THE DEVELOPMENT OF PROPERTY-LIABILITY INSURANCE PRICING MODELS IN THE UNITED STATES (1ST AFIR INTERNATIONAL COLLOQUIUM, 4/90)

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Synopsis

This contribution to the first AFIR Colloquium will summarize the development of insurance pricing models as they have been applied to property-liability (general or non-life) lines in the United States during the period 1969-1989. The development is traced through regulatory decisions and academic research rather than through individual company methods of analysis, the latter being proprietary in nature. This review is especially pertinent to an understanding of the relationship of insurance to general financial markets. The major developments in modern financial economics; namely, the Capital Asset Pricing Model (CAPM), Arbitrage Pricing Theory (APT), and Options Pricing Theory (OPT) all have been applied to pricing the insurance contract and will be reviewed. Finally, fundamental issues faced by insurers again in California with the current implementation of Proposition 103 will be discussed as well as prospects for future development.

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1. INTRODUCTION

1. General Setting

The essence of an insurance policy is the promise by the insurer to pay all claims of the insured that are covered by the policy. In return for the insurer's promise, the insured pays the policy premium. In return for the policy premium, the insurer commits its own capital, also known in the literature as surplus or net worth, to assure that the promise will be kept even under adverse or catastrophic circumstances. The determination of the appropriate premium to be charged for the risk of the capital commitment lies at the very heart of the financial dynamics of an insurance company. Actuaries need to be able to determine proper rate levels for the insurance product in ways that are fully consistent with modern financial economics.

I want to describe **ratemaking** in this context as the method for determining the (list) price to be charged for each homogeneous subset of insurance contracts. What makes the insurance transaction essentially different from some other transactions in the economy, and therefore interesting to us, is that the payment of the price (premium) and the delivery of the goods and services (promise to pay all claims) do not occur simultaneously, but rather they can occur with a long time gap between premium and claim payments. This makes the insurance contract risky. Indeed, the insurance contract is risky for <u>both</u> the insured and the insurer.[1] This time gap is also present in other financial intermediary transactions such as stock and bond issues, mortgage contracts, as well as options and future contracts. The pricing of those risky financial contracts is generally accomplished in open competitive markets for capital. Insurance ratemaking, therefore, should recognize that it must coexist with the competitive market pricing of other financial intermediary products and other goods and services in general. For insurance policies in a competitive market we might strike an analogy with prices in the general economy.

By the **Actuarial Premium**, I mean the result of providing the best current value estimate of all the components of the policy contract by means of the insurer's analytic process. In a real sense, the actuarial premium is only the list price for the insurance contract. By the **Market Premium**, I mean the policy premium that results from the actuarial premium after dividends, schedule rating and all other marketing devices have had their influence on the actuarial price in order to match the competitive market sale price. Only in theory, or under strict price controlling regulation, will the best actuarial premium be equal to the dynamic market determined premium.

The purpose of this review is to provide some highlights of the various ways in which the United States property-liability insurers have seen financial pricing models, primarily in the regulatory arena, developed for their products during the past twenty years, 1969-1989. Individual companies will tend to use a method or model, or several methods or models, which the management deems suitable for their own profit targeting or assessment of results. Precisely which companies use which methods or models at various points in time during 1969-1989 is, of course, unknown.

In the sections that follow various models are discussed which are designed to create the Actuarial Premium. Testing whether or not these models produce results which yield true competitive market premiums is very difficult to do and well beyond the scope of this paper. The interested reader can consult a recent paper by Stephen P. D'Arcy and James R. Garven [8 and 10] for the first extensive attempt at an ex-post test of the financial models.

2. Early Regulatory Decisions

The story begins with the watershed Clifford Decision [2] in the so-called "New Jersey Remand case" rendered in 1972 after the State Insurance Department and the State Supreme Court questioned in 1969 the determination of premium rates using a "traditional" 5% profit figure. Various credits for book or accounting returns on invested policyholders funds, unearned premiums and loss reserves were ordered to be included in determining a proper rate. The overall theory employed by Clifford was that the total return to the company from underwriting and investment, on its properly invested capital,[2] would be sufficient reward for the risk of the insurance contract. Clifford set a target operating return, after-tax underwriting plus net investment income (no capital gains), of 3.5% on surplus at the one-to-one level to written premium.

While insurers tried to cope in theory and in practice with the Clifford approach, another pacesetting rate decision was rendered in Massachusetts by Commissioner James M. Stone [19] in the Worker's Compensation case to set 1975 rates. Stone ordered that future underwriting profit margins on premiums be set at whatever level, positive or negative, that would be expected to provide for, when combined with the investment income from a minimum reasonable investment yield, an independently determined target rate of return. The setting of the target return on capital should involve the use of some of the same techniques of financial economics, such as the Capital Asset Pricing Model (CAPM), that were then being applied to regulate returns on monopolistic public utilities.

By 1979, William B. Fairley [5, Chap. 1] had worked out a one-period model for Stone that employed the CAPM to describe the expected returns on both the required surplus and on the portfolio of investments. This dual role allowed for the complete elimination of the dependence of the profit margins on the composition or the actual outcomes of investment portfolios of individual companies. Instead, the margin depended only on the government-bond yield (the risk-free rate of the CAPM), the lengths of the cash flows of each line of insurance, and the systematic risk of underwriting (the underwriting CAPM beta). The modern financial economic paradigm of CAPM had arrived with enough theoretical force to dispense with any dependence on real investment portfolios, according to Fairley.

3. New Approaches in the 1980's

Discontent with the total reliance on the CAPM and the approximations of Fairley's one period approach led to alternate adaptations of another financial economics paradigm to the insurance pricing problem. Stewart C. Myers and Richard A. Cohn, both at M.I.T. at the time, proposed the use of a multi-period discounted cash flow model [5, Chap. 3]. Their approach highlighted the need for surplus allocation and risk valuation at all points of the life of the insurance policy, including the run off of losses. They also explicitly provided for the important consideration of corporate income taxes in the price of the policy. The Myers-Cohn approach has been used in Massachusetts for Automobile and Workers' Compensation rate setting since its introduction in 1981. Disputes over input parameters, however, have been lively and substantial.

A parallel multi-period approach was taken by the New York Compensation Board, and the National Council on Compensation Insurance (NCCI). Rather than using the net present value formulation employed by Myers and Cohn, they used the standard corporate finance technique for evaluation of projects based on their expected internal rate of return [1, Chap. 5]. Once an underwriting profit was selected, and all shareholder flows to and from the company were identified, an expected internal rate of return could be calculated. That calculated rate of return was then compared to an independently determined fair rate of return for workers compensation insurers. The comparative virtues of the Myers/Cohn discounted cash flow model and the NCCI internal rate of return approaches have been documented in a recent summary paper by Cummins [4].

More sophisticated financial models were produced by researchers during the entire decade of the 1980's. Among the notable ones were the efforts of Alan Kraus and Stephen A. Ross [5, Chap. 5] to incorporate both the stochastic nature of the loss process and the financial asset theory known as the Arbitrage Pricing Theory (APT). Their objective was to create a valuation model to explain how the market value of the insurance firm reacts to changes in prices (premiums) it charges. At its simplest level, Kraus and Ross show that because premium income and loss and expense payments are all in nominal dollars, the "fair" premium is affected by inflation only as far as real rates of interest are likely to change. They observe, similar to Fairley and Myers and Cohn, that in case the underwriting betas are negative (insurance losses are a hedge against systematic economic risk), the fair premium will be higher than the (risk-free) discounted expected losses and expenses. Stated differently, there would be a charge to the policyholder for the exposure of surplus to insure the payment of all claims. (See also [2] and [5, Chap. 6]).

Currently, the efforts which show the most promise for future development and understanding have been those which seek to incorporate Options Pricing Theory (OPT) in a fundamental way. In a 1986 paper in the Journal of Finance, Neil A. Doherty and James R. Garven [13] provided for the valuation of insolvency risk and the redundancy of underwriting tax shields in their adaptation of OPT. Meanwhile, J. David Cummins [3] used the stochastic setting of diffusion processes for asset and liabilities to extract risk-based premiums for guaranty funds. Cummins developed both run-off and policy cohort models which produced non-analytic numerical solutions in the more complicated, but realistic, cases. Finally, the author [8] applied Cummins' policy cohort model, using specific variational parameters derived from Massachusetts Automobile and Workers' Compensation lines, in order to derive consistent and interrelated levels of surplus commitment and risk premium charges.

These latter two papers were presented at the First International Conference on Insurance Solvency at the Wharton School, University of Pennsylvania, in 1986. It was at the Solvency Conference that participating actuaries and financial economists exposed the clash between the financial modelling approach espoused by the American researchers and the traditional stochastic variational approach so dominant in the European literature. The common ground at that conference, expected again at AFIR, was the essential role of the multi-period valuation model, especially those models which accommodated all the stochastic aspects of the insurance transaction. The ICIS proceedings are now published in two volumes [7,8] and will be followed by the further progress recorded at the second ICIS conference at Brighton, England during 1989[9]. A third ICIS is planned for 1991 at Erasmus University, Rotterdam, the Netherlands.

The following sections of this review will provide as many details of the developments described above as are needed to give the actuary an appreciation of the financial pricing issues involved and their developing solutions. A final section will discuss the major issues in these approaches, the prospects for discovery and rediscovery of those issues during the important review of property-liability rates now underway in California under Proposition 103, and prospects for future development and understanding.

2. THE NEW JERSEY CASE AND BOOK RETURNS

1. The Origins of the Case.

Rate increases for New Jersey private passenger automobile liability and physical damage insurance, as well as commercial vehicle physical damage insurance, were filed in early 1967 by the appropriate industry rating organizations.[3] Resistance to the requested increase on the part of the regulator led to a denial of the increase in early 1968, an industry appeal to the New Jersey Supreme Court, and a subsequent decision by the Court (In re Insurance Rating Board, 55 N.J. 19(1969)) ordering a remand hearing based upon instructions from the Court. That remand hearing with 33 sessions was held during 1970 and 1971. New Jersey Insurance Commissioner Robert L. Clifford issued a landmark decision on February 3, 1972 in which he delineated new rules for the regulatory determination of the appropriate level of the provision for underwriting profit and contingencies within approved rates.

The core issue for both the original case and the remand was whether the traditional[4] underwriting profit and contingency margin of 5% of premium was appropriate. Recognition was given by all sides to the fact that an insurance company also derives part of its total profit from investing the assets of the company primarily in stocks and bonds but also, to a lesser extent, in real estate. The court evidently (Clifford, p1) found the whole matter "obscure"; required that "more information" be provided on the "amount an insurer should receive as a reasonable profit"; inquired as to the origin of the 5% provision and its justification; and ordered the remand hearing to determine "what is a proper factor for profit and contingency."

It appears from Clifford's Decision (p22) that the principal criterion for weighing the "appropriateness" of the underwriting provision was "the return required on needed funds to attract and retain capital in the automobile insurance business", the so-called capital attraction standard.[5] As a total return standard, this led the parties and Clifford to consider the major subsidiary issues which must arise when judging the appropriate total return to be expected by an insurer after premiums or rates are set. Those issues, which curiously enough have resurfaced once again, twenty years later, in the hearings following the passage in 1988 of California's controversial Proposition 103, are discussed next.

2. The Issues in the Case.

As defined by Clifford (p4), the origin and justification for the traditional 5% of premium underwriting profit and contingency provision became moot by nature of the remand position taken by the industry bureau;[6] namely, that a provision for underwriting profit and contingencies be arrived at "after income from all sources, including capital gains, has been considered." Once the all-income approach is taken, several generic issues were confronted. These issues included:

1. Required rate of return recognizing income from all sources (p. 14-22);
2. Level of invested capital from which to calculate that rate of return (p. 5-12);
3. Sources and expected amounts of income from underwriting and investment (p. 12-13);
4. Risk involved in underwriting and investing so that a proper rate of return can be targeted, one that is appropriate for the risk of the enterprise (p. 6-8, 15-18).

Unfortunately, some major issues were only tangentially mentioned. These issues include:

1. Annual Statement (Book) values and their appropriateness for pricing the sometimes long term commitment of the insurance contract (p1);
2. Loss and Expense Components of the rates, their relation (above or below) to actual incurred values and their effect on the real underwriting profit expected in the rates(p9);
3. Purpose for regulation and the approved profit provision in rates. (p21-22);
4. Limitations on the extent of current knowledge and the precision of estimates of key parameters (p10, 22).

After a review of the issues decided in the case, a few words will be in order on the remaining issues.

Clifford's decision confronts the capital requirement issue first (p. 5-12). The industry's position was that the book values of policyholders surplus (assets minus liabilities) from the decade of the 1960s showed that insurer committed capital in a direct one-to-one relation to premiums written.[7] Opposition witnesses from academia[8] took a theoretical position, based upon "highly technical" theories, that insurers could count only one dollar of capital for every three dollars of written premium without danger of "failure of the insurer." After agreeing that the required capital is tied into the risk of the enterprise, Clifford laments that "the issue remains obscure with respect to an attempt to decide this matter on a mathematical or scientific basis."[9]

In a Solomon-like decision, Clifford cites an earlier New York Insurance Department report on Insurance Holding Companies,[10] creating the (artificial) concept of "surplus-surplus" and finds that a two-to-one written premium to surplus ratio should be used to determine required capital. The Holding Company Report theoretically isolated a portion of policyholders surplus which was "needed" to cover any shortfalls in provisions for losses and expenses for a "reasonable" period of time, in addition to any declines in asset values. That needed or required surplus presumably guarantees the payment of policyholder claims. Any other remaining surplus on the company books is not "needed" and is deemed surplus (extra) - surplus. Ultimately, Clifford found that insurers require a return on all of their committed surplus but at different rates for the needed vs. the un-needed portions.

In subsequent sections, Clifford finds that the rates should target after-tax returns of 3 1/2% of premium on all policyholders surplus (6% on the required surplus) after the inclusion of after-tax net investment income (no capital gains) on policyholders funds supplied through underwriting, i.e., on premium and loss reserves. This, of course, required that insurers forecast various book values for reserve and investment income levels, an adventure that Clifford left to future rate filings. In reaching his decision to target an operating return, underwriting plus net investment income, rather than a total return, Clifford discusses, but does not use, expert testimony that rates of return in the range of 12% to 16% were offered as appropriate.

3. Looking Back on the Decision.

Although the Clifford decision claims no arithmetic relationship, it seems clear that Clifford anticipated insurer's returns on all stockholder funds (one-to-one premium to surplus) at a level in excess of 12%. That return was to be made up of 7% on invested surplus, 3 1/2% on underwriting net of investment income and an unspecified amount of capital gains on the entire levered investment portfolio. The latter, even if confined as it is in the Annual Statement values almost entirely to stock capital gains, could reasonably be expected to be in excess of 1 1/2% of surplus.[11]

Except for the practical effect of providing a regulatory formula for deciding on an appropriate underwriting profit and contingency provision,[12] Clifford's Decision raised, but did not settle, any subsidiary issues. The decision did have precendential value which led to the conclusion that (1) investment income, including capital gains, mattered when setting insurance premiums; (2) the ultimate source for judging the appropriateness of the profit provision, as opposed to the overall rates, was the total return to an assumed investor in a fully equity financed stock insurance company; and (3) derivative underwriting profit provisions would differ by line of insurance and would more likely be near zero for liability coverages than near the traditional 5% level.

In wrestling with the required capital issue, Clifford cited the fact that there were wide differences in (book) premium to capital ratios for individual companies. In concluding that there must be surplus-surplus, Clifford ignored the reality of a clientele effect, i.e., different levels of capital for different organizational forms and different levels of assurances against default on claim payments. The notion of varying levels of required capital, rather than varying income levels, was missing, even as an alternative, from the Decision.[13] He also ignored the problems which arise naturally when market based concepts of risk, return and capital are discussed in relation to book (non-market) values as revealed by the Annual Statement. Only in the combined (unreal) world of no-bond trading and the (real) world of no market value for reserves will market and book values, so necessary to the discussion of concepts and numbers simultaneously, be identical. Finally, he ignored his own finding by permitting a return (1%) on company surplus funds which were deemed "unneeded".

Clifford's light treatment of risk, the essential concept in determining the appropriate level of return under any financially valid scheme [1, p. 125-201], reflected a general reluctance to confront this difficult issue. He dismissed any discussion of theories of risk and, presumably, of pricing that risk, because he found those theories "extraneous to the question before us" (p.22). One should read that statement, as so many others in the Decision, as statements made to satisfy simultaneously the court order for some action involving the profit provision and the need to preserve a viable insurance market (p.24).

Most unfortunate was Clifford's failure to deal with the ultimate purpose of an underwriting profit and contingency factor in approved rates. Under Bureau made and state approved maximum rates, as in Massachusetts, the profit provision should be set as high as feasible for the most adverse of risks so that competition in the form of downward deviations, differentiable classification based pricing, and/or policyholder dividends can find the economically efficient equilibrium values for individual rates. The actual profit outcome in this case will be lower than the provision in the rates and, with experience, can be estimated and forecast. If, on the other hand, the provision in the rates is also intended to be the expected underwriting profit sufficient enough to attract capital, then regulators must eschew the obligatory reduction of company rate requests, unless and until it is shown that the realized underwriting profit is in excess of, on average, the otherwise determined acceptable level.[14] The Massachusetts experience shows that this is an extremely difficult, if not an impossible, assumption to make about regulatory behavior in the United States (Derrig [5, Chap. 6, p. 141]).

We now turn to the market based and theoretical concepts advanced in Massachusetts under Commissioner Stone during the late 1970s.

3. THE 1976 MASSACHUSETTS CASE AND REGULATORY STANDARD RETURNS

1. The 1975 Massachusetts Workmen's Compensation Rate Case

The beginning of the Massachusetts story lies in Commissioner James M. Stone's initial decision on workers' compensation rates on May 22, 1975 [19]. For those rates, the insurance industry had filed the traditional underwriting profit and contingency provision of 2.5 percent of premiums. While most other components of the ratemaking mechanism were justified by relying explicitly on recent data for premiums, losses, and expenses, the underwriting profit provision was a fixed budgetary item seemingly buttressed only by tradition. Stone's knowledge[15] of the importance of investment income to total industry profits most likely led him to demand that the underwriting profit provision be explicitly justified as well.

The ratemaking methods Stone reviewed reflected the industry's commonly held view that investment and underwriting were separate operations. Underwriting profits would emerge from the actual experience of companies using rates with a pro forma markup on sales, the underwriting profit provision. Investment profits would arise from the management of the portfolio of all invested assets. Since total profits from investment and underwriting were at least subject to ex-post review, they would be presumed to be reasonable overall for ratemaking purposes. The underwriting profit provision used in ratemaking would then be deemed reasonable by implication. According to the industry, the process would satisfy the common statutory principle for regulatory review that "due consideration be given to ... a reasonable margin for underwriting profit and contingencies." The Massachusetts ratemaking statute (c. 90, §113B and c. 152 §52C) somewhat similarly required that "due consideration shall be given to ... a reasonable margin for underwriting profit and contingencies (and) investment income on unearned premium reserves and loss reserves...."

Stone would not accept such an indirect treatment of underwriting and investment income. He saw no reason not to mesh the traditional insurance concept of rate regulation with the concept of rate of return regulation common in other regulated sectors of the U.S. economy. The investment income question had just been considered by Clifford in the "New Jersey Remand Case," which held that New Jersey automobile insurance rates were to be computed to yield an after-tax 3.5 percent return on premiums including net investment income (no capital gains) from policyholder-supplied funds.

Stone approved the use of the 2.5 percent underwriting profit provision for workers' compensation rates in 1975 but made it clear that the ratemaking format should also change in Massachusetts to accommodate investment income. His decision stated [19]:

> To compute the true profit one must count all net gains from the insurance transaction, underwriting and investment, and compare those gains with the capital at risk in the transaction. This is the most commonly accepted rate of return measure in the relevant economic literature. While a 2.5 percent underwriting margin is not necessarily unreasonable, it is only a guess at the proper figure until this sort of calculation is made.

In order to pursue this approach, however, Stone had to deal with an important problem: namely, that the insurance commissioner had very little control over the investment operations of insurers and no control over capital market outcomes which provided the investment returns. Clifford had rather neatly sidestepped that issue in the New Jersey case by leaving the investment income determination to future rate hearings.

Stone announced that he had overcome this problem, which he characterized as "the Gordian Knot of measuring investment return in insurance." He noted the wide variation in investment results across companies and over time and concluded that actual investment policies should be ignored in favor of a simple investment policy for ratemaking purposes. He would use the concept of including income from investments in risk-free U.S. Treasury securities as a minimal attainable investment standard for making insurance rates under his total return criterion. This approach of using virtually riskless Treasury investment returns, together with the applicable corporate tax rate, became known as the "regulatory standard" company approach. Stone warned the industry to be prepared for his version of total return regulation for all future rate decisions.

2. Stone's 1976 Automobile Decision

The calculation of an appropriate underwriting profit provision for automobile insurance became an area of acute controversy in Massachusetts with 1976 Bodily Injury Liability Coverage Rate Decision issued by Stone in November 1975. Stone implemented the total return concept by "finding that level of underwriting profit allowance which, if earned along with minimum reasonable investment results, would produce for the average carrier a rate of return on capital equal to that achieved by a typical non-regulated firm of similar risk characteristics."[18] In other words, if he could set an overall target return in some fashion, the underwriting profit provision would simply be chosen to yield the difference between the total return target and the risk-free investment return.

For 1976 rates, Stone adopted the concept of requiring total return to be calculated separately for bodily injury liability and property damage coverages based upon a judgment of the overall risk of the "regulatory standard" company. For the bodily injury liability decision, he used a recent average return for 850 of the largest U.S. corporations plus some upward adjustment to account for the increased riskiness of the insurance sector during inflationary times because of "slow-pay" losses.[17] In his property damage decision later that same year, Stone agreed with expert witnesses at the hearings who suggested that the Capital Asset Pricing Model (CAPM) could provide the necessary measure of risk for calculating the target rate of return. The theoretical and empirical underpinnings of the CAPM beta to be used, however, appeared to be weak. These two hearings produced underwriting profit provisions of -4 percent for bodily injury coverages and 5 percent for property damage coverages.

Stone's model formula was ad hoc but simple and patterned after the calculation of accounting returns. He proposed that the following equation be satisfied prospectively using currently available data:

$$r = (1 - t)[sp + r_f + sR(1 - p)]$$

where

r = the target (total) rate of return
s = the premium-to-capital ratio
t = the tax rate
r_f = the risk-free rate
R = a discount factor from cash flow
p = the underwriting profit provision

Stone's formula includes the major parameters necessary to solve for the underwriting profit provision as the balancing unknown. The parameters included a cash flow schedule; an investment rate; an overall federal tax rate; invested capital both as a base for the total rate of return and as a measure of the leverage of the cash flow from premiums; and a measure of total risk in the formulation of the target rate of return. Stone had made "crude" estimates of the model and parametric inputs. In its approval of his methods, the Massachusetts Supreme Judicial Court warned that this imprecision might not be acceptable in future rate cases (Mintel [15] p. 191).

4. THE FAIRLEY MODEL AND MARKET RETURNS

1. Problems With Accounting Based Models

Theoretical drawbacks were apparent both in the Clifford - New Jersey methodology and in the Stone - Massachusetts procedure for determining an underwriting margin. Clifford's view used an arbitrary and unswerving target return for underwriting (3.5%) together with an adjustment based upon book value investment returns on reserves. Moreover, investment returns on individual assets had to be parsed retrospectively into policyholder returns (income) and shareholder returns (capital gains). Stone's view used a hypothetical regulatory standard company in which all investment income from risk-free securities contributed to an overall total return on invested capital. Neither view confronted the obvious question of how to accommodate prospectively the myriad possible configurations of actual company investment portfolios for which market returns are expected to be earned. The capital asset pricing model (CAPM) provided a neat trick for Fairley to finesse that important question.

2. The CAPM Contribution

In his Opinion, Findings, and Decision on 1978 Automobile Insurance Rates, Stone adopted the methodology proposed by William Fairley and filed by the State Rating Bureau (SRB).[18] Fairley's method employed the CAPM in an attempt to develop a consistent relationship between the assumptions of cash flow, investment, and capital structure, on the one hand, and the treatment of risk on the other. The SRB suggested and Stone agreed to underwriting profit provisions of -4 percent on bodily injury coverages and 2 percent on property damage coverages for 1978 rates.

The central principle of the CAPM is that risk is divisible into systematic (market-related and nondiversifiable) and unsystematic components but that a risk premium is due the investor only for systematic risk.[19] The CAPM rate of return equation is

$$r = r_f + \beta(E(r_m) - r_f]$$

where

r = the required rate of return for a given asset
r_f = the risk-free rate of return
r_m = the rate of return on the market portfolio of risky assets
β = a measure of the asset's systematic risk, which is defined as $cov(r, r_m)/var(r_m)$ where cov( ) denotes covariance and var( ) denotes variance. E( ) denotes expected value.

Fairley's methodology used principles derived from the CAPM to impute income to the regulated company.[20] The company's target return on equity was presumed to be the risk-free rate adjusted for the levered riskiness of investments and underwriting, the latter by an "underwriting beta" which had to be measured indirectly.[21] The CAPM also was used to estimate the investment income that companies should expect to earn.

Fairley used the CAPM to estimate both expected total return on equity and expected investment return. As a result, in theory, the Fairley model's equilibrium underwriting profit margin did not depend on the risk of the company's investment portfolio. That underwriting margin is given by (Fairley's equation 11a):

$$p = -kr_f - k\beta_L[E(r_m) - r_f] + \left[\frac{t}{(1-t)s} \; r_f \right]$$

where

- p = the underwriting profit margin
- k = a measure of the availability of investable policyholder funds, which is roughly equal to the ratio of reserves to premiums
- r_f = the risk-free rate
- β_L = the underwriting profit beta for the line of insurance
- $E(r_m)-r_f$ = the market risk premium
- t = the overall effective federal tax rate
- s = the premium-to-surplus ratio

In words, the underwriting profit margin reflects a credit for the investment income on policyholders' funds that is offset by an expected reward for the risk of underwriting (negative beta) and by an allowance for federal income taxes. Fairley's use of the CAPM had replaced retrospective book returns with prospective market returns, a more palatable concept for financial economists, if not insurers.

The use of this model, or slight variations, produced expected underwriting profit provisions for Massachusetts automobile insurance rates ranging from +2.3% to -5.3% from 1977 to 1980.

Although the target return/investment return question is seemingly resolved, by using the CAPM, major problems arise with the Stone-Fairley CAPM application. First, the method totally relies upon the unobservable CAPM underwriting beta to load the premium for the risk borne by the exposure of insurer's equity capital. Major difficulties are encountered in any attempt to induce the elusive market beta from insurer's accounting returns matched with asset market returns (Cummins and Harrington [6]). Second, the method intrinsically relied for underlying structure on a one-period total rate of return model. Since the life of the insurance contract is multi-period, approximate methods had to be used to force multi-period market cash flows into book accounting one-period flows, thereby masking the essential structure of the contract. Surplus requirements, an essential area of contention from the beginning of the Clifford proceedings, were erroneously considered as a one-period constant rather than as the life-of-the-policy commitment that is necessary. Finally, disenchantment with the ability of the CAPM to explain fully the returns of asset markets over time led to questioning the use of the CAPM to infer returns for non-traded insurance contracts. All of those problems led to the development in Massachusetts, and elsewhere, of multi-period alternatives to the Stone-Fairley model.

5. MULTI-PERIOD DISCOUNTED CASH FLOW MODELS.

1. Rate of Return Versus Present Value

Two kinds of financial models have been used in regulation of Property-Liability lines in the United States, rate of return and present value models. A **Rate of Return Model** seeks to determine the rate of return on those insurance contracts (the underwriting profit) as that residual profit needed in order that the rate of return on investments plus the underwriting profit equal an appropriate rate of return on the equity invested to underwrite those contracts. Rate of return models are most naturally applicable in a one-period context with the central valuation taking place at the end of the period. For actuarial pricing purposes, since most insurance contracts expect multi-period payments of claims, the simple rate of return model must be reset for the multi-period context to be practical. That simple model is necessarily an approximate or accounting method. Of note is the fact that the Fairley model combines the general rate of return approach with a specific financial rate of return model (CAPM). This results in an equilibrium solution matching the investor's expected return on equity with the insurance company's expected return on operations. The underwriting profit margin is a residual.

A **Present Value Model**, on the other hand, deals directly with the multi-period context by simply equating the present value of the premium payments with the present value of all loss, expense and tax payments. The present value model developed for Massachusetts by Professors Myers and Cohn [5, Chap. 3], and adopted for ratemaking in 1981, highlighted two additional requirements for insurance contracts. First, the present value of losses and expenses must be calculated using a discount rate adjusted for risk. This results in using a discount rate somewhat higher than the prevailing risk-free rate in order to load a positive expected profit. Second, the actuarial premium must contain a provision for the present value of <u>all</u> federal income taxes, taxes on both investment and underwriting income. The inclusion of taxes is of the utmost importance for real applications of these models. For a general discussion of present value versus rate of return models see Brealey and Myers [1, Chap. 5].

2. <u>The Myers/Cohn Model</u>

The Myers/Cohn model is based on the fundamental principle that a fair premium is equal to the present value of the anticipated losses and expenses that must be paid, plus the present value of the income tax liabilities generated by the writing of the policy. The present value of the losses and expenses are estimated by discounting them from the expected date of payment to the present by a risk adjusted discount rate. The discounting procedure accomplishes two things. It credits the policyholder with investment income at the risk-free rate on premium, from the date of receipt of the premium by the company to the date of payment of the losses or expense on the policy. Income is credited to the policyholder at the risk-free rate reflecting the fact that the policyholder does not share in the asset risk inherent in the company's investment decisions. In addition, the discounting process recognizes the compensation that must be paid to shareholders for accepting the risk of engaging in the insurance business, apart from the investment risk associated with the company's portfolio decisions. This underwriting risk is currently measured rather crudely in Massachusetts, in accordance with the capital asset pricing model (CAPM), by the beta of liabilities. This risk is assumed to be the same, per dollar of outstanding liabilities, in each quarter until all losses on the policy are paid. This strong assumption is necessitated by the crude methods used in the past to estimate a risk premium by means of CAPM. However, nothing in the Myers-Cohn model requires that the risk adjustment be derived from CAPM or any other particular theory; they only require that the risk adjustment be the market determined value of the underwriting risk.

Second, the model recognizes that a fair premium must include the present value of the income tax liabilities generated by writing the policy. These tax liabilities include the tax on underwriting income, and the tax on the investment income earned on the assets, whether purchased with funds supplied by policyholders or by shareholders, required to guarantee the company's obligations on the policy. The tax on underwriting income may be positive or negative, depending on whether the underwriting profit provision in the rates is positive or negative. If it is negative, it can be used as a credit against the positive taxes on the investment income, thus reducing the premium that would otherwise be required.

The tax on the investment income on premium funds is a necessary cost of writing insurance which must therefore be included in the fair premium. The tax on investment income on the assets provided by the shareholders is also properly included in the fair premium, because insurance companies pay additional taxes on that investment income, which shareholders would not have to pay if they invested those funds personally. To induce shareholders to invest in an insurance company, they must receive the same risk-adjusted return as they could earn on any other investment.

Thus, the fair premium includes (1) the amounts necessary to pay all expected losses and expenses on the policy, discounted to present value to reflect the investment income that can be earned on those funds before the losses and expenses are paid; (2) compensation to the shareholder for the risk of investments which the shareholder alone bears; and (3) a provision to pay the taxes that a company must pay by virtue of being in the insurance business.

One essential observation that arises from the consideration of a multi-period model is the insurer's commitment of surplus, or underlying capital, during the entire life of the contract. Crude premium to surplus rules, such as invoked in an ad hoc manner by Clifford at two-to-one, do not translate directly to the multi-period context. Myers and Cohn recognized in setting the asset balance each period that an amount of surplus must be committed approximately equal to a fixed proportion[22] of the discounted value of outstanding liabilities. Since the promise to pay all claims is renewable each period (in a market-driven context think of loss portfolio transfers for run-off liabilities), the required surplus commitment must be expected to be renewed when setting the initial premium. This simple observation, based on standard financial principles (constant debt/equity ratio for equivalent projects), leads to accounting (book) allocations of capital more or less in line with New York Regulation 70 than with the fixed all-lines surplus commitment in the one-period rate of return model assumptions of Clifford, Stone, and Fairley.

A second observation by Myers is crucial in the implementation of the present value of the tax portion of the model. Myers showed, in the 1985 Massachusetts automobile rate hearings, that the present value of the tax on investment income does not depend upon the risk of the securities held by the insurance company. It depends only on the risk-free interest rate and on the effective tax rate. This has become known as the Myers Theorem (Derrig [12]).

3. <u>The NCCI Internal Rate of Return Model</u>

As Cummins [4] points out, the insurance contract can be priced by adopting a perspective. From the perspective of the policyholder, valuation of all cash flows between the company and, or on behalf of, the policyholder results in a consistent model for pricing. The Myers-Cohn model adopts this policyholder perspective. The alternative perspective to adopt is that of the shareholder. Valuation of all the cash flows between the company and the shareholder (the infusion of surplus and the receipt of dividends) also leads to a consistent model for pricing. The National Council on Compensation Insurance (NCCI) has adopted [23] the shareholder perspective in using an internal rate of return model for their pricing purposes.

Briefly, the NCCI approach sets up a multi-period cash flow model of surplus inflows, underwriting investment, and tax flows within the company for a policy cohort, and shareholders dividend flows from the excess of expected assets over expected surplus commitments each period. An internal rate of return is calculated from the net flows of surplus commitments and shareholder dividends. These flows will change depending, among other things, on the underwriting profit and contingency provision assumed for the underwriting flows. The calculated internal rate of return is then compared, as in capital budgeting problems, to an otherwise determined target or "fair" rate of return for the riskiness of the line of insurance under consideration. The underwriting profit and contingency provision is judged "fair and reasonable" if the resulting internal rate of return is judged reasonable by some external standard (such as CAPM, Gordon Growth Model or some other financially based market model).

While both multi-period models, Myers-Cohn and NCCI internal rate of return models, incorporate proper surplus flows over the life of the policy, the levels of those commitments remain an area for fruitful future research.

Alan Kraus and Stephen A. Ross ([5, Chap. 5]) derived a multi-period contingent claim model in a 1982 paper in the Journal of Finance. In that paper, Kraus and Ross examined single and multi-period models both under certainty and stochastic constraints. As far as incorporating the financial evaluation of risk, the authors apply the Arbitrage Pricing Theory (APT) model developed by Ross to the insurance context. Kraus and Ross find that since competitive premia are denominated in current dollars, they will rise with inflation. Real rates of interest also play a fundamental role in their model. Further exploration of the contingent claim approach with notions from options pricing theory are considered next.

6. THE USE OF OPTIONS PRICING THEORY

1. The Rationale for Options in Insurance

If we think about it, the insurance contract is quite like a collection of options. Financial options, like puts (the option to sell) and calls (the options to buy) on stocks, are distinguished by their all-or-nothing like payoffs. If, for example, I have a call option to buy IBM for 125 tomorrow, it will net me one dollar for each dollar that IBM is above 125 and nothing for each dollar IBM is below 125. For the right to this option, I presumably paid some premium to acquire that right sometime in the past (usually 90 to 180 days). And I can trade any well known financial options I have in the open options markets at market-determined prices.

Likewise, several options come into play in the insurance policy. Two examples should suffice for this purpose. First, if we think about an ideal insurance transaction, the insured pays the risk premium as the price of the put option he acquires to sell the insurers' assets (including the equity capital) in the case that the insured's claims[24] exceed the expected amount of claims (the risk-premium-free policy premium). Meanwhile, the insured implicitly retains a put on his own (non-premium) assets to sell them in the case that his claims exceed the combined insured/insurer assets, the assets of the company. If this view of the insurance contract is appropriate, and I believe it is, then there is no single answer to the required capital question raised by Clifford in 1972 and California regulators in 1989. Rather, there is a fair premium level to be charged for every level of capital commitment; the higher the surplus commitment, the higher the value of the put option purchased by the insured, and, therefore, the higher the necessary fair premium level. Although this concept is rigorous and correct, like other financial models before it, the Options Pricing Theory (OPT) models bring substantive parametric measurement problems with them.

2. Two Approaches Using Options Pricing Models

Recently, both Cummins [8] and Doherty and Garven [12], have proposed that option pricing theory can be used to determine risk loadings appropriate for insurance contracts. Those studies provide somewhat differing views of the insurance process but each eventually adapts some rather sophisticated notions underlying the financial theory of contingent claims to provide a natural setting for the pricing of insurance and reinsurance contracts. Doherty and Garven prefer to work with a discrete model while Cummins chooses to adapt a continuous model. Both employ normality assumptions for tractability. At bottom, however, their common central view is that the insurance contract provides policyholders with a priority claim on the insurance company's assets (premiums and surplus) in return for a "fair" premium. Intuitively, it then follows that the more assets the company has to satisfy the policyholders claim (the more surplus contributed by shareholders), the more valuable the policyholders claim becomes and the larger the "fair" premium should be. The contingent claims view may provide, therefore, the essential analytic and structural dependence of the premium upon the surplus provided by the company rather than a mere tangential dependency on surplus for including the tax liability in the fair premium, as in the earlier Fairley and Myers-Cohn models.

The options approach by Doherty and Garven [13], is driven by a desire to circumvent the need for direct estimation, as in the case of the Fairley underwriting beta, of the risk premium embedded within the fair price for the insurance contract. They apply the concept of risk neutral valuation of the policyholders contingent claim on the insurer's assets in order to derive the competitive price of the contract and, derivatively, the fair rate of return on equity. Superimposing the necessary option that the government also has on the insurer's assets by virtue of its taxing authority, the authors use the same criterion as Myers and Cohn - the value of the investor's claim on the assets, immediately after the insurance transaction is executed, is the same as the transaction free value of the invested capital - to produce a market driven equilibrium "fair" premium. Separate equations for the insured's option and the government tax option combine to yield a premium solution which depends upon (1) the level of equity commitment (a desirable feature); (2) the variances and covariance of investment and underwriting returns (solace for the industry side of the 1970 New Jersey Remand Case); (3) the marginal corporate tax rate, and the effective tax shield for company investments; and (4) the riskless rate of interest. This formulation views the required rate of return as consisting of three parts (1) the return required in a risk-neutral world without default and tax shield redundancy; (2) the return for bearing systematic risk in a default-free setting; and (3) a premium to compensate for default risk (the insured's retained put option above) and tax shield redundancy, better known as net operating losses (NOLs).

In Cummins's policy cohort model ([3] and [8], p. 283-302) the asset liability process is assumed to be generated by two simultaneous geometric Brownian motion processes with drift.

$$dA = (r_A A - \theta L)dt + \sigma_A A \, dZ_A$$

$$dL = (r_L L - \theta L)dt + \sigma_L L \, dZ_L$$

Where assets A, invested in marketable securities, continually change according to the returns on those invested assets r_A, less the claims payment θL, subject to a random disturbance term with variance parameter σ^2. Liabilities, at some point $\tau = \tau_0$ in the process, also continually change at some rate r_L, less the claim payment θL, subject to its random disturbance term with variance parameters σ_L^2. Further, it is assumed that all liabilities (claim payments) are paid through a claim on the assets A, available to the policy cohort, plus other assets (not included in A) for which a premium Π (A,L) must be paid.

Cummins derives a tractable solution by using the Ito calculus together with the assumptions that

Π reflects only systematic risk.

Systematic risk of liabilities is zero, and

$\Pi(A,L) = \pi(x)\, L$, with $x = A/L$.

These assumptions allow the reduction of the diffusion equations to an ordinary 2nd order linear differential equation in x, the asset/-liability ratio,

$$\pi(r-r_L+\theta) = \pi_X[x(r-r_L+\theta) - \theta] + 1/2\ x^2\ \pi_{XX}\ (\sigma_A^2 + \sigma_L^2)$$

where
- r = risk-free rate, assumed constant
- r_L = rate of return on liabilities, assumed constant
- θ = rate of payment of liabilities, assumed constant
- σ_A^2 = variance of returns on assets, assumed constant
- σ_L = variance of returns on liabilities, assumed constant

With suitable boundary conditions, the fair premium level is given (approximately) by the value of the risk premium, $\pi(1)$, at an asset/liability ratio of unity (the policyholders pre-insurance condition). In the case that the contract is not fully guaranteed, it would be appropriate to deduct the premium $\pi(x)$ for x equal to the asset/liability ratio of the default-possible insurer.

The analytic shape of π is given as follows.

(Diagram #1 here)

3. Implications from the OPT Approach

The useful descriptive resolution of long standing problems (capital requirements, fair rates of return, risk premium) via the OPT approaches is quite appealing. Risk, capital structure and return are all put into the kind of consistent structure where they belong as equilibrium financial model components. Derrig [8] used the Cummins policy cohort model together with underwriting parameters derived from Massachusetts automobile and workers compensation lines of insurance to conclude that, except for physical damage, the New York Regulation 70 premium to capital ratio for automobile and workers compensation were reasonable and that risk premia, as a percent of the present value of liabilities, on the order of 3% to 12% could be appropriate for given levels of underwriting and regulatory[25] risk. Despite apparent shortcomings, most notably the inability to explain the derivation of the equilibrium solution to non-experts (recall Clifford's disdain for theoretical formulae), the application of OPT remains the most promising framework for understanding and valuing the insurance contract.

7. OUTLOOK FOR THE FUTURE

1. The California Rediscovery

On November 8, 1988, California voters approved a ballot initiative known as Proposition 103 which, among other things, mandated a rollback in rates for automobile insurance and some other lines to a level 20% below the level existing one year earlier, November 8, 1987. The ballot initiative also provided for a one year rate freeze unless the insurer was "substantially threatened with insolvency." Subsequent to the one year period, rates could be changed only under a prior approval system with a key change in the criterion for approval.

This setting of financial policy and prices by popular vote violated the insurers rights to due process under the State and Federal Constitutions. Such a decision was handed down on May 4, 1989 by the California Supreme Court (CALFARM INS. CO. v. Deukmejian 258 Cal. Rept. 161 (Cal 1989)) which found that the "Insolvency Standard" was unconstitutional on its face. While the rollback (to 1987) and reduction (20%) were not invalid per se, they were subject to the right of the insurer to demonstrate a particular rate was confiscatory. The Court said it was not concerned with the way rates were set but with whether the result was confiscatory, i.e., not fair and reasonable. The Court reaffirmed that the capital attraction standard of the Hope Decision would stand for the purpose of determining a fair and reasonable opportunity for a return on invested capital commensurate with the risk of the enterprise. In discarding the year-long rate freeze the Court said that, considering the difference between rates which may be the result of current competition (de facto fair) and rates mandated to be 20% below a prior rate level, insurers must be given "an adequate method for obtaining individual relief" from rate which are confiscatory.

The two events of the approval of Proposition 103 and the subsequent Court Decision have created a regulatory review of individual by-line-by company rates unprecedented in U.S. regulatory history. Prior to Proposition 103, the rate statute prohibited inadequate, excessive or unfairly discriminatory rates, but said that a rate in a competitive market could not be held excessive. This latter provision provided for the fiercely competitive California Auto Insurance market prior to the ballot initiative.[26] Under Proposition 103 (1861.05(a)) the standard rate adjustment became "(n)o rate shall be approved or remain in effect which is excessive, inadequate, or unfairly discriminatory. In considering whether a rate is excessive, inadequate or unfairly discriminatory no consideration shall be given to the degree of competition and the commissioner shall consider whether the rate mathematically reflects the insurance company's investment income." Finally, the Court admonished, and the Department of Insurance picked up as a standard for review, "(O)ver the long term the state must permit insurers a fair return ... "

Since the announcement of procedures and schedules for review (the May 11, 1989 announcement set June 3, 1989 as a deadline to file for a review of rates from the rollback and reduction levels), a total of 443 of 724 licensed insurers had filed for exceptions from the rollback by July 3, 1989. Hearings on those company petitions, and on Department-ordered rate reductions, continue as of this writing. Early forms and schedules hinted that Clifford-era book calculations would be required for review. Later information showed the possibility of using some of the financial models discussed above. Unfortunately, the Department, in order to dramatize the fact that they might order rate givebacks,[27] unilaterally and arbitrarily set the rate of return guildline at 11.2%, given a premium to surplus leverage ratio of three to one (recall Clifford). The return level of 11.2% was a 15 year historical average. (The "long term" of the Court's criterion). As an ex-post average, it will only coincidentally be fair as an ex-ante target return, especially when applied with an abnormally low leverage ratio. All of these issues are expected to be thrashed out, as they have been in Massachusetts, during long, complicated and contentious hearings. We await with you, the discoveries and rediscoveries of issues and solutions.

2. An Application to Pricing the Tax Reform Act of 1986

While the California situation will simmer and, perhaps, produce interesting developments between this writing and the AFIR Colloquium, there are several general observations to be made on current and future progress. One might be left with an impression that the development of financial models represents only regulatory or academic exercises. To dispel that notion one important real-life application should be noted.

The Tax Reform Act (TRA) was signed by President Reagan on October 22, 1986. It has set in motion changes to a great many parts of the federal tax code. An analysis of the text of the new tax law, examples of how the tax burden will be calculated, and an analysis of investment strategies were all covered nicely in a May, 1987 CAS discussion paper by Owen Gleeson and Gerald Lenrow [14]. The pricing effects of the changes will all be felt in the calculation of the underwriting profit provision, a calculation not necessarily left to the actuary, but one which can readily be evaluated using a financial model for pricing.

The Myers-Cohn model described in a prior section is flexible enough, while handling the tax liability in a full and proper fashion, to allow calculations and comparisons using alternate tax codes. Those calculations were performed for Massachusetts Automobile and Workers' Compensation rate filings to be effective in early 1987, the first year of implementation. The sum of the effects of the tax code changes on Massachusetts Private Passenger Automobile Insurance in 1988 was to raise the otherwise-determined overall underwriting profit provision from -7.8% to -6.3%. This increase of 1.5% results from the direct incorporation of the Reform Act Provisions relating to (1) the inclusion in taxable income of a portion of the unearned premium reserve, the so-called "revenue offset"; (2) the inclusion of Loss Reserve Discounting for incurred losses and expenses; and (3) the corporate tax rate change to 34% for taxable years beginning July 1, 1987. The changes to the deductibility, for regular tax purposes, of stock dividends and tax-exempt income, so-called "proration", is included in the calculation of the investment tax rate.

Dramatic differences were seen in the effects of the individual tax code changes by line of insurance. While claim payout patterns for Massachusetts automobile are about like the countrywide all lines patterns, those patterns for Massachusetts Workers' Compensation were quite a bit longer. The following results were calculated by line.[28]

TRA Changes

		Auto	WC
1.	Tax Rate Changes	+0.5%	+1.5%
2.	Discounting Reserves	+0.2%	+2.7%
3.	Revenue Offset	+0.8%	+0.8%
4.	Total	+1.5%	+5.0%

Interpreting these results for their countrywide implications yielded an overall estimate of the increase in tax burden of more than $3 billion per year, more than double the estimate made by Congress. That estimate was confirmed recently by a retrospective detailed survey of actual 1987 taxes of major property-liability insurers conducted by Price Waterhouse.

3. Looking Forward

Several promising areas of inquiry have been opened toward the understanding of the financial underpinnings of the insurance contract. Several of the major developments were discussed in earlier sections. The recent book by Neil A. Doherty and Stephen P. D'Arcy [10] provides a useful and readable review of the foundations. Other fruitful avenues of inquiry have been pursued in conjunction with the first and second International Conferences on Insurance Solvency.[29] Although all published contributions from the Conferences are worthy of your review [7, 8, 9], let me highlight a few of them not already mentioned above.

A major area of study has been the development of larger scale technically complex cash flow modelling schemes. Pentikainen [7], Coutts and Devitt [8], the U.K. Solvency Working Party of the Institute of Actuaries [8, 9] and Paulson and Dixit [8] all make substantial contributions to the emerging techniques of cash flow reporting and evaluation. Summary reviews of solvency concepts and methods by Taylor and Buchanan [7], as well as Kahane, Tapiero and Jacques [8], combined with new insights provided by the application of Agency Theory by Garven [8] and regulatory policy by Doherty [8] all help to illuminate a critically important research area.

Contributions to the second ICIS conference [9] by D'Arcy and Garven in testing the validity of the financial models, Butsic in estimating risk premia for loss reserve discounting, Taylor in analyzing underwriting cycles and Cummins in evaluating the effect of capital structure on pricing also provided valuable progress in understanding and technique.

Of central importance to the upcoming ICIS-3 conference in 1991 will be the allocation of capital to lines of insurance. This problem, as well as the other interesting actuarial, statistical, finance and accounting problems, should provide opportunities for AFIR participants to contribute to the expanding frontiers.

NOTES

1. If you can't imagine that your own personal auto policy is risky to you as the insured then think of your company as an insured when it reinsures some of its direct business. The risk to your company is whether the reinsurers will pay, a very real problem in today's markets.

2. The Clifford Decision rejected the historic ratio of one dollar of written premium to one dollar of net worth of an auto insurance company by declaring only half the surplus was "needed" while the other half was "surplus-surplus."

3. The filings were made by the National Bureau of Casualty Underwriters (NBCU) and the National Automobile Underwriters Association (NAVA). Both merged in 1968 into the Insurance Rating Board (IRB).

4. Tradition traces the 5% underwriting profit back to 1921 where the decision was made by the National Convention of Insurance Commissioners to keep underwriting and "banking" or investment profits separate and to set the underwriting profit at 5% plus 3% for "conflagrations," [16, Vol. I, p. 27, 28].

5. The source of the capital attraction standard that is most often cited is Federal Power Comm'n v. Hope Natural Gas Co., 320 U.S. 591 (1944). "By the (Hope) Standard, 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" (See also CALFARM v. Deukmegian, 258 CAL Rept. 161 (CAL 1989) 167 ftn. 9).

6. The industry bureau (IRB) position was presented by Dr. Irving H. Plotkin and Dr. Emilio C. Venezian of the consulting firm of Arthur D. Little, Cambridge, Ma.

7. The net written premium to surplus ratio for the decade 1978-1987 was about 1.9 (book value).

8. Clifford specifically cites the testimony of Professors James D. Hammond and Alfred E. Hofflander.

9. For a review of the "science" of required capital since that time see Derrig [8].

10. Report of the Special Committee on Insurance Holding Companies to the Superintendent of Insurance of the State of New York, February 16, 1968.

11. Historical stock market returns were about 8 to 9% in excess of Treasury Bill rates, according to Ibbotson and Sinquefield (See Fairley in [5]). With Treasury Bills yields about 4% in the 1960'2 and stock dividends at about 4-6% on about 1/4 of the assets, that would leave about 6-9% for the expected capital gain component.

12. The New Jersey formula became 3.5% minus net after-tax investment income without capital gains, all put on a pre-tax level by dividing by one minus the marginal corporate rate, which at the time was about 50%. This evolved into the so-called ISO State X method cited by the NAIC in the early 1980s [16, Vol. 1, 106-108].

13. It took until 1975 for New York Regulation 70 to suggest that capital be allocated in different proportions to different lines of insurance. See Derrig [8, p. 305-307].

14. An alternative, which is at odds with free capital market theories but which provides an asymetric assurance to regulators, is ex-post excess profits regulation. See C. A. Williams in [20] for the New York model.

15. Stone served as Commissioner of Insurance in Massachusetts from 1975-1979. His academic background in economics, finance, and insurance qualified him to consider the investment income issue.

16. This concept, as contained in his 1976 automobile rate decision (p. 25), was designed to conform with the criterion in the landmark utility regulation case, Federal Power Commission v. Hope Natural Gas Company, 320 U.S. 591 (1944).

17. The target return for bodily injury liability coverages had a judgmentally added 1.5 percent to guard against "inflation risk" and "unforeseen economic contingencies." Stone's original target rates of return were based upon returns earned by other comparable nonregulated companies on their total capital rather than their equity capital. The use of total capital was criticized in the Massachusetts Supreme Judicial Court's 1976 decision.

18. The SRB was created in 1976 by the Massachusetts Legislature at Stone's request in order to provide additional actuarial expertise to the Division of Insurance and to monitor the competitive rating system. The SRB made a complete filing for 1978 and subsequent rates, usually in opposition to the industry proposal.

19. For background on the CAPM, see for example, Brealey and Myers [1].

20. For a more extensive explanation of this methodology, see Fairley (1979), which is reprinted as chapter 1 of Cummins and Harrington [5].

21. Security betas commonly are measured by regressing the observed rate of return of the security on the rate of return on a market proxy. Because an underwriting security does not trade in an open market, the betas of underwriting must be measured in a different fashion. See, for example, Hill and Modigliani (1981), a revised version of which is included in Cummins and Harrington [5, Chap. 2].

22. The fixed proportion is tied in the Myers-Cohn formulation to a constant per period risk-adjustment. If varying risk adjustments were appropriate over the life of the contract then varying surplus commitment proportions would also be appropriate. No such varying risk adjustments are known buy they are theorized to exist (Hill and Modigliani [5, Chap. 2, 46-48] and Kraus and Ross [5, Chap. 5, 115]).

23. The NCCI internal rate of return model, as well as the New York Compensation Board IRR model [18], was developed with contributions from company actuaries (Richard G. Woll and Claus Metzner) and Council economists (John D. Worrell and David Appel).

24. More realistically would be the case that all insureds' claims collectively exceed the insurer's assets and that each insured shares in some proportion in that excess.

25. Clifford's decision [2, p.21] blamed "bad ratemaking" for any past shortfalls from targeted profit levels as he dismissed the need for any "contingency" margin. The Massachusetts experience (Derrig [5], p. 141) clearly shows that "bad regulation" can also play an essential role in affecting a shortfall.

26. California Department of Insurance figures released in a press conference on August 1, 1989 showed that during 1987 auto insurers lost about 2.7% of premium after the consideration of investment income.

27. Curiously enough, the DOI formula for givebacks calculated large excesses in rates of returns for earthquake insurance in 1988. Will the DOI allow the large inadequacy in 1989 earthquake rates to induce givebacks on the part of the policyholders?

28. Detailed calculations are available from the author.

29. Conference Convenors included Stewart Coutts (UK), Teivo Pentikainen (Finland), Gregory C. Taylor (Australia), J. David Cummins (US), Alfred S. Paulson (US), Richard G. Woll (US) and the author.

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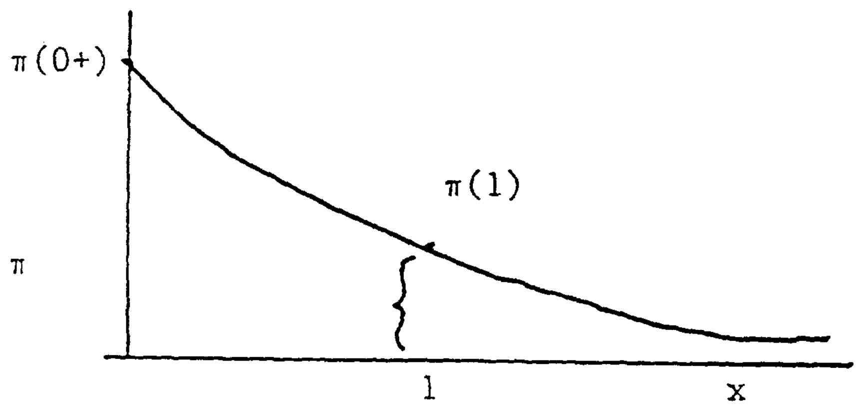
Richard A. Derrig
The Development of Property-Liability Insurance
Pricing Models in the United States 1969 - 1989

Diagram 1



π(1) IS THE RISK PREMIUM FOR A FULLY GUARANTEED CONTRACT