The Financial Modeling of Property/Casualty Insurance Companies

by Douglas M. Hodes
Tony Neghaiwi, FCAS
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Sholom Feldblum, FCAS, ASA

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Abstract

This paper describes a financial model currently being used by a major U.S. multi-line insurer. The model, which was first developed for solvency monitoring purposes, is now being employed for a variety of internal management purposes, including (i) the allocation of equity to corporate units, thereby allowing measurements of profitability by business segment and by policy year, as well as analysis of the progression of "free surplus," (ii) the analysis of major risks, such as inflation risks, interest rate risks, and reserving risks, that have heretofore been difficult to quantify, and (iii) consideration of varying scenarios on the company's financial performance, both of macroeconomic conditions as well as of the insurance environment.

This paper begins with the genesis of the model and with its structure. It moves on to equity considerations and to performance measurement. It then discusses the major risks that have heretofore resisted actuarial analysis, such as interest rate risk (inflation risk), reserving risk, and scenario testing. The paper shows how cash flow financial models can deal with global risks that simultaneously affect various aspects of the insurer's operations, delineating the resulting changes in the company's performance.

The Financial Modeling of Property-Casualty Insurance Companies

(Authors)

Douglas M. Hodes is a Vice President and Corporate Actuary with the Liberty Mutual Insurance Company in Boston, Massachusetts. He oversees the Corporate Actuarial and Corporate Research divisions of the company, and he is responsible for capital allocation, financial modeling, surplus adequacy monitoring, and reserving oversight functions.

Mr. Hodes is a graduate of Yale University (1970), and he completed the Advanced Management Program at Harvard University in 1988. He is a Fellow of the Society of Actuaries, a member of the American Academy of Actuaries, a member of the American Academy of Actuaries Life Insurance Risk-Based Capital Task Force, and a former member of the Actuarial Committee of the New York Guaranty Association. Before joining Liberty Mutual, Mr. Hodes was a Vice President in Corporate Actuarial at the Metropolitan Life Insurance Company, where his responsibilities included the development of a life insurance financial model.

Mr. Hodes is the author of "Interest Rate Risk and Capital Requirements for Property-Casualty Insurance Companies" (with Mr. Sholom Feldblum) and of "Workers' Compensation Reserve Uncertainty" (with Dr. Gary Blumsohn and Mr. Feldblum). These papers apply actuarial and financial techniques to quantify risks associated with interest rate movements and with unexpected reserve developments. In addition, Mr. Hodes is a frequent speaker at actuarial conventions on such topics as dynamic financial analysis and risk-based capital.

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Tony Neghaiwi, FCAS, is an Associate Actuary with the Liberty Mutual Insurance Company, where he is responsible for the development and the maintenance of the model described in this paper.

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Dr. *J. David Cummins* is the Harry J. Loman Professor of Insurance and Risk Management and Executive Director of the S. S. Huebner Foundation for Insurance Education at the Wharton School of the University of Pennsylvania. Dr. Cummins' primary research interests are the financial management of insurance companies, the economics of insurance markets, and insurance rate of return and solvency regulation. He is the editor of the *Journal of Risk and Insurance* and past president of the American Risk and Insurance Association and the Risk Theory Society.

Dr. Cummins has written or edited fourteen books and published more than forty journal articles in publications such as the *Journal of Finance*, *Management Science*, the *Journal of Banking and Finance*, the *Journal of Economic Perspectives*, the *Journal of Risk and Uncertainty*, and the *Astin Bulletin*. Among his recent publications are "Insolvency Experience, Risk-Based Capital, and Prompt Corrective Action in Property-Liability Insurance," *Journal of Banking and Finance* (1995); "Pricing Insurance Catastrophe Futures and Call Spreads: An Arbitrage Approach," *Journal of Fixed Income* (1995); and "Capital Structure and the Cost of

Equity Capital in Property-Liability Insurance," *Insurance: Mathematics and Economics* (1994). His paper, "An Asian Option Approach to Pricing Insurance Futures Contracts," was awarded the Best Paper prize at the 1995 AFIR Colloquium in Brussels, Belgium.

Dr. Cummins has served as consultant to numerous business and governmental organizations. He has consulted and testified on the cost of capital in insurance for organizations such as the National Council on Compensation Insurance and Liberty Mutual Insurance Group. He has conducted research on insurance cycles and crises for the National Association of Insurance Commissioners, and he has testified for several state departments of insurance and the U.S. Department of Justice. He advised the Alliance of American Insurers on risk-based capital in property-liability insurance.

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Dr. *Richard D. Phillips* is an Assistant Professor of Risk Management and Insurance at Georgia State University. He received his Ph.D. in Finance and Insurance in 1994 from the Wharton School, University of Pennsylvania.

Dr. Phillips's recent publications on topics related to insurance company financial modeling include "Financial Pricing of Insurance in the Multiple-Line Insurance Company" (with J. David Cummins) and "The Economics of Risk and Insurance." From March 1992 through January 1994, Dr. Phillips was a principle investigator in the Alliance of American Insurers project to develop a risk-based capital cash flow solvency model, which used an earlier version of the model described in this paper.

Dr. Phillips is a frequent speaker at research seminars on such topics as cash flow modeling, financial pricing, and insurance regulation.

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Sholom Feldblum is an Assistant Vice President and Associate Actuary with the Liberty Mutual Insurance Company. He holds the FCAS, CPCU, ASA, and MAAA designations, and he is a member of the CAS Syllabus Committee and of the American Academy of Actuaries Task Force on Risk-Based Capital. He is the author of numerous papers on ratemaking, loss reserving, statutory accounting, insurance economics, competitive strategy, investment theory, solvency monitoring, and finance, which have appeared in *Best's Review*, the *CPCU Journal*, the *Proceedings of the Casualty Actuarial Society*, the *Actuarial Digest*, the *CAS Forum*, the *Journal of Insurance Regulation*, the *Journal of Reinsurance* and the *CAS Discussion Paper Program*. He was the recipient of the CAS Michelbacher Prize in 1993 for his paper on "Professional Ethics and the Actuary."

In addition to the two papers co-authored with Douglas Hodes (see above), Mr. Feldblum is the author of "European Approaches to Insurance Solvency," which describes the British and Finnish foundations upon which the model described in this paper is based, and "Forecasting the Future: Stochastic Simulation and Scenario Testing," which describes the use of scenario testing in financial models.

THE FINANCIAL MODELING OF PROPERTY-CASUALTY INSURANCE COMPANIES

Introduction

The existing literature on the financial modeling of property-casualty insurance companies consists predominantly of theoretical discourses seen through the eyes of the research actuary. The sophistication of complex stochastic simulation is extolled; the practical implementation of the models is rarely considered.

This paper, in contrast, describes a financial model currently being used by a major U.S. multi-line insurer. The first version of the model was developed in 1993 for solvency monitoring purposes. In the three years since then, the model has been greatly expanded and it has been applied to a variety of internal management uses, including (i) the allocation of equity to corporate units, thereby allowing measurements of profitability by business segment and by policy year, as well as analysis of the progression of "free surplus," (ii) the analysis of major risks, such as inflation risks, interest rate risks, and reserving risks, that have heretofore been difficult to quantify, and (iii) consideration of varying scenarios on the company's financial performance, both of macroeconomic conditions as well as of the insurance environment.

Many multiline insurance enterprises are complex organizations, with dozens of distinct yet interrelated parts. This complexity is the major stimulus for financial models that consider the workings of the entire corporation. At times, however, this complexity renders cumbersome the documentation of the models. To facilitate the readability of this paper, the numerical exhibits are contained in the appendices, so that the text flows more easily.

This paper discusses the following topics:

- Genesis: that is, the factors that stimulated the development of the model.
- Structure: that is, the types of underwriting and financial operations and the types of time periods with which it deals. Since this paper is not just a theoretical discourse but also a practical description of a working model, it shows the actual inputs and outputs: what variables must be provided by the user, and several types of tables, charts, and graphs that are produced by the model.
- Equity considerations: how net worth ("economic surplus") is determined by line of business (LOB) and how the progression of "free surplus" is viewed.
- Profitability measures: given the actual (past) or expected (future) cash flows, along with the progression of LOB surplus and of free surplus, how profitability is measured.

The financial model described here is particularly important for evaluating three types of risk that are not easily analyzed by other methods:

- Risks that simultaneously affect several components of an insurance company's operations, such as inflation risks and interest rate risks.
- Risks that results from an overall change in the external economic environment, such as recessions, or from changes in the insurance industry as a whole, such as underwriting cycle movements.

- Risks that depend on complex, random fluctuations, such as reserving risks.

This paper shows how the financial model deals with these types of risk.

Genesis of the Model

The company's modeling efforts were stimulated by several developments:

1. From 1990 through 1993, the NAIC developed new risk-based capital requirements for both property-casualty and life insurance companies. Many observers have criticized the NAIC efforts from three perspectives:

   A. The risk-based capital formulas are based on accounting figures.
   B. Some of the RBC charges seem to be "ad hoc" factors, lacking actuarial or financial justification.
   C. Several important risks are not even considered.

   For example, these critics have said that

   A. The statutory financial statements that underlie the risk-based capital formulas should be replaced by cash flow approaches or by market value accounting, both for solvency monitoring by state regulators and for management evaluation of the company's performance.[1]

   B. The reserving risk charges in the NAIC formula, which are based on the NAIC "worst case year" method coupled with a large dose of "regulatory judgment," should be replaced by rigorous actuarial analyses of reserve variability. Similar analyses should be undertaken for the underwriting risk of new business ("written premium risk" in RBC terminology) and for the risks of reinsurance collectibility.

   C. Interest rate risk, which affects both assets and liabilities, should be incorporated into the formula. Interest rate risk is particularly difficult to model in the NAIC formula, since (i) it is a market value phenomenon, not an accounting phenomenon, and (ii) it is intertwined with other risks, such as inflation risks and reserving risks.

2. Meanwhile, the American Academy of Actuaries has proposed an expanded vision of the Appointed Actuary's role, covering not just opinions on the reasonableness of loss and loss adjustment expense reserves but also statements on the financial strength of the insurance enterprise under varying longer term scenarios and on the resilience of the company to different types of adverse external conditions. The model described in this paper is the practical implementation of the AAA vision: it shows the cash flows of the company under varying future scenarios.

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[1] Compare especially Robert P. Butsic, "Solvency Measurement for Property-Liability Risk-Based Capital Applications," *Journal of Risk and Insurance*, Volume 61, Number 4 (December 1994), pages 656-690, who discusses the "measurement bias" introduced when GAAP or statutory accounting statements are used for solvency monitoring purposes.

❸ Soon after this model was implemented, the authors changed their emphasis from solvency monitoring to profitability measurement. When insurance companies fare poorly, financial models are important for monitoring solvency. In the early 1990's, the multi-line insurer using this model fared extremely well, because of both strong industry profits in its major lines of business and its own favorable performance relative to its peer companies. It elected to expand into new markets, develop new products, and acquire other (related) businesses. It required a sophisticated management model, in order to judge both the immediate risks and the long-term uncertainties associated with the new projects, as well as the capital needed to safely undertake them.

Description of the Model

The financial model described here provides three types of results:

❶ The model itself uses a *cash-flow* approach, following the method developed by the British Solvency Working Party in the 1980's.[2] The cash flow results are particularly important for Appointed Actuary work and for comparing the effects of different scenarios.

❷ For management purposes, the model can generate statutory accounting results, as would be needed for pro-forma financial statements. Statutory accounting is an important constraint on insurance company strategy. These results are useful for analyzing the progression of "free surplus."[3]

❸ By selecting appropriate discount rates for loss outflows and for investment inflows, the analyst can determine market values of the insurance enterprise at various points in time

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2 For a more complete presentation of the British Solvency Working Party approach, see Chris D. Daykin, G. D. Bernstein, S. M. Coutts, E. R. F. Devitt, G. B. Hey, D. I. W. Reynolds, and P. D. Smith, "Assessing the Solvency and Financial Strength of a General Insurance Company," *Journal of the Institute of Actuaries*, Volume 114, Part 2 (1987), pages 227-310; Chris D. Daykin, G. D. Bernstein, S. M. Coutts, E. R. F. Devitt, G. B. Hey, D. I. W. Reynolds, and P. D. Smith, "The Solvency of a General Insurance Company in Terms of Emerging Costs," in J. David Cummins and Richard Derrig, *Financial Models of Insurance Solvency* (Boston: Kluwer Academic Publishers, 1989), pages 87-149, or in *ASTIN Bulletin*, Volume 117, No. 1 (1987), pages 85-132; Chris D. Daykin and G. B. Hey, "Managing Uncertainty in a General Insurance Company," *Journal of the Institute of Actuaries*, Volume 117, Part 2, No. 467 (September 1990), pages 173-259. The recent text by Chris D. Daykin, Teivo Pentikäinen, and M. Pesonen, *Practical Risk Theory for Actuaries* (Chapman and Hall, 1994), combines the cash flow approach of the British Solvency Working Party and the accounting approach of the Finnish Working Party. In addition, that textbook emphasizes stochastic procedures to develop scenarios, whereas the model described here uses stochastic procedures for risks that are random and "scenario building" for global risks with interdependent elements.

3 For reasons of space, the translation of net cash flows and market values into statutory values is not shown in the exhibits in this paper. The required work is primarily accounting, not actuarial, and it is not germane to the theoretical framework of the model.

or under various scenarios. These results are important for determining profitability of existing and of new business.

Past and Future Business

For *past business*, the model uses actual company results, along with

- chain ladder paid loss development for the run-off of existing reserves,
- stated coupon rates for fixed income securities, and
- expected dividend yields on common stocks for investment returns.

Two further adjustments are made:

❶ The company has large investments in mortgage-backed securities, with high prepayments as borrowers change homes or simply refinance their mortgages when interest rates are low. The expected cash flows are adjusted in each scenario for these options, and the effects are shown in the exhibits. Similar adjustments are used for other options, such as call provisions in corporate bonds.[4]

❷ About half of the company's workers' compensation business is written on loss sensitive contracts. The premium payment patterns extend for about ten years after the policy expires, as shown in the exhibits.

For *future years' operations*, the cash flows are based on a combination of company business plans and actuarial projections. For instance, written premium by line of business is taken from the business plans. The anticipated loss and LAE ratios and the anticipated underwriting expense ratios are actuarial projections. These figures are combined with the payment and collection *patterns* developed from past business to model the cash flows from new business.

Base Case and Alternative Scenarios

To illustrate the power of the financial model, two scenarios are shown in the exhibits and discussed in the text.

❶ The *base case scenario* assumes an annual inflation rate of 4.0% and growth in real exposures of 2.0%, for a nominal growth in underwriting cash flows of 6.1% per annum. These assumptions affect premiums, losses, and expenses for each line of business. In practice, of course, the assumed growth in real exposures will vary by line, depending on the company's business plans. [The model allows for separate assumptions by line and by policy year, which are used in actual work.]

The average pre-tax yield on the bond portfolio held by the company is 8.3% per annum. The assumed stock dividend yield is 2.75% per annum, and the rate of growth in stock values is 8.0% per annum, providing an annual return on common stocks of 10.75%.

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4 These expected cash inflows are similar to those required in the new NAIC risk-based capital "supplementary asset schedule" used to measure interest rate risk; see Douglas M. Hodes and Sholom Feldblum, "Interest Rate Risk and Capital Requirements for Property-Casualty Insurance Companies" (CAS Part 10 examination study note).

The federal income tax rate is 35%. Since income taxes are explicitly included in the cash flows, the model uses an after tax discount rate of 5.4% to determine the present values of insurance operations (when present values are used in the analyses). [5.4% is 8.3% * (1–35%).] The expected after-tax yield on the company's investment portfolio is about 5.7%, reflecting the higher returns on the common stocks.

❷ The *alternative scenario* assumes that the inflation rate increases by 200 basis points to 6.0% with a concomitant increase in the pre-tax bond yield on new investments to 10.3%. [The market value of existing fixed-income securities, of course, falls when the interest rate rises, with the magnitude of the effect depending on the duration of the fixed income portfolio.] The growth in real exposures remains 2.0%, for a nominal growth in underwriting cash flows of 8.1%. The immediate effect on underwriting and investment results is twofold:

A. For each line of business, the new rates affect premiums, losses, and expenses. When rates first increase, however, the nominal losses grow more quickly than premiums, leading to an initial increase in the loss ratios.

B. Market values of bonds and of mortgages, as well as of mortgage-backed securities, fall when interest rates rise. Initially, common stock prices also drop when interest rates increase, as noted by many investment economists.[5] This decline, however, is fully recovered in the subsequent two years, since the simultaneous rise in inflation and interest rates causes no change in the real equity value of corporations.

The federal income tax rate remains 35%. The after tax discount rate for insurance cash flows now changes to 6.7%.

The summary assumptions for the base case scenario and for the alternative scenario are shown on Exhibit 1 of Appendix A. Exhibits 2 through 5 of Appendix A show the projected written premium, incurred loss plus loss adjustment expense, and other underwriting expenses, as well as the loss ratios, expense ratios, and combined ratios, for new business, under each of the two scenarios.

The exhibits shows ten years of new business, as would be used in a "going-concern" valuation. For clarity of exposition, the text discusses a single year of new business (policy year 1995), though we show exhibits and graphs for ten years of new writings as well. For the "progression of free surplus," the exhibits also show the anticipated 1996 written premiums.

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[5] See, for example, Eugene F. Fama and G. William Schwert, "Asset Returns and Inflation," *Journal of Financial Economics*, Volume 5 (1977), pages 115-146. Fama and Schwert's paper uses data which is now 20 years "out-of-date." Other analysts have replicated the Fama and Schwert results, though the theoretical explanations vary from author to author; see, for instance, Martin Feldstein, "Inflation and the Stock Market," *American Economic Review*, Volume 70 (December 1980), pages 839-487. To parameterize our model, we replicated the Fama and Schwert study using the most recent 20 years of data from the Ibbotson and Sinquefield indices. The signs of the coefficients in our analysis were generally consistent with the signs found by Fama and Schwert, though the magnitudes of the coefficients were dampened.

Asset Returns

The finâncial model uses the expected cash flows from each group of securities, not the stated cash flows. The difference is particularly great for mortgages and for mortgage backed securities (which form significant proportions of life insurance and property-casualty insurance investment portfolios, respectively), for two reasons:

1. As borrowers move to different homes, they pre-pay the mortgages. This effect occurs even if interest rates do not change. It is dependent on interest rate changes to the extent that real estate purchases depend on the availability of "affordable mortgages."[6]

2. When interest rates decline, many homeowners refinance their mortgages. Conversely, when interest rates rise, refinancings become less frequent.

The rise in interest rates under the "alternative scenario" has two effects on the market value of mortgage backed securities.

1. Since the payment obligations are in fixed dollar terms, but the appropriate discount rate rises, the market value of these assets decline.

2. When interest rates rise, refinancings become less frequent, causing a further decline in the market value of the assets.

Similar analyses are performed for each class of securities. The model requires cash flows by type of security for each scenario. One begins with the stated cash flows from each category of securities, before consideration of issuer options. For each scenario, the model then incorporates the effects of options, such as calls on corporate bonds and pre-payment options on mortgages.[7]

Exhibits 2 and 3 of Appendix B show graphically the effects of a 2% rise in interest rates on the *cash flows and remaining balances* from mortgage backed securities. Exhibits 4 and 5 of Appendix B shows the overall effects of a 2% rise in interest rates on the entire fixed income portfolio.

Exhibit 1 of Appendix B shows graphically the effect of a 2% rise in interest rate on the *market value* of mortgage backed securities. The effect is divided into two pieces. The dominant portion of the decline in value, from the third bar to the middle bar, stems from the higher discount rate. A second portion of the decline in value, from the middle bar to the top bar, stems from the fewer prepayments.

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6 On the effect of interest rates on real estate values, see Charles A. D'Ambrosio's chapter in J. L. Maginn and D. L. Tuttle (editors), *Managing Investment Portfolio: A Dynamic Process*, Second Edition (Warren, Gorham, and Lamont, 1990).

7 Because of federal income tax provisions, the model is substantially more complex than is described here. Fixed income investments are divided between taxables and tax-exempts (e.g., municipal bonds), and the latter category is further subdivided by date of acquisition (i.e., pre-August 6, 1986 and post August 6, 1986).

The model performs this analysis for each type of security. Since federal income taxes have a great effect on net income, the analysis is performed separately for taxable versus tax-exempt bonds, with the appropriate tax rates applied to each.

Combining Operations

The model described here provides numerous advantages over other analyses of an insurance company's operations:

❶ The different components of the company, such as premium inflows, investment inflows, loss outflows, and expense outflows, are combined. For instance, Exhibits 1 and 2 of Appendix C show the cash flows in future years from the run-off of existing workers' compensation business under each of the two scenarios mentioned above. [Exhibits 3 and 4 show the individual cash flows separately for each component of the company for two years, for the pure run-off case versus the run-off with one additional policy year, and for the base scenario versus the alternative scenario. Exhibits 5 through 10 show the combined cash flows for assets versus liabilities for 35 years, for the pure run-off case versus the run-off with one additional policy year, and for the base scenario versus the alternative scenario. Exhibit 11 shows the loss and loss adjustment expense cash flows for the two scenarios.]

Workers' compensation provides a particularly good example of the model's operations, so we use this example repeatedly in the paper. The statutory benefits in workers' compensation make a chain ladder paid loss development reserving procedure accurate for this line of business, since the cash outflow patterns for loss reserves are relatively stable. The dominance of retrospectively rated contracts in this company's workers' compensation book of business causes retrospective premium payments for about ten years past the expiration date of the policies. Since the company uses primarily paid loss retros for its large accounts, a cash flow approach is most useful.

The expected cash flows from assets are projected by the company's Chief Investment Officer and his staff, and they are incorporated as inputs into the model. Since the company has a large life insurance subsidiary, these cash flow projections under different interest rate scenarios are needed for the "asset adequacy analysis."[8]

Existing vs New Business

❷ Equally important as the combination of the different components of the company is the *differentiation of blocks of business*. In particular, the model separates (i) the cash inflows and outflows from the run-off of the current business from (ii) the cash inflows and

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[8] Life insurance companies must have an "asset adequacy analysis," signed by a Fellow of the Society of Actuaries, showing whether the income of the company from its investments will suffice to meet benefit obligation under sever future interest scenarios. These cash flow projections must take into account both issuer options on the asset side and policyholder options on the liability side. For the property-casualty model, we use the same cash flow projections on the asset side. The casualty liabilities do not have the complication of policyholder options, but they have other complexities, such as inflation sensitivity and dependence on macro-economic conditions. See below in the text for the manner in which these are handled.

outflows resulting from new business. Previous analyses often asked: "Is the company's workers' compensation book of business profitable?" This question is not just simplistic; it misses the point. Rather, the actuary must ask two sets of questions:

1A. What are the net cash flows from the run-off of the existing book of business? We are concerned with business already written, not business already earned. Thus, this "run-off" includes both

- the future (retrospective) premium collections from exposures already earned and payments for losses already incurred, as well as
- the earnings from the unexpired portions of policies already written and the expected loss accruals from these policies.

1B. If external conditions change, how would the net cash flows change, and what is the implied change in profitability for the run-off of existing business?

2A. What are the net cash flows from an additional policy year of business, or from additional policy years of business? As noted above, the future earning of premium and accrual of losses from the most recent policy year is included in the "run-off" section. The present question ties the valuation analysis to the current underwriting procedures, policy provisions, and premium rates. We are asking: "Based on the company's current business plans and our actuarial projections, what are the expected net cash flows from the new business?"

2B. If external conditions change, how would the net cash flows from the new business change, and what is the implied change in profitability of this business?

The difference between questions 2A and 2B is crucial for the valuation analysis, and it demonstrates the power of the financial model. All the exhibits in this paper differentiate between the effects on the existing business and the effects on new business. For instance, Exhibits 5 and 6 of Appendix C shows the investment and the net liability cash flows for the base case scenario for (i) the run-off of existing business and (ii) the run-off of existing business plus one year of new business. In the former case, the net liability cash outflows greatly exceed the investment income cash inflows in the first subsequent calendar year (1995 in the exhibits), since most of the premium has already been collected whereas most of the losses remain to be paid. In the latter case, the net liability cash outflow is small, since the premiums from the new business nearly equal the total loss and expense payments in that year.

External changes have vastly different effects on the run-off of existing business versus the profitability of new business. For example, an important external change that affects property-casualty insurance company profitability is a movement in inflation, with a concomitant movement in interest rates, as we have in the two scenarios. This is interest rate risk, which the financial model quantifies. First, however, let us consider the issue conceptually.[9]

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9 The more sophisticated analysis described below in this paper quantifies more carefully how loss liabilities are affected by inflationary changes, by calculating "real dollar" link ratios for the chain ladder loss development procedure, projecting future inflation rates that are tied to the assumed future interest rates (which affect the asset values), determining the "inflation

We must consider the effects on the run-off of previously written business versus the effects on new business. We have the following characteristics of workers' compensation business:

Run-Off Valuation and Interest Rate Risk

1. Workers' compensation benefit payments consist of indemnity ("wage-loss") benefits and medical benefits. Incurred losses are about 55-60% indemnity and 40-45% medical. Since medical benefits are paid more quickly, the reserves are about 65-75% indemnity and 25-35% medical.

2. Medical benefits are fully inflation sensitive. If inflation increases by 2%, medical benefits (in nominal terms) will be 2% higher.[10]

3. In about half the U.S. jurisdictions, COLA adjustments make certain indemnity benefits inflation sensitive as well. Generally, the COLA adjustments in these jurisdictions apply only to long-term indemnity benefits, such as benefits two years or more after the accident, and the adjustments are often capped at a relatively low amount, such as 5% per annum.

4. For simplicity, let us assume that overall workers' compensation reserves are 50% inflation sensitive. In other words, a 2% rise in inflation causes *nominal loss costs on previously written business* to rise by about 1%. [As noted earlier, the 1% rise applies to losses paid one year after the valuation date. A loss paid three years after the valuation date would increase by about 3%. The actual model, of course, separately quantifies indemnity and medical workers' compensation benefits and their respective cash flows. The "50%" inflation sensitivity is used in this explanation for heuristic purposes only.]

5. Workers' compensation loss reserves have a long average payment date, generally about 7 to 8 years. [Permanent total claims, or "lifetime pension" cases, form a higher proportion of reserves than they do of incurred losses, thereby greatly lengthening the duration of reserves compared to the duration of incurred losses.] Because of the high retention levels of workers' compensation business and the generally upward sloping yield curves, most companies will choose asset portfolios with longer maturities than the average maturity of the loss reserves. Given the steady benefit outflows in workers' compensation, a common asset liability management strategy would call for high grade corporate bonds or mortgage backed securities with an average maturity of ten years or longer.

6. A 2% rise in inflation, with a corresponding 2% rise in interest rates, would severely

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sensitivity" of each reserve component (such as workers' compensation medical benefits versus workers' compensation indemnity benefits), and then calculating the cash outflows each year.

[10] The textual explanation given here over-simplifies the effects. Since the average payment date of the reserves exceeds one year, the increase in nominal value of reserves exceeds 2%. That is, reserves paid out one year hence will rise in nominal value by 2%; reserves paid out in two years' time will rise by about 4%; and so forth. Since the financial model tracks the cash flows, the true effects are easily seen. The explanation in the text, however, is simplified, to highlight the differences between existing business and new business.

depress the market values of these corporate bonds or mortgage backed securities. The market value of the liabilities would decline by a lower amount, since their nominal value rises (as the liabilities are 50% inflation sensitive) and their duration is shorter.

7. The financial model shows this explicitly, since the cash inflows from the existing bond portfolio do not change in nominal terms, whereas the cash outflows from the reserve portfolio increase in nominal terms. Discounting at the new interest rate shows the loss resulting from interest rate risk.

New Business and Interest Rate Risk

The situation is entirely different for the new business.

1. For simplicity, suppose that inflation increases by 2% just before the new business is written, and interest rates show a corresponding 2% jump. Both medical and indemnity losses will be 2% higher, but since the discount rate is also 2% higher, their economic value does not change. Similarly, the coupon rate on newly issued bonds will be 2% higher, but since the discount rate is also 2% higher, their economic value does not change. There is almost no change to the expected value of new business from interest rate risk.[11]

2. Again, the financial model shows this explicitly. The model shows the cash flows from assets and for benefit payments. There is a 2% increase in the cash inflows from assets and a concomitant 2% increase in cash outflows for benefits, leading to no net change. Alternatively, discounting both sets of flows at the new (higher) discount rate shows no change in the present value of either cash flow.

3. In sum, interest rate risk has a great effect on the run-off of existing workers' compensation business, but little effect (if any) on the expected profitability of new business.

Recessions

There is no reason to assume that changes in the external environment affect only the valuation of run-off business but not the value of new business. Consider the effects of a recession on a workers' compensation carrier.

A recession has two effects on workers' compensation benefit costs.

- During recessions, firms lay off recently hired and inexperienced workers, and overtime work decreases. Conversely, during prosperous years, firms hire young and inexperienced workers, and overtime work increases. Workers' compensation accident frequency is higher for young and inexperienced workers, particularly when they are working long

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[11] Since this is new business, the assets purchased with the newly collected premiums either have higher coupons (for newly issued bonds) or higher yields to maturity (for bonds bought in the secondary market). The change in timing of loss payments and tax payments slightly affect the results for the alternative scenario. In addition, the difference between the increase in workers' compensation benefits and the assume increase in inflation slightly increases the expected profitability.

hours. Thus, accident frequency is higher during prosperous years than during recessions.

Moreover, during recessions, workers are often reluctant to file workers' compensation claims for less severe injuries, for fear that there may not be a job to return to when they have fully recovered from the injury. In addition, some workers are afraid that if they do file a claim during a recession, the employer will look less favorably upon them during promotion and advancement decisions. Thus, even for the same *accident frequency* levels, the *claim filing frequency* is lower during recessions.

❷ During recessions, *durations of disability* lengthen. Group health insurance studies of long-term disability coverage show that as unemployment increases, disabled employees tend to remain on disability for longer periods, apparently because there may be no job to return to. This phenomenon is equally true for workers' compensation: during recessions, unemployment rises and durations of disability lengthen.[12]

For new business, these two effects are offsetting, though the effects of claim frequency are stronger. The exact magnitudes depend on a host of factors, such as the type of industry, unemployment levels, seniority effects on job retention patterns, overtime practices, and the relationships between experience levels and injury rates. A general rule of thumb, though, is that for every 2% decline in claim frequency during recessions, one can expect a 1% increase in loss costs from lengthening durations of disability, for an overall 1% decline in loss costs.

For reserves, there is no effect from a decline in claim frequency. Moreover, workers' compensation reserves are dominated by permanent total cases, permanent partial cases, and medium term temporary total cases. For the latter two types of cases, the increase in durations of disability is particularly noticeable. A recession causing a 2% decline in loss frequency and a 1% increase in loss severity (duration of disability) for new business would cause a 1% or greater increase in reserves.

Recessions are generally accompanied by declines in interest rates. As discussed above, the decline in interest rates would not affect the valuation of new business. For the run-off business, however, the decline in interest rates raises the value of fixed-income assets supporting the reserves more than it raises the value of compensation benefit obligations.

In sum, the effect of a recession on the value of the insurance enterprise holding a block of workers' compensation reserves is unclear. Depending on the input assumptions, the financial model may show either a net increase or a net decrease. For new business, however, the model will generally show an increase in the value of the insurance enterprise.[13]

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[12] For the effects of macroeconomic conditions on workers' compensation claim frequency and durations of disability, see Sholom Feldblum, "Workers' Compensation Ratemaking," (Casualty Actuarial Society Part 6 Study Note, Sept. 1993) and the references cited therein.

[13] Numerous items that we have not discussed in the text have opposing effects. For instance, written premium declines during recessions, (i) first as payrolls decline and the demand for workers' compensation coverage decreases, and (ii) second as carriers compete more strenuously for the remaining business. The decline in written premium raises expense ratios and reduces overall profits. Moreover, the collectibility of premiums receivable

Surplus and Profitability

Many insurance profitability models deal with returns on equity. Some do so directly, such as by setting a target return on equity that the insurance operations must provide. Some do so indirectly, such as by using the target return on equity to determine a risk adjustment to the loss reserve discount rate or to determine a risk margin in the premium.[14] For the internal rate of return models often used in workers' compensation rate setting, the desired return on equity becomes the internal rate of return that the projected premium must achieve.

Most of these models use equity assumptions, such as "assumed premium to surplus" ratios or "reserves to surplus ratios." These models tell us little about the actual profitability of the insurance enterprise. Indeed, the implications are sometimes counter-intuitive. For instance, an internal rate of return model with a fixed reserves to surplus ratio may imply that a company with poor underwriting experience and high reserves is using more surplus. In fact, the company has less surplus, which is precisely the item we are trying to measure.

The financial model described in this paper uses two methods to measure performance.

- For the operating performance of distinct blocks of business, the model uses a return on (economic) surplus. [The calculation of the needed economic surplus is described below.] For instance, in December 1995, the model will simulate the expected return from policy year 1996 workers' compensation business, given assumptions about 1996 compensation underwriting experience, scenarios about interest rates and inflation rates, and analysis of the economic surplus needed to support this business.

- Surplus needed to "support" insurance underwriting is "tied up" in the "day to day" operations of the company. The insurer's management asks: "How much 'free surplus' does the company have?" "Is this 'free surplus' increasing or decreasing?" "What operations of the company are contributing to the increase or decrease?"

To properly measure the returns on surplus and the progression of free surplus, the insurance

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decreases, as employers find it difficult to meet their payment obligations. Both of these effects must be incorporated into the financial model to accurately ascertain the expected results from a recession on the profitability of new business.

[14] The former method is used by the Fireman's Fund risk-adjusted discounted cash flow model; see Robert P. Butsic and Stuart Lerwick, "An Illustrated Guide to the Use of the Risk-Compensated Discounted Cash Flow Method," *Casualty Actuarial Society Forum* (Spring 1990), pages 303-347. The latter method is used by Stephen Philbrick to determine a pricing risk margin (or "narrow risk margin," in Philbrick's terms) from the capital requirements (or the "broad risk margin" in Philbrick's terms); see his "Accounting for Risk Margins," *Casualty Actuarial Society Forum* (Spring 1994), Volume I, pages 1-90. The relationship between the narrow risk margin and the broad risk margin, in Philbrick's method, depends on the relationship the risk-free interest rate and the desired return on equity.

company's economic surplus (i.e., the economic net worth) is divided into three components:[15]

❶ *Surplus supporting the run-off business.* This surplus supports the variability in the indicated reserves (i.e., unexpected adverse loss development), as well as credit risk from reinsurance recoverables, and asset risks (such as default risk or market fluctuation risks) on the investments supporting the reserves. The amount of surplus needed is determined by stochastic simulation analyses, using target expected policyholder deficit ratios or target probability of ruin percentiles, and then translated into target *reserves to surplus* leverage ratios, which differ for each line of business.

❷ *Surplus supporting the new business.* This surplus supports the variability in underwriting results, stemming from underwriting cycle movements, from random loss fluctuations, and from natural catastrophes. In addition, this surplus supports the risk from poor reinsurance arrangements, as well as the asset risk as the newly collected premium is held in the investment markets before the losses are paid. Once again, the amount of surplus needed is determined by stochastic simulation analyses, using target expected policyholder deficit ratios or target probability of ruin percentiles, and then translated into target *premium to surplus* leverage ratios, which differ for each line of business.

❸ *Free surplus.* This is the company's economic surplus that is not needed to support its insurance operations. (a) It may be used for other operations, such as surplus supporting overseas expansion, business growth, or an investment company subsidiary, (b) it may be required for regulatory purposes (e.g., it may be needed to achieve a high risk-based capital ratio), or (c) it may be pure "surplus surplus."

Consider first a monoline insurance company, with past workers' compensation reserves and a new policy year of workers' compensation business. The stochastic simulation analyses combined with target expected policyholder deficit ratios are used to set reserves to surplus leverage ratios and premium to surplus leverage ratios for the surplus supporting the run-off

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15 Throughout the surplus allocation process described here, we are concerned with "economic net worth," not "statutory surplus." The distinction is particular important for the surplus supporting workers' compensation reserves. The stability of workers' compensation loss payout patterns, along with the long duration of these patterns, makes the "implicit interest margin" in undiscounted workers' compensation reserves far exceed the capital required to safeguard the company against even highly unlikely adverse scenarios (i.e., low probabilities of ruin or low expected policyholder deficit ratios); see below in the text. In other words, the statutory surplus needed to support workers compensation reserves is negative, since the economic surplus needed is less than the interest cushion in the undiscounted reserve. The exhibits in this paper, however, show positive surplus, since we are looking at economic values of assets and of liabilities, not at statutory figures.

Statutory accounting, however, is a constraint on insurance company operations. For instance, a monoline workers' compensation carrier with steady underwriting results may feel forced to hold significant statutory surplus to support these reserves because of the NAIC's 11% risk-based capital reserving risk charge. For allocating surplus by line of business, we have actually used a combination of surplus determined by the economic allocation described in this paper and surplus as determined by the NAIC's risk-based capital formula.

business and the surplus supporting the new business, respectively.[16]

The leverage ratios determine the amount of surplus needed at the inception of the new policy year. The company's remaining economic surplus at the inception of the new policy year is "free surplus."

Return on Surplus and Surplus Progression

As the year progresses, there are three "returns."

❶ The *expected* return on the surplus supporting reserves is composed of two pieces: The assets corresponding to this surplus earn a return in the investment market. In addition, since the discount rate for loss reserves is generally less than the investment yield on the surplus funds, the difference in the two yield rates times the reserves to surplus ratio is an additional return on these surplus funds.[17] The *actual* return on the surplus supporting reserves includes a third piece: the favorable or adverse development on these reserves.

❷ The *expected* return on the surplus supporting new business is also composed of two pieces: The assets corresponding to this surplus earn a return in the investment market. In addition, the projected underwriting gain or loss on this business is an additional return on these surplus funds. As is true for surplus supporting reserves, the *actual* return on the surplus supporting new business includes a third piece: the favorable or adverse underwriting performance of this business.[18]

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[16] These leverage ratios use market value accounting. For instance, we use an "discounted reserves" to "economic surplus" leverage ratio, not a "statutory reserves" to "statutory surplus" leverage ratio. [Pricing actuaries, in contrast, who must file rate revisions with state insurance departments, use statutory leverage ratios; see Sholom Feldblum, "Pricing Insurance Policies: The Internal Rate of Return Model" (Casualty Actuarial Society Part 10A Examination Study Note, May 1992) for the standard workers' compensastion procedures.] For an illustration of the method in this paper, using a stochastic simulation with 10,000 runs of workers' compensation reserves along with a 1% expected policyholder deficit ratio, see below in the text.

[17] To determine the economic value of the loss reserves, the financial model uses a "risk-free" discount rate, which is the yield rate on Treasury securities of short to medium maturities. The investment yield of the company is somewhat higher than this rate, since the investment portfolio includes also common stocks, corporate bonds, and mortgage-backed securities. Daniel Gogol uses a similar procedure, where the return on surplus allocated to reserves stems from the difference between a risk-free rate used for assets supporting the reserves and a risk-adjusted rate used to value the reserves themselves; see his "Pricing to Optimize an Insurer's Risk-Return Relation," *CAS Forum*, Winter 1996 Edition (Casualty Actuarial Society, 1995), pages 213-242.

[18] The two returns – the return on the run-off of existing business and the return on new business – are not independent. Since the greatest value of the existing consumer base is the retention of insureds and the expected future profits, persistency rates are high in most casualty lines, such as personal automobile and workers' compensation. Meanwhile, insurers

- *Finally, there is a progression of "free surplus."* The total surplus of the company increases by the returns on investable funds plus underwriting gains (or minus losses) minus federal income taxes and minus the unwinding of the interest discount on economic reserves. We assume that the company expects to write a similar volume of business one year from now as it is writing in the new policy year, with appropriate adjustments for inflation and expected real business growth.

  The free surplus at the beginning of the year minus the surplus needed to support both the run-off business and the new business is the initial free surplus. The initial reserves decline over the course of the year, and the new business becomes run-off business, both leading to lower surplus requirements. Conversely, there is a new year of new business, with additional surplus requirements. The third profitability measure shown by the financial model asks: "How will the amount of free surplus progress over the course of the year, given the assumptions for underwriting results, reserve developments, and investment performance?" Similarly, once the year has actually transpired, the financial model asks: "How has the amount of free surplus progressed over the course of the year?"

The three profitability measures overlap. They are used for different purposes; they are not independent. For instance, good expected underwriting results for new business will raise the return on surplus supporting this business and also result in an increase in free surplus. The

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are reluctant to implement (and regulators are equally reluctant to allow) large rate changes. The result is that many of the same policyholders occupy the company's existing book of business as well as its future book of business.

Thus, *unexpected* favorable or adverse results on the run-off of the existing book may portent corresponding favorable or adverse results on the book of new business. For expected results, however, the two pieces are largely independent. The model accrues profit as the premium is written, not as the losses are paid. Expected underwriting profits are included in the new business section. The return on the run-off of existing business (if interest rates do not change) is

  the investment return on the assets supporting the reserves,
\+ the investment return on the surplus supporting the reserves,
− the amortization of discount on the market value of the reserves.

This is different from the approaches used by Robert Butsic and by Stephen Philbrick. Butsic incorporates an "implicit reserve margin" by using a reserve discount rate lower than the risk-free rate. Philbrick incorporates an "explicit reserve margin" (his "narrow risk margin" or NRM) that is embedded in the policy premium, held "above the line," and ultimately paid to equityholders.

The Butsic and Philbrick models seek to align the return with "uncertainty." As long as there is uncertainty in the ultimate loss payments, the insurer, or the insurer's owners, must earn a "risk-compensated" return. The financial model described in this paper seeks to align the return with the insurer's operating decisions. Once the policy has been written and earned, the insurer's action do not much affect the random reserve developments that determine the actual return. [The choice of investments does affect the insurer's returns, so the investment yield on the assets supporting the reserves does influence the return.]

return on surplus supporting the new business shows the profitability of the insurance operations. The progression of free surplus shows how much money is available for other corporate functions, such as expansion into new markets. Exhibits 1 and 2 of Appendix D illustrate graphically the connection between the return on surplus and the progression of "free surplus." Exhibits 3 through 7 detail the results for each line of business.

Scenarios and Returns on Surplus

Exhibits 8 through 12 of Appendix D show the various measures of return described above, for both the base case scenario and for the alternative scenario. Consider first the return on surplus supporting the run-off business.

❶ For the base case, the return is slightly higher than the expected after-tax return on assets, depending on the "discounted reserves to economic surplus" leverage ratio used for each line. For workers' compensation, for instance, the after tax investment yield is 5.7%, and the loss reserve discount rate is 5.4%.[19] With a three to one "reserves to surplus" leverage ratio, the 30 basis point difference in yield contributes 90 basis points to the return on surplus, resulting in a 6.6% return.

❷ In the alternative scenario, the return drops sharply, from 6.6% to –7.3%. The magnitude of the change in the return is driven by several items, particularly the duration of the assets supporting the compensation reserves, the inflation sensitivity of the losses, the sensitivity of workers' compensation retrospective premiums, the federal income tax implications, and the discount rates used.

The return on surplus supporting new business is driven primarily by expected underwriting gains and losses. Industry-wide workers' compensation results have been good in the early 1990's, and the company projects an 80% loss and loss adjustment expense ratio. The company's direct writing distribution system (a salaried sales force) provide for a low underwriting expense ratio of 18%, yielding a combined ratio of 98%. [See Exhibit 3 of Appendix A for these figures.] The long payment lag in workers' compensation produce an anticipated return on surplus of 42.7%.

This return is not much affected by changing interest rates or inflation rates, as discussed earlier. In fact, the alternative scenario, with a 2% rise in inflation and interest rates, causes only an insignificant change in the return, from 42.8% to 42.6%. However, there are differences in the other lines of business, primarily because of the drop in the market value of investments. [See Appendix D, exhibits 8-12, for the total returns, and exhibits 13-19, for an analysis of the sources of return.]

In fact, the high 1994 and 1995 returns in workers' compensation result from strong benefit reforms in many states along with a movement to "managed care" program, with only partially

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19 This difference reflects the lower yielding bonds supporting the reserves, not a "risk adjustment" for reserve variability. The reserve variability is used to determine the target leverage ratio, using an expected policyholder deficit analysis, not the appropriate discount rate. Greater reserve variability means that the insurer must hold more surplus to support the reserves, and it therefore has less surplus for other uses. It does not mean that the insurer "earns" more by holding these reserves.

offsetting rate reductions.[20] The incentive effects of the benefit reforms were greater than anticipated, with large reductions in workers' compensation claim frequencies. Rate level decreases in 1996 (as in Massachusetts) will reduce the anticipated return on new business, though they will have no effect on the anticipated return on surplus supporting existing business.

Exhibits 13 and 14 of Appendix D show the overall company results under both the base scenario and the alternative scenario for (i) surplus supporting the run-off versus (ii) surplus supporting the new business, with additional detail showing types of assets, types of liabilities, and federal income taxes. The return on surplus supporting the run-off business drops sharply, whereas the return on surplus supporting new business does not change significantly.

Surplus Requirements

The measurement of expected profitability requires an assessment of the capital needed to support the business. Past actuarial attempts to assess surplus requirements have several failings, which are avoided in the financial model described here.

❶ Most commonly, analysts use an "assumed surplus requirement," such as a "two-to-one premium to surplus ratio," or a "three-to-one reserves to surplus ratio," to model the needed capital. Such assumptions simply beg the question of how much capital is actually needed.

Another common approach has been to take the company's existing surplus and simply allocate it to lines of business based upon premium volume or reserve volume. This procedure skirts the issue entirely. If the company is profitable, it allocates more capital to each line of business, reducing the expected return on equity. The financial model described here takes a different approach. If the company is profitable, more capital is moved to "free surplus," which the company may use for other purposes.

This approach demands a method of quantifying the capital truly needed, not simply an allocation of existing capital. Similarly, it is insufficient to adopt simple rules-of-thumb, such as the Kenney rule used by some regulators of a "two-to-one premium to surplus ratio" or the ad hoc "reserves to surplus" ratios often used by pricing actuaries for workers' compensation ratemaking.

Actuarial science has developed several methods of quantifying the needed capital. The financial model described here began with leverage ratios determined from "probability of ruin" analyses. [These are the leverage ratios which are reproduced in the exhibits in the Appendix.] The capital requirements used in the model are now being updated, using an "expected policyholder deficit" analysis by line of business from simulation analyses.

❷ Some analysts use the same leverage ratio, such as a premium to surplus ratio or a reserves to surplus ratio, for the entire underwriting risk. This approach has two shortcomings.

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20 Because of the competitive characteristics of the commercial insurance market, one may expect workers' compensation rate levels to decrease in line with costs, as has already occurred in several states in 1995 and 1996.

- First, it fails to recognize that there are two distinct risks, which are important for different insurance personnel. (a) The underwriter seeking to sell new policies or the pricing actuary seeking to make rates for new business must quantify the variability of loss costs over the coming policy period. (b) The corporate accountant seeking to complete the company's financial statements or the reserving actuary seeking to estimate the company's loss obligations must quantify the variability of adverse reserve developments on the company's existing reserve portfolio.

- Second, the proper type of leverage ratio, as well as the needed analysis, differs for these two types of risk. (a) For new business, one must know the volume of exposures, the degree of diversification, and the adequacy of reinsurance arrangements. For instance, to assess the surplus needed to support a new policy year of Homeowners writings, new business volume – as considered in a premium to surplus ratio – is appropriate. A reserves to surplus leverage ratio is irrelevant. (b) To assess the surplus needed to support the run-off of pollution and asbestos claims, a premium to surplus ratio is irrelevant. The needed surplus to support these reserves may be estimated either by a reserves to surplus leverage ratio or by other actuarial techniques.[21]

❸ Past approaches often use leverage ratios of *statutory* figures to statutory surplus. These approaches ignore the implicit interest margins inherent in undiscounted reserves.

For instance, a standard measure of surplus needed to support workers' compensation writings, as used in some internal rate of return pricing models, is an assumed ratio of statutory reserves to statutory surplus. This approach compounds all three errors discussed above:

- Undiscounted workers' compensation loss reserves contain an enormous "implicit interest margin," since workers' compensation loss reserves, like life annuities, have slow but steady payment patterns combined with long durations.[22]

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[21] Insurer liabilities for environmental exposures highlight the difference between returns on surplus and the progression of free surplus. Insurance companies want to know the effects of alternative environmental scenarios on the company's performance. But insurers are not holding pollution and asbestos reserves in order to earn a high return on surplus. And no insurer would say that the great uncertainty in pollution payments necessitate a low discount rate for determining the present value of the reserves, thereby leading to a high expected return on surplus. Rather, the insurer's management asks: "How do different scenarios relating to environmental liabilities affect the company's net worth?" Rephrased in the terms used by the financial model, this question is: "How do these different scenarios affect the progression of 'free surplus'?"

[22] For a rough estimate of the payout pattern of workers' compensation reserves, see Richard G. Woll, "Insurance Profits: Keeping Score," *Financial Analysis of Insurance Companies*, (Casualty Actuarial Society 1987 Discussion Paper Program), pages 446-533. Woll's estimates, which are based on ten years of Schedule P data, are severely understated, since the lifetime pension cases, which form the bulk of workers' compensation reserves for older policy years, have an extremely slow payout pattern. The authors' own analyses, based on

- The major risks in workers' compensation business are not the fluctuations in loss reserves but the uncertainties in new business, whether by the random occurrences of accidents or by macroeconomic conditions, industry underwriting cycles, or the regulatory climate that affect the claim frequency rate, the expected premium levels, or the prospects for rate level increases.

- A "three-to-one" reserves to surplus ratio has no more actuarial support than a "two-to-one" premium to surplus ratio. The latter has a long regulatory tradition, and the former has a short actuarial tradition. Neither has much theoretical foundation.

The Expected Policyholder Deficit Approach

The original leverage ratios used in the financial model were developed from a probability of ruin analysis. These ratios are shown in Exhibit 1 of Appendix F. The supporting exhibits for workers' compensation, based upon 2,000 runs of a stochastic simulation analysis, are shown in Exhibits 2 and 3 of Appendix F.

Most of the deficiencies of past analyses are solved by these leverage ratios:

- The ratios are determined by probability of ruin analyses, not by tradition or by rule of thumb.
- Separate ratios are used for the run-off of existing business (reserving risk) and for the writing of new business (premium risk).
- All measures use "economic surplus" and "economic reserves."

The financial model described here is now being refined by means of the expected policyholder deficit (EPD) concept developed by Robert Butsic. The EPD ratio analysis says that

- The appropriate measure of solvency is the ratio of the expected policyholder deficit to the obligations to policyholders (i.e., the expected losses).[23]

The corollary to this is that the appropriate amount of capital needed to guard against any

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25 years of paid loss experience from 10% of the industry's business, show an average time to payment of about eight years for workers' compensation reserves.

[23] *This statement should be qualified. The appropriate measure of solvency for regulators* and for policyholders is the expected policyholder deficit ratio. The appropriate measure of financial strength for investors and for company management is the probability of ruin. Policyholders are indeed concerned about the amount of loss. Regulatory measures of solvency, which serve to protect policyholders, are concerned with the same issue. The "corporate shield," however, insulates investors from the magnitude of the loss after bankruptcy. Similarly, management and employees are concerned with job security, which is not affected by the magnitude of the post-insolvency loss.

Thus, the appropriate measure of financial strength should depend on the use of the model. However, there are other advantages of the EPD approach, particularly when different risks are being considered in combination, so we present the results from this approach.

risk is the amount of capital needed to reduce the EPD ratio to a predetermined figure.

- Capital requirements, expressed in terms of EPD ratios, should be uniform across risks. That is, the capital needed to guard against workers' compensation reserving risk should produce the same EPD ratio as the capital needed to guard against personal auto reserving risk.

The Expected Policyholder Deficit

To properly quantify the surplus needed for each type of risk, we combine a simulation analysis with an expected policyholder deficit approach. We illustrate this for workers' compensation reserving risk, for which we have completed the full analysis.[24] The calculations are as follows:

Were there no uncertainty in the future loss payments, then the insurer need hold funds just equal to the reserve amount to meet its loss obligations. Since future loss payments are not certain, funds equal to the expected loss amount will sometimes suffice to meet future obligations and will sometimes fall short. The insurer holds surplus to ensure that the loss obligations will indeed be met.

When the future loss obligations are less than the funds held by the insurance company to meet these obligations, the "deficit" is zero. When the future loss obligations are greater than the funds held, the "deficit" is the difference between the two. The "expected policyholder deficit" is the average deficit over all scenarios, weighted by the probability of each scenario. In the analysis here, the expected deficit is the average deficit over all simulations, each of which is equally weighted.

The Stochastic Simulation

How should we measure the uncertainty inherent in the loss reserve estimates? We use stochastic simulation of the experience data to ensure statistically meaningful results, with simulation parameters that are based upon the actual experience of the company.

We begin with 25 years of countrywide paid loss workers' compensation experience, separately for indemnity and medical benefits, for accident years 1970 through 1994. From these data we develop 24 columns of paid loss "age-to-age" link ratios, as shown in Exhibit 1 of Appendix H.

We fit each column of "age-to-age" link ratios to lognormal curves, determining "mu" (μ) and "sigma" (σ) parameters for each. We perform 10,000 sets of stochastic simulations. Each simulation produces 24 "age-to-age" link ratios (one for each column). These are the age-to-age factors that drive the actual loss payments.

The 10,000 simulations produce 10,000 reserve amounts. For ease of presentation, we normalize the results to $100 of average undiscounted reserves. We ask: "How tight is this

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[24] A more complete description is contained in Douglas M. Hodes, Sholom Feldblum, and Gary Blumsohn, "Workers' Compensation Reserve Uncertainty" (1996 Casualty Loss Reserve Seminar discussion paper program, forthcoming), which discusses the stochastic simulation, the curve fitting considerations, and the influences on reserve uncertainty.

distribution of reserve amounts?" We answer in two ways.

- We show the standard deviation, the mean, and two other percentiles of the distribution (5% and 95%). For instance, the table below shows that for discounted reserves with no adjustments for inflation, the mean reserve amount is \$5.27 million, the standard deviation is \$3.4 million, the 95th percentile is \$58.7 million, and the 5th percentile is \$47.9 million.

- To facilitate the comparison of reserve uncertainty with other types of risk used in the financial model, we use the "expected policyholder deficit (EPD) ratio" as a yardstick. We ask: "How much additional capital must the insurer hold to have a 1% EPD ratio?" The table below shows that for discounted reserves, the required capital for a 1% EPD ratio is \$2.4 million.

	Average Reserve Amount	Standard Deviation of Reserve	95th Percentile of Reserve	5th Percentile of Reserve	Capital Needed for 1% EPD Ratio
Undiscounted	100.0	19.5	135.3	74.0	31.0
Discounted: 6.75%	52.7	3.4	58.7	47.9	2.4

Reserve Discounting

We are primarily concerned with the economic values, or discounted values, of the reserves, not with undiscounted amounts. Much of the variation in statutory reserve requirements stems from fluctuations in "tail factors." This fluctuation depends in part on inflation rates. For discounted reserves, the effects of changes in the long-term inflation rate are offset by corresponding changes in the discount rate. Moreover, tail factor uncertainty has a relatively minor effect on the present value of loss reserves, even if the discount rate is held fixed. Thus, the distribution of discounted loss reserve amounts is more compact than the distribution of undiscounted loss reserve amounts.

Because statutory accounting mandates that insurers hold undiscounted reserves, we show analyze results both for discounted and for undiscounted reserves. Moreover, the difference between the discounted and undiscounted reserve amounts is the "implicit interest margin" in the reserves, which is important for assessing the implications of the reserve uncertainty on the financial position of an insurance company.

Length of the Development

The paid loss development for 25 years is based on observed data. Workers' compensation paid loss patterns extend well beyond 25 years. For each simulation, we complete the development pattern as follows:

1. Given the 24 paid loss "age-to-age" link ratios from the set of stochastic simulations on the fitted lognormal curves, we fit an inverse power curve to provide the remaining

"age-to-age" factors.[25] This fit is deterministic.

- The length of the tail is chosen (stochastically) from a linear distribution of 30 to 70 years.

Let us suppose first that the company holds no capital besides the funds supporting the reserves. We ran our analysis For the discounted analysis, the average reserve amount is $52.7 million. About half the simulations give reserve amounts less than $52.7 million. In these cases, the deficit is zero. The remaining simulations give reserve amounts greater than $52.7 million; these give positive deficits. The average deficit over all 10,000 simulations is the expected policyholder deficit, the EPD. The "EPD ratio" is the ratio of the EPD to the expected losses, which are $52.7 million in this case.

Clearly, if the probability distribution of the needed reserve amounts is "compact," or "tight," then the EPD ratio will be relatively low. Conversely, if the probability distribution of the needed reserve amounts is "dispersed" – that is, if there is much uncertainty in the loss reserves – then the EPD ratio will be relatively great.

We now "fix" the EPD ratio at a desired level of financial solidity and determine how much additional capital is needed to achieve this EPD ratio. We use a 1% EPD ratio as our benchmark, since this is the ratio which Butsic uses for risk-based capital applications.

Suppose the desired EPD ratio is 1%. If the reserve distribution is extremely compact, then even if the insurer holds no capital beyond that required to fund the expected loss payments, the EPD ratio may be 1% or less. If the reserve distribution is more dispersed, then the insurer must hold additional capital to achieve an EPD ratio of 1%. The greater the reserve uncertainty, the greater the required capital.

Results

The results for the base case, with discounted reserves, are shown in the table above.[26] The average discounted reserves are $52.7 million, and additional capital of $2.4 million is needed to achieve a 1% EPD ratio.

The corresponding full value reserves are $100.0 million. The company uses tabular discounts on the indemnity portion of life-time pension cases at a 3.5% discount rates, which is the rate used in the NCCI unit statistical plan. The resulting statutory reserves, normalized to a $100

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25 On the use of the inverse power curve, see Richard Sherman, "Extrapolating, Smoothing, and Interpolating Development Factors," *Proceedings of the Casualty Actuarial Society*, Vol. 71 (1984), pages 122-192, as well as the discussion by Stephen Lowe and David Mohrman, vol 72 (1985), page 182, and Sherman's reply to the discussion, page 190.

26 We ran our simulation for several cases: (i) discounted versus undiscounted reserves, (ii) with and without various adjustments for medical inflation, and (iii) with and without consideration of loss-sensitive contracts. The "base case" in our analysis uses discounted reserves with no adjustments for medical inflation or for loss-sensitive contracts. For a full description of the analysis, see Hodes, Feldblum, and Blumsohn, "Workers' Compensation Reserves Uncertainty" (op. cit.).

million undiscounted reserve, are about $92 million.

The difference between the perspective in the financial model described here and the "received actuarial wisdom" warrants further comments. The common view is that workers' compensation reserve estimates are highly uncertain, because of the long duration of the claim payments and because of the unlimited nature of the insurance contract form. This uncertainty creates a great need for capital to hedge against unexpected reserve development. In fact, the opposite is true. There is indeed great underwriting uncertainty in workers' compensation, and regulatory constraints on the pricing and marketing of this line of business have disrupted markets and contributed to the financial distress of several carriers. But once the policy term has expired and the accidents have occurred, little uncertainty remains. The difference between the economic value of the reserves and the reported (statutory) reserves, or the "implicit interest margin," is many times greater than capital that would be needed to hedge against reserve uncertainty.

These results have important implications for our financial model.

- There is no "leverage ratio" between statutory reserves and statutory surplus, since one needs *negative* statutory surplus to support workers' compensation reserves (if undiscounted reserves are indeed held).

- Regulatory requirements, however, such as risk-based capital requirements, force companies to hold more surplus to guard against "reserving risk" than they actually need.[27]

Thus, our financial model assumes that the implicit interest margin in the compensation reserves provides the full economic surplus needed to support the reserves as well as a substantial amount of "free surplus." However, because of the constraints imposed by statutory accounting and by the NAIC's risk-based capital formula, the leverage ratios used in the financial model are still lower than the implicit leverage ratios from the EPD analysis.[28]

Inflation and Interest Rate Risks

For the past twenty years – ever since the dramatic rise in inflation during the late 1970s – casualty actuaries have debated the effects of inflation on the economic worth of insurance companies. Because there are multiple and simultaneous effects, several of which are difficult to quantify without a sophisticated financial model, past analyses of this issue have often been

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[27] For instance, the current NAIC risk-based capital formula uses an 11% reserving risk charge for workers' compensation, before company-specific adjustments, such as the company's average reserve development, the percentage of business written on loss-sensitive contracts, and loss concentration factor; see Sholom Feldblum, "Risk-Based Capital Requirements" (Casualty Actuarial Society Part 10 Examination Study Note, Second Edition, July 1995), for a complete description of the NAIC risk-based capital reserving risk charge.

[28] The final surplus requirements by line of business and by operational unit used by the company were determined in part by management discretion, with consideration of rating company expectations, peer company practices, and NAIC constraints, not solely by the actuarial analysis reviewed in this paper.

incomplete.

Inflationary changes have several effects on the financial solidity of an insurance enterprise. For the "alternative scenario" discussed earlier, we assume that the inflationary change is matched by a corresponding change in interest rate (the "Fisher effect").

- *They reduce the market value of fixed income securities.* The effects on payment patterns and market values of fixed income securities have been studied by both investment analysts and by actuaries (primarily life actuaries). A full analysis requires consideration also of issuer options, such as calls on corporate bonds and prepayments on mortgages and mortgage backed securities. The effects on the company's portfolio of mortgage backed securities are shown in the exhibits and they are discussed further below.

- *They temporarily reduce the market value of common stock investments*, though not of real estate investments. The effect on all equity investments, however, is generally short-term. Over the long-term, equity investments serve as a "hedge" against inflation.

  Good data on the magnitude of the relationships are lacking. Our model uses in-house studies based on the stock market experience of the past twenty years, as described further below.

- *They reduce the market value of fixed liabilities*, such as some workers' compensation indemnity payments or personal automobile no-fault compensation payments.

- *They increase the nominal value of most casualty loss reserves.* In other words, most casualty loss reserves are "inflation sensitive": if inflation increases, the nominal amounts increase as well, with little change in the market value.

Quantifying the last of these effects is particularly difficult without a financial model. In workers' compensation, for instance, inflation affects *medical* benefits through the payment date. In about half of the U.S. jurisdictions, *indemnity* payments that extend beyond two years have COLA adjustments that depend on inflation.

To properly assess the effects of inflation on the company's loss reserves, we "strip" out past inflation from the historical loss triangles, determine the paid loss "age-to-age" link ratios, then restore expected future inflation to the indicated (future) link ratios. In other words, we make the following adjustments to the loss reserve development analysis used to project future loss payments:

❶ We convert the paid losses to "real dollar" amounts by means of an appropriate inflation index. For workers' compensation medical benefits, we used the medical component of the CPI.

❷ We select a future inflation rate that is consistent with the scenario being analyzed. For instance, if we project future inflation at 6% per annum, we may select 7% per annum as the medical inflation rate.

❸ Finally, we combine the projected link ratios and the projected inflation rate to determine the expected loss outflows.

Exhibits 1 through 5 of Appendix G shows the method of "stripping" inflation out of the loss payment triangle, determining link ratios in real dollars, and then restoring the projected inflation to the assumed future payments.

Results

A comparison of the results from the financial model with the recommendations on the American Academy of Actuaries task force on risk-based capital regarding interest rate risk is most instructive. The *statutory* interest rate risk considered by the AAA task force differs in two respects from the economic effects of a simultaneous shift in interest rates and inflation rates:

➊ The *statutory* effect must consider the valuation rates used for assets and liabilities. For NAIC risk-based capital purposes, this is the rate implicit in amortized values for fixed income assets and a flat 5% rate used for loss liabilities, since this is the rate used to discount losses for the reserving risk charge. The difference between these rates may provide either a cushion or an extra charge for interest rate risk.

The financial model described here deals with cash flows. There are no valuation rates. Accounting conventions serve only as constraints; they do not enter the underlying analysis.

➋ The risk-based capital charge must consider the interplay of reserving risk and interest rate risk. Increases in interest rates that are accompanied by increases in inflation cause adverse development of undiscounted losses. The risk-based capital formula picks up this adverse development in the reserving risk charge. To reflect it also in the interest rate risk charge would be "double-counting" the same risk.

The financial model used here, however, is a scenario based model. The surplus needed to support the reserves is determined by an "expected policyholder deficit" analysis, not by a "worst-case year" approach (see above). The inflation sensitivity of casualty reserves, which causes higher *nominal* cash flows when inflation increases, must be explicitly incorporated into the results.

The resulting differences between the statutory charges developed by the AAA task force on risk-based capital for interest rate risk and the economic effects quantified by the financial model described here are large. For a two point increase in interest rates and in inflation rates, the economic return on the surplus supporting reserves changes from a positive return to a significant negative return. For most companies, the AAA recommendations would show a slight interest rate risk charge, if it would show any at all.

The reason for this difference is the overstatement of the reserving risk charge in the NAIC risk-based capital formula.

- The NAIC formula uses a flat 5% discount rate to determine the implicit interest margin in the reserves. The financial model described here the anticipated cash flows. "Economic values," when needed, are determined by means of market interest rates.

- The NAIC formula uses a "worst-case year" approach to determine the surplus needed to support reserves. The financial model described here uses either an "expected policyholder deficit" analysis or a "probability of ruin" analysis to determine the surplus needed to support reserves.

We have included this comparison of the financial model described here with the NAIC risk-based capital charges to highlight the importance of actuarial analysis. Many observers have pointed out that the NAIC reserving risk charges and written premium risk charges seem to be *ad hoc* numbers only marginally related to the actual risks faced by companies. The AAA interest rate risk recommendations were hampered by the need to fit into an existing formula that did not accurately reflect the actual risks.

The financial model described here shows the expected results under a variety of future scenarios. Some risks are more serious than those implied by the NAIC risk-based capital formula; some are less serious. Valuation actuaries must be careful to consider the risks highlighted by financial models of the type described here.

Scenario Testing

The proper management of an insurance enterprise requires consideration of the overall environment, not of isolated risks. An insurance executive does not ask: "What is the effect of a 200 basis point drop in interest rates, or a 10% rise in personal auto claim frequency, on the company's financial position?" Rather, he or she may ask: "What would be the effect of an economic recession, or of an underwriting cycle downturn, on the company's performance?" The actuary must translate the scenarios into model assumptions and rerun the cash flow projections to answer such questions.

Scenarios may be divided into two categories: economic scenarios and insurance scenarios. Economic scenarios posit changes in the macro-economic environment, such as recessions, high unemployment, or prosperous years. Insurance industry scenarios posit changes in such elements as the underwriting cycle, industry competition, or state regulation.

Scenarios are composed of interdependent elements, each of which may affect multiple elements of an insurance company's operations. For instance, economic recessions are often characterized by falling interest rates and high unemployment, which affect bond prices and stock prices (which are similar for most insurers) as well as claim frequency and claim severity (which vary by line of business). Thus, modeling the effects of scenarios is a two step process:

- The analyst must translate the scenario into a set of model assumptions. For instance, a recession scenario may be characterized by a drop in interest rates, a fall in stock market prices, a drop in inflation, and a rise in unemployment.

- These economic assumptions must be applied to the company's characteristics and run through the financial model. For instance,

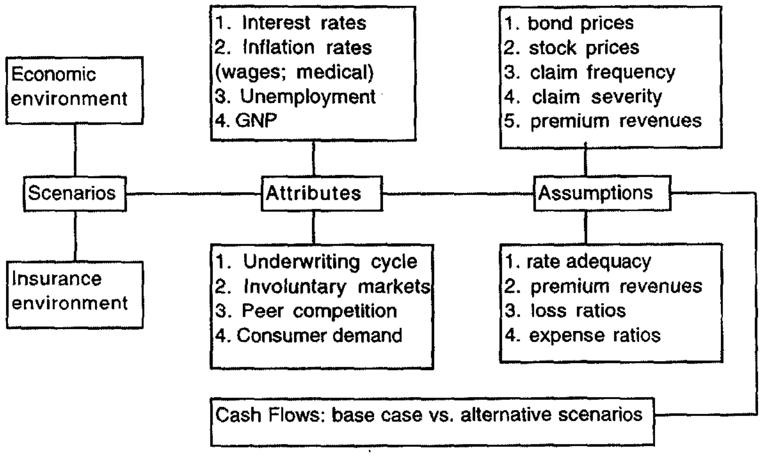
    - a drop in interest rates would increase the market values of fixed income securities,
    - a drop in inflation would decrease the (nominal) required reserve in some lines of business, though the economic value may increase because of the decline in interest rates, and
    - the rise in unemployment would probably decrease workers' compensation claim frequency but increase workers' compensation claim severity (or "durations of disability").

In other words, the effects of the economic scenario depend on the composition of the investment portfolio, the lines of business written, and the nature of the loss reserves.

Insurance scenarios are equally complex. For instance, an underwriting cycle downturn would involve changes in premium revenues (because of changes in rate adequacy), changes in expense ratios (because of changes in the percent of the market turning to self-insurance), changes in involuntary market sizes and "burdens," and changes in the expected loss ratio.[29]

The economic environment and the insurance environment are not independent. For instance, interest rate movements and changes in the cost of capital may affect the course of the underwriting cycle. Specifying the attributes and associated characteristics of a scenario requires a keen understanding both of the macroeconomic environment and of the effects of external factors on company operations.

The types of scenarios, their distinguishing attributes, and the assumptions relevant for the financial model are shown in the graph below.



We have applied this analysis with two scenarios, an economic recession and an underwriting downturn, for the company's workers' compensation book of business. Workers' compensation is particularly appropriate for scenario testing for two reasons:

- The effects of economic conditions, such as high unemployment, and of insurance industry conditions, such as growing involuntary markets, are clearer in this line of business than in most others.

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29 For a more complete discussion of the process of scenario building, see Sholom Feldblum, "Forecasting the Future: Stochastic Simulation and Scenario Testing," in *Incorporating Risk Factors in Dynamic Financial Analysis*, Casualty Actuarial Society 1995 Discussion Paper Program (Landover, Maryland: Colortone Press, 1995), pages 151-177.

Consider several effects of a recession on claim frequency and claim severity in workers' compensation. (a) Workplace accidents are noticeably greater for young and inexperience workers, who are frequently unfamiliar with the hazards of the machines or equipment used. During prosperous years, firms hire new workers, and workers' compensation claim frequency rises. (b) In addition, overtime work increases. Carefulness does not abide well with fatigue, and claim frequency increases even more. (c) Finally, during recession, workers are loath to file claims, lest there be no job to return once they have recuperated.

The effects on claim frequency affect new business results. They have no effect on the run-off of existing business.

Conversely, recessions cause a lengthening of durations of disability. An injured worker is unlikely to declare himself healed if there is no job to return to.[30] [Note the distinction: *working* employees are less likely to file claims during recession. *Disabled* employees are less likely to recover from disabilities during recessions.] This relationships affects primarily the run-off of existing business, not the results of new business.

Some analysts err by assuming that the effects on claim frequency and claim severity (durations of disability) offset each other, so neither need by quantified. In truth, they affect separate components of the insurer's business (new business versus run-off business). Needed rate increases or decreases for the new book of business are should not be offset against unexpected gains or losses on the existing reserve portfolio. The financial model described here separates the effects of the projected scenario on these two components.

- The long duration of workers' compensation business, where a rise in unemployment may cause a lengthening of durations of disability whose financial effects are spread out over thirty years, make cash flow projections essential for proper performance measurement. In other words, claim frequency rates can be quantified by monthly reports. Durations of disability can be quantified only over periods of years.

As noted above, the model allows the analyst to separate individual lines of business or blocks of business. In addition, the analyst must also allocate the assets supporting the reserves of each line of business, and allocate surplus (or economic net worth) backing each line of business.

The use of a financial model for scenario testing has two advantages:

❶ The interdependence of the various scenario components, and the complexity of their effects on insurance operations, makes the problem almost intractable at first glance. Translating the projected scenario into model assumptions, running both the base assumptions and the revised assumptions through the model, and comparing the resulting cash flows, enables the user to see the effects of a changing environment.

❷ Users often have different opinions about the components of scenarios and about their effects on company operations. For instance, users may have different views on the expected stock

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30 This influence is based on the experience of employer provided group health insurance. During the late 1970s, when unemployment rates rose, durations of disability under these plans rose concomitantly.

market movements during a recession or on the effects of unemployment on workers' compensation claim frequency. With the financial model described in this paper, the analyst can show the cash flows resulting from different model assumptions, as well as the sensitivity of the results to changes in the assumptions.

Conclusion

Corporate financial models are less important for a company writing short-tailed lines of business with an assured consumer base, adequate rates, and little competition. But financial models are essential for companies writing long-tailed lines of business, with fluctuating rate adequacy, severe competition, and volatile consumer bases.

Dynamic financial models take various forms, corresponding to the types of business written by the insurance enterprise and the issues that they address. Unlike traditional ratemaking or reserving techniques, there are no "cookbook" approaches to serve as benchmarks.

Actuarial practice is outracing actuarial literature. Property-casualty insurance companies are adopting models originally designed for life insurance companies and adapting them to their specific risks. The NAIC and the major rating agencies have developed solvency models to help ascertain companies' resilience to adverse future conditions.

This paper documents the cash-flow financial model used by a major commercial line insurance company. It discusses the uses of the model, the types of risks addressed, and the scenarios that it analyses. It should acquaint new actuaries with the many components of dynamic financial analysis, and it would confront experience actuaries with the complexities of reserving risk, interest rate risk (inflation risk), and scenario testing. And it should inform all actuaries that financial modeling is here to stay.

Notes to Underwriting Assumptions

Base Case Scenario

Annual inflation rate	4.00%
Growth in real exposures	2.00%
Resulting growth in underwriting	6.08%

For each line of business, the above rates affect equally losses, expenses, and premium.

Pre-tax Yield on Bonds	8.30%
Stock Dividend Yield	2.75%
Rate of growth in value of stock	8.00%
Resulting annual return on stock	10.75%

Federal income tax rate	35.00%
Discount Rate for Insurance operations cash flow*	5.40%

* This rate is the after-tax yield on bonds. After-tax rate is appropriate because income taxes are explicitly included in the cash flows.

Alternative Scenario:

Additional increase in inflation:	2.00%
Resulting annual inflation:	6.00%
Additional growth in real exposures	0.00%
Resulting growth in real exposures	2.00%
Resulting growth in underwriting	8.12%

For each line of business, the above rates affect equally losses, expenses, and premium. However, when rates first increase, nominal losses grow at a higher rate than premium, resulting in the overall increase in loss ratio.

Additional increase in interest rates	2.00%
Resulting new bond pre-tax bond yield	10.30%
Stock Dividend Yield	2.75%
Rate of growth in value of stock#	10.00%
Resulting annual return on stock	12.75%

The above growth rate for stocks is the long-term rate. In the short term, the market value of stock reacts negatively to increase in interest and inflation rates. In our alternative scenario, we assumed that initially, the market value of stock declines by five percentage points for each percentage point increase in interest rates. This decline was assumed to be eventually recovered after two years.

Federal income tax rate	35.00%
Discount Rate for Insurance operations cash flow	6.70%

Note: Actual input in the model had finer line detail.

Projected Written Premium ($ Millions)					
Policy	Voluntary, Involuntary, Net of Reinsurance				Total
Year	Work Comp	GL & CMP	Comm Auto & Other	Pers Auto & HO	
1995	2,415	513	562	2,374	5,864
1996	2,562	544	596	2,518	6,220
1997	2,718	577	633	2,671	6,599
1998	2,883	612	671	2,834	7,000
1999	3,058	650	712	3,006	7,425
2000	3,244	689	755	3,189	7,877
2001	3,441	731	801	3,382	8,356
2002	3,650	776	850	3,588	8,864
2003	3,872	823	902	3,806	9,403
2004	4,108	873	956	4,038	9,974

Projected Loss and Adjustment Expense ($ Millions)					
Policy	Voluntary, Involuntary, Net of Reinsurance				Total
Year	Work Comp	GL & CMP	Comm Auto & Other	Pers Auto & HO	
1995	1,966	505	462	1,855	4,787
1996	2,086	535	490	1,968	5,078
1997	2,212	568	520	2,087	5,387
1998	2,347	602	551	2,214	5,715
1999	2,490	639	585	2,349	6,062
2000	2,641	678	620	2,491	6,431
2001	2,801	719	658	2,643	6,822
2002	2,972	763	698	2,804	7,236
2003	3,152	809	741	2,974	7,676
2004	3,344	858	786	3,155	8,143

Projected Other Expense ($ Millions)					
Policy	Voluntary, Involuntary, Net of Reinsurance				Total
Year	Work Comp	GL & CMP	Comm Auto & Other	Pers Auto & HO	
1995	482	118	124	478	1,201
1996	511	125	131	507	1,274
1997	542	133	139	538	1,352
1998	575	141	148	570	1,434
1999	610	149	157	605	1,521
2000	647	158	166	642	1,613
2001	687	168	176	681	1,711
2002	728	178	187	722	1,815
2003	773	189	198	766	1,926
2004	820	201	210	813	2,043

Note: Actual input in the model had finer line detail.

Projected Loss and Adjustment Expense Ratio

Policy Year	Voluntary, Involuntary, Net of Reinsurance				Total
	Work Comp	GL & CMP	Comm Auto & Other	Pers Auto & HO	
1995	81%	98%	82%	78%	82%
1996	81%	98%	82%	78%	82%
1997	81%	98%	82%	78%	82%
1998	81%	98%	82%	78%	82%
1999	81%	98%	82%	78%	82%
2000	81%	98%	82%	78%	82%
2001	81%	98%	82%	78%	82%
2002	81%	98%	82%	78%	82%
2003	81%	98%	82%	78%	82%
2004	81%	98%	82%	78%	82%

Policy Year	Voluntary, Involuntary, Net of Reinsurance				Total
	Work Comp Comp	GL & CMP Liab	Comm Auto & Other	Pers Auto & HO	
1995	20%	23%	22%	20%	20%
1996	20%	23%	22%	20%	20%
1997	20%	23%	22%	20%	20%
1998	20%	23%	22%	20%	20%
1999	20%	23%	22%	20%	20%
2000	20%	23%	22%	20%	20%
2001	20%	23%	22%	20%	20%
2002	20%	23%	22%	20%	20%
2003	20%	23%	22%	20%	20%
2004	20%	23%	22%	20%	20%

Projected Underwriting Ratio

Policy Year	Voluntary, Involuntary, Net of Reinsurance				Total
	Work Comp	GL & CMP	Comm Auto & Other	Pers Auto & HO	
1995	101%	121%	104%	98%	102%
1996	101%	121%	104%	98%	102%
1997	101%	121%	104%	98%	102%
1998	101%	121%	104%	98%	102%
1999	101%	121%	104%	98%	102%
2000	101%	121%	104%	98%	102%
2001	101%	121%	104%	98%	102%
2002	101%	121%	104%	98%	102%
2003	101%	121%	104%	98%	102%
2004	101%	121%	104%	98%	102%

Note: Actual input in the model had finer line detail.

Projected Written Premium ($ Millions)					
Policy	Voluntary, Involuntary, Net of Reinsurance				Total
Year	Work Comp	GL & CMP	Comm Auto & Other	Pers Auto & HO	Comp
1995	2,514	534	589	2,421	6,058
1996	2,720	578	637	2,620	6,555
1997	2,944	625	690	2,835	7,093
1998	3,185	676	746	3,067	7,675
1999	3,446	732	807	3,319	8,304
2000	3,729	792	874	3,591	8,985
2001	4,035	857	945	3,885	9,722
2002	4,366	927	1,023	4,204	10,519
2003	4,724	1,003	1,107	4,549	11,382
2004	5,111	1,085	1,198	4,922	12,316

Projected Loss and Adjustment Expense ($ Millions)					
Policy	Voluntary, Involuntary, Net of Reinsurance				Total
Year	Work Comp	GL & CMP	Comm Auto & Other	Pers Auto & HO	Comp
1995	2,175	562	496	1,949	5,182
1996	2,353	608	536	2,109	5,607
1997	2,546	658	580	2,282	6,067
1998	2,755	712	628	2,469	6,564
1999	2,981	770	680	2,672	7,103
2000	3,225	834	735	2,891	7,685
2001	3,490	902	796	3,128	8,316
2002	3,776	976	861	3,385	8,998
2003	4,086	1,056	931	3,662	9,736
2004	4,421	1,143	1,008	3,963	10,534

Projected Other Expense ($ Millions)					
Policy	Voluntary, Involuntary, Net of Reinsurance				Total
Year	Work Comp	GL & CMP	Comm Auto & Other	Pers Auto & HO	Comp
1995	501	122	129	490	1,241
1996	541	132	139	529	1,341
1997	586	143	150	573	1,451
1998	634	154	163	620	1,570
1999	686	167	176	671	1,699
2000	742	181	190	726	1,839
2001	803	195	206	785	1,989
2002	869	211	223	850	2,153
2003	933	229	241	918	2,321
2004	979	243	256	968	2,445

Note: Actual input in the model had finer line detail.

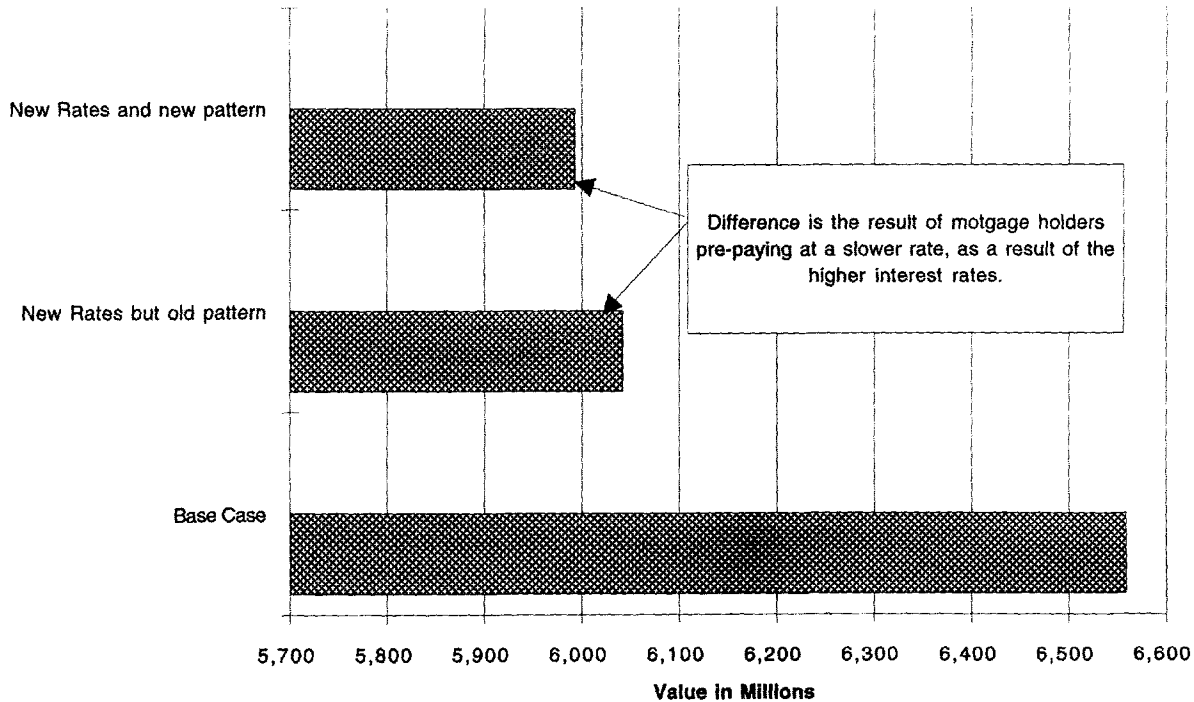
Projected Loss and Adjustment Expense Ratio					
Policy	Voluntary, Involuntary, Net of Reinsurance				Total
Year	Work Comp	GL & CMP	Comm Auto & Other	Pers Auto & HO	
1995	87%	105%	84%	81%	86%
1996	87%	105%	84%	81%	86%
1997	87%	105%	84%	81%	86%
1998	87%	105%	84%	81%	86%
1999	87%	105%	84%	81%	86%
2000	87%	105%	84%	81%	86%
2001	87%	105%	84%	81%	86%
2002	87%	105%	84%	81%	86%
2003	87%	105%	84%	81%	86%
2004	87%	105%	84%	81%	86%

Policy	Voluntary, Involuntary, Net of Reinsurance				Total
Year	Work Comp Comp	GL & CMP Liab	Comm Auto & Other	Pers Auto & HO	Comp
1995	20%	23%	22%	20%	20%
1996	20%	23%	22%	20%	20%
1997	20%	23%	22%	20%	20%
1998	20%	23%	22%	20%	20%
1999	20%	23%	22%	20%	20%
2000	20%	23%	22%	20%	20%
2001	20%	23%	22%	20%	20%
2002	20%	23%	22%	20%	20%
2003	20%	23%	22%	20%	20%
2004	19%	22%	21%	20%	20%

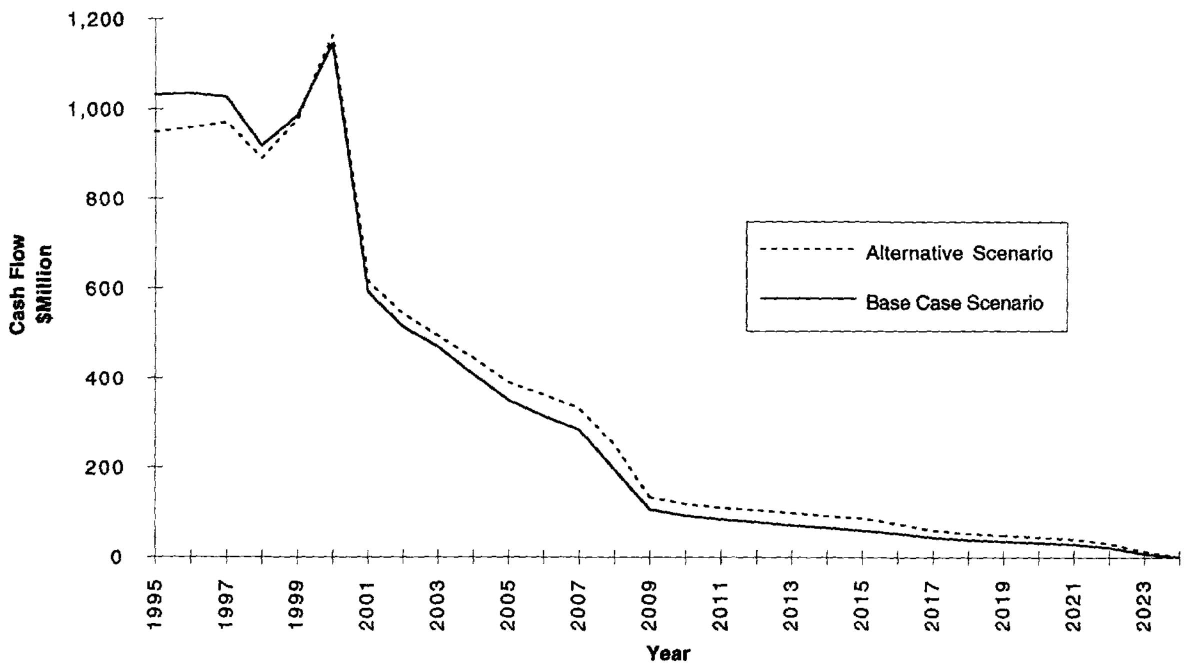
Projected Underwriting Ratio					
Policy	Voluntary, Involuntary, Net of Reinsurance				Total
Year	Work Comp	GL & CMP	Comm Auto & Other	Pers Auto & HO	
1995	106%	128%	106%	101%	106%
1996	106%	128%	106%	101%	106%
1997	106%	128%	106%	101%	106%
1998	106%	128%	106%	101%	106%
1999	106%	128%	106%	101%	106%
2000	106%	128%	106%	101%	106%
2001	106%	128%	106%	101%	106%
2002	106%	128%	106%	101%	106%
2003	106%	128%	106%	101%	106%
2004	106%	128%	105%	100%	105%

Note: Actual input in the model had finer line detail.

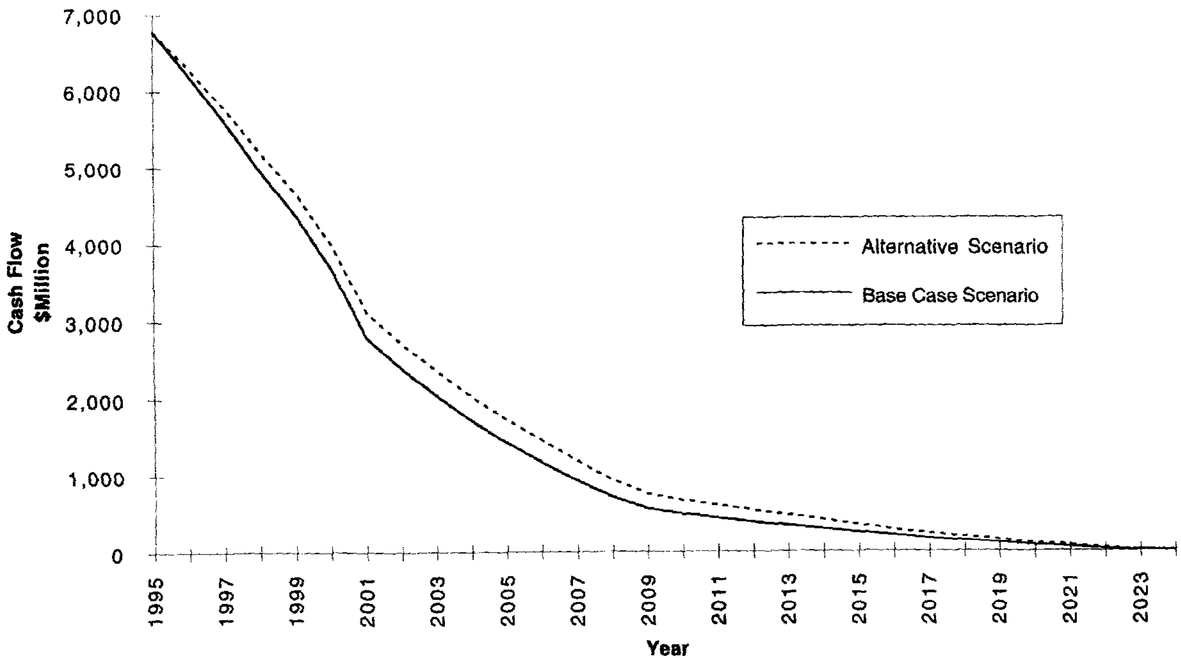
Market Value of Mortgage Backed Securuites



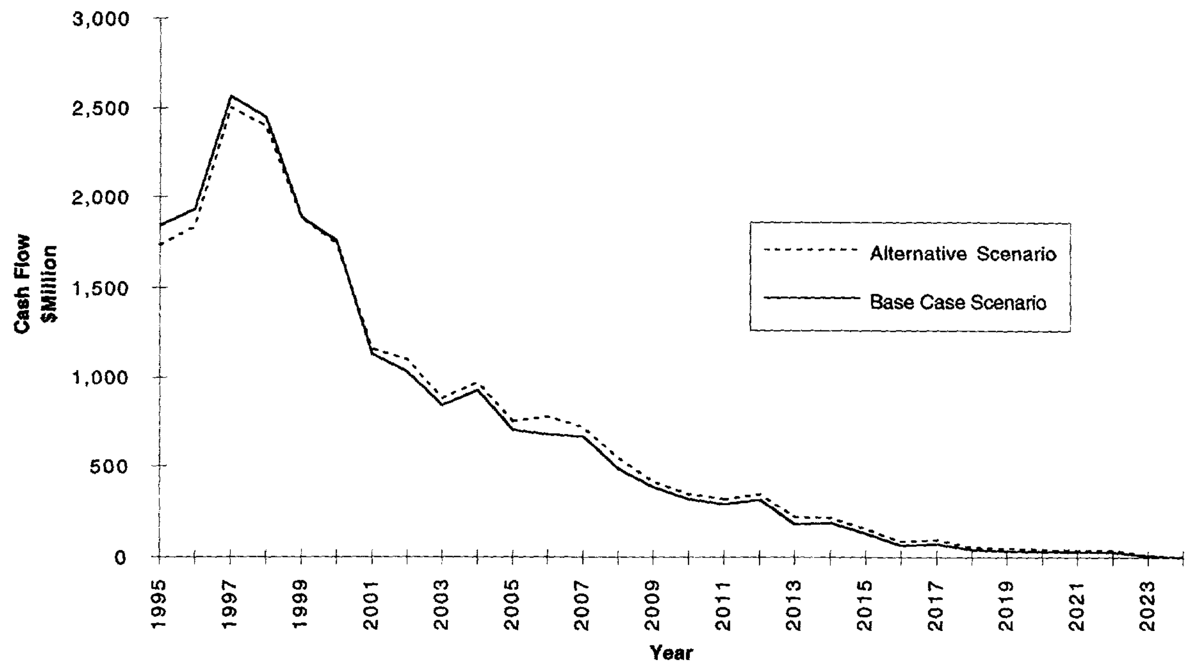
Mortgage Backed Securities Cash Flow
Effect of Prepayment from interest rate increase



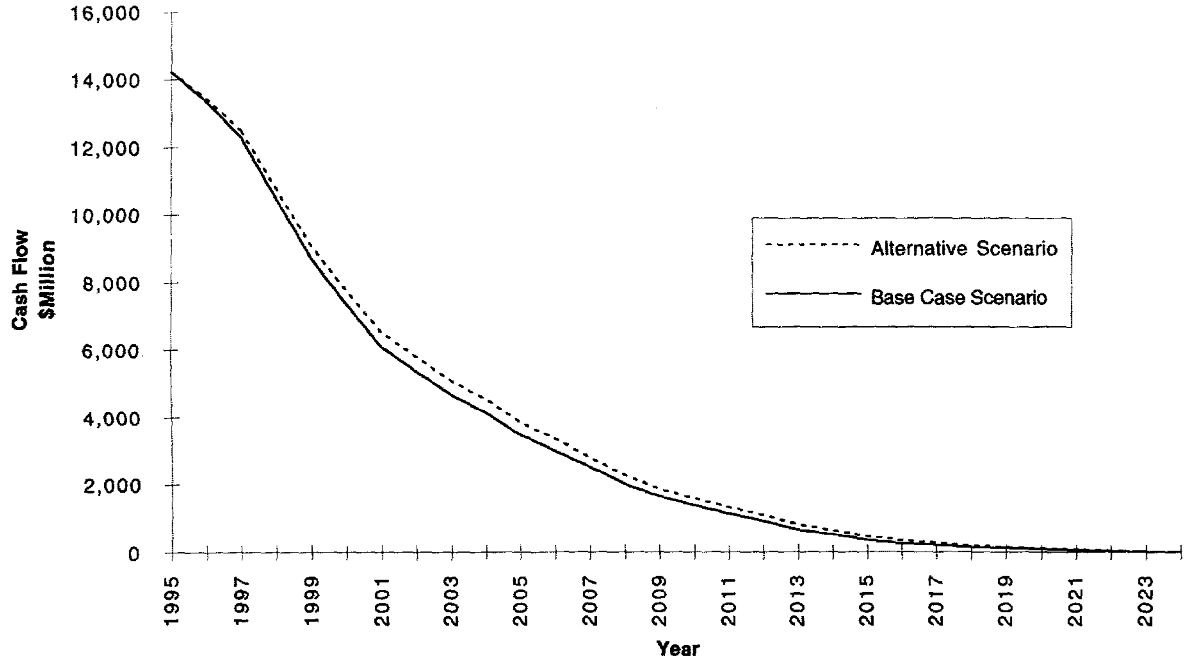
Mortgage Backed Securities Remaining Balance
Effect of Prepayment from Interest rate increase



Total Fixed Income Securities Cash Flow
Effect of Prepayment from interest rate increase



Total Fixed Income Securities Remaining Balance
Effect of Prepayment from interest rate increase



Appendix C
Exhibit 1

Sample Financial Model
Workers Compensation Insurance Operations Cash Flows (Base Case)
12/94 Runoff Business Only

	Premium	Loss & LAE	Other Expense	FIT from Underwriting	Net Insurance Operations
1995	819,224	1,741,739	160,648	(126,161)	(957,003)
1996	360,641	1,216,972	30,747	(124,299)	(762,780)
1997	327,524	874,610	9,744	(102,362)	(454,467)
1998	199,793	679,871	4,050	(89,976)	(394,152)
1999	131,450	542,334	1,481	(77,534)	(334,831)
2000	101,706	452,309	1,293	(73,695)	(278,201)
2001	80,702	390,858	959	(63,945)	(247,170)
2002	65,481	344,704	529	(54,703)	(225,049)
2003	55,504	308,930	310	(44,212)	(209,525)
2004	46,612	279,126	199	(33,199)	(199,514)
2005	38,352	253,854	0	(23,853)	(191,650)
2006	23,969	231,812	0	(16,284)	(191,559)
2007	16,185	213,346	0	(11,254)	(185,907)
2008	9,650	197,115	0	(7,503)	(179,962)
2009	3,517	182,693	0	(3,956)	(175,219)
2010	0	170,360	0	(2,182)	(168,178)
2011	0	158,640	0	(2,033)	(156,607)
2012	0	147,477	0	(1,892)	(145,586)
2013	0	136,635	0	(1,754)	(134,881)
2014	0	126,130	0	(1,621)	(124,509)
2015	0	116,117	0	(1,494)	(114,623)
2016	0	106,497	0	(1,371)	(105,126)
2017	0	97,502	0	(1,256)	(96,247)
2018	0	89,685	0	(1,155)	(88,530)
2019	0	82,569	0	(1,065)	(81,504)
2020	0	75,303	0	(974)	(74,329)
2021	0	67,002	0	(872)	(66,130)
Total	2,280,311	9,509,120	209,961	(873,568)	(6,565,202)

Appendix C
Exhibit 2

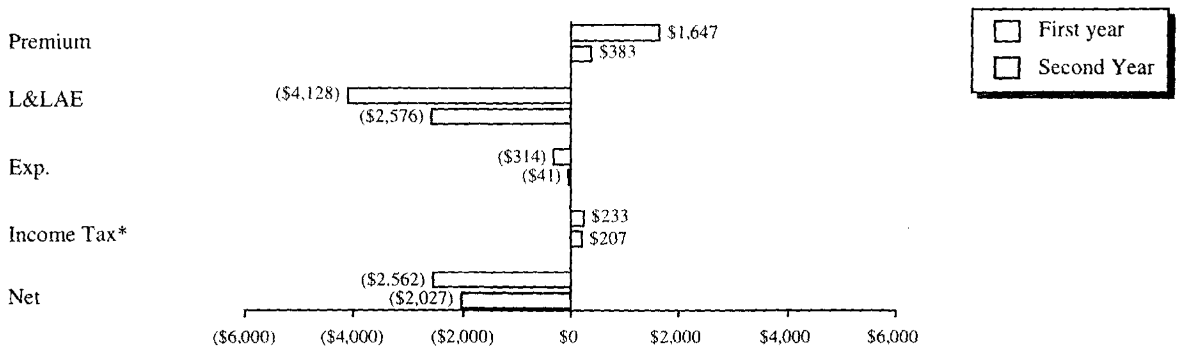
Sample Financial Model
Workers Compensation Insurance Operations Cash Flows (Alternative)
12/94 Runoff Business Only

	Premium	Loss & LAE	Other Expense	FIT from Underwriting	Net Insurance Operations
1995	917,281	1,767,629	167,816	(132,687)	(885,478)
1996	375,222	1,252,167	31,890	(162,408)	(746,427)
1997	341,376	912,170	10,580	(135,572)	(445,802)
1998	209,446	719,144	4,633	(121,097)	(393,234)
1999	138,075	582,025	1,881	(107,231)	(338,600)
2000	106,499	492,559	1,582	(102,958)	(284,685)
2001	84,030	432,021	1,160	(92,220)	(256,931)
2002	67,708	386,815	664	(81,833)	(237,937)
2003	57,079	352,105	405	(69,608)	(225,823)
2004	47,664	323,218	263	(56,279)	(219,538)
2005	39,040	298,762	42	(44,460)	(215,304)
2006	24,473	277,467	30	(34,404)	(218,621)
2007	16,599	259,747	25	(27,171)	(216,002)
2008	9,984	244,170	20	(21,364)	(212,842)
2009	3,808	230,277	18	(15,624)	(210,862)
2010	43	218,538	3	(12,131)	(206,366)
2011	0	207,191	0	(10,837)	(196,354)
2012	0	196,164	0	(9,624)	(186,540)
2013	0	185,162	0	(8,500)	(176,662)
2014	0	174,220	0	(7,468)	(166,752)
2015	0	163,554	0	(6,520)	(157,034)
2016	0	152,966	0	(5,628)	(147,338)
2017	0	142,804	0	(4,786)	(138,018)
2018	0	133,958	0	(3,988)	(129,970)
2019	0	125,700	0	(3,205)	(122,495)
2020	0	116,804	0	(2,466)	(114,338)
2021	0	105,876	0	(1,809)	(104,067)
Total	2,438,327	10,829,116	221,012	(1,284,129)	(7,327,673)

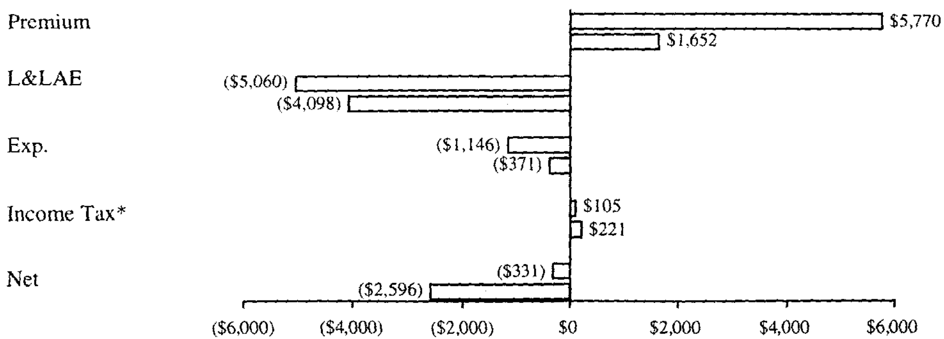
Insurance Operations Base Case Cash Flows
First Year and Second Year Comparison

Appendix C
Exhibit 3

Runoff Only



Runoff and One New Policy Year

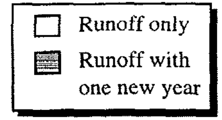


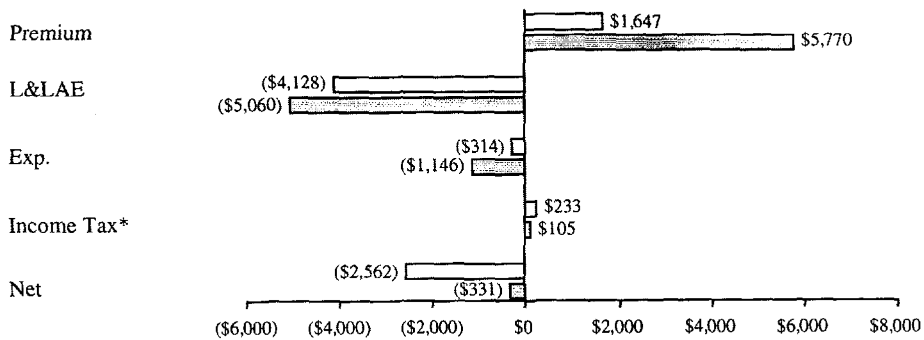
*Income tax excludes tax on investment

Insurance Operations Cash Flow in First Year

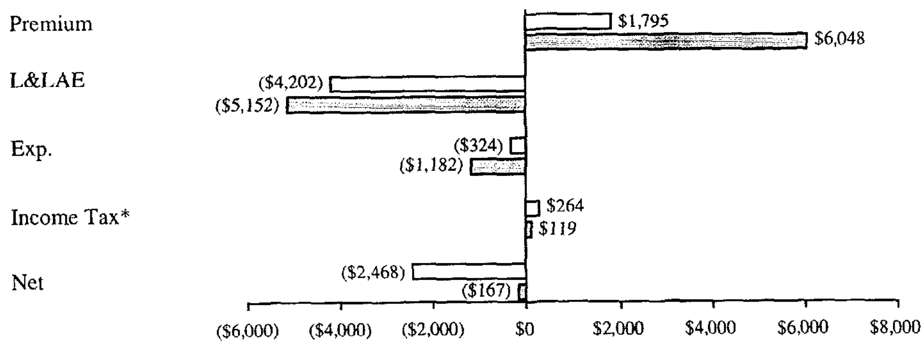
Appendix C
Exhibit 4

Base Case





Alternative Scenario



*Income tax excludes tax on investment

Investments and Net Liability Cash Flows
Cash Flow from Runoff Only
Base Case Scenario

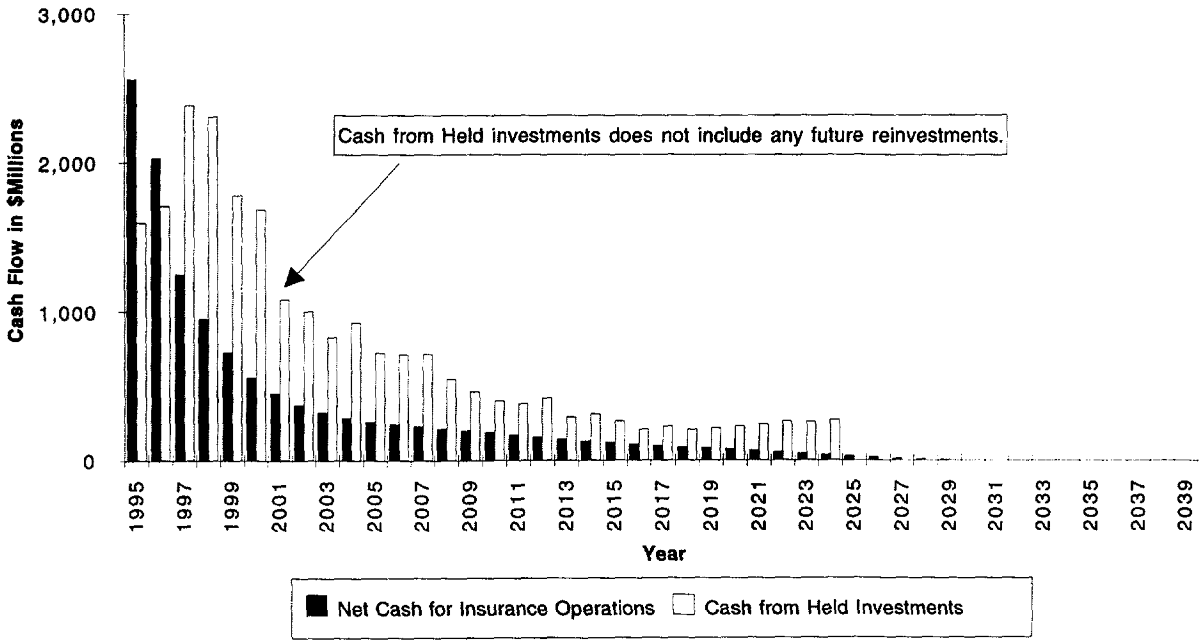
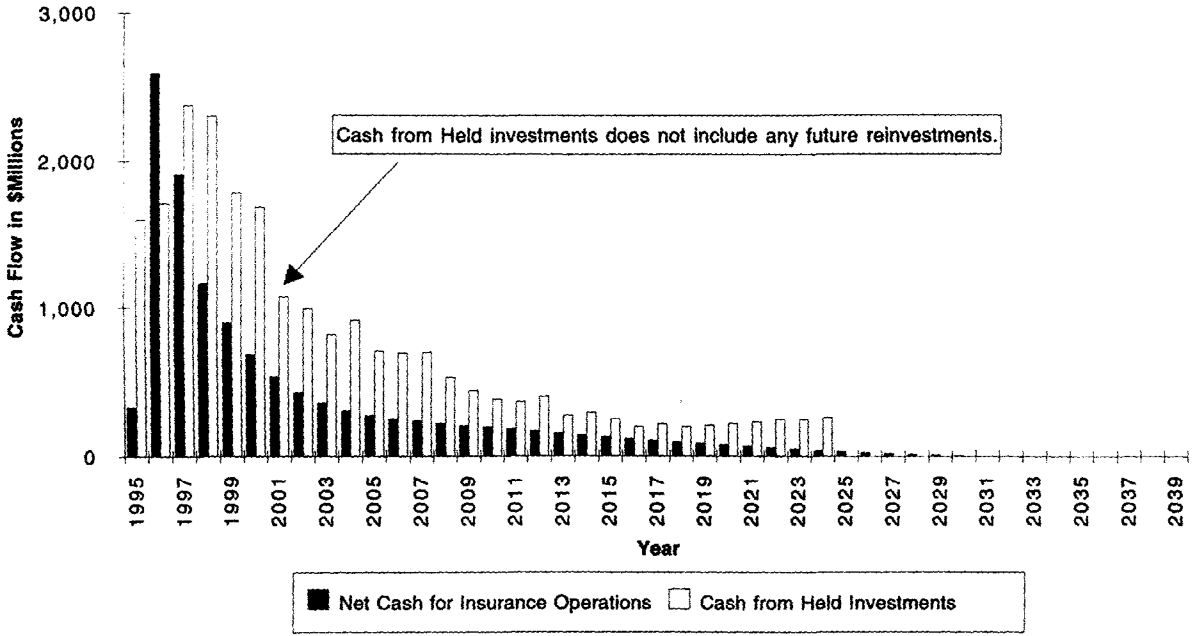
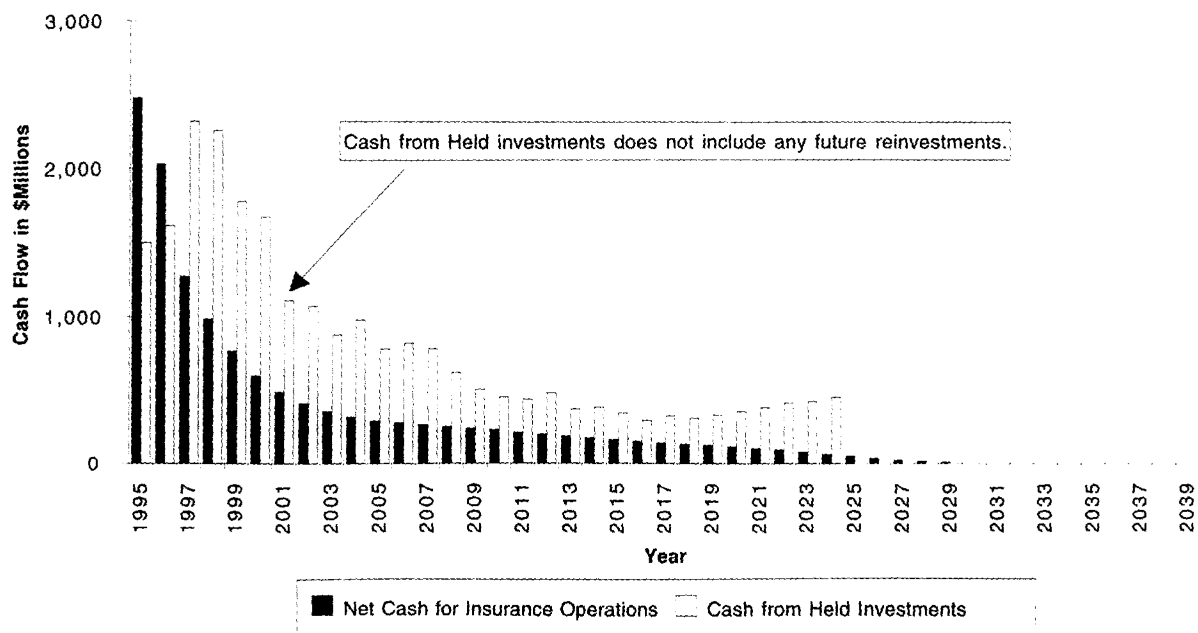


Exhibit 6

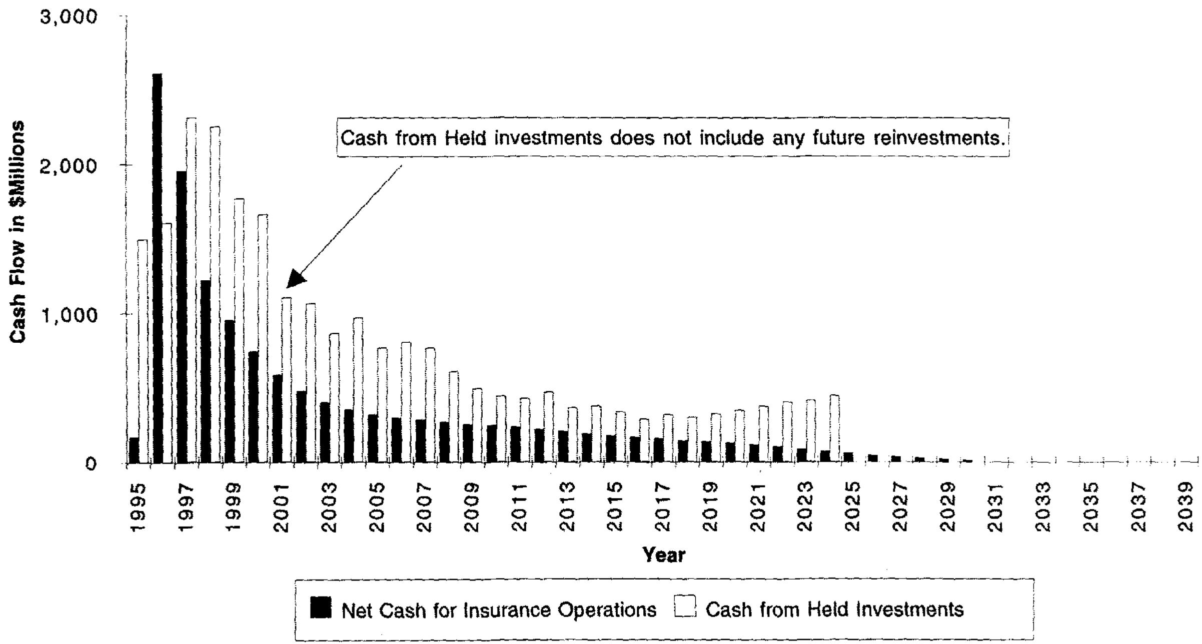
Investments and Net Liability Cash Flows
Cash Flow from Runoff and One New Policy Year
Base Case Scenario



Investments and Net Liability Cash Flows
Cash Flow from Runoff Only
Alternative Scenario



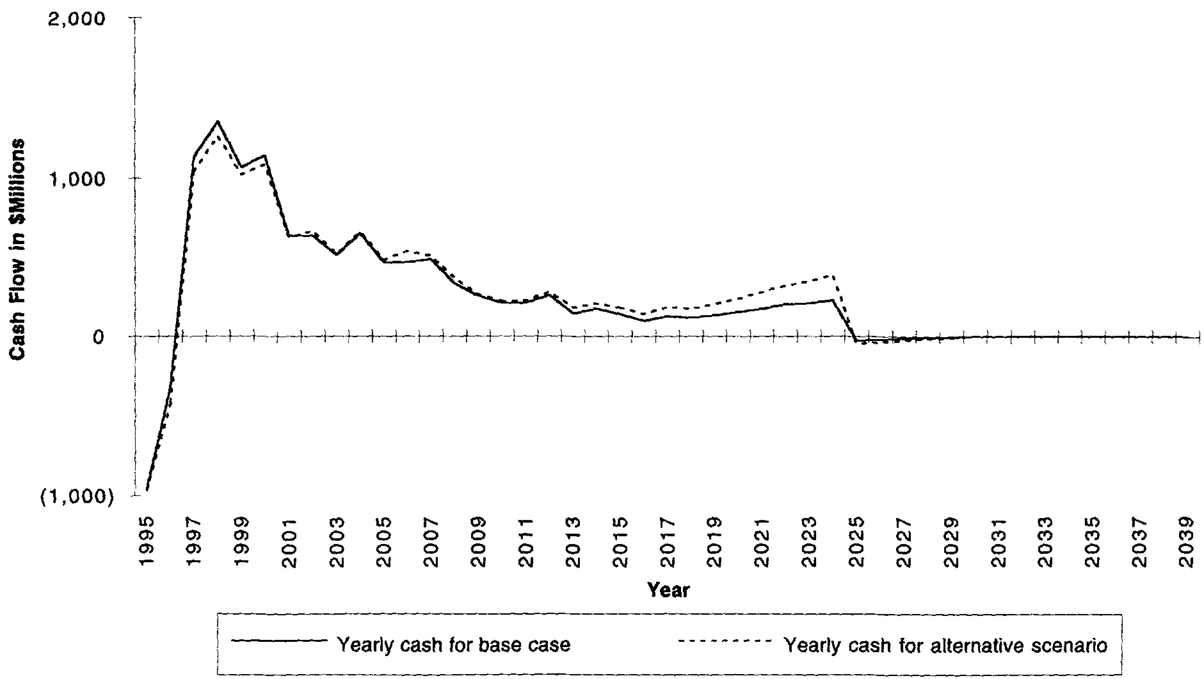
Investments and Net Liability Cash Flows
Cash Flow from Runoff and One New Policy Year
Alternative Scenario



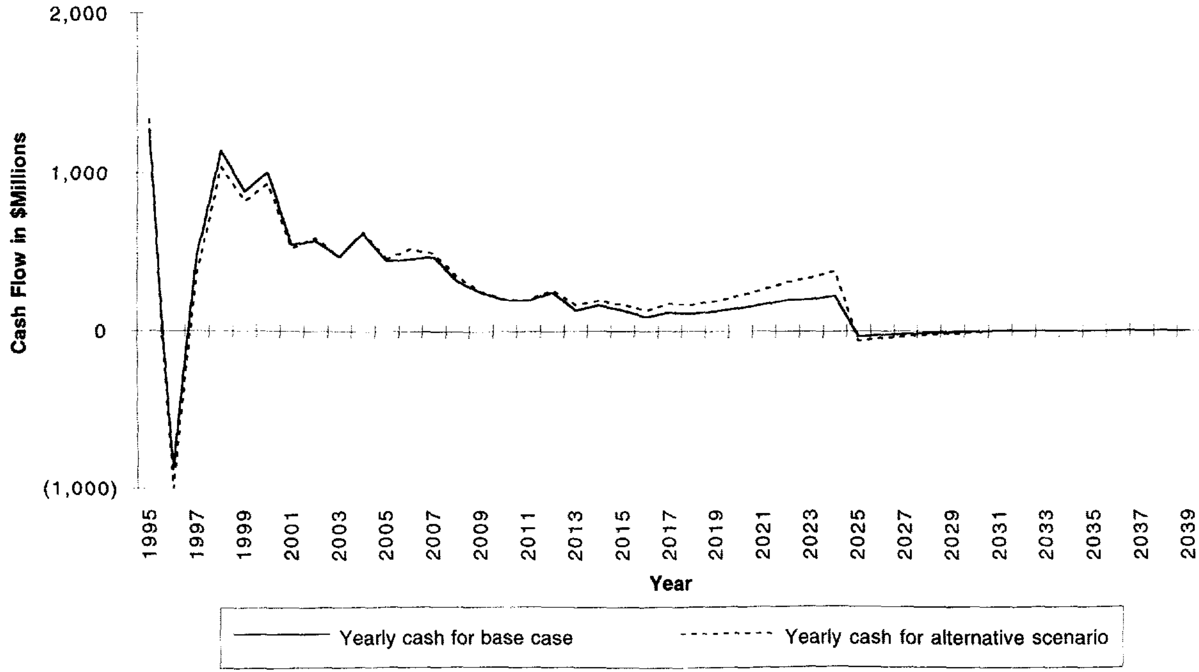
Sample Financial Model

Appendix C
Exhibit 9

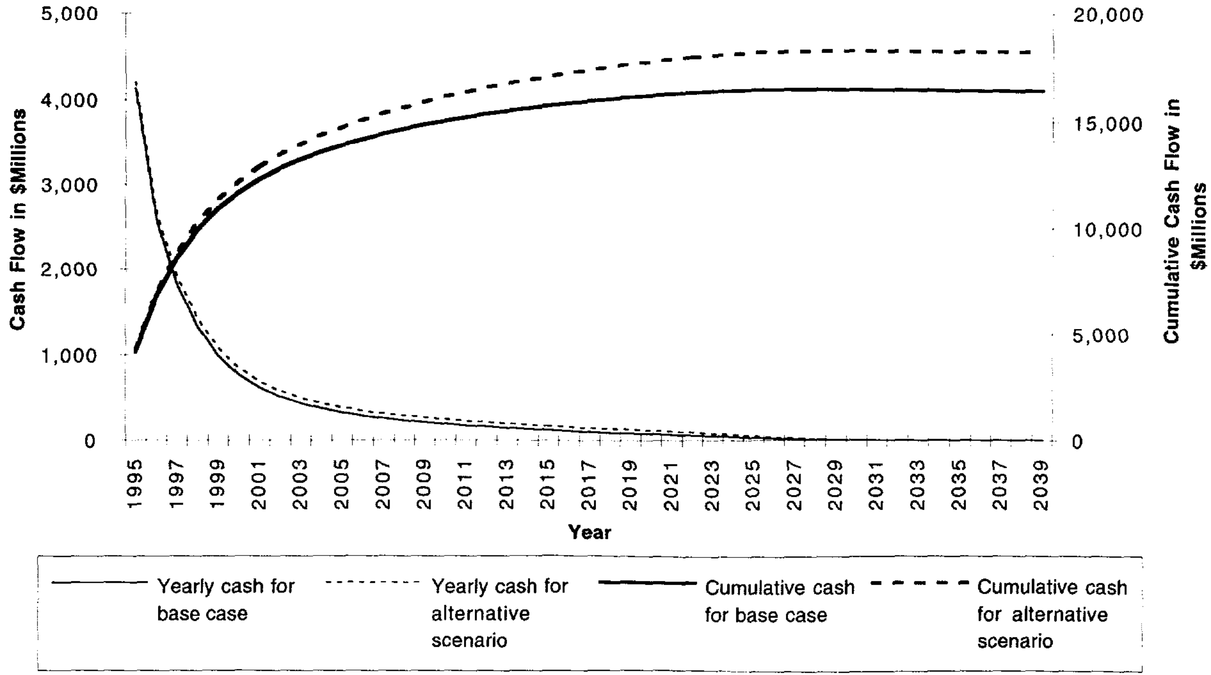
Net cash flows under the two Scenarios
Cash Flow from Runoff Only



Net cash flows under the two Scenarios
Cash Flow from Runoff and One New Policy Year

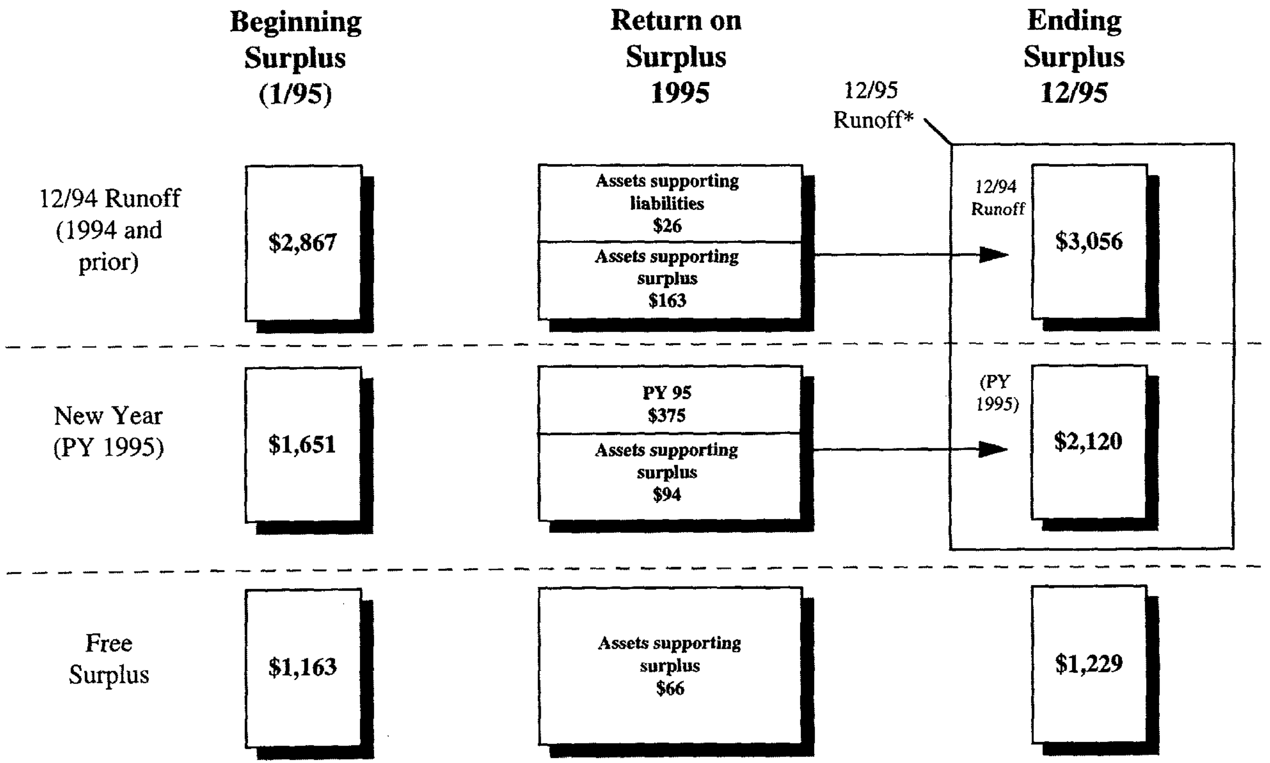


Loss and LAE cash flows under the two Scenarios
Cash Flow from Runoff Only



Return on Capital Illustration

Base Case



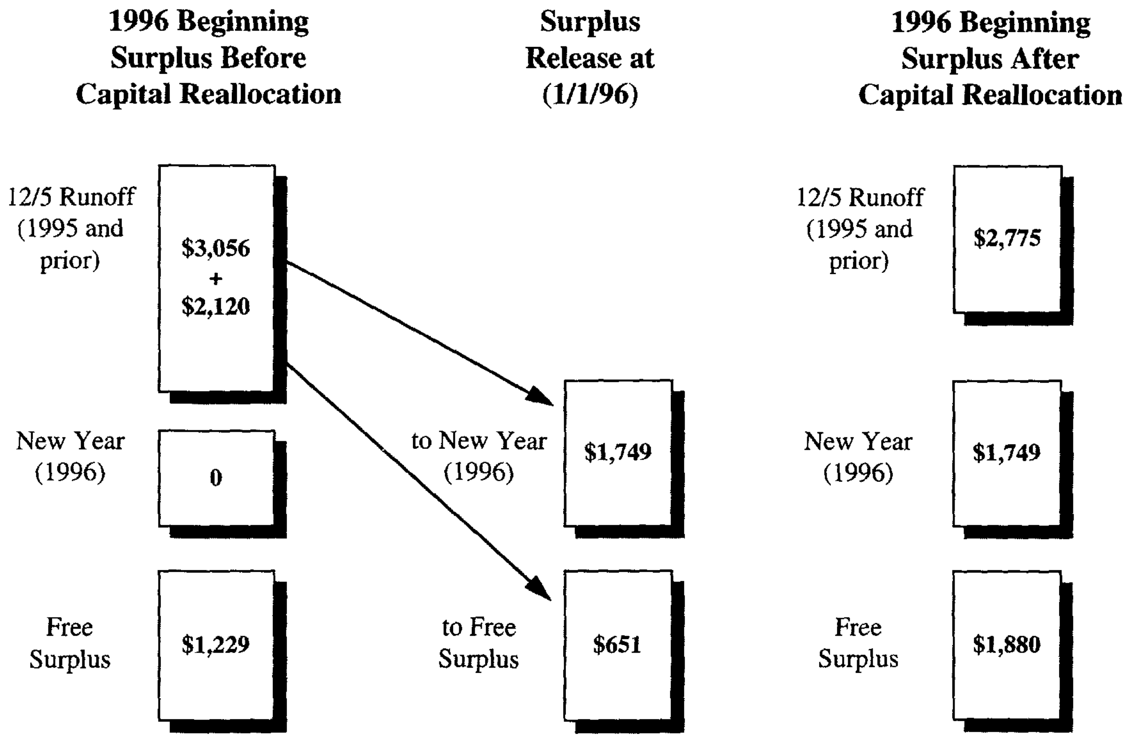
(Millions of Dollars)

*This combination makes up the 12/95 runoff surplus

Appendix D
Exhibit 2

Release of Capital Illustration

Base Case



(Millions of Dollars)

Note: Excess runoff surplus is released first to support the new year, and the remainder is released to free surplus.

Summary of return on Capital and release of Capital
Base Case

Appendix D
Exhibit 3

Total

	beginning surplus	ending surplus before new year U/W	% return	additional return from new year	% return	ending surplus	% return
Runoff	2,867,226	3,055,745	6.6%	–		3,055,745	6.6%
new year	1,650,585	1,744,225	5.7%	375,495	22.7%	2,119,720	28.4%
free surplus	1,162,973	1,228,951	5.7%	–		1,228,951	5.7%
Total	5,680,784	6,028,921	6.1%	375,495	6.6%	6,404,416	12.7%

Surplus allocated at the beginning of the following year

	capital needed	capital available	capital released	reallocated capital needed
Runoff	2,775,303	5,175,465	2,400,162	2,775,303
new year	1,749,224	–	(1,749,224)	1,749,224
free surplus	–	1,228,951	–	1,879,889
Total	4,524,527	6,404,416	650,938	6,404,416

Summary of return on Capital and release of Capital
Base Case

Appendix D
Exhibit 4

WC

	beginning surplus	ending surplus before new year U/W	% return	additional return from new year	% return	ending surplus	% return
Runoff	1,299,488	1,385,532	6.6%	–		1,385,532	6.6%
new year	588,698	622,097	5.7%	218,418	37.1%	840,515	42.8%
Total	1,888,186	2,007,629	6.3%	218,418	11.6%	2,226,047	17.9%

Surplus allocated at the beginning of the following year

	capital needed	capital available	capital released
Runoff	1,292,212	2,226,047	933,835
new year	623,879	–	(623,879)
Total	1,916,091	2,226,047	309,956

GL

	beginning surplus	ending surplus before new year U/W	% return	additional return from new year	% return	ending surplus	% return
Runoff	493,855	524,978	6.3%	–		524,978	6.3%
new year	203,021	214,538	5.7%	(1,050)	-0.5%	213,488	5.2%
Total	696,876	739,516	6.1%	(1,050)	-0.2%	738,466	6.0%

Surplus allocated at the beginning of the following year

	capital needed	capital available	capital released
Runoff	472,917	738,466	265,549
new year	215,153	–	(215,153)
Total	688,070	738,466	50,396

Summary of return on Capital and release of Capital
Base Case

CMP

	beginning surplus	ending surplus before new year U/W	% return	additional return from new year	% return	ending surplus	% return
Runoff	150,610	159,616	6.0%	–		159,616	6.0%
new year	82,935	87,640	5.7%	(2,098)	-2.5%	85,542	3.1%
Total	233,545	247,256	5.9%	(2,098)	-0.9%	245,158	5.0%

Surplus allocated at the beginning of the following year

	capital needed	capital available	capital released
Runoff	140,488	245,158	104,670
new year	87,892	–	(87,892)
Total	228,380	245,158	16,778

CA

	beginning surplus	ending surplus before new year U/W	% return	additional return from new year	% return	ending surplus	% return
Runoff	174,893	186,587	6.7%	–		186,587	6.7%
new year	133,752	141,340	5.7%	30,436	22.8%	171,776	28.4%
Total	308,645	327,927	6.2%	30,436	9.9%	358,363	16.1%

Surplus allocated at the beginning of the following year

	capital needed	capital available	capital released
Runoff	190,065	358,363	168,298
new year	141,745	–	(141,745)
Total	331,810	358,363	26,553

Summary of return on Capital and release of Capital
Base Case

Appendix D
Exhibit 6

Other Bus.

	beginning surplus	ending surplus before new year U/W	% return	additional return from new year	% return	ending surplus	% return
Runoff	4,832	5,130	6.2%	–		5,130	6.2%
new year	13,776	14,557	5.7%	(10,182)	-73.9%	4,375	-68.2%
Total	18,608	19,687	5.8%	(10,182)	-54.7%	9,505	-48.9%

Surplus allocated at the beginning of the following year

	capital needed	capital available	capital released
Runoff	10,752	9,505	(1,247)
new year	14,599	–	(14,599)
Total	25,351	9,505	(15,846)

PA

	beginning surplus	ending surplus before new year U/W	% return	additional return from new year	% return	ending surplus	% return
Runoff	317,159	340,008	7.2%	–		340,008	7.2%
new year	461,749	487,945	5.7%	144,259	31.2%	632,204	36.9%
Total	778,908	827,953	6.3%	144,259	18.5%	972,212	24.8%

Surplus allocated at the beginning of the following year

	capital needed	capital available	capital released
Runoff	324,266	972,212	647,946
new year	489,343	–	(489,343)
Total	813,609	972,212	158,603

Summary of Return on Capital and Release of Capital
Base Case

HO & Other

	beginning surplus	ending surplus before new year U/W	% return	additional return from new year	% return	ending surplus	% return
Runoff	426,389	453,894	6.5%	-		453,894	6.5%
new year	166,654	176,108	5.7%	(4,288)	-2.6%	171,820	3.1%
Total	593,043	630,002	6.2%	(4,288)	-0.7%	625,714	5.5%

Surplus allocated at the beginning of the following year

	capital needed	capital available	capital released
Runoff	344,603	625,714	281,111
new year	176,613	-	(176,613)
Total	521,216	625,714	104,498

Comparison of return on Capital between base case and alternative case

Appendix D
Exhibit 8

Total

Base Case

	beggining surplus	ending surplus before new year U/W	% return	additional return from new year	% return	ending surplus	% return
Runoff	2,867,226	3,055,745	6.6%	–		3,055,745	6.6%
new year	1,650,585	1,744,225	5.7%	375,495	22.7%	2,119,720	28.4%
free surplus	1,162,973	1,228,951	5.7%	–		1,228,951	5.7%
Total	5,680,784	6,028,921	6.1%	375,495	6.6%	6,404,416	12.7%

Alternative Case

	beggining surplus	ending surplus before new year U/W	% return	additional return from new year	% return	ending surplus	% return
Runoff	2,867,226	2,481,714	-13.4%	–		2,481,714	-13.4%
new year	1,650,585	1,664,141	0.8%	402,158	24.4%	2,066,297	25.2%
free surplus	1,162,973	1,172,522	0.8%			1,172,524	0.8%
Total	5,680,784	5,318,377	-6.4%	402,158	7.1%	5,720,535	0.7%

Comparison of return on Capital between base case and alternative case

Appendix D
Exhibit 9

WC

Base Case

	beggining surplus	ending surplus before new year U/W	% return	additional return from new year	% return	ending surplus	% return
Runoff	1,299,488	1,385,532	6.6%	–		1,385,532	6.6%
new year	588,698	622,097	5.7%	218,418	37.1%	840,515	42.8%
Total	1,888,186	2,007,629	6.3%	218,418	11.6%	2,226,047	17.9%

Alternative Case

	beggining surplus	ending surplus before new year U/W	% return	additional return from new year	% return	ending surplus	% return
Runoff	1,299,488	1,205,016	-7.3%	–		1,205,016	-7.3%
new year	588,698	593,533	0.8%	245,885	41.8%	839,418	42.6%
Total	1,888,186	1,798,549	-4.7%	245,885	13.0%	2,044,434	8.3%

GL

Base Case

	beggining surplus	ending surplus before new year U/W	% return	additional return from new year	% return	ending surplus	% return
Runoff	493,855	524,978	6.3%	–		524,978	6.3%
new year	203,021	214,538	5.7%	(1,050)	-0.5%	213,488	5.2%
Total	696,876	739,516	6.1%	(1,050)	-0.2%	738,466	6.0%

Alternative Case

	beggining surplus	ending surplus before new year U/W	% return	additional return from new year	% return	ending surplus	% return
Runoff	493,855	430,088	-12.9%	–		430,088	-12.9%
new year	203,021	204,688	0.8%	(461)	-0.2%	204,227	0.6%
Total	696,876	634,776	-8.9%	(461)	-0.1%	634,315	-9.0%

Comparison of return on Capital between base case and alternative case

Appendix D
Exhibit 10

CMP

Base Case

	beggining surplus	ending surplus before new year U/W	% return	additional return from new year	% return	ending surplus	% return
Runoff	150,610	159,616	6.0%	–		159,616	6.0%
new year	82,935	87,640	5.7%	(2,098)	-2.5%	85,542	3.1%
Total	233,545	247,256	5.9%	(2,098)	-0.9%	245,158	5.0%

Alternative Case

	beggining surplus	ending surplus before new year U/W	% return	additional return from new year	% return	ending surplus	% return
Runoff	150,610	136,968	-9.1%	–		136,968	-9.1%
new year	82,935	83,617	0.8%	(3,217)	-3.9%	80,400	-3.1%
Total	233,545	220,585	-5.5%	(3,217)	-1.4%	217,368	-6.9%

CA

Base Case

	beggining surplus	ending surplus before new year U/W	% return	additional return from new year	% return	ending surplus	% return
Runoff	174,893	186,587	6.7%	–		186,587	6.7%
new year	133,752	141,340	5.7%	30,436	22.8%	171,776	28.4%
Total	308,645	327,927	6.2%	30,436	9.9%	358,363	16.1%

Alternative Case

	beggining surplus	ending surplus before new year U/W	% return	additional return from new year	% return	ending surplus	% return
Runoff	174,893	152,101	-13.0%	–		152,101	-13.0%
new year	133,752	134,850	0.8%	35,870	26.8%	170,720	27.6%
Total	308,645	286,951	-7.0%	35,870	11.6%	322,821	4.6%

Comparison of return on Capital between base case and alternative case

Appendix D
Exhibit 11

Other Bus.

Base Case

	beggining surplus	ending surplus before new year U/W	% return	additional return from new year	% return	ending surplus	% return
Runoff	4,832	5,130	6.2%	–		5,130	6.2%
new year	13,776	14,557	5.7%	(10,182)	-73.9%	4,375	-68.2%
Total	18,608	19,687	5.8%	(10,182)	-54.7%	9,505	-48.9%

Alternative Case

	beggining surplus	ending surplus before new year U/W	% return	additional return from new year	% return	ending surplus	% return
Runoff	4,832	4,062	-15.9%	–		4,062	-15.9%
new year	13,776	13,889	0.8%	(10,807)	-78.4%	3,082	-77.6%
Total	18,608	17,951	-3.5%	(10,807)	-58.1%	7,144	-61.6%

PA

Base Case

	beggining surplus	ending surplus before new year U/W	% return	additional return from new year	% return	ending surplus	% return
Runoff	317,159	340,008	7.2%	–		340,008	7.2%
new year	461,749	487,945	5.7%	144,259	31.2%	632,204	36.9%
Total	778,908	827,953	6.3%	144,259	18.5%	972,212	24.8%

Alternative Case

	beggining surplus	ending surplus before new year U/W	% return	additional return from new year	% return	ending surplus	% return
Runoff	317,159	202,110	-36.3%	–		202,110	-36.3%
new year	461,749	465,541	0.8%	140,949	30.5%	606,490	31.3%
Total	778,908	667,651	-14.3%	140,949	18.1%	808,600	3.8%

Comparison of Return on Capital between base case and alternative scenario

Appendix D
Exhibit 12

HO & Other

	beggining surplus	ending surplus before new year U/W	% return	additional return from new year	% return	ending surplus	% return
Base Case							
Runoff	426,389	453,894	6.5%	–		453,894	6.5%
new year	166,654	176,108	5.7%	(4,288)	-2.6%	171,820	3.1%
Total	593,043	630,002	6.2%	(4,288)	-0.7%	625,714	5.5%
Alternative Case	beggining surplus	ending surplus before new year U/W	% return	additional return from new year	% return	ending surplus	% return
Runoff	426,389	351,369	-17.6%	–		351,369	-17.6%
new year	166,654	168,023	0.8%	(6,063)	-3.6%	161,960	-2.8%
Total	593,043	519,392	-12.4%	(6,063)	-1.0%	513,329	-13.4%

Illustration of Return
Overall Company
Base Case Scenario

Return on Runoff Before any New Business

Item	Market Value @ 12/94	Return	Rate of Return	Market Value @ 12/95
Fixed Income Securities	13,942	786	5.6%	14,728
Stocks	1,200	125	10.4%	1,325
Unrecognized FIT on Investments	(79)	(55)		(134)
Other Assets	(90)	(6)	7.0%	(96)
Collectable Premium	3,009	162	5.4%	3,172
Loss & LAE	(12,960)	(699)	5.4%	(13,659)
Other Expense	(360)	(19)	5.4%	(379)
FIT on Underwriting Income	1,018	55	5.4%	1,073
Net Market Value	5,681	348	6.1%	6,029
Net Value of Investments & Other	14,973	849	5.7%	15,823
Net Value of Insurance Operations	(9,292)	(501)	5.4%	(9,794)

Additional Return from New Policy Year (1995 PY)

Item	Nominal Value	Dec-95 Market Value	Discount Factor
Premium	5,864	5,839	99.6%
Loss & LAE	(4,787)	(4,257)	88.9%
Other Expense	(1,201)	(1,210)	100.8%
Income Tax	44	4	
Net Return from New Policy Year	(81)	375	

Summary of Results

	Market Value @ 12/94	Return	Rate of Return	Market Value @ 12/95
All Items	5,681	724	12.7%	6,404

Note: *Actual input in the model had finer line detail.*

Illustration of Return
Overall Company
Alternative Scenario

Return on Runoff Before any New Business

Item	Market Value @ 12/94	Return	Rate of Return	Market Value @ 12/95
Fixed Income Securities	13,942	(210)	-1.5%	13,732
Stocks	1,200	1	0.1%	1,201
Unrecognized FIT on Investments	(79)	339		259
Other Assets	(90)	(6)	7.0%	(96)
Collectable Premium	3,009	336	11.2%	3,346
Loss & LAE	(12,960)	(1,202)	9.3%	(14,162)
Other Expense	(360)	(34)	9.5%	(394)
FIT on Underwriting Income	1,018	414	40.7%	1,433
Net Market Value	5,681	(362)	-6.4%	5,318
Net Value of Investments & Other	14,973	123	0.8%	15,096
Net Value of Insurance Operations	(9,292)	(485)	5.2%	(9,778)

Additional Return from New Policy Year (1995 PY)

Item	Nominal Value	Dec-95 Market Value	Discount Factor
Premium	6,058	6,016	99.3%
Loss & LAE	(5,182)	(4,418)	85.3%
Other Expense	(1,241)	(1,246)	100.4%
Income Tax	xxxx	50	
Net Return from New Policy Year	(365)	402	

Summary of Results

	Market Value @ 12/94	Return	Rate of Return	Market Value @ 12/95
All Items	5,681	40	0.7%	5,721

Note: Actual input in the model had finer line detail.

Analysis of Returns (Before New Business)
Illustration of Base Case Scenario for the Overall Company

The difference in returns results from the combination of two factors, both of which need to exist simultaneously. The first is because of how assets and liabilities are allocated. The second is because the after-tax rate return on investments is different from the after-tax rate of discount in the reserves.

How are assets and liabilities allocated? Recall the stated Results (Before new year underwriting):

Type of Surplus	Beginning Surplus	Ending Surplus	Dollar Return	Rate of Return
Runoff	2,867	3,056	189	6.6%
New Year	1,651	1,744	94	5.7%
Free Surplus	1,163	1,229	66	5.7%

To get an explanation as to why the return on the runoff surplus is different from the return on the other surplus, one needs to look at the composition of assets and net liabilities in each of these segments. At the beginning of the year, all of the net liabilities, with a starting market value of $9,298 million, is allocated to the runoff surplus. Why? By definition, the runoff surplus is dedicated to support all of the insurance operations that were generated prior to the evaluation date, which is the net liabilities from the insurance operations.

Investments, and other miscellaneous items, can thus be broken into four parts, two of which go to the runoff surplus. First, we allocate enough assets to support the net insurance operations liabilities. Second, we allocate assets to support the runoff surplus. These two portfolios are allocated to the runoff surplus. The rest of the assets are then allocated to support each of the remaining surplus items: new year surplus, and free surplus. This allocation procedure results in the following "summarized balance sheets".

Composition of the Beginning Surplus			
	Investments and Misc.	Ins. Ops Liabilities	Surplus
Runoff	12,160	(9,292)	2,867
New Year	1,651	0	1,651
Free Surplus	1,163	0	1,163

We now turn to the second factor, the difference between the investment rate of return and the rate of discount in the reserves. Reserves are discounted at 5.4%, the after-tax yield rate of a selected bond portfolio. However, the actual investment portfolio was projected to yield 5.7%, mainly because this portfolio includes common stocks with a projected after-tax return of 6.7%. If the rate of return on investments and the discount rate were equal, then the return from the assets supporting the liabilities, would be exactly offset by the unwinding of the discount in the liabilities. However since the rate of return on investments is higher than the discount rate, the unwinding of the discount will not completely offset the return on investments. The table below reconciles the returns.

	Value of Item	Dollar Return	Rate of Return
(1) Assets supporting liabilities	9,292	527	5.7%
(2) liabilities	(9,292)	(501)	5.4%
(3) Net = (1) + (2)	0	26	
(4) pure runoff surplus	2,867	163	5.7%
(5) runoff surplus (3) + (4)	2,867	189	6.6%
(6) new year surplus	1,651	94	5.7%
(7) free surplus	1,163	66	5.7%
(8) total surplus	5,681	348	6.1%

Note that a real quick way to double-check the reasonability of the results:
Return on runoff surplus = 5.7% + ((5.7% - 5.4%) * (9,292 / 2,867)) = 6.6%.
Return on total surplus = 5.7% + ((5.7% - 5.4%) * (9,292 / 5,681)) = 6.1%.

For convenience, we shall call the 5.7% return as the return on assets supporting surplus, and the 0.3% (5.7% - 5.4%) as the return on assets supporting liabilities. The above short cut can be used to confirm the computation for each of the lines. One needs only the ratio of liabilities to surplus (all on a market value basis), in addition to the above returns. The following are examples for some selected lines.

Leverage Ratios			
	Market Values of		Liability-to-
	Insurance Operations	Allocated Surplus	Surplus Ratio
Workers Compensation	4,429	1,299	3.408
General Liability	1,116	494	2.260
Personal Auto	1,745	317	5.503

(1) Return on Investments	5.7%
(2) Insurance Operations Discount Rate	5.4%
(3) Return on Assets Supporting Surplus = (1)	5.7%
(4) Return on Assets Supporting Liabilities = (1) - (2)	0.3%

Return on the Runoff (Base Case)				
	Liability-to-	Return on Assets		% Return
	Surplus Ratio	Supporing Liabilities *	Supporing Surplus **	on Surplus
Workers Compensation	3.408	0.9%	5.7%	6.6%
General Liability	2.260	0.6%	5.7%	6.3%
Personal Auto	5.503	1.5%	5.7%	7.2%

* Return on Assets Supporting Liabilities = product of liabilities-to-surplus ratio and the net yield of assets supporting liabilities

** Return on assets supporting surplus = net yield of assets supporting surplus.

Analysis of Change in Inflation and Interest Rates
Impact on the Return on Runoff Surplus

In the illustrated alternative scenario, we assumed that both inflation and interest rates jump by 200 basis points and remain at the new level. The model assumes that the nominal paid loss and adjustment expenses increase at the 2% annual rate. The only exception is that a portion of workers comp indemnity reserves, in the non-COLA states, are not sensitive to chnages in inflation . All other expenses, except for acquisition expenses, grow at the rate of inflation. There are other consequences that are considered in the model.

First, the retrospective premiums are sensitive to loss experience, and should similarly increase, but not necessarily at the same rate. The increase in premium is dependent on the retrospective contracts. In the illustrated scenario, the sensitivity of retro premium to loss experience was based on the company's historic premium sensitivity to loss and was heavily dependent on the relative age at which the loss development occurs.

Second, one needs to consider the actual reaction of held reserves to the change in inflation outlook. From a market value perspective, held reserves affect only the timing of income taxes. Unfortunately, the reaction of held reserves to changes in inflation are not easily quantifiable. The difficulty stems not from theoretical reasons, since one can easily quantify such impact, rather the difficulty is in attempting to mimic the real world. The standard actuarial techniques do not consider inflation implicitly. True, Inflation is explicitly projected in the standard techniques, but these techniques average out inflation throughout the life of the policy or accident year and, as a result, do not calculate reserves under different inflation scenarios. In our scenario, WC nominal reserves ultimately grow 14% because of the 200 basis points jump in inflation. Company managers do not increase and reduce the reserve levels by such levels just because inflation has gone up. Because of these considerations, the scenario above assumes that the nominal held reserves increase at the rate of inflation.

Third, All the changes above will impact future earned premium and incurred loss and expenses. The tax implications from these earnings and losses are considered in the model. The change of 200 basis points in interest rates causes a change of 130 basis points in the discount rate, since the discount rate is an after-tax rate.

We had discussed previously the impact on investments from a 200 basis points increase in interest rates. Overall, the after-tax return on investments drops from 5.7% in the base case scenario, to 0.8% in the alternative scenario.

The following exhibits will illustrate the change in return on the runoff for some of the lines.

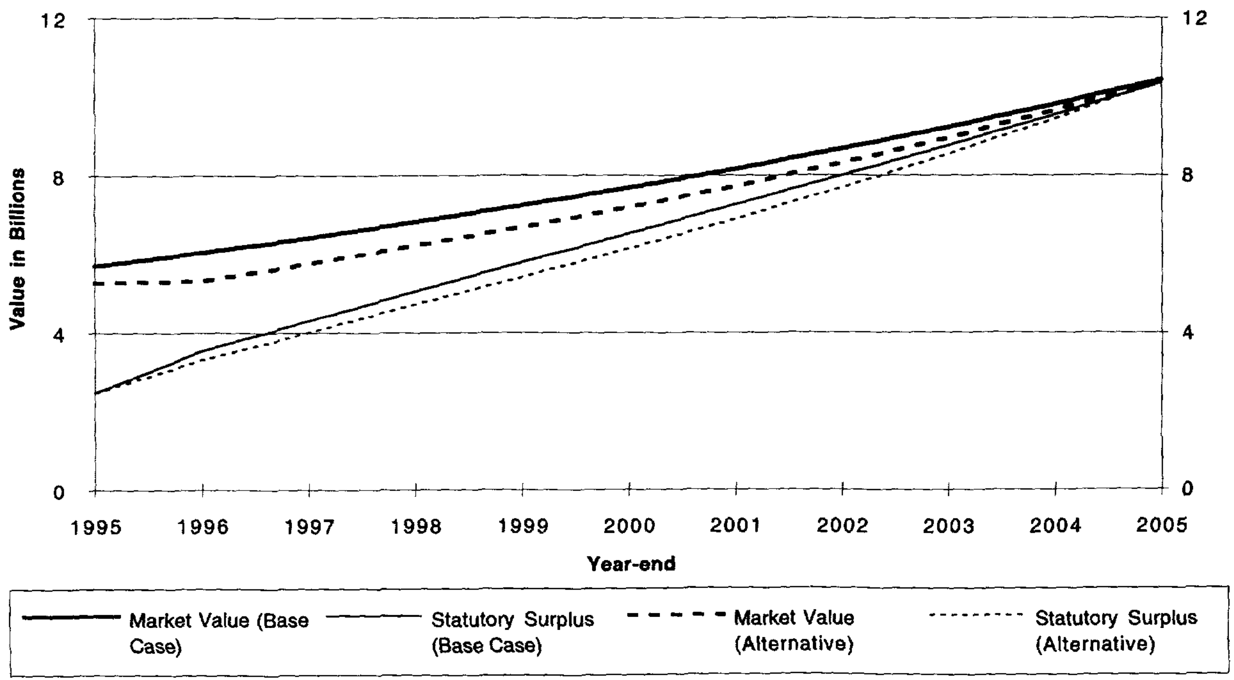
Change in Nominal Values of Insurance Operations				
	Premium	L & LAE	Oth. Exp.	FIT
Workers Compensation	158	(1,320)	(11)	411
General Liability	34	(158)	(1)	44
Personal Auto	N/A	(132)	(1)	47
Total All-Lines	227	(1,800)	(15)	556

Change in Market Values of Insurance Operations				
	Premium	L & LAE	Oth. Exp.	FIT
Workers Compensation	112	(247)	(11)	243
General Liability	27	(74)	(1)	32
Personal Auto	1	(78)	(1)	40
Total All-Lines	174	(503)	(15)	359

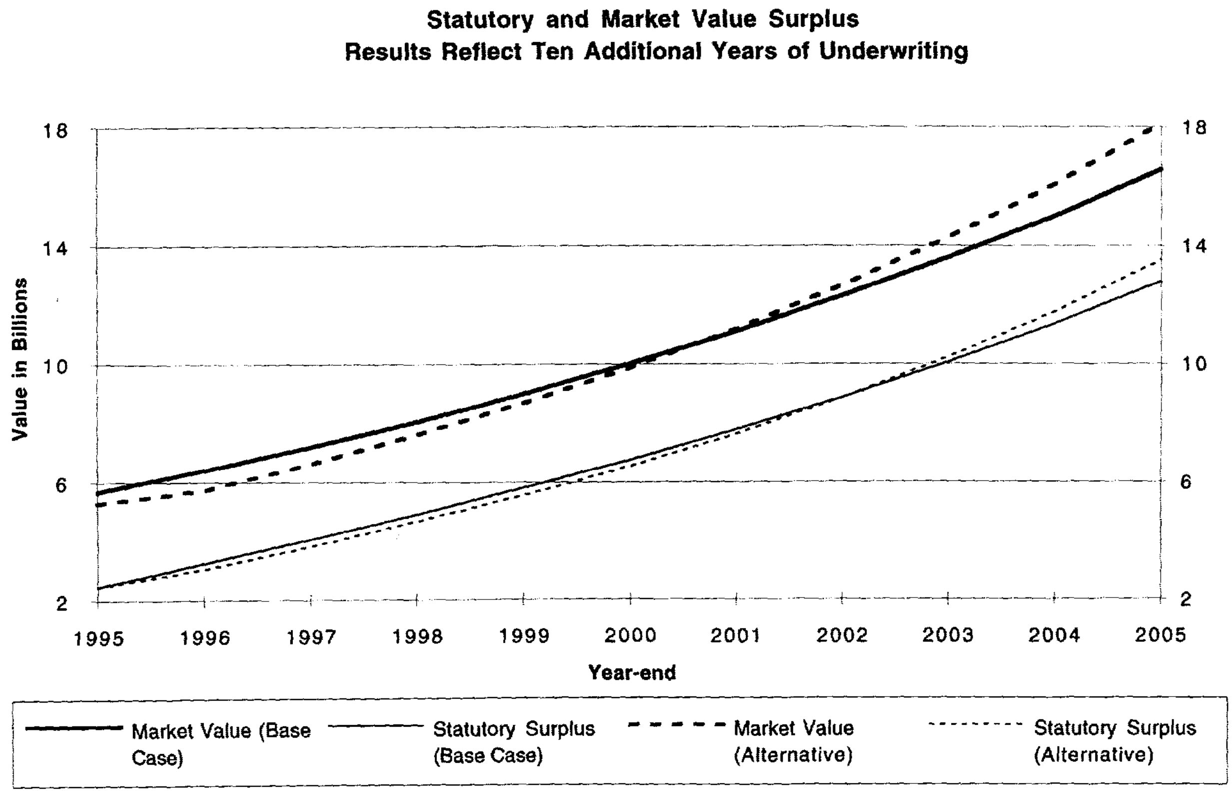
Change in Market Values of Investments			
	Beginning Investments	% Change in Return	Change in Return
Workers Compensation	5,728	-4.9%	(278)
General Liability	1,610	-4.9%	(78)
Personal Auto	2,062	-4.9%	(100)
Total All-Lines	12,160	-4.9%	(590)

Total Change in Return				
	Insurance Operations	Investments	Total Change	Change as % of Surplus
Workers Compensation	97	(278)	(180)	-13.9%
General Liability	(17)	(78)	(95)	-19.2%
Personal Auto	(38)	(100)	(138)	-43.5%
Total All-Lines	16	(590)	(574)	-20.0%

Statutory and Market Value Surplus
Runoff With No New Policy Years



Statistory and Market Value Surplus



Capital Allocation Rules for Base Case Scenario

Capital Allocation Rules	WC	GL	CMP	Other Lines *	Total
Dsic. Reserves-to-surplus ratio	5.3	3.1	2.8	(Mixed)	(Mixed)
Premium-to-surplus ratio	4.1	1.7	2.1	(Mixed)	(Mixed)

1/1/95 Capital Allocation

Information for 1/1/95 Capital Allocation	WC	GL	CMP	Other Lines *	Total
12/94 Discounted Reserves	6,898,630	1,523,676	417,945	4,119,895	12,960,146
1995 Planned premium	2,414,960	342,930	170,109	2,935,919	5,863,918

1/1/95 Allocated Capital	WC	GL	CMP	Other Lines *	Total
Runoff Business	1,298,213	493,371	150,462	922,368	2,864,415
New Policy Year	588,121	202,821	82,854	775,170	1,648,966
Total Capital	1,886,335	696,192	233,316	1,697,538	4,513,381

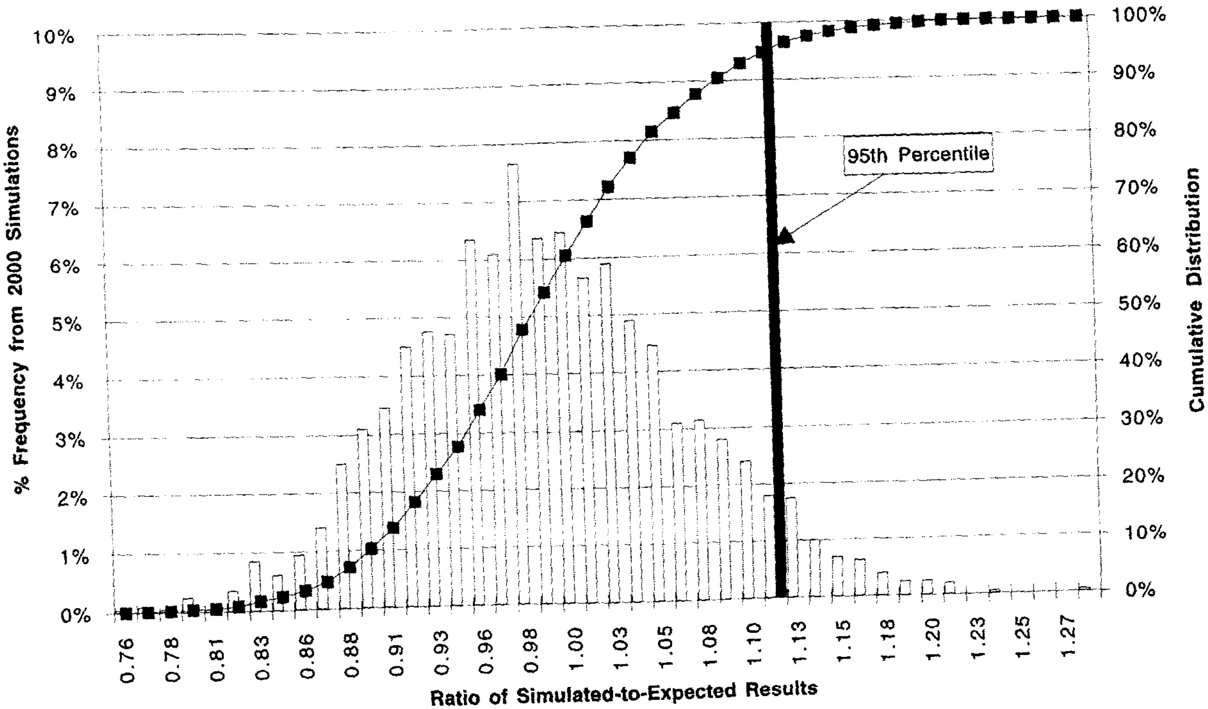
1/1/96 Capital Allocation

Information for 1/1/96 Capital Allocation	WC	GL	CMP	Other Lines *	Total
12/95 Discounted Reserves	6,866,738	1,460,508	390,241	4,005,847	12,723,333
1996 Planned premium	2,561,790	363,780	180,451	3,114,423	6,220,444

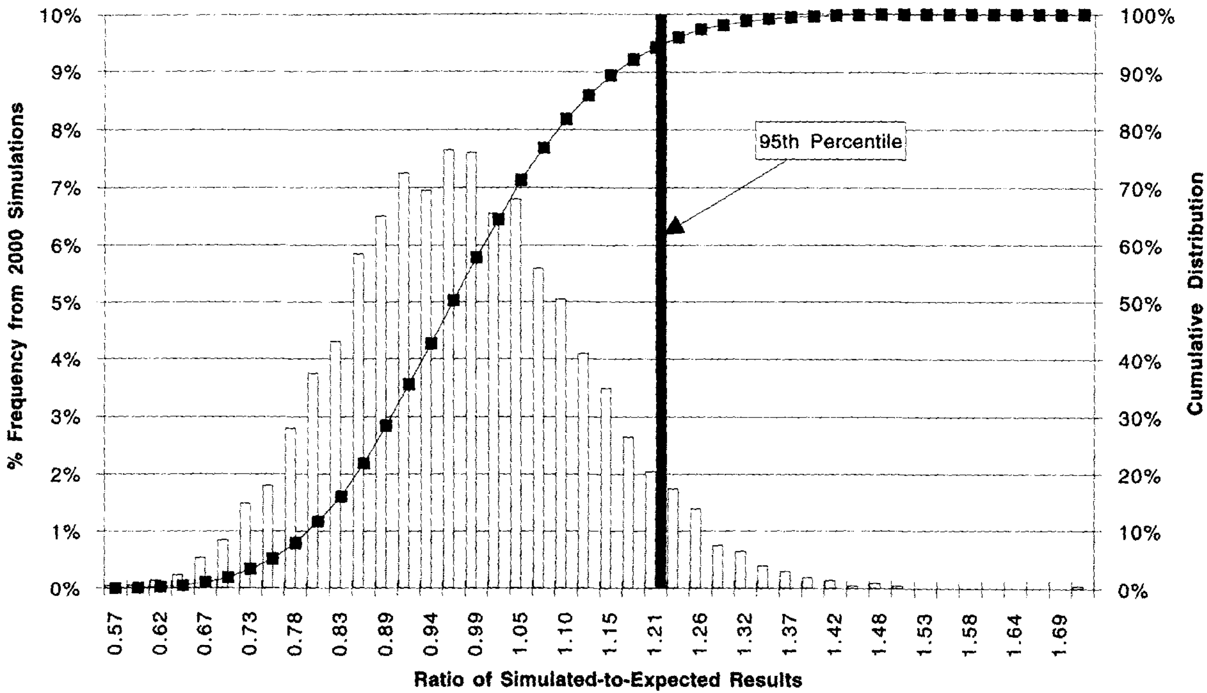
1/1/96 Allocated Capital	WC	GL	CMP	Other Lines *	Total
Runoff Business	1,292,212	472,917	140,488	869,686	2,775,303
New Policy Year	623,879	215,153	87,892	822,300	1,749,224
Total Capital	1,916,091	688,070	228,380	1,691,986	4,524,527

* Other Lines Capital Ratios varied by specific lines.

Workers Compensation Variability in the Discounted Loss & LAE Reserves



Workers Compensation Variability in the New Year's Results



Appendix G
Exhibit 1

Impact of Medical Inflation
Illustration based on a Fifteen-Year Triangle where the Dollar amounts and the payment patterns are the Fixed Basis for Further Simulations

Year	Payments in Nominal Dollars ($Millions)														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1976	600	263	114	50	22	10	4	2	1	0	0	0	0	0	0
1977	658	285	125	55	24	11	5	2	1	0	0	0	0	0	0
1978	713	311	138	61	27	12	5	2	1	0	0	0	0	0	0
1979	778	346	153	68	30	13	5	2	1	0	0	0	0	0	0
1980	864	383	171	74	32	13	6	2	1	0	0	0	0	0	0
1981	956	427	186	79	34	14	6	3	1	0	0	0	0	0	
1982	1,067	465	197	84	36	15	7	3	1	1	0	0	0		
1983	1,161	493	210	90	38	16	7	3	1	1	0	0			
1984	1,233	524	226	96	41	18	8	3	1	1	0				
1985	1,311	564	240	102	44	19	8	4	2	1					
1986	1,409	601	256	110	48	21	9	4	2						
1987	1,502	640	276	120	52	22	10	4							
1988	1,600	689	301	131	56	24	10								
1989	1,723	751	327	140	59	25									
1990	1,878	817	351	149	62										
1991	2,042	877	372	156											
1992	2,193	929	389												
1993	2,323	974													
1994	2,434														

Impact of Medical Inflation
Illustration based on a Fifteen-Year Triangle where the Dollar amounts
and the payment patterns are the Fixed Basis for Further Simulations

Appendix G
Exhibit 2

Year		1 - 2	2 - 3	3 - 4	4 - 5	5 - 6	6 - 7	7 - 8	8 - 9	9 - 10	10 - 11	11 - 12	12 - 13	13 - 14	14 - 15
	Loss Development Factors Based on Nominal Payments														
1976		1.438	1.132	1.051	1.022	1.009	1.004	1.002	1.001	1.000	1.000	1.000	1.000	1.000	1.000
1977		1.434	1.132	1.052	1.022	1.010	1.004	1.002	1.001	·1.000	1.000	1.000	1.000	1.000	1.000
1978		1.437	1.135	1.053	1.022	1.010	1.004	1.002	1.001	1.000	1.000	1.000	1.000	1.000	1.000
1979		1.444	1.136	1.053	1.022	1.009	1.004	1.002	1.001	1.000	1.000	1.000	1.000	1.000	1.000
1980		1.443	1.137	1.052	1.021	1.009	1.004	1.002	1.001	1.000	1.000	1.000	1.000	1.000	1.000
1981		1.446	1.134	1.050	1.020	1.009	1.004	1.002	1.001	1.000	1.000	1.000	1.000	1.000	
1982		1.435	1.129	1.049	1.020	1.008	1.004	1.002	1.001	1.000	1.000	1.000	1.000		
1983		1.425	1.127	1.048	1.020	1.008	1.004	1.002	1.001	1.000	1.000	1.000			
1984		1.425	1.128	1.048	1.020	1.008	1.004	1.002	1.001	1.000	1.000				
1985		1.430	1.128	1.048	1.020	1.009	1.004	1.002	1.001	1.000					
1986		1.426	1.127	1.049	1.020	1.009	1.004	1.002	1.001						
1987		1.426	1.129	1.050	1.021	1.009	1.004	1.002							
1988		1.431	1.131	1.050	1.021	1.009	1.004								
1989		1.436	1.132	1.050	1.020	1.008									
1990		1.435	1.130	1.049	1.020										
1991		1.430	1.127	1.047											
1992		1.424	1.125												
1993		1.419													
1994															
	Five Year Averages														
Link Ratio		1.429	1.129	1.049	1.020	1.009	1.004	1.002	1.001	1.000	1.000	1.000	1.000	1.000	1.000
Factor to Ultimate		1.753	1.227	1.087	1.035	1.015	1.006	1.003	1.001	1.001	1.000	1.000	1.000	1.000	1.000
Cum. Pay Pattern	57.1%	81.5%	92.0%	96.6%	98.5%	99.4%	99.7%	99.9%	99.9%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Pay Pattern	57.1%	24.5%	10.5%	4.5%	2.0%	0.8%	0.4%	0.2%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Calculation of Indicated Reserves (Nominal Dollars)

Year	1994	1993	1992	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980
Paid-to-date	2,434	3,297	3,512	3,447	3,257	3,026	2,811	2,627	2,460	2,295	2,151	2,022	1,876	1,707	1,547
Ultimate	4,266	4,044	3,815	3,569	3,306	3,045	2,818	2,630	2,461	2,296	2,152	2,022	1,876	1,707	1,547
Reserves	1,832	748	304	122	49	19	8	3	1	0	0	0	0	0	0
Total Reserves	3,086														

Impact of Medical Inflation
Illustration based on a Fifteen-Year Triangle where the Dollar amounts and the payment patterns are the Fixed Basis for Further Simulations

Year	Inflation Factors (1994 $Dollar)														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1976	4.057	3.701	3.415	3.127	2.817	2.545	2.280	2.096	1.973	1.856	1.727	1.620	1.521	1.412	1.296
1977	3.701	3.415	3.127	2.817	2.545	2.280	2.096	1.973	1.856	1.727	1.620	1.521	1.412	1.296	1.192
1978	3.415	3.127	2.817	2.545	2.280	2.096	1.973	1.856	1.727	1.620	1.521	1.412	1.296	1.192	1.110
1979	3.127	2.817	2.545	2.280	2.096	1.973	1.856	1.727	1.620	1.521	1.412	1.296	1.192	1.110	1.048
1980	2.817	2.545	2.280	2.096	1.973	1.856	1.727	1.620	1.521	1.412	1.296	1.192	1.110	1.048	1.000
1981	2.545	2.280	2.096	1.973	1.856	1.727	1.620	1.521	1.412	1.296	1.192	1.110	1.048	1.000	
1982	2.280	2.096	1.973	1.856	1.727	1.620	1.521	1.412	1.296	1.192	1.110	1.048	1.000		
1983	2.096	1.973	1.856	1.727	1.620	1.521	1.412	1.296	1.192	1.110	1.048	1.000			
1984	1.973	1.856	1.727	1.620	1.521	1.412	1.296	1.192	1.110	1.048	1.000				
1985	1.856	1.727	1.620	1.521	1.412	1.296	1.192	1.110	1.048	1.000					
1986	1.727	1.620	1.521	1.412	1.296	1.192	1.110	1.048	1.000						
1987	1.620	1.521	1.412	1.296	1.192	1.110	1.048	1.000							
1988	1.521	1.412	1.296	1.192	1.110	1.048	1.000								
1989	1.412	1.296	1.192	1.110	1.048	1.000									
1990	1.296	1.192	1.110	1.048	1.000										
1991	1.192	1.110	1.048	1.000											
1992	1.110	1.048	1.000												
1993	1.048	1.000													
1994	1.000														

Appendix G
Exhibit 4

Impact of Medical Inflation
Illustration based on a Fifteen-Year Triangle where the Dollar amounts and the payment patterns are the Fixed Basis for Further Simulations

Year	Payments in 1994 Dollars ($millions)														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1976	2,434	974	389	156	62	25	10	4	2	1	0	0	0	0	0
1977	2,434	974	389	156	62	25	10	4	2	1	0	0	0	0	0
1978	2,434	974	389	156	62	25	10	4	2	1	0	0	0	0	0
1979	2,434	974	389	156	62	25	10	4	2	1	0	0	0	0	0
1980	2,434	974	389	156	62	25	10	4	2	1	0	0	0	0	0
1981	2,434	974	389	156	62	25	10	4	2	1	0	0	0	0	
1982	2,434	974	389	156	62	25	10	4	2	1	0	0	0		
1983	2,434	974	389	156	62	25	10	4	2	1	0	0			
1984	2,434	974	389	156	62	25	10	4	2	1	0				
1985	2,434	974	389	156	62	25	10	4	2	1					
1986	2,434	974	389	156	62	25	10	4	2						
1987	2,434	974	389	156	62	25	10	4							
1988	2,434	974	389	156	62	25	10								
1989	2,434	974	389	156	62	25									
1990	2,434	974	389	156	62										
1991	2,434	974	389	156											
1992	2,434	974	389												
1993	2,434	974													
1994	2,434														

Impact of Medical Inflation

Illustration based on a Fifteen-Year Triangle where the Dollar amounts and the payment patterns are the Fixed Basis for Further Simulations

Year		1 - 2	2 - 3	3 - 4	4 - 5	5 - 6	6 - 7	7 - 8	8 - 9	9 - 10	10 - 11	11 - 12	12 - 13	13 - 14	14 - 15
		Loss Development Factors Based on Payments Converted to 1994 $Dollars													
1976		1.400	1.114	1.041	1.016	1.006	1.002	1.001	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1977		1.400	1.114	1.041	1.016	1.006	1.002	1.001	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1978		1.400	1.114	1.041	1.016	1.006	1.002	1.001	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1979		1.400	1.114	1.041	1.016	1.006	1.002	1.001	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1980		1.400	1.114	1.041	1.016	1.006	1.002	1.001	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1981		1.400	1.114	1.041	1.016	1.006	1.002	1.001	1.000	1.000	1.000	1.000	1.000	1.000	
1982		1.400	1.114	1.041	1.016	1.006	1.002	1.001	1.000	1.000	1.000	1.000	1.000		
1983		1.400	1.114	1.041	1.016	1.006	1.002	1.001	1.000	1.000	1.000	1.000			
1984		1.400	1.114	1.041	1.016	1.006	1.002	1.001	1.000	1.000	1.000				
1985		1.400	1.114	1.041	1.016	1.006	1.002	1.001	1.000	1.000					
1986		1.400	1.114	1.041	1.016	1.006	1.002	1.001	1.000						
1987		1.400	1.114	1.041	1.016	1.006	1.002	1.001							
1988		1.400	1.114	1.041	1.016	1.006	1.002								
1989		1.400	1.114	1.041	1.016	1.006									
1990		1.400	1.114	1.041	1.016										
1991		1.400	1.114	1.041											
1992		1.400	1.114												
1993		1.400													
1994															
		Five Year Averages													
Link Ratio		1.400	1.114	1.041	1.016	1.006	1.002	1.001	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Factor to Ultimate		1.667	1.190	1.068	1.026	1.010	1.004	1.002	1.001	1.000	1.000	1.000	1.000	1.000	1.000
Cum. Pay Pattern	60.0%	84.0%	93.6%	97.4%	99.0%	99.6%	99.8%	99.9%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Pay Pattern	60.0%	24.0%	9.6%	3.8%	1.5%	0.6%	0.2%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Calculation of Indicated Reserves (in 1994 Dollars)

Year	1994	1993	1992	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980
Paid-to-date	2,434	3,408	3,797	3,953	4,015	4,040	4,050	4,054	4,056	4,056	4,057	4,057	4,057	4,057	4,057
Ultimate	4,057	4,057	4,057	4,057	4,057	4,057	4,057	4,057	4,057	4,057	4,057	4,057	4,057	4,057	4,057
Reserves	1,623	649	260	104	42	17	7	3	1	0	0	0	0	0	0
Total Reserves	2,704														

Appendix G
Exhibit 6

Impact of Medical Inflation
Illustration based on a Fifteen-Year Triangle where the Dollar amounts
and the payment patterns are the Fixed Basis for Further Simulations

		Expected Payment of Reserves in													
Year	Total	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1994 Dollars	2,704	1,623	649	260	104	42	17	7	3	1	0	0	0	0	0
		Reinflated Payments													
4% Inflation	2,890	1,688	702	292	121	51	21	9	4	2	1	0	0	0	0
8% Inflation	3,085	1,752	757	327	141	61	26	11	5	2	1	0	0	0	0
10% Inflation	3,187	1,785	785	346	152	67	29	13	6	3	1	0	0	0	0

Development Factors for Indemnity and ALAE

Period	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	120 - 132	132 - 144
1970 Dec					1.055	1.040	1.028	1.021	1.018	1.016	1.012
1971 Dec				1.094	1.055	1.041	1.026	1.024	1.016	1.011	1.010
1972 Dec			1.168	1.093	1.065	1.043	1.032	1.025	1.016	1.018	1.018
1973 Dec		1.386	1.169	1.096	1.062	1.049	1.033	1.025	1.020	1.017	1.012
1974 Dec	2.334	1.385	1.164	1.093	1.068	1.044	1.034	1.022	1.019	1.016	1.013
1975 Dec	2.310	1.398	1.190	1.116	1.076	1.051	1.037	1.026	1.021	1.016	1.013
1976 Dec	2.262	1.388	1.195	1.117	1.069	1.048	1.031	1.027	1.020	1.017	1.013
1977 Dec	2.192	1.397	1.191	1.111	1.070	1.048	1.031	1.023	1.019	1.016	1.015
1978 Dec	2.246	1.407	1.193	1.113	1.068	1.048	1.031	1.027	1.022	1.019	1.016
1979 Dec	2.199	1.409	1.192	1.109	1.068	1.045	1.036	1.027	1.023	1.020	1.019
1980 Dec	2.169	1.400	1.209	1.107	1.074	1.050	1.038	1.030	1.023	1.020	1.017
1981 Dec	2.191	1.400	1.185	1.115	1.075	1.055	1.041	1.032	1.025	1.019	1.017
1982 Dec	2.179	1.395	1.207	1.131	1.098	1.059	1.046	1.043	1.026	1.024	1.020
1983 Dec	2.283	1.437	1.227	1.140	1.088	1.064	1.048	1.037	1.025	1.022	.1.017
1984 Dec	2.345	1.473	1.228	1.134	1.089	1.064	1.044	1.033	1.027	1.018	
1985 Dec	2.422	1.473	1.245	1.140	1.087	1.057	1.041	1.030	1.020		
1986 Dec	2.377	1.500	1.237	1.133	1.085	1.055	1.038	1.026			
1987 Dec	2.452	1.496	1.234	1.127	1.080	1.053	1.034				
1988 Dec	2.496	1.498	1.228	1.126	1.074	1.047					
1989 Dec	2.502	1.512	1.231	1.121	1.068						
1990 Dec	2.666	1.520	1.232	1.109							
1991 Dec	2.529	1.507	1.217								
1992 Dec	2.454	1.470									
1993 Dec	2.426										
1994 Dec											
	1	2	3	4	5	6	7	8	9	10	11
*Lognormal Parameters:**											
mu	0.30	-0.82	-1.58	-2.16	-2.62	-3.00	-3.33	-3.59	-3.86	-4.03	-4.21
sigma	0.101934	0.113505	0.124266	0.132860	0.154326	0.138741	0.167132	0.182388	0.157487	0.174078	0.203765
Simulated ATA**	2.304	1.354	1.167	1.136	1.063	1.059	1.039	1.019	1.021	1.014	1.016

* Lognormal parameters are based on fitting a lognormal distribution to the column of age-to-age factors. To get a better fit, the distribution is fit to (ATA - 1), rather than to the age-to-age factors themselves.

** The simulated age-to-age factors are used in a Monte-Carlo simulation, and are derived by inverting the Cumulative Density of the lognormal, assuming no correlation among the development at different maturities.

Appendix H
Exhibit 1
Page 2

144 - 156	156 - 168	168 - 180	180 - 192	192 - 204	204 - 216	216 - 228	228 - 240	240 - 252	252 - 264	264 - 276	276 - 288	288 - 300
1.013	1.009	1.008	1.007	1.021	1.001	1.004	1.006	1.005	1.004	1.004	1.004	1.005
1.011	1.007	1.010	1.012	1.009	1.005	1.006	1.005	1.005	1.004	1.006	1.005	
1.010	1.012	1.011	1.008	1.008	1.008	1.007	1.007	1.006	1.006	1.008		
1.013	1.012	1.011	1.008	1.008	1.007	1.007	1.007	1.005	1.007			
1.010	1.013	1.009	1.008	1.009	1.007	1.006	1.008	1.007				
1.014	1.012	1.011	1.010	1.009	1.010	1.010	1.010					
1.013	1.012	1.008	1.011	1.009	1.009	1.009						
1.013	1.011	1.010	1.009	1.009	1.009							
1.014	1.012	1.012	1.011	1.009								
1.013	1.011	1.012	1.012									
1.017	1.011	1.011										
1.016	1.011											
1.015												
12	13	14	15	16	17	18	19	20	21	22	23	24
-4.34	-4.52	-4.61	-4.65	-4.64	-5.21	-5.00	-4.95	-5.19	-5.23	-5.12		
0.163310	0.176673	0.160767	0.170090	0.291440	0.985813	0.279841	0.226982	0.190354	0.226015	0.280225		
1.014	1.013	1.010	1.011	1.007	1.018	1.006	1.005	1.006	1.005	1.007		