

of the final ten pages entitled "The Cycles Revisited," which adds little to the results. Their findings that workers compensation cycles are state-specific is very insightful, however, and has important regulatory and ratemaking implications.

The other article in the book on heterogeneity bias by Worrall and Butler, has the most limited audience. This paper provides fundamental information for anyone doing research involving workers' compensation loss data. Their purpose is to improve the research performed in the workers' compensation area and thus "help stimulate further research into how heterogeneity affects our ability to forecast workers' compensation cost" as they state in their conclusion on page 41.

Overall, this book is very readable and thought-provoking, and with the exception of the cycles article, includes excellent conclusions which crystallize the purpose, findings, and implications of the research. (The cycles article has no conclusions section.) The book is a significant addition to the literature in the workers' compensation area.

Financial Models of Insurance Solvency, edited by J. David Cummins and Richard A. Derrig. (Huebner International Series On Risk, Insurance, And Economic Security, Kluwer Academic Publishers, 1989), 363 pages.

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Financial Models Of Insurance Solvency, edited by J. David Cummins and Richard A. Derrig, is Volume II of the Proceedings of the First International Conference on Insurer Solvency which was held in 1986 at the Wharton School, University of Pennsylvania. This volume is a collection of eleven papers that fall into two groups. The first group consists of papers that adopt an essentially actuarial or statistical approach to solvency modelling. The emphasis is on cash flow analysis that incorporates investment income, inflation, taxation, and other economic variables. Most of these variables were modelled as stochastic processes. Whereas traditional definitions of insolvency involve static ratios, liquidation, and book value of assets below the book value of liabilities, these cash flow models describe insolvency as a situation in which the present value of cash outflows exceeds the present value of cash inflows and the market value of liabilities exceeds the market value of assets on an ongoing basis. The second group consists of papers that use asset pricing models, capital structure theory, and the economic theory of agency in financial economics to analyze various aspects of insurer solvency. In contrast to the actuarial models that treat capital as exogenous, the financial models assume capital is determined in the financial markets of the economy. Similarly, the actuarial models treat the price of the product as determined by the actuary

whereas the financial models determine the equilibrium product price that reflects risk in the financial markets.

Without naming either the papers or the authors, a brief overview of each paper will be given. In Paper 1 a stochastic simulation model is described that could be applied to all types of insurers and would be valuable for both assessment of solvency and financial management of an insurer. The model allows both the asset and the liability cash flows to be uncertain in both amount and timing. In Paper 2 the authors develop an insurance company simulation model that integrates the underwriting and financial sides of the insurer. The model allows for multiple lines of insurance, multiple types of investment, and multiple planning periods while developing rates of return, measures of premium adequacy and solvency with confidence limits. In Paper 3 the author develops a simulation model that incorporates investment strategies, terms to maturity, investment risk, and premium rates on the present value of profits for endowment insurance policies. In Paper 4 the authors develop a simulation model that can be used to check whether the cash flows from the assets will be adequate to meet the "emerging costs" of the liabilities for an individual insurer. In Paper 5 the authors present a method to calculate the total loss distribution and the probability of ruin. They invert the characteristic function of the total claims distribution and compare those approximations to the tail of the loss distribution with the Normal Power method. In Paper 6 the author develops a model using stochastic control theory that includes the original claims process, claims reserves, reinsurance, investment return, premiums, and solvency margin. The features of the model are demonstrated with an application to workers' compensation data. In Paper 7 the authors review the theories of mean-variance portfolio, capital structure, and agency. They stress the importance of considering solvency in terms of both underwriting and investment as well as other actions of management and external economic conditions. In Paper 8 the author discusses those characteristics of insurers—redundant tax shield, bankruptcy costs, and agency costs—that might change the capital structure of insurers from that associated with traditional capital structure theory. In Paper 9 the author uses the options pricing model and the imperfections of the insurance product market to derive a capital structure with equity. But, to increase the equity value, the insurer has an incentive to increase the risk in the asset and insurance market. In Paper 10 the author argues that flat (non-risk-based) solvency premiums for insurers can lead to riskier behavior for the insurers. The author derives market equilibrium risk-based premium formulae using conventional options theory, options models with jumps (catastrophes), and a perpetual options model. The author states that these models can also be used in the financial pricing of insurance contracts. In Paper 11 the author uses the capital asset pricing model and the options model to demonstrate that premium to capital ratios should vary by line and that surplus should be allocated by line in proportion to the market value of reserves rather than the book value. The author applies the model to the automobile and worker's compensation lines.

The purpose of the Conference was to bring together the two approaches to modelling insurer solvency. As the editors mention in the excellent preface, the actuaries cited mostly other actuarial work and the financial economists cited work by other economists. The gap between the two approaches is wide. The quality of the work presented in this book should help to reduce that gap. However, the book and the work is probably best suited for other actuaries and financial economists.

