	4.03	4.27
49	Jan-96	2.43	2.42	2.10	0.47	5.02	0.41	2.02	2.01	1.69
50	Feb-96	1.51	-4.96	-4.32	-0.39	4.87	0.40	1.12	-5.36	-4.72

OBS	MONTH	SPDELTA	DJDELTA	ELEDELTA	LDCDELTA	TBILL	SPLESS	DJLESS	ELELESS	LDCLESS
51	Mar-96	0.92	-3.03	-3.72	-1.76	4.96	0.40	0.52	-3.43	-4.13
52	Apr-96	0.96	-1.25	-5.36	-1.39	4.99	0.41	0.55	-1.66	-5.76
53	May-96	2.45	0.83	4.56	0.78	5.02	0.41	2.04	0.42	4.15
54	Jun-96	0.23	3.99	0.90	4.58	5.11	0.42	-0.18	3.57	0.49
55	Jul-96	-5.21	-6.88	-7.90	-5.31	5.17	0.42	-5.63	-7.30	-8.32
56	Aug-96	2.65	4.49	2.51	8.58	5.09	0.41	2.23	4.08	2.09
57	Sep-96	5.46	1.18	0.55	-6.73	5.15	0.42	5.04	0.76	0.13
58	Oct-96	2.09	4.54	4.40	5.84	5.01	0.41	1.68	4.13	3.99
59	Nov-96	7.80	3.95	3.91	4.95	5.03	0.41	7.39	3.54	3.50
60	Dec-96	-1.89	-1.34	-1.59	-1.82	4.87	0.40	-2.29	-1.73	-1.99

Autoreg Procedure

Dependent Variable = ELEDELTA

Ordinary Least Squares Estimates

SSE	673.4502	DFE	58
MSE	11.61121	Root MSE	3.407523
SBC	323.5455	AIC	319.3568
Reg Rsq	0.1001	Total Rsq	0.1001
Durbin-Watson	1.8033		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.595357	0.4925	-1.209	0.2316
SPDELTA	1	0.508992	0.2003	2.541	0.0138

Autoreg Procedure

Estimates of Autocorrelations

```
Lag  Covariance  Correlation -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1

  0    11.22417     1.000000 |                    |********************|
  1    0.476125     0.042420 |                    |*                   |
  2    -2.39363    -0.213256 |                ****|                    |
  3    0.775582     0.069099 |                    |*                   |
  4    1.930592     0.172003 |                    |***                 |
  5    0.629957     0.056125 |                    |*                   |
  6    -0.83509    -0.074401 |                   *|                    |
  7    -0.41894    -0.037325 |                   *|                    |
  8    -0.64678    -0.057624 |                   *|                    |
  9    0.001668     0.000149 |                    |                    |
 10    -0.45756    -0.040766 |                   *|                    |
 11    -2.31859    -0.206571 |                ****|                    |
 12    -0.63046    -0.056170 |                   *|                    |
```

Backward Elimination of Autoregressive Terms

Lag	Estimate	t-Ratio	Prob
7	-0.004763	-0.0320	0.9746
6	0.023684	0.1610	0.8728

Autoreg Procedure

1	-0.024962	-0.1736	0.8629
12	0.039397	0.2822	0.7790
10	0.056102	0.4098	0.6837
9	0.061768	0.4521	0.6531
5	-0.074609	-0.5525	0.5830
3	-0.065316	-0.5023	0.6175
8	0.082016	0.6268	0.5334
4	-0.124665	-0.9530	0.3448
11	0.206539	1.6186	0.1112
2	0.213256	1.6480	0.1049

Autoreg Procedure

Dependent Variable = LDCDELTA

Ordinary Least Squares Estimates

SSE	610.0815	DFE	58
MSE	10.51865	Root MSE	3.243246
SBC	317.6162	AIC	313.4275
Reg Rsq	0.0707	Total Rsq	0.0707
Durbin-Watson	2.3846		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	0.100920	0.4688	0.215	0.8303
SPDELTA	1	0.400494	0.1907	2.100	0.0401

Autoreg Procedure

Estimates of Autocorrelations

```
Lag  Covariance  Correlation -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1

  0    10.16802     1.000000 |                    |********************|
  1    -2.02058    -0.198719 |                ****|                    |
  2    1.975567     0.194292 |                    |****                |
  3    -0.86728    -0.085295 |                  **|                    |
  4    -1.17153    -0.115217 |                  **|                    |
  5    -0.43377    -0.042660 |                   *|                    |
  6    1.308331     0.128671 |                    |***                 |
  7    -0.23651    -0.023260 |                    |                    |
  8    0.493782     0.048562 |                    |*                   |
  9    1.132526     0.111381 |                    |**                  |
 10    0.229809     0.022601 |                    |                    |
 11     -0.5255    -0.051682 |                   *|                    |
 12    0.368995     0.036290 |                    |*                   |
```

Backward Elimination of Autoregressive Terms

Lag	Estimate	t-Ratio	Prob
5	0.002447	0.0158	0.9874
7	0.019939	0.1359	0.8925

Autoreg Procedure

12	0.024737	0.1714	0.8646
3	0.051279	0.3716	0.7118
8	0.056819	0.3983	0.6921
11	0.082722	0.6170	0.5399
10	-0.117705	-0.8777	0.3842
9	-0.133040	-1.0402	0.3030
1	0.164023	1.2588	0.2135
6	-0.197777	-1.4963	0.1403
4	0.158968	1.2049	0.2333
2	-0.194292	-1.4954	0.1403

Autoreg Procedure

Dependent Variable = DJDELTA

Ordinary Least Squares Estimates

SSE	725.8918	DFE	58
MSE	12.51538	Root MSE	3.537708
SBC	328.0447	AIC	323.856
Reg Rsq	0.0751	Total Rsq	0.0751
Durbin-Watson	1.8135		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-0.386798	0.5113	-0.756	0.4524
SPDELTA	1	0.451498	0.2080	2.171	0.0341

Autoreg Procedure

Estimates of Autocorrelations

```
Lag  Covariance  Correlation -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1

  0     12.0982     1.000000 |                    |********************|
  1    0.329675     0.027250 |                    |*                   |
  2    -1.84377    -0.152400 |                 ***|                    |
  3    1.050045     0.086794 |                    |**                  |
  4    2.066305     0.170794 |                    |***                 |
  5    -0.44824    -0.037050 |                   *|                    |
  6     -0.3566    -0.029476 |                   *|                    |
  7     0.20708     0.017117 |                    |                    |
  8    -1.31971    -0.109083 |                  **|                    |
  9    -0.06962    -0.005754 |                    |                    |
 10    -0.57489    -0.047518 |                   *|                    |
 11     -1.0043    -0.083012 |                  **|                    |
 12    -0.77041    -0.063680 |                   *|                    |
```

Backward Elimination of Autoregressive Terms

Lag	Estimate	t-Ratio	Prob
6	-0.004286	-0.0287	0.9772

Autoreg Procedure

7	-0.004976	-0.0338	0.9732
9	-0.011265	-0.0781	0.9381
5	0.014022	0.0993	0.9213
1	-0.025105	-0.1815	0.8567
12	0.039645	0.2849	0.7769
11	0.063700	0.4745	0.6371
10	0.082555	0.6144	0.5416
3	-0.080544	-0.6133	0.5423
2	0.129880	0.9847	0.3291
8	0.142408	1.0767	0.2863
4	-0.170794	-1.3087	0.1959

Autoreg Procedure

Dependent Variable = ELELESS

Ordinary Least Squares Estimates

SSE	761.2843	DFE	58
MSE	13.12559	Root MSE	3.622926
SBC	330.9011	AIC	326.7124
Reg Rsq	0.0230	Total Rsq	0.0230
Durbin-Watson	1.8437		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-2.564534	2.0490	-1.252	0.2157
SPLESS	1	6.699043	5.7379	1.168	0.2478

Autoreg Procedure

Estimates of Autocorrelations

```
Lag  Covariance  Correlation -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1

 0    12.68807     1.000000 |                    |********************|
 1    0.577624     0.045525 |                    |*                   |
 2     -1.2924    -0.101860 |                  **|                    |
 3    1.174437     0.092562 |                    |**                  |
 4    1.838799     0.144923 |                    |***                 |
 5    0.705525     0.055605 |                    |*                   |
 6    -0.03374    -0.002659 |                    |                    |
 7     0.16645     0.013119 |                    |                    |
 8    -0.96334    -0.075925 |                  **|                    |
 9    -0.43878    -0.034582 |                   *|                    |
10    -1.11957    -0.088238 |                  **|                    |
11    -0.68434    -0.053935 |                   *|                    |
12    -1.16262    -0.091631 |                  **|                    |
```

Backward Elimination of Autoregressive Terms

Lag	Estimate	t-Ratio	Prob
1	-0.020327	-0.1383	0.8906
7	-0.025055	-0.1705	0.8654

Autoreg Procedure

6	-0.028961	-0.1999	0.8424
11	0.036948	0.2646	0.7925
9	0.035786	0.2583	0.7972
12	0.086167	0.6229	0.5361
5	-0.088056	-0.6447	0.5220
3	-0.098198	-0.7341	0.4661
2	0.094851	0.7090	0.4814
10	0.098941	0.7451	0.4594
8	0.099007	0.7446	0.4597
4	-0.144923	-1.1058	0.2734

Autoreg Procedure

Dependent Variable = LDCLESS

Ordinary Least Squares Estimates

SSE	731.015	DFE	58
MSE	12.60371	Root MSE	3.55017
SBC	328.4667	AIC	324.278
Reg Rsq	0.0168	Total Rsq	0.0168
Durbin-Watson	1.7958		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-2.325015	2.0078	-1.158	0.2516
SPLESS	1	5.592565	5.6226	0.995	0.3240

Autoreg Procedure

Estimates of Autocorrelations

```
Lag  Covariance  Correlation -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1

  0    12.18358     1.000000 |                    |********************|
  1    0.972433     0.079815 |                    |**                  |
  2    -2.08114    -0.170815 |                 ***|                    |
  3    1.245684     0.102243 |                    |**                  |
  4     1.77318     0.145538 |                    |***                 |
  5      1.5938     0.130815 |                    |***                 |
  6     -0.3665    -0.030081 |                   *|                    |
  7    -0.94356    -0.077445 |                  **|                    |
  8    -0.15103    -0.012396 |                    |                    |
  9    -0.72754    -0.059715 |                   *|                    |
 10    -0.94249    -0.077358 |                  **|                    |
 11    -1.91148    -0.156890 |                 ***|                    |
 12    -1.04005    -0.085365 |                  **|                    |
```

Backward Elimination of Autoregressive Terms

Lag	Estimate	t-Ratio	Prob
6	-0.019972	-0.1317	0.8958
7	0.029354	0.1965	0.8451

Autoreg Procedure

8	0.045670	0.3191	0.7511
12	0.056442	0.4038	0.6881
10	0.062359	0.4636	0.6450
1	-0.073471	-0.5414	0.5906
4	-0.089215	-0.6635	0.5099
9	0.132251	0.9927	0.3253
3	-0.146424	-1.1112	0.2714
5	-0.145869	-1.1205	0.2674
11	0.167688	1.2901	0.2023
2	0.170815	1.3089	0.1958

Autoreg Procedure

Dependent Variable = DJLESS

Ordinary Least Squares Estimates

SSE	269.3762	DFE	58
MSE	4.644417	Root MSE	2.155091
SBC	268.5672	AIC	264.3785
Reg Rsq	0.0514	Total Rsq	0.0514
Durbin-Watson	1.8174		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	-1.346240	1.2188	-1.105	0.2739
SPLESS	1	6.051504	3.4132	1.773	0.0815

Autoreg Procedure

Estimates of Autocorrelations

```
Lag  Covariance  Correlation -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1

  0    4.489603     1.000000 |                    |********************|
  1    -0.00991    -0.002208 |                    |                    |
  2    -0.34346    -0.076502 |                  **|                    |
  3    0.022371     0.004983 |                    |                    |
  4    -0.64994    -0.144766 |                 ***|                    |
  5    -0.15034    -0.033487 |                   *|                    |
  6     0.12052     0.026844 |                    |*                   |
  7    -0.04451    -0.009914 |                    |                    |
  8    0.253302     0.056420 |                    |*                   |
  9     -0.2043    -0.045505 |                   *|                    |
 10    0.161277     0.035922 |                    |*                   |
 11    0.248852     0.055429 |                    |*                   |
 12    -0.53589    -0.119362 |                  **|                    |
```

Backward Elimination of Autoregressive Terms

Lag	Estimate	t-Ratio	Prob
1	-0.001771	-0.0121	0.9904

Autoreg Procedure

3	0.005955	0.0411	0.9674
6	-0.016112	-0.1111	0.9120
7	0.016711	0.1176	0.9069
8	-0.025828	-0.1828	0.8557
10	-0.035145	-0.2557	0.7992
5	0.043465	0.3176	0.7521
11	-0.046398	-0.3442	0.7320
9	0.050721	0.3807	0.7049
2	0.083714	0.6314	0.5304
12	0.111549	0.8477	0.4002
4	0.144766	1.1046	0.2740

IMAGE EVALUATION TEST TARGET (QA-3)

150mm

6″

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