APPLICATION OF COST OF EQUITY MODELS TO PROPERTY-CASUALTY INSURANCE FIRMS: AN EMPIRICAL ANALYSIS

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Scope and Method of Study: This study employs correlation analysis to determine if similarities exist between four cost of equity models. The four models used are 1) the capital asset pricing model, 2) the discounted cash flow model, 3) the equity versus debt spread model, and 4) the earnings/price ratio. Equity estimates are obtained for 20 property-casualty insurance firms utilizing each model. The sample consists of insurance companies that wrote less than 25% of total premiums in life insurance during any of the years 1977-1980, or were designated as "Fire, Marine and Casualty Insurance Firms" by the Value Line Million Dollar Directory. Data for the models are historical stock prices between December, 1975 and December, 1980 obtained from Standard and Poor's Daily Stock Price quote books, and dividend and earnings per share data listed in Moody's Dividend Record and the Standard and Poor's Stock Guide.

Findings and Conclusions: Upon calculating equity estimates for each firm utilizing each model, it was found that few firms displayed a range of equity costs narrow enough to permit insurance regulatory authorities to make a decision regarding the "correct" equity cost for use in insurance rate-setting. Correlation analysis revealed that of the six possible combinations of correlations between the models, four were not statistically significant, leading to the conclusion that the models are not estimating the same cost of equity.

APPLICATION OF COST OF EQUITY MODELS

TO PROPERTY-CASUALTY INSURANCE FIRMS:

AN EMPIRICAL ANALYSIS

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CHAPTER I

INTRODUCTION

Considering the volume of research directed toward regulated industries, it is surprising that there has been very little inquiry into the field of insurance rate regulation in general, and rate regulation of property-casualty insurance firms in particular. This branch of the insurance industry, with 1971 premiums totalling $35 billion and assets of $68 billion, deserves more than just the passing attention relegated it by leading financial texts [12].

Numerous problems have arisen in the process of regulating the rates insurance companies may charge their customers. One of the biggest difficulties is the measurement of the cost of equity for a particular firm. An insurance company must be able to charge rates that will allow it to receive a return commensurate with other firms in the same risk class and at the same time, one that is sufficient to allow the company to attract equity capital. It is the method utilized in determining an appropriate rate of return that is the main controversy in insurance rate-making. The central problem to be explored by the present research is:

> What is the appropriate method of computing the "fair" rate of return for a regulated property-casualty company?

There are an abundance of cost of equity models available for use. Ideally, each model should produce the same cost of equity measurement. In practice, this seems to be far from true. Linke and Zumwalt approach the problem directly: "Regulatory proceedings reveal the . . . models coexist more as rival rather than complementary approaches to estimating equity costs" [15]. The profusion of regulatory battles also confirms the fact that regulated industries and regulatory bodies are not arriving at the same answer when estimating the cost of equity capital. When Martin, Scott, and Petty calculated the cost of equity capital for 51 firms using six different methods, only 9 models were found that produced significantly correlated costs of equity [17]. Linke and Zumwalt [15] also encountered difficulties in reconciling various methods of computing the return expected by investors. It appears that various methods of the computation of the cost of capital are not revealing statistically comparable answers. The hypothesis to be empirically tested is:

> Different methods of computing the cost of equity capital are expected to yield significantly different estimates of the fair rate of return for property-casualty companies.

The purpose of the present study is to test four equity models for similarities of results. The four models employed are 1) the capital asset pricing model, 2) the discounted cash flow method, 3) the equity versus debt spread model, and 4) the earnings/price ratio. Because the common underlying goal of each of the methods is to quantify investors' expectations with regard to a firm's returns, each of the methods would be expected to result in statistically equal costs of equity. If this is the case, the ideal situation is at hand. All of the measures employed produce the same cost of equity, and insurance firms and regulatory agencies alike may utilize any method for the purpose of determining the appropriate rate of return.

Should each model yield statistically different costs of equity, an unfortunate situation exists. One solution to the problem would be to hopefully arrive at a fairly narrow range of costs and employ a cost within this range, or to use an average of the costs. Even in this case there is ample room for rate-making disputes between insurance firms and regulatory agencies.

Chapter II of this study reviews the history of rate regulation, various methods of regulation, and the concept of a "fair" rate of return. The characteristics that give rise to regulation in the insurance industry are compared to similar characteristics of utility companies. Considerable research has been conducted in the area of utility regulation, therefore much of the present investigation is based on literature examining utility regulation. The concepts set forth and conclusions reached, however, are believed to be applicable to the insurance industry. Chapter III discusses several approaches to estimating the cost of equity capital for regulated industries and examines the process by which these approaches evolved for both utilities and insurance firms. Chapter IV details the methodology of the study. This section utilizes the approaches discussed in Chapter III to compute the cost of equity capital for a sample of 20 property-casualty firms. Correlation analysis was employed to determine if the methods are yielding statistically similar costs of equity. If the different methods of computing the cost of equity yield similar results, there should be little argument between regulated industries and their regulatory agencies as to the allowable rates to be charged consumers. This is not expected to be the case. Varying computational methods are expected to give rise to statistically different costs of equity. Chapter V summarizes the results of the study and examines the implications of these results for insurance rate-making.

CHAPTER II

THE REGULATION OF PROPERTY-CASUALTY INSURANCE COMPANIES

History of Regulation

Insurance rate regulation has its origins in the early 1800's beginning with local regulatory boards, e.g. the New York Board established in 1819. Until the latter part of the century, the insurance industry was virtually exempt from all anti-trust laws and was dominated by the local rate-fixing cartels [12].

In a national effort to control agents' commissions and to maintain uniform premium rates, the National Board of Fire Underwriters was organized in 1866. The Board's main purpose was to act as a cartel to fix rates and to see that the industry did not succumb to the ill effects of competition--namely the instability arising from the administering of rates that were too low. Membership in the Board was voluntary, and as a consequence, there was difficulty in enforcing its rules. The Board disbanded in 1877 and was replaced by local and state rating bureaus.

One of the first state laws passed regarding industry regulation was in New York in 1911. This act, based extensively upon the findings of the Merritt Committee, a joint legislative committee, permitted "action in concert in the fixing of fire insurance rates, but required rating associations or bureaus to file such rates with the Superintendant of Insurance" [12].

Prior to 1944, the statutes arising from the findings of the Merritt Committee and the relative exemption of insurance firms from anti-trust laws continued. In the 1944 case of the United States vs. South-Eastern Underwriters Association, the court declared the insurance industry a commerce industry/12/. Under this designation, rate fixing by insurance firms would be in direct violation of the Sherman-Antitrust Act.

Immediately industry spokesman started predicting general chaos and the demise of the industry. Under tremendous pressure from the industry, the McCarran-Ferguson Act was signed by President Roosevelt in March, 1945. The McCarran-Ferguson Act declared insurance regulation to be in the public's best interest and that anti-trust acts were to be used against the industry only to the extent that the states did not regulate the business. The role of the federal government in the realm of insurance regulation had finally been established.

Upon delegation of the responsibility for regulation to the states, the National Association of Insurance Commissioners (NAIC) drafted two model bills aimed at establishing state regulation of the insurance industry. Eventually, 44 states adopted some form of these "All-Industry" model bills. These laws, known as prior-approval laws, were to remain the primary form of property-liability insurance regulation until 1970.

Types of Regulation

Prior approval laws require regulators to determine whether the rates fixed by insurers contain a "reasonable" profit loading. Under these laws, rates are usually set with a standard formula published by the NAIC. The general formula "sets rates to cover losses, expenses and a profit factor . . . based on aggregate experience for the industry as a whole in a particular state" /12/. The formula may be stated as:

$$p = \frac{PN - L - E}{PN} \qquad (1)$$

where
p = profit rate,
P = premium per policy,
N = number of policies,
L = losses associated with writing a certain dollar volume of premiums, PN, and
E = expenses associated with writing those policies.

The rate recommended by the NAIC in 1921 (and a rate still very much adhered to) was 5% return on premiums. If this 5% loading is employed as a rate guideline, the premium to be set per policy is

$$P = \frac{L + E}{N(1 - .05)} \quad . \qquad (2)$$

It was mentioned earlier that rates are set so as to avoid extensive price competition. According to Joskow, rate-setting has produced the indended effect [12]. If a firm does not wish to set rates through a bureau, it may file deviated rates for one or more classes of insurance. Even though firms are not required to use bureau-set rates, in New York as late as 1969 only 47% of the top 30 property-casualty insurance companies were charging off-bureau rates for automobile physical damage insurance. This figure drops to 25% for homeowners' insurance for the top 30 firms [12].

One could argue that the bureaus were setting competitive rates. However, this does not appear to be the case. When New York established an experimental open competition pricing law, the percentage of off-bureau rates set rose substantially. Eighty-five percent of the top 30 firms were charging off-bureau rates for automobile physical damage insurance in 1972 [12].

In summary, it appears that the prior approval system of insurance rate setting has had the intended effect. Price competition was held to a minimum in almost all property-casualty lines of insurance.

Open competitions laws are aimed at providing just that: open competition among insurance companies. These laws which began gaining acceptance about 1970 do not require prior rate approvals, or even filing of proposed rates. They also prohibit pricing through rating bureaus.

California has been operating under an open competition or "no-filing" system since 1947 [12]. There has been neither the chaos in the marketplace or bankruptcies predicted. The primary advantage under this system is that insurance firms have found they can adjust much more quickly to loss conditions by not having to apply to regulatory commissions and move through all the necessary regulatory hearings. As was the case in New York under the experimental open competition period, California has a much higher percentage of rates set off-bureau than at the suggested bureau rates[1] [12].

Excess profits statutes are perhaps the most recent form of rate regulation to affect the insurance industry. Mainly applicable to automobile insurance, this method of regulation provides a means by which firms return to the insured profits in excess of some specified target. These statutes were enacted primarily as a result of the 1974 law establishing the 55 mile per hour speed limit [24]. Reduced speed limits lowered property losses, thereby causing profits in this class of insurance to rise substantially.

As of 1978, six states had either a "windfall profits" or "excess profits" statutes [24]. Insurance firms in Georgia and South Carolina are required to return profits to policyholders that were made unexpectedly as a result of energy regulation (windfall profits). Florida, Hawaii,

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[1] Rate bureaus in California function only in an advisory capacity.

Minnesota, and New York have instituted excess profits statutes. These laws require the companies to return any profits in excess of a set figure, regardless of the circumstances from which they arose.

The Fair Rate of Return for Regulation

Since regulation of insurance rates began, there has been an ongoing controversy as to what constitutes a "reasonable" return. This is the central concept around which the entire process of the determination of rates to charge consumers revolves.

"Just and reasonable" rates of return have been variously defined as rates that are "not too high on the average; i.e., they do not produce excess profits for insurers. Adequate rates protects (sic) insurers against involvency" /24/, "rates that . . . would exist if utilities operated in a competitive market if the industry were not regulated" /15/; and a rate "that would produce a reasonable rate of return on the insurer's equity defined as its capital surplus, and equity in the unearned premium reserve" /24/. The term "insurance companies" could easily be substituted for "utilities" in the second definition. Regardless of the academic definitions given, the Supreme Court set legal precedent by defining an appropriate rate or return in the Hope decision:

> "The return to the equity owner should be commensurate with returns on investment 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 to attract capital." /6/

Although there has been much disagreement in financial circles as to what constitutes a "reasonable" return, in insurance circles, the profit loading of 5% established by the NAIC has generally been used as the definition of a reasonable return for the past 60 years. This loading has never been justified in any logical way and as Joskow states "appears to have been picked out of thin air" [12]. The issue of the five percent loading has gone unresolved to this day, although it has been discussed frequently through the years in NAIC meetings. Several states have taken steps in defining "just and reasonable" returns, which is essentially the first step in determining the percentage figure of a reasonable return.

One step to be taken in defining a reasonable return is determining what factors should be taken into consideration when computing income for an insurance firm. Questions have been raised as to whether investment profits should be included in the profit formulas. This is in addition to the source that one would normally imagine an insurance firm to derive its profits from: underwriting.[2]

It appears, upon casual observation, that some states are beginning to recognize the role of investment income in setting insurance rates. The Board of Insurance in Texas became the first department to set a profit figure using a target rate of return that included all sources of income: underwriting, rents, capital gains, dividends and interest. Virginia took steps in the late 1960's to establish a sound definition of a reasonable return. By 1969, the state was recognizing investment income as well as capital gains and other sources of income in setting profit loadings. According to Hill [11], by 1979, 21 states were recognizing investment income when setting fair rates of return for insurance firms.

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[2]There has been debate as to whether underwriting profits are negative or positive. Under normal conditions, a firm attracts capital at a positive cost. When borrowing money, more funds flow out of the firm in the form of debt repayment plus principal than flow into the firm. In the case of insurance companies, insureds are paying in premiums to insurance companies and receiving no interest payments for the lending of the funds thereby loaning money to insurance companies at a negative cost. Foster [7], Biger and Kahane [3], and Quirin and Waters [19] offer a detailed examination of the phenomenon of positive underwriting profits.

After an overview of the various means of regulation (especially laws that "permit" open competition) one might well ask why insurance companies are regulated at all. In the next two sections, characteristics of the property-casualty industry will be contrasted to those of another heavily regulated industry: the utility industry. Even though the conclusion is reached that property-casualty firms are operating in an essentially competitive environment, this does not negate the fact that these firms are regulated. Therefore, the reasons for regulation will also be discussed.

A Comparison of the Regulation of Insurance Companies and Public Utilities

In 1971, there were 1,206 property-casualty insurance firms operating in the United States [12]. These firms offered a wide variety of insurance including fire, automobile liability and physical damage, hoemowners', workmen's compensation, and other miscellaneous classes of coverage. Joskow [12] presents an extensive review of the characteristics of the property-liability insurance industry. Insight into these characteristics is crucial to comprehension of why the industry is regulâted and also to the understanding of the process of determination of insurance rates.

At first glance, the property-casualty insurance industry seems an unlikely cnadidate for any type of regulation. In contrast to utilities or other heavily regulated industries, the property-casualty industry does not embody the characteristics that give impetus to regulation. Three measures for determining if there is monopoly potential within an industry are the number of firms in the industry, the concentration of business among these firms and the relative ease or difficulty of entry into the business.

Though there are approximately 1,200 firms selling insurance in the United States, this does not necessarily imply the existence of competitive market conditions. If only a few firms control the major portion of the business, a potential monopoly position can exist. Joskow [12] compared the share of total property-casualty premiums written by the largest firm and the four, eight, and twenty largest firms to sales figures of other industries operating in the United States. The measure of concentration utilized, premiums written, was chosen so as to facilitate the comparison of insurance firms' concentration ratios and "sales" data with the sales and concentration figures of these industries.

Concentration levels for the top eight firms in the property-liability business in 1962 stood at 29% of total premiums written. The levels may be compared with concentration levels of 30% to 100% for the top eight firms of ten representative manufacturing industries at the same point in time. By 1971, the concentration levels of the top eight firms had only risen to 32.8% [12]. At this relatively small growth rate, it would take 34 years for these eight firms to claim even a 50% concentration ratio. It can be stated with some degree of confidence, that these is a low level of concentration within this section of the insurance industry.

Given the large number of firms in the industry and relatively low concentration levels, it seems unlikely that any method of price fixing could develop so as to deter new firms from entering the industry. This appears to be the case. The demand for property-liability insurance has risen rapidly in the past 15-20 years and along with it, the number of property-casualty insurance firms. The lowest growth rate observed in the past 20 years was the entry of 14 firms in 1966. The highest entry rate was seen in 1961 when 51 firms entered [12]. Primary contributing factors to these growth rates are the comparatively low entry barriers that exist. Entry barriers include economies of scale, artificial contraints and capital requirements.

To test for economies of scale, Joskow [12] examined the expense levels of 121 property-casualty firms. Expense ratios were regarded as a function of the firm's size and variables measuring marketing characteristics. The presence of economies of scale would be suggested by a negative relationship between firm size and the expense ratio. The correlation coefficients between the two variables for three different lines of insurance (fire, mutual automobile, and stock automobile firms) was never greater than .09 [12]. Although the sample size of each group was fairly low (range 25-37), this is a preliminary indication that there is little cost advantage to be gained by a larger firm.

Artificial constraints such as unavailability of state licensing, or inassessability of rating bureaus are becoming less frequent. Today these institutions pose little if any constraint on entry.

The final constraint, capital requirements, appears to afford little difficulty to entry also. Some states have requirements of paid-in capital as low as $250,000 for entering firms, dependent upon the line of insurance to be written.

In summary, the property-liability insurance industry appears to be operating under the conditions of a competitive market. There are a large number of firms, low concentration within the industry, and entry into the industry may be achieved with relative ease. These characteristics can be directly contrasted with those of another heavily regulated industry: the utility industry.

Utilities have been appropriately termed by Hill and Lowry as "natural monopolies" [11,16]. Simply by the nature of a utility's business, only a few firms can exist. Cities would be very confusing to live in if there were two or three telephone or power companies. A 1921 Report of the House Subcommittee commented on the duplication of "telecommunications facilities":

> "In many cities in the United States, and in rural communities as well, there are dual and competing telephone systems, doing both local and long-distnace business . . . In order to reach all the people using telephones, the telephone patron finds that he must install two telephones in his house and office. This entails additional expense and usually results in inferior service over both systems" [16]

The technical limitations resulting from the existence of a number of public utilities such as the proliferation of conduits, mains, or wires would suggest the existence of relatively few public utilities. This is indeed the case. There is essentially only one telephone company operating within the United States. A few local companies do exist, but not without the problems of trying to provide the same all-encompassing service that the larger company offers. The same situation exists for utilities such as gas and electricity. It is rare to find more than one of these utilities operating in any given city.

The entry barriers that exist for utilities were thoroughly examined by Lowry [16]. Lowry quoted a 1937 text book by Richard T. Ely in which Ely distinguishes between three classes of natural monopolies, one of which arises from "peculiar properties" inherent in the business. Ely emphasized the incompatability of these industries with competition: "Natural monopolies are . . . rooted in conditions that make competition self destructive" [16]. One of these conditions is that "The business must be one of such a nature as to make the creation of a large number of competitive plants impossible . . . The business is one in which special advantages attach to large scale production . . ." [16]. Ely went on to argue that when a competitor entered a monopolized market, a price war was followed by either the merger of the competitor and the original firm or a price fixing agreement.

One other entry barrier in the utility industry is capital requirements. The outlay for new property, plant and equipment for a power plant is so large that very few infant firms can raise the funds. Entry barriers are high in this area, with most utility companies having been in existence for lengthy periods of time.

Clemens summarized the forces that worked toward making certain industries monopolies: "conditions of space and geography, large capital investments, economies of decreasing costs, technical limitations of the marketplace" [16]. Clemens concluded that the public would benefit from the regulation of these industries.

One last difference between property-casualty firms and utilities is the relative magnitude of rates set. It will be seen that insurance rates are set in an effort to prevent the companies from setting rates that are too low. Utilities, on the other hand, are regulated so as rates will not be set too high and customers taken advantage of. Adams wrote that "society should be guaranteed against the oppression of exclusive privileges administered for personal profit" [16].

In conclusion, it appears that although both the insurance and utility industries are regulated, they exhibit practically opposite characteristics with regard to competitive levels, number of firms, and certain entry barriers. Since it has been concluded that insurance firms operate in an essentially competitive environment, there must be reasons why they are regulated.

Reasons for Regulation

When the National Board of Fire Underwriters was established in 1866 for the purpose of fixing insurance rates, the main responsibility of the board was to monitor the industry so that it did not fall victim to rates that were set too low. Historically, this is the reason for not allowing insurance firms to operate in the naturally competitive environment in which they exist. It was believed that too high a level of competition would lead to instability of pricing. To much competition, and the resultant price undercutting by firms to gain advantage over one another could theoretically lead to a higher rate of default on policies. True to this belief, past regulation has been intent on setting minimum prices with firms only being allowed to deviate from the minimum through formal rate filing. [11].

Another justification for regulation given by insurers, related to the reason cited above, is for protection against the growing power of insurance agents [13]. Independent agents sell several different brands of insurance. One advantage an agent has is being able to "package" different types of policies from different firms to custom tailor the insurance policies to the needs of the consumer. As the American Agency System grew, insurers resorted to what Kouatly refers to as "reverse competition" [13]. Instead of competing for customers, insurance companies began to compete for agents. Since the agents held the power to set rates and to transfer business between companies, it was important to the insurer to attract the agent. In their efforts to attract agents, many companies resorted to a policy of predatory pricing, culminating in rate wars which endangered the solvency of numerous insurers" [13]. To control the agents, insurers entered into agreements to fix rate and commission levels. These "compacts" as they were called were not entirely successful because of some firms' unwillingness to participate and also to the enactment of certain "anti-compact" laws in several states.

A third argument set forth in defense of insurance regulation is that it corrects certain flaws in the marketplace. When other regulated industries such as utilities are considered, this is a fair argument. Linke and Zumwalt assert that "utility regulation attempts to achieve the allocative efficiency that would exist if utilities operated in a competitive market by fostering the same marginal conditions that exist under a competitive environment" /15/. This makes sense for "natural" monopolies like utilities, but the insurance industry exhibits very few characteristics of a monopoly.

In recent years changes in insurance laws have been proposed by several parties. In 1973, Joskow /12/ offered these general recommendations for the property-liability insurance industry:

1) Rate making bureaus should become strictly service agencies. The main responsibility of the bureaus would be to collect and process data for their customers,

2) State insurance departments should take on the role of providing consumer information and protection, and

3) Prior approval rate regulation should be abolished. Insurance companies should be required to file rate schedules - but only as a matter of providing information to the public.

In addition, at its annual meeting in the summer of 1980 the NAIC suggested that prior approval laws be abolished for most lines of property-casualty insurance. For lines in which it was determined there was inadequate competition, prior filing would be required /1/.

Now that the history of insurance rate regulation has been explored, as well as the reasons behind regulation and the concept of a "reasonable" return, the computation of that return will be examined. In the next chapter, four methods of computing the cost of equity are explored. Problems associated with the implementation of each method as well as previous research undertaken to test each method is considered. These methods will then be evaluated relative to their application to both utility and insurance rate regulation.

CHAPTER III

THE COST OF EQUITY CAPITAL AND RATE REGULATION

Four methods for the estimation of the cost of equity capital are considered: 1) the capital asset pricing model, 2) the discounted cash flow method, 3) the equity versus debt spread method, and 4) the earnings/price ratio.

Capital Asset Pricing Model

The capital asset pricing model (CAPM) can be expressed as follows:

$$k_e = \bar{R}_f + \beta(\bar{R}_m - \bar{R}_f). \qquad (3)$$

Originally attributed to Sharpe [20], the CAPM appears relatively straight-forward to calculate. Only three parameters need be estimated: the risk-free rate of interest - $\bar{R}_f$, a measure of the firm's systematic risk - β, and the expected return on the market - $\bar{R}_m$. However, difficult problems are encountered in the estimation of all the model parameters. When estimating the cost of equity capital with the CAPM, one is using an ex post computation of an ex ante model. All three parameters are estimated utilizing historical data in an effort to render an accurate picture of future expectations. The estimation of the CAPM assumes that the behavior of the future returns on the market, the risk-free rate, and the firm's beta are reflected by past returns.

Other more specific problems arise when estimating each individual parameter. The stability of beta, the measure of a firm's risk relative to the risk of the market, has been extensively investigated. Blume computed beta coefficients for six non-overlapping 7-year periods for a large sample of firms. The average correlation between the beta coefficients in contiguous periods was approximately .62 [9]. Blume concluded that beta coefficients are not stable over time.

Cooper [9] computed beta coefficients for all the firms traded on the New York Stock Exchange. Beginning in 1931, 60 months of price data was collected and beta coefficients computed. In the next phase, the first 12 months of data was dropped and a new year of data added. The beta was then recalculated. Finally, all of the beta estimates were divided into risk classes and the probability that a firm would change its risk class after one and five years was computed. Reinforcing the contention of unstable betas, 62% of the firms in the sample changed risk classes after one year. This percentage increased to 79% after a five year period.

Pettway [18], found results slightly to the contrary. Test periods of six years, each divided into eight separate intervals were used to develop beta estimates for 36 electric utility companies. These estimates were then compared to the observed beta coefficients in the next time period. This technique enabled the investigator to directly observe the validity of estimated date in relation to the actual data. Pettway did find periods in which the betas of some firms were stable enough to furnish a good estimate of the utility's subsequent beta values. There were also periods of instability, often exceeding one year. Pettway observed that these unstable periods, though long, were transitory, and that the observed betas eventually returned to their former levels [18]. Upon reviewing the evidence, the general conclusion is that a firm's beta coefficient is not stable over time.

Not only is the coefficient presumed to be unstable by many, Brigham and Crum [2] feel that betas estimated with historical data will give biased estimates of the true betas. This phenomenon is observed whenever a firm experiences a change in its systematic risk position and its expected earnings do not rise (fall) to offset the increase (decrease) in associated risk. Brigham and Crum assert that "Unless there is an immediate offsetting increase in the *expected* rate of return on the company's *assets*, the increase in risk will cause a drop in the price of the stock. This stock price decline will lower the most recent holding period return used to calculate the beta. This in turn can result in a biased estimate of the true beta, β" [2].

The estimation of $\bar{R}_m$ also entails problems. $\bar{R}_m$ represents the return on the market portfolio of assets. The market portfolio contains every available asset "in exact proportion of that asset's fraction of the total market value of assets" [23]. For example, if the total value of gold on the market represents 20% of the total value of all assets available, then the market portfolio would include gold as 20% of its total value. Unfortunately, no index exists that includes returns from every available financial asset or real asset. Instead, certain market indices have been formulated to represent returns on the "market", such as the New York Stock Exchange Index, and the Standard and Poor's 500. Both of these indices and other "market" indices are constructed differently and all are not equally volatile. Consequently, there is the possibiltiy that different estimates of equity will be calculated when different market proxies are utilized.

Discounted Cash Flow Model

The discounted cash flow (DCF) model, also referred to as the Gordon-Dividend model [8], was one of the earliest methods used in establishing a regulated firm's cost of equity capital [9]. This approach equates the required rate of return on equity (k_e) with the sum of the current dividend yield (D_1/P_o) and an anticipated growth rate or capital gains yield:

$$k_e = \frac{D_1}{P_o} + g \quad . \tag{4}$$

The basis of this technique is the belief that the required or expected return on equity is a function of the firm's dividends and prices (future cash flows) as opposed to its earnings [17].

The model makes several assumptions that are important. Personal taxes on investor's dividends are assumed away. Constant business and financial risk is also assumed [17]. Business risk is defined as the risk inherent in the operations of the business. Should the operating environment of a firm change, the business risk of the firm will also change. Financial risk is the "additional risk induced by the use of financial leverage" [23]. A firm's ratio of debt to equity will not be stationary over a long period of time. As a firm acquires more debt and assets are not acquired in the same proportion, its financial risk will increase. Also assumed in the DCF method is a constant dividend yield. That is, the model makes the assumption that the market price of the company's stock will grow at the same rate as its dividends. Any annual report of a firm and past stock price figures will demonstrate that this is not necessarily the case.

The previous problems are only secondary to the key problem faced by users of the DCF technique: the estimation of g, the firm's expected growth rate. In practice, the growth rate is usually estimated by extrapolating past growth rates. This procedure may only be valid if investors form their expectations of future growth rates solely on the basis of the growth rates of past returns or if those past growth rates actually persist over time. In addition, when using the DCF formula the firm's growth rate is assumed to be constant and perpetual. Most firms, however, go through "life cycles" during which growth rates will be unstable. Weston and Brigham [23] give as examples computer equipment manufacturers in the 1960's and the automobile industry in the 1920's.

Lintner and Glauber tested the usefullness of past earnings growth for forecasting future growth. The researchers correlated five-year earnings growth of 323 companies for four adjacent, non-overlapping five-year periods. Testing yielded only a small positive correlation of earnings growth in different time periods [9]. Says Hagerman "if investors are rational it seems unlikely that they will base their expectations on simple extrapolations that have no forecasting ability" [9].

Equity versus Debt Spread Model

Levy [14] believes that the most appealing approach to the determination of a rate of return on equity is the examination of the equity versus debt spreads of a firm. The approach involves determining the historical spread between the return on debt and the return on equity. This spread is adjusted in accordance with the relative risk of the firm and the result added to the current debt yield to arrive at an approximation of the required return on equity.

Several problems must be overcome when using this approach. One such problem is the historical time period over which the spread is to be established. Levy suggests "an alledgedly normal historical period" [14] or a very lengthy time frame. Since identification of a "normal" time period creates problems, a long time frame is probably more plausible. Levy [14] proposes a minimum of 25 years data, possibly a time period of 50 years if the data is available.

A second dilemma encountered in employing this method involved the decision to use historical or anticipated returns. Ideally, expected returns should be calculated. But how does one calculate historical spreads on expected returns? According to modern financial theory, over long periods of time, an equilibrium is established between expected and realized returns [14]. In the short run, unforseen events will cause a discrepancy between the two rates. Over the long run however, time will serve to smooth out these unanticipated events. Therefore, Levy asserts "historical periods are an excellent guide to expected returns for the same time span" [14].

The final "problem" with this approach is that it distinctly resembles the CAPM. Levy first suggests that the historical spread between equity and debt be determined using the Standard and Poor's 500 ($\bar{R}_m$) and "U.S. government issues with three to five years to maturity" ($\bar{R}_f$) [14]:

$$\text{Debt-Equity Spread} = \bar{R}_m - \bar{R}_f \ . \qquad (5)$$

He next suggests adjusting this spread for any risk differences between ths S & P 500 and the stock in question. One adjustment factor recommended by Levy is the beta of the stock (β):

$$\text{Risk Adjusted EDS} = \beta(\bar{R}_m - \bar{R}_f) \ . \qquad (6)$$

After the spread has been adjusted for the individual riskiness of the stock, this figure is added to the current debt yield or the T-bill rate so that:

$$k_e = \bar{R}_f + \beta(\bar{R}_m - \bar{R}_f) \qquad (7)$$

is equivalent to the CAPM. However, Levy circumvents the problem by suggesting an adjustment factor other than beta. The CAPM, or the equity-debt model as given above is a partial risk model. Unsystematic risk is assumed to be diversified away. Levy's other adjustment factor, the ratio of the standard deviation of the firm's stock price to the standard deviation of market returns $\left(\frac{\sigma_R}{\sigma_{Rm}}\right)$, is a total risk adjustment factor. By using a total risk model, one is assuming that the stock is either being put into a portfolio in which all unsystematic risk is not diversified away or not put into a portfolio at all. Therefore, the equity-debt spread model becomes:

$$k_e = R_f + \frac{\sigma_R}{\sigma_{Rm}} (\bar{R}_m - \bar{R}_f) \quad . \qquad (8)$$

<u>Earnings/Price Model</u>

The last model to be examined for computing equity costs is the earnings/price ratio, which is frequently used due to its simplictiy. Initially considered in Solomon /21/, two versions of the model have typically been employed. One earnings/price ratio is based on current earnings and stock price, the other upon anticipated earnings. Although anticipated earnings have been touted as the ideal, as a result of measurement difficulty, the problem has been circumvented by utilizing present earnings and applying an estimated growth parameter to the earnings/price ratio.

The models, based on current earnings (a) and incorporating a growth rate (b), are expressed as follows:

$$(a)\ k_e = \frac{E_o}{P_o} \quad . \qquad (9)$$

$$(b)\ k_e = \frac{E_o}{P_o} + g \qquad (10)$$

where
E_o = earnings per share, year zero,
P_o = price per share, year zero, and
g = annual compound growth rate.

Without reiterating the problems in the estimation of the growth rate, the model embodies other problems. First, the earnings/price ratio /21/ does not incorporate any degree of business risk /17/. The implications of business risk were discussed earlier in conjunction with the DCF model /23/. Secondly, the earnings/price approach assumes all earnings are being paid out as dividends, that is a dividend payout ratio of 100%. Finally, Equation (9), the model utilized in the present study, assumes a growth rate of zero /17/.

A final disadvanatge to the earnings/price approach is that the growth rate of investor return requirements is equal to the difference between earnings per share and dividends per share divided by the market price of the stock. Levy /14/ asserts that "if this growth rate does not accurately reflect investor anticipations, then the earnings/price ratio misstates the cost of equity". He then goes on to illustrate that

> If earnings/price ratios are used to establish the return on equity, then:
>
> $$\frac{E_o}{P_o} = \frac{D_1}{P_o} + g \quad \text{and} \qquad (12)$$
>
> $$g = \frac{E_o - D_1}{P} \quad . \qquad (13)$$

At a lower growth rate than the required, the earnings/price ratio will misstate the cost of equity on the high side. If the expected growth rate is higher than the equilibrium rate, the earnings/price ratio will understate the cost of equity.

The Cost of Equity for Public Utilities

The earliest method to be utilized in the regulation of public utility rates was the "comparable earnings" approach. The sequence of the evolution of utility rate regulation models can be diagrammed as follows:

Comparable earnings ⟶ DCF ⟶ CAPM.

The purpose of utility regulation is to achieve the efficient allocation of resources that would exist if the utility operated in a competitive (non-regulated) market [15]. The concept of "comparable earnings" was established by the first sentence of the Hope decision. This statement stated in effect that the returns to an equity owner of a utility be *comparable with returns of other businesses having the same risk* [15]. Past theory suggests that the benchmark for a utility's "comparable earnings" be its cost of capital. The cost of capital was interpreted as the mean accounting return on equity capital for firms, either regulated or unregulated, in the same risk class as the utility. The drawbacks of this method are; (1) locating firms whose risk characteristics matched those of the utility and (2) using a model based on past returns while investors base their required return on expected future earnings.

Dissatisfied with the limitations of the comparable earnings method, beginning in the early 1960's regulators and utility officials alike began to use the DCF method for determining the cost of equity. Linke and Zumwalt [15] describe the cost of equity computed with the DCF method as "a market rate of return defined in terms of anticipated dividends and capital gains relative to stock prices" [15]. The DCF model eliminated two problems associated with the comparable earnings method: (1) locating comparable risk firms, and (2) using accounting returns on equity to estimate investors expected returns. This model, too, is not without its problems.

The problems inherent in the DCF method, especially those associated with the estimate of the earnings growth rate led regulatory commissions and utility companies to experiment with the capital asset pricing model. The CAPM is a "risk adjusted estimate of investors' required or expected return" [15]. The model defines an asset's return as being directly proportional to it's systematic risk. Theoretically, since both the DCF and CAPM estimate investor's expected returns, the models should yield the same results when the market is in equilibrium. The main advantage of the CAPM over the DCF is that the earnings growth rate need not be estimated. Use of the CAPM does however involve its own problems, especially with estimation of the beta coefficient. Another problem arises with the CAPM that is unique to utilities. One of the basic assumptions of the CAPM is that the returns on a security are randomly distributed and that these returns exhibit a symmetrical distribution. This symmetry signifies that losses on one security are offset by gains on another, making it possible to diversify away unsystematic risk. In a truly diversified portfolio, the only risk is systematic risk, represented by the beta coefficient. Brigham and Crum concluded that utility "returns are skewed to the left (some probability of large losses but no probability of large gains)" [2]. When this is the case, unsystematic risk cannot be diversified away and a model based solely on systematic risk is not valid. The next reasonable step for utilities might be the equity-debt spread model. This total risk model would serve to incorporate the unsystematic risk that Brigham and Crum feel is inherent in utility stocks.

The Cost of Equity for Property-Casualty Insurance Firms

A review of the literature suggests that the evolution of insurance rate regulation models has taken a slightly different path than that of utility rate regulation:

NAIC based estimates ————→ CAPM .

Regulatory "models" seem to have moved directly from arbitrary numbers representing "fair" returns to the suggested use of the market based CAPM. The use of the NAIC estimate or other arbitrary figures representing a fair profit to insurance companies "was largely the result of a compromise and weak on statistical justification" [24]. The drawbacks of utilizing an arbitrary, statistically unproven number as a "fair" rate of return are obvious. Intuitively, the next step would have been for insurance firms to begin using the DCF model in the early 1960's, as utilities did. This was not the case. No literature was located that specifically referred to the use, or even advocated the use, of the DCF model by insurance firms. Instead, the literature seems to have moved directly to the proposed use of the CAPM, as suggested by the examination of regulatory proceeding records.[3]

Quirin and Waters [19], Haugen and Kroncke [10], Fairley [4], Biger and Kahane [3], and Foster [7], utilize the CAPM, or derivations thereof, for the determination of the cost of equity for insurance firms. Each author adjusts the model to take the special properties of insurance firms (such as negative underwriting or income from investment) into account.

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[3]According to Fairley [4], at the December, 1975 hearings, on Massachusetts automobile insurnace rates, three financial experts justified that the proper target rate of return should be determined by utilizing the CAPM. These experts were Eli Shapiro and Fischer Black of the Sloan School of Management and Peter Jones of Harvard Business School.

Proceeding on the hypothesis that property-casualty firms are able to earn returns in excess of those suggested by the capital market line by underwriting insurance at positive margins, Quirin and Waters [19] developed a risk-expected return model that enabled them to compare the risk-return opportunities available to 25 Canadian property-casualty firms to the opportunities avaliable to other "capital market participants" [19]. The authors utilized accounting data to develop estimates of the expected rate of return and risk measure (σ_k) "for various combinations of 'insurance exposure' $\left(\frac{B}{K}\right)$ and 'investment exposure' $\left(\frac{S}{K}\right)$, which are the two principal policy variables by which insurance companies are assumed to influence their expected rate of return and risk levels" [19]. Insurance exposure represents the ratio of the average investment in bonds (B) to the policyholders' surplus (shareholders' equity, retained earnings, and contingency reserves, K). Investment exposure is the ratio of the firm's average investment in stock (S) to the policyholders' surplus. Total risk was calculated as the "standard deviation of the annual rates of return" [19] and systematic risk, or the beta coefficient, was calculated by regressing the returns on policyholders' surplus on the realized returns on the Toronto Stock Exchange .

Upon plotting the risk-return combinations, it was found that they fell below the Sharpe capital market line. Since these combinations were thought to be unattainable, Quirin and Waters ultimately concluded that insurance companies were able to achieve "returns in excess of those implied by the capital market line" [19].

This conclusion is supported by Haugen and Kroncke [10], who also investigated investment opportunities available to insurance firms within the context of the capital asset pricing model. The rate of return on an individual asset is expressed as follows:

$$E(r_j) = \frac{i + E(r_p) - i}{\sigma(r_p)^2} \text{Cov}_{jp} \qquad (14)$$

where

$E(r_j)$ = return on individual asset j,

i = risk free rate of return,

$E(r_p)$ = return on a market portfolio of assets,

$\sigma(r_p)^2$ = variance of the returns on the market portfolio, and

Cov_{jp} = covariance of returns on asset j and the market portfolio.

If insurance firms sell premiums and invest the proceeds plus A dollars of their own capital in a portfolio of assets, j, assuming negative underwriting costs, the total rate of return to A is:

$$E(r_j) = aE(R_j) + (1-a)E(r_e) \qquad (15)$$

where

a = proportion of equity capital invested in j - (for an insurance firm $a > 1$ since the firm is investing not only its own equity, but also equity received in the form of premiums),

1-a = position in insurance portfolio e (Since the firm sells insurance, this position is negative), and

$E(r_j)$ = expected rate of cost of the portfolio of insurance poilicies sold.

The above equation expresses the fact that the insurance firm (intermediary) is "borrowing money at one rate and investing it at a higher rate. The intermediary receives the difference and the expected rate of return on its equity is higher than if it had not sold insurance" [10]. Haugen and Kroncke's preliminary evidence reveals that when firms charge insurance rates based on returns indicated by the CAPM, the resultant insurance rates will be in excess of the objective of rate regulation which is "to allow the insurer a rate of return on equity investment sufficient to compensate for the risks incurred in providing the service" [10]. This is indicated by the "no risk" or very low risk position involved in underwriting insurance. The term $E(r_e)$ will be negative since the insurance firm is not paying the insured for the use of its premium capital.

Fairley [4] applies the CAPM to property-casualty firms by first expressing the beta in terms of investment and underwriting risk. The systematic risk applicable to underwriting profits and to investment profits may be stated as follows:

$$B_E = [B_A\ (ks + 1) + B_P s] \quad (16)$$

where
B_E = systematic risk of equity,
B_A = beta for the return on assets,
k = market value of investment earnings,
s = premium to capital ratio, and
B_P = beta for the return on liabilities (underwriting).

This term is then substituted into the CAPM framework. According to Fairley, the risk adjusted after-tax target return is expressed as:

$$r^g_{E,N} = \bar{r}_f + [B_A\ (k_N s + 1) + B_{P,N} s](\bar{r}_m - \bar{r}_f) \quad (17)$$

Fairley proceeds to use this return to derive required profit margins for premiums in major lines of property-casualty insurance.

Biger and Kahane [3], like Fairley break the systematic risk of the insurer (B_y) into the systematic risk of investment and the systematic risk of underwriting:

$$B_y = (1 + L)B_p - LB_u \quad (18)$$

where
B_y = systematic risk of return on equity,
L = premium/equity ratio of the insurance company,
B_p = systematic risk of the investment portfolio, and
B_u = systematic risk of underwriting.

The authors depart slightly from Fairley's cost of equity estimate in that they do not include the market value of expected investment earnings in the investment component (Fairley's k):

$$E(\tilde{r}_y) = [(1 + L)B_p - LB_u][E(\tilde{r}_m) - r_f + r_f] \quad (19)$$

where
$E(\tilde{r}_m)$ = expected return on the market portfolio, and
r_f = risk-free rate of return.

Note that the last term, systematic risk of underwriting is subtracted in Biger and Kahane's formula, but is added in Fairley's cost formula. The effect is the same since the systematic risk associated with underwriting is zero or negative (policyholders are paying the insurer for loaning the insurer money).

Hill expresses the return on a firm's equity as:

$$R_i = \frac{R_j(PN + K) - L}{K} \qquad (20)$$

where
R_i = return on the firm's equity (return on K),
R_j = return on investments,
P = premium per policy,
N = number of policies written,
K = capital supplied by shareholder's, and
L = sum of losses ($E(L) = N c \bar{y}$ where c is the payoff for each policy on which a loss occurs and $\bar{y}$ is a dummy variable describing whether or not a loss occurs on a policy.)

The author then substitutes the calculated R_i into the CAPM market equilibrium condition:

$$R_i = R + \lambda \cdot \mathrm{cov}\ (R_i, R_m) \qquad (21)$$

where
R = risk free rate of interest,
λ = $(R_m - R)/\mathrm{var}\ (R_m)$ = "market price of risk", and
$\mathrm{cov}(R_i, R_m)$ = covariance of the returns of the stock with the returns of a standard market portfolio.

The true effect of the CAPM in the determination of a fair rate to charge on insurance premiums may be seen in Hill's profit formula:

$$P = \frac{K\lambda \cdot \mathrm{cov}(R_i, R_m) + N c \bar{y} + K(R - \bar{R}_j)}{\bar{R}_j N} \qquad (22)$$

Finally, Foster [7], in his research on property-casualty firm valuation parameters, employs an equity valuation model consisting of a growth and a no-growth component. The no-growth component is a derivation of the capital asset pricing model and is used indirectly to estimate the expected capital gains on portfolios of assets held by property-casualty companies. Using the standard formula

$$E(\tilde{R}_i) = R_f + B \left[E(\tilde{R}_m) - R_f \right] \qquad (23)$$

Foster computes the return on the market portfolio (excluding dividends). The beta utilized is 1.0 and since only capital gains are wanted the final model is expressed as:

$$E(\widetilde{C.G.}) = R_f + \left[E(R_m) - R_f \right] - E(\widetilde{D.Y.}) \qquad (24)$$

where
$E(\widetilde{C.G.})$ = expected capital gains component of R_m, and
$E(\widetilde{D.Y.})$ = expected dividend yield component of R_m.

As shown by the above approaches, application of the CAPM to property-casualty firms can take on many different forms. Of the above five authors, one utilizes accounting returns to estimate equity costs, another estimates the total rate of return as a function of the CAPM derived return and negative underwriting costs, two break down the beta coefficient into systematic risk for underwriting and investment, and a final author utilizes a cost of equity estimate consisting of a growth component and a no-growth component, the no-growth component being the CAPM. It was stated earlier that the first step in determining the appropriate insurance rate to charge consumers is to first develop a standardized method for calculating the required return on equity capital. This step clearly needs more research.

The next chapter discusses the methodology utilized in the present study and subsequent chapters consider the results in light of property-casualty insurance regulation and present the conclusions.

CHAPTER IV

RESEARCH METHODOLOGY

Sample and Data

Because the study involved equity cost estimates for property-casualty insurance firms, every effort was made to obtain a sample that included only "pure" property-casualty firms. This was a rigid requirement to fulfill and was done so at some expense to sample size.

Twenty property-casualty firms were chosen for the sample. A list of the total sample, along with the percentage of property-casualty premiums written is found in Table I. Twelve of the firms were chosen from lists published by the A. M. Best Company of the leading property-casualty insurance companies. If a firm wrote 75% or more of its total premiums in property-casualty lines for any of the years 1977-1980, it was included in the sample. The balance of the sample was obtained by selecting firms categorized in the Standard and Poor's Register of Dun and Bradstreet's Million Dollar Directory as "Fire, Marine and Casualty Insurance" firms (SIC 6331).

Data utilized in the models was obtained from Standard and Poor's Daily Stock Quotes, Moody's Dividend Record, and recent issues of Economic Indicators. Table II summarizes the models used, and the source of information for each variable in the model.

Statistical Techniques

Once the initial data (stock prices, earnings per share, and dividends) were collected, preliminary calculations were made to estimate growth rates, beta coefficients, and standard deviation risk-adjustment ratios. Growth rates were calculated as the annual compound growth rate in stock prices. For firms for which less than 60 months of stock price data was available, prices were utilized as far back as was available. The shortest span of time for which a growth rate was calculated was 2.5 years. The firm was Employee Benefits.

In order to calculate equity estimates utilizing the CAPM, the beta coefficient was calculated using the following regression equation:

$$\ln(1 + r_{i,t}) = \alpha_i + \beta_i \ln(1 + R_{m,t}) + \epsilon_i \qquad (25)$$

where

$r_{i,t}$ = rate of return on the i-th property-casualty firm for period t,
$R_{m,t}$ = realized rate of return on the New York Stock Exchange Index over period t,
ln = natural logarithm,
α_i = constant term or alpha coefficient,
β_i = beta coefficient, and
ϵ_i = random error term [5].

Calculation of the beta coefficient proved to be the main problem in estimating equity costs using the CAPM. Levy [14] suggests one of the problems in this calculation is that the time span used can have a significant impact on the resulting coefficient. This appears to be the case in the present study. Of the seven firms for which less than 60 months of returns were available, three had negative beta coefficients. For these firms, the beta coefficient published in the Value Line Investment Survey, or the Merrill-Lynch Monthly Research Review was utilized. These firms are appropriately designated in Table III which contains calculated beta coefficients for each firm. A longer time span might have improved the reliability of the beta. A fourth firm, Chubb Insurance, had a calculated beta coefficient out of the range of either the Merrill Lynch or Value Line estimate. The Value Line estimate was used.

Finally, each regression equation was tested for auto-correlation among residuals. The Durbin-Watson statistics are shown in Table III. None of the statistics were significant at the 5% level, allowing for the acceptance of the hypothesis of no positive or negative correlation among the residuals.

The last variable calculated was the risk-adjustment factor, $\left(\frac{\sigma_R}{\sigma_{Rm}}\right)$, employed in the Equity-Debt Spread model. This statistic suffered from the same problems as the beta coefficient, namely there were seven firms for which less than 60 months of data was available for the calculation. This could conceivably cause distortions in the standard deviation computations.

A second point is again related to both the CAPM and the Equity-Debt Spread models. Levy [14] suggests that the proxy for the risk-free rate (R_f) and market return (R_m) be based on data extending back as far as 50 years. However, because of the volatility of short term interest rates, a more realistic estimate of R_f may be obtained from using a recent rate. The return on 3-month Treasury securities as of December, 1980 was employed as the risk-free rate. The proxy for the return on the market (R_m) was the yield on the Standard and Poor's 500 Index from December, 1975 through December, 1980.

The Earnings/Price ratio was perhaps the easiest equity cost to compute. This seems logical in that the only data needed was December 31, 1980 stock prices and 1980 earnings per share. The only firms that provided any difficulties were Criterion and Employee Benefits. Earnings per share for each firm for 1980 could not be located. For Criterion, the latest EPS figure found and subsequently used in the calculation was for 1978. Employee Benefits merged with Orion Capital on December 31, 1980 and did not publish 1980 financial reports. Earnings per share for 1979 was utilized.

Upon computing costs of equity under each model for all firms, the Spearman rank-order correlation coefficient was calculated between models. The Spearman correlation coefficient assists in determining whether the rank of a firm's equity cost is equivalent between different cost of equity estimates. Statistically, the hypothesis tested was that there was no linear correlation between any two models:

$$H_o: \rho_{xy} = 0 \tag{26}$$

against the hypothesis that there is a positive linear relationship between any of the models:

$$H_a: \rho_{xy} > 0 \tag{27}$$

A correlation coefficient of $\rho = +1$ would indicate each model was statistically estimating the same cost of equity, or that the ranks were identical.

The next chapter will reveal the results of the study, offer implications of these results and present the conclusions.

CHAPTER V

RESULTS AND CONCLUSIONS

The cost of equity estimates indicate that the possibility of developing a narrow range of equity costs for each firm based on different models was not feasible (Refer to Table IV). The most narrow range of costs calculated was 19.20% for United Fire and Casualty. The widest range resulted in a spread of 71.08% for Zenith National. Averaging these costs results in equity costs of 21.66% for United Fire and 42.39% for Zenith National.

Upon examining the cost of equity estimates, a logical pattern develops. The Equity versus Debt Spread model produced the highest overall equity costs. This is to be expected considering the model incorporates the total risk of a firm's returns: both systematic and unsystematic. However, from the theoretical perspective, most unsystematic risk can be eliminated by properly diversifying a portfolio. Wagner and Lau [23] constructed equal weighted portfolios using 1 to 20 randomly selected securities. As the number of securities in each portfolio increased, the standard deviation of the portfolio returns σ_p , or the total risk, declined at a decreasing rate. As the total risk declined, the correlation of the portfolio return with the market index increased. A broadly diversified portfolio will be highly correlated with the market and "its risk is (1) largely systematic and (2) arises because of general market movements," [23].

The Earnings/Price model offers the least logical estimates of equity costs. When one considers that the risk-free rate as of December, 1980 was 15.66%, it seems highly unlikely a firm would pay less for its equity than it would for debt. The primary reason these estimates are so low is because of the exclusion of expected growth rates. In essence, investors utilizing this model were saying that the return they required as of December 31, 1980 is equal to the return they will require indefinitely. These investors expect the earnings per share and market price of the stock to remain constant, or if they change, to change by the same relative amount.

In all but two cases, the Discounted Cash Flow model yielded higher equity estimates than the Earnings/Price ratio. Since both models assume a dividend payout ratio of 100%, and both do not take the effect of business risk into account, it is concluded that the primary difference in estimates is a result of the incorporation of an expected growth rate by the DCF model.

In addition, the DCF estimates were lower than the Equity versus Debt Spread estimates. Van Horne [22] defines the cost of equity capital utilizing the DCF model as the "market rate of discount, k_e, that equates the present value of all expected future dividends per share with the current market price of the stock" [22]. The EDS model expresses the cost of equity as a function of the riskiness of the returns of this stock in relation to the riskiness of the returns of a market index. Since the market price of the stock is established by taking only systematic risk into account (unsystematic risk is assumed to be diversified away), the DCF rates will tend to be lower than the estimates derived from the EDS model. (The EDS model considers total risk.)

The most intuitively appealing rates were calculated with the CAPM. As mentioned earlier, use of the CAPM appears to be the most theoretically defensible position. The cost of equity estimates resulting from using the CAPM were higher than the Earnings/Price or DCF estimates. The CAPM, like the EDS model computes the required rate of return on a stock by taking into account that stock's relationship to the market. In addition, the CAPM estimates were lower than the EDS costs. When using the EDS, a firm is paying an investor a return that compensates the investor for not diversifying his portfolio. There is no justifiable reason for doing this when firms are able to find equity investors who do diversify their portfolios and therefore will accept a lower (CAPM) rate of return.

The correlation coefficients exhibited in Table V indicate that of the six combinations of possible correlations, four are not significant at the 5% level. These findings support not only the author's original typothesis, but also the results recorded by Linke and Zumwalt, who found no significant correlation between the DCF and CAPM models for utility firms /15/. Martin, Scott, and Petty /17/, computed correlations between two versions of each of three cost of equity models (DCF, E/P, and CAPM) and also arrived at similar conclusions. For seventeen utilities, the only significant correlations were for the Discounted Cash Flow and the two variations of the Earnings/Price model.

Of the two significant correlations computed, the CAPM and EDS correlation seems logical. Because of the inclusion of total risk, the EDS model is essentially a "stepped up" version of the CAPM and most EDS estimates will result in about the same relative rankings as the CAPM.

The significant correlation between the EDS and the DCF models is more difficult to explain. Statistically, the models are producing the same equity costs. Given the high correlation, the ranks of the costs under the two models should be nearly identical. What is making the ranks identical is possibly due to the expected growth rates. It was found that when the DCF/EDS ranks were closest, the corresponding firms were among those with the highest growth rates. Of the 13 firms that had rankings within four ranks of each other, eight firms were among those with the highest growth rates. Conversely, seven firms had DCF/EDS "rank spreads" that were greater than four ranks. Four of these seven were among the 10 firms with the lowest growth rates. It seems that although the DCF model is not based directly upon the stock's relation to market data, investors are taking these external market forces into consideration when establishing expected growth rates.

Fiven the problems inherent in applying the DCF model (estimation of growth rates), the E/P model (failure to recognize business risk, assumes a 100% dividend payout ratio, assumes no growth), the EDS model (inclusion of total risk) and the empirical results obtained in this investigation, the Capital Asset Pricing Model for the cost of equity estimation appears to be the most suitable for regulation of property-casualty insurance companies. The CAPM considers the individual stock and its relation to the market while assuming the security will be placed in a diversified portfolio thereby eliminating the need to consider total risk. This model is not without its problems, however. As noted earlier it too is susceptible to the use of short time periods when calculating both market and individual stock returns. Also, there is evidence suggesting some inherent instability of the beta coefficient. However, because of its reliance on only systematic risk, and the simple fact that the numbers appear logical in light of today's economic conditions, this is the model that is advocated for use in rate regulation hearings for the purpose of determining equity costs for property-casualty firms.

that the numbers appear logical in light of today's economic conditions, this is the model that is advocated for use in rate regulation hearings for the purpose of determining equity costs for property-casualty firms.

TABLE I

PROPERTY-CASUALTY INSURANCE FIRMS

Company	Property-Casualty Premiums Written (% of Total Premiums)
American Bankers Insurance Company of Florida	100.00%
BITCO	100.00
Carolina Casualty	100.00
Chubb	88.30
Cincinnati Financial	75.40
Criterion	100.00
Crum and Forster	99.93
Employee Benefits	100.00
Employer's Casualty	100.00
Fremont General	98.00
GEICO	94.70
General Reinsurance	75.50
Hanover	100.00
Hartford Steam Boiler	100.00
Mission Insurance	100.00
Orion Capital	80.80
St. Paul	80.90
U.S. Fidelity and Guaranty	96.70
United Fire and Casualty	100.00
Zenith National	100.00

TABLE II

COST OF EQUITY MODELS

1	Capital Asset Pricing Model (CAPM)	$\bar{R}_f + \beta(\bar{R}_m - \bar{R}_f)$
2	Discounted Cash Flow (DCF)	$D_1 / P_o + g$
3	Equity versus Debt Spread (EDS)	$\bar{R}_f + \frac{\sigma_R}{\sigma_{Rm}} (\bar{R}_m - \bar{R}_f)$
4	Earnings/Price Ratio (E/P)	E_o / P_o

R_f - 3 month Treasury Bill rate, December, 1980

β - Regression coeffecient: Ratio of the co-variance of the returns of the stock to the variance of the returns of the market

$\bar{R}_m$ - Yield, Standard and Poor's 500 Index, December, 1975 - December, 1980

D_1 - Expected dividend per share, year-end 1981

P_o - Price per share, year-end, December, 1980

g - Compound capital gains rate, December, 1975 - December, 1980

E_o - Earnings per share, year-end, December, 1980

$\frac{\sigma_R}{\sigma_{Rm}}$ - Ratio of the standard deviation of the returns of the stock to the standard deviation of the returns of the Standard and Poor's 500

TABLE III

CALCULATED BETA COEFFICIENTS AND
DURBIN-WATSON STATISTICS

	Beta	Durbin-Watson
American Bankers	1.20*	1.89
BITCO	1.50*	2.41
Carolina Casualty	1.00	2.30
Chubb	.53 (.90)	2.24
Cincinnati Financial	.80	2.02
Criterion	- .38* (1.02)	2.15
Crum and Forster	.85	2.34
Employee Benefits	1.35*	2.71
Employer's Casualty	.34	2.41
Fremont General	- .05* (1.10)	2.08
GEICO	- .02* (1.11)	2.45
General Reinsurance	.80	1.91
Hanover	1.25	2.04
Hartford Steam Boiler	.73	2.49
Mission Insurance	1.19	2.42
Orion	1.23*	2.16
St. Paul	.81	2.25
U. S. Fidelity and Guaranty	.21	2.32
United Fire and Casualty	.68	2.21
Zenith	.74	2.28

*Less than 60 months of return information available for calculation of β. 'VL' or 'ML' signifies the use of the <u>Value Line</u> or <u>Merrill Lynch</u> beta coefficient. Numbers in parentheses represent beta coefficients used in the study.

30 months - Employee Benefits
36 months - BITCO
Fremont General-VL

49 months - Criterion-VL
50 months - American Bankers
GEICO-ML[1]
Orion Capital

[1]GEICO was not listed in either <u>Value Line</u> or <u>Merrill Lynch</u>. The <u>Merrill Lynch</u> industry average for property-casualty firms was used.

TABLE IV

COST OF EQUITY ESTIMATES

Company	CAPM 1	DCF 2	EDS 3	E/P 4
American Bankers	38.03%	33.51%	45.52%	9.78%
BITCO	41.95	45.37	38.95	15.23
Carolina Casualty	33.82	34.62	35.56	12.95
Chubb	31.78	9.43	32.44	21.53
Cincinnati Financial	29.94	35.73	33.11	11.43
Criterion	33.92	25.47	51.35	11.43
Crum and Forster	30.80	21.81	37.73	9.99
Employee Benefits	39.27	14.42	45.26	5.51
Employer's Casualty	21.71	40.00	34.19	6.91
Fremont General	35.36	54.14	46.36	5.23
GEICO	35.53	37.66	17.34	18.09
General Reinsurance	30.01	7.13	32.08	3.30
Hanover	38.13	49.80	42.40	16.22
Hartford Steam Boiler	28.70	18.73	30.72	7.10
Mission Insurance	37.03	56.55	42.59	6.73
Orion Capital	37.72	29.91	41.37	12.96
St. Paul	30.12	9.81	33.31	16.05
U. S. Fidelity and Guaranty	19.49	48.81	34.2	3.85
United Fire and Casualty	27.79	21.25	30.90	11.70
Zenith National	28.96	82.52	46.62	11.44

TABLE V

SPEARMAN RANK CORRELATION COEFFICIENTS

	CAPM	DCF	EDS	E/P
CAPM	-	.116	.477*	.265
DCF	-	-	.457*	-.179
EDS	-	-	-	-.136

* Significant at the 5% level

BIBLIOGRAPHY

1. Beane, Reg, and Haren R. Aronstein. "Open Competition Bill Highlights NAIC Meeting." Risk Management, Vol. 27, (July 1980), pp. 7-8.

2. Brigham, Eugene F. and Roy L. Crum. "On the Use of the CAPM in Public Utility Rate Cases." Financial Management, Vol. 6, No.2, (Summer 1977), pp.7-15.

3. Biger, Nahum and Yehuda Kahane. "Risk Considerations in Insurance Ratemaking." Working paper, Tel-Aviv University, School of Business Administration, (November, 1977).

4. Fairley, William B. "Investment Income and Profit Margins in Property-Liability Insurance: Theory and Empirical Results." The Bell Journal of Economics, Vol. 10, No. 1, (Spring 1979), pp.172-191.

5. Fama, Eugene F. Foundations of Finance, New York: Basic Books, 1976.

6. Federal Power Commission et. al vs. Hope Natural Gas Company, 320 U.S. 591, (1949).

7. Foster, George. "Valuation Parameters of Property/Liabiltiy Companies." Journal of Finance, Vol. 32, No. 3, (June 1977).

8. Gordon, Myron J., and Eli Shapiro. "Capital Equipment Analysis: The Required Rate of Profit." Management Science, (October 1956), pp. 102-110.

9. Hagerman, Roger L. "Finance Theory in Rate Hearings." Financial Management, Vol. 5, No. 1 (Spring 1976), pp. 18-22.

10. Haugen, Robert A., and Charles O. Kroncke. "Rate Regulation and the Cost of Capital in the Insurance Industry." Journal of Financial and Quantitative Analysis, Vol. 6, No. 5, (December 1971), pp. 1283-1305.

11. Hill, Raymond D. "Profit Regulation in Property-Liability Insurance." The Bell Journal of Economics, Vol. 10, No. 1, (Spring 1979), pp. 172-191.

12. Joskow, Paul L. "Cartels, Competition, and Regulation in the Property-Liability Insurance Industry." The Bell Journal of Economics, Vol. 4, No. 2, (Autumn 1973), pp. 375-427.

13. Kouatly, Youssef J. "Is There Life for Insurance After McCarran-Ferguson?" Risk Management, Vol. 27, (July 1980), pp.13-23.

14. Levy, Robert E. "Fair Return on Equity for Public Utilities." Business Economics, Vol. 13, No. 4, (September 1978) pp. 46-57.

15. Linke, Charles M., and J. Kenton Zumwalt. "Toward a Reconciliation of the Comparable Earnings and CAPM Approaches to Public Utility Rate Regulation: An Empirical Analysis." (Paper presented at the ninth annual meeting of the Financial Management Association, 1979).

16. Lowry, Edward D. "Justification for Regulation: The Case for Natural Monopolies." Public Utilities Fortnightly, Vol. 92, No. 10, (November 1973), pp.17-23.

17. Martin, John D., David F. Scott, and J. William Petty II. "Required Rate of Return Measurements: Application Dissimilarities." (Paper presented at the annual meeting of the Eastern Finance Association, 1976).

18. Pettway, Richard H. "On the Use of Beta in Regulatory Proceedings: An Empirical Examination." The Bell Journal of Economics, Vol. 9, No. 1 (Spring 1978), pp. 239-248.

19. Quirin, G. David, and William R. Waters. "Market Efficiency and the Cost of Capital: The Strange Case of Fire and Casualty Insurance Companies." Journal of Finance, Vol. 30, No. 2, (May 1975), pp. 427-445.

20. Sharpe, William F. "Capital Asset Prices: A Theory of Market Equilibrium Under Conditions of Risk." Journal of Finance, (September 1964), pp. 425-442.

21. Solomon, Ezra. The Theory of Financial Management. New York: Columbia University Press, 1963.

22. Van Horne, James C. Financial Management and Policy, fifth edition. Englewood Cliffs, New Jersey: Prentice-Hall, 1980.

23. Weston, Fred J., and Eugene F. Brigham. Managerial Finance, sixth edition, Hinsdale, Illinois: The Dryden Press, 1978.

24. Williams, C. Arthur, Jr. "Excess Profits Approach to Automobile Insurance Rate Regulation." (Paper presented at the eighth annual meeting of the Financial Management Association, 1978).

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