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ASTIN Bulletin

Volume **30** (2), 2000

Grübel, R.& Hermesmeier, R. *Computation of compound distributions II: discretization errors and Richardson extrapolation.* 309-331. The standard methods for the calculation of total claim size distributions and ruin probabilities, Panjer recursion and algorithms based on transforms, both apply to lattice-type distributions only and therefore require an initial discretization step if continuous distribution functions are of interest. We discuss the associated discretization error and show that it can often be reduced substantially by an extrapolation technique.

Gutiérrez-Delgado, M. C. & Korabinski, A. A. *Initial selection and cause of disability for individual permanent health insurance.* 369-389. We investigate the influence of initial selection (the impact of underwriting during the early years of a policy's life) on individual Permanent Health Insurance claim inceptions. In Gutiérrez-Delgado (1999) a decreasing trend was found. In this paper we include the effect of cause of disability and fit a generalized linear model in order to gain a greater understanding of the phenomenon. Both effects, policy duration and cause of disability, are found to have a significant effect on the number of claims. We describe their influence using factors that collect the information available through the fitted model. Results from both factors suggest that the grouping of diseases selected for the research helps to explain partially our earlier results. In addition there is some evidence of moral hazard in mental disorders and musculoskeletal diseases which also contributes to the understanding of the negative trend found.

Lane, M. N. *Pricing risk transfer functions.* 259-293. Should the pricing of reinsurance catastrophes be related to the price of the default risk embedded in corporate bonds? If not, why not?

A risk is a risk is a risk, in whatever market it appears. Shouldn't the risk-prices in these different markets be comparable? More basically perhaps, how should reinsurance prices and bond prices be set? How does the market currently set them? These questions are central to the inquiry contained in this paper.

Avoiding unnecessary suspense, our answers are: Yes, cat prices should be related to credit prices because both risks contain a characteristic trade-off between the frequency of and severity of adverse events. We leave the question of how prices should be set to others and focus on the empirical question of how they have been set by the markets. In the process, we develop a fairly robust pricing mechanism and explore its potential uses in many different contexts.

The 1999 Insurance-Linked Securities (ILS) market (aka, Cat Bond market) provides the empirical springboard to the discussion. The ILS market is only 4 years old. As such, it represents a new and unique intersection of reinsurance and financial markets. It provides a wonderful laboratory for exploring risk-pricing.

The ILS market, still in its experimental phase, appears to require more generous (cheap) pricing of insurance risk than does the bond market of default risk. So much so that academics have begun to weigh in on the question of why. Previously, insurance pricing discussions had been confined to practicing insurance professionals, particularly actuaries. For finance professionals, insurance pricing, much less reinsurance pricing, seldom made the index of their financial texts — though even that is beginning to change.

Perhaps academic reticence occurred because prior to the advent of cat bonds, reinsurance markets were opaque. Reinsurance prices were unavailable to the investing community. With insurance securitization, however, the pricing of embedded insurance risks is exposed to, and must be made appetizing for, investors. Prices ought to converge towards other alternative fixed income assets. At the very least, risk-pricing of insurance can now be compared with other investor alternatives. And yet, insurance is different.

MACK, T. *Credible claims reserve: the Benktander method.* 333-347. A claims reserving method is reviewed which was introduced by Gunnar Benktander in 1976. It is a very intuitive credibility mixture of Bornhuetter/Ferguson and Chain Ladder. In this paper, the mean squared errors of all 3 methods are calculated and compared on the basis of a very simple stochastic model. The Benktander method is found to have almost always a smaller mean squared error than the other two methods and to be almost as precise as an exact Bayesian procedure.

MATA, A. J. *Pricing excess of loss reinsurance with reinstatements.* 349-368. In this paper we discuss the concept of excess of loss reinsurance with reinstatements. The main objective is to provide a methodology to calculate the distribution of total aggregate losses for two or more consecutive layers when there is a limited number of reinstatements. We also compare different premium principles and their properties to price these treaties for any number of free or paid reinstatements.

NIELSEN, J. P. & SANDQVIST, B. L. *Credibility weighted hazard estimation.* 405-417. Credibility weighting is helpful in many insurance applications where sparse data crave information from other sources of data. In this paper we aim at estimating a hazard curve using the nonparametric kernel method, where a credibility weighting principle is used locally, so that areas of sparse data for one subgroup can be alleviated by available information from other subgroups. The credibility estimator is found through a Hilbert space projection formulation of Bühlmann-Straub's credibility approach.

NIELSEN, J. P. *Super-efficient prediction based on high-quality market information.* 295-303. Nielsen (1999) showed the surprising fact that a nonparametric one-dimensional hazard as a function of time can be estimated $\sqrt{n}$-consistently if a high quality marker is observed. In this paper we show that the hazard relevant for predicting remaining duration time, given the current status of a high quality marker, can be estimated $\sqrt{n}$-consistently if a Markov type property holds for the high quality marker.

SUNDT, B. *Multivariate compound Poisson distributions and infinite divisibility.* 305-308. In this note we give a multivariate extension of the proof of Ospina & Gerber (1987) of the result of Feller (1968) that a univariate distribution on the non-negative integers is infinitely divisible if and only if it can be expressed as a compound Poisson distribution.

WAHLIN, J.-F. & PARIS, J. *The true claim amount and frequency distribution of a bonus-malus system.* 391-403. We apply Lemaire's algorithm and a non-parametric mixed Poisson fit to a motor insurance portfolio in order to find the true claim frequency and claim amount distributions. The algorithm we develop accounts for the fact that observed distributions are distorted by bonus hunger, when a bonus-malus system is used by the insurer.

ASTIN BULLETIN

Volume **31** (1), 2001

BEIRLANT, J., MATTHYS, G. & DIERCKX, G. *Heavy-tailed distributions and rating.* 37-58. In this paper we consider the problem raised in the ASTIN Bulletin (1999) by Prof. Benktander

at the occasion of his 80th birthday concerning the choice of an appropriate claim size distribution in connection with reinsurance rating problems. Appropriate models for large claim distributions play a central role in this matter. We review the literature on extreme value methodology and consider its use in reinsurance. Whereas the models in extreme-value methods are non-parametric or semi-parametric of nature, practitioners often need a fully parametric model for assessing a portfolio risk both in the tails and in more central portions of the claim distribution. To this end we propose a parametric model, termed the generalised Burr-gamma distribution, which possesses such flexibility. Throughout we consider a Norwegian fire insurance portfolio data set in order to illustrate the concepts. A small sample simulation study is performed to validate the different methods for estimating excess-of-loss reinsurance premiums.

DESJARDINS, D., DIONNE, G. & PINQUET, J. *Experience rating schemes for fleets of vehicles.* 81-105. This paper proposes bonus-malus systems for fleets of vehicles, by using the individual characteristics of both the vehicles and the carriers. Bonus-malus coefficients are computed from the history of claims or from the history of safety offences of the carriers and the drivers. The empirical results are derived from a data set obtained from the Société de l'Assurance Automobile du Québec, the public insurer for bodily injuries and the regulator of road safety.

FRANGOS, N. E. & VRONTOS, S. D. *Design of optimal bonus-malus systems with a frequency and a severity component on an individual basis in automobile insurance.* 1-22. The majority of optimal bonus-malus systems (BMS) presented up to now in the actuarial literature assign to each policyholder a premium based on the number of his accidents. In this way a policyholder who had an accident with a small size of loss is penalized unfairly in the same way with a policyholder who had an accident with a big size of loss. Motivated by this, we develop in this paper, the design of optimal BMS with both a frequency and a severity component. The optimal BMS designed are based both on the number of accidents of each policyholder and on the size of loss (severity) for each accident incurred. Optimality is obtained by minimizing the insurer's risk. Furthermore we incorporate in the above design of optimal BMS the important a priori information we have for each policyholder. Thus we propose a generalised BMS that takes into consideration simultaneously the individual's characteristics, the number of his accidents and the exact level of severity for each accident.

HOLTAN, J. *Optimal insurance coverage under bonus-malus contracts.* 175-186. The paper analyses the questions: *Should — or should not — an individual buy insurance? And if so, what insurance coverage should he prefer?* Unlike classical studies of optimal insurance coverage, this paper analyses these questions from a bonus-malus point of view, that is, for insurance contracts with individual bonus-malus (experience rating or no-claim) adjustments. The paper outlines a set of new statements for bonus-malus contracts and compares them with corresponding classical statements for standard insurance contracts. The theoretical framework is an expected utility model, and both optimal coverage for a fixed premium function and Pareto optimal coverage are analysed. The paper is an extension of another paper by the author, see Holtan (2001), where the necessary insight into — and concepts of — bonus-malus contracts are outlined.

HOLTAN, J. *Optimal loss financing under bonus-malus contracts.* 161-173. The paper analyses the question: *Should an insurance customer carry an occurred loss himself, or should he make a claim to the insurance company?* This question is important within bonus-malus contracts with individual experience adjustments of the premium. The analysis model includes a bonus hunger strategy where the customers prefer the most profitable financial alternative, that is, the alternative which represents the lowest rate of interest. Hence the loss of bonus after a claim is calculated as a rate of interest paid from the customer to the insurer. Within this

model the paper outlines the existence of a true compensation function and a relative cost function for each customer. A set of properties for bonus-malus contracts are presented and discussed. A concrete example of a bonus-malus system and an insurance compensation function illustrates the theoretical framework in a practical matter.

HÜRLIMANN, W. *Analytical evaluation of economic risk capital for portfolios of gamma risks.* 107-122. Based on the notions of value-at-risk and expected shortfall, we consider two functionals, abbreviated VaR and RaC, which represent the economic risk capital of a risky business over some time period required to cover losses with a high probability. These functionals are consistent with the risk preferences of profit-seeking (and risk averse) decision makers and preserve the stochastic dominance order (and the stop-loss order). Quantitatively, RaC is equal to VaR plus an additional stop-loss dependent term, which takes into account the average amount at loss. Furthermore, RaC is additive for comonotonic risks, which is an important extremal situation encountered in the modeling of dependencies in multivariate risk portfolios. Numerical illustrations for portfolios of gamma distributed risks follow. As a result of independent interest, new analytical expressions for the exact probability density of sums of independent gamma random variables are included, which are similar but different to previous expressions by Provost (1989) and Sim (1992).

HÜRLIMANN, W. *Financial data analysis with two symmetric distributions.* 187-211. The normal inverted gamma mixture or generalized Student t and the symmetric double Weibull, as well as their logarithmic counterparts, are proposed for modeling some loss distributions in non-life insurance and daily index return distributions in financial markets. For three specific data sets, the overall goodness-of-fit from these models, as measured simultaneously by the negative log-likelihood, chi-square and minimum distance statistics, is found to be superior to that of various 'good' competitive models including the log-normal, the Burr, and the symmetric alpha-stable distribution. Furthermore, the study justifies on a statistical basis different important models of financial returns like the model of Black-Scholes (1973), the log-Laplace model of Hürlimann (1995), the normal mixture by Praetz (1972), the symmetric alpha-stable model by Mandelbrot (1963) and Fama (1965), and the recent double Weibull as limiting geometric-multiplication stable scheme in Mittnik and Rachev (1993). As an application, the prediction of one-year index returns from daily index returns is discussed.

KAUFMANN, R., GADMER, A. & KLETT, R. *Introduction to dynamic financial analysis.* 213-249. In the last few years we have witnessed growing interest in dynamic financial analysis (DFA) in the non-life insurance industry. DFA combines many economic and mathematical concepts and methods. It is almost impossible to identify and describe a unique DFA methodology. There are some DFA software products for non-life companies available on the market, each of them relying on its own approach to DFA. Our goal is to give an introduction into this field by presenting a model framework comprising those components many DFA models have in common. By explicit reference to mathematical language we introduce an up-and-running model that can easily be implemented and adjusted to individual needs. An application of this model is presented as well.

LUAN, C. *Insurance premium calculations with anticipated utility theory.* 23-35. This paper examines an insurance or risk premium calculation method called the mean-value-distortion pricing principle in the general framework of anticipated utility theory. Then the relationship between comonotonicity and independence is explored. Two types of risk aversion and optimal reinsurance contracts are also discussed in the context of the pricing principle.

TAYLOR, G. C. *Geographic premium rating by Whittaker — spatial smoothing.* 147-160. Whittaker graduation is applied to the spatial smoothing of insurance data. Such data (eg claim frequency) form a surface over the 2-dimensional geographic domain to which they

relate. Observations on this surface are subject to sampling error. They need to be smoothed spatially if a reliable estimate of the underlying surface is to be obtained. A measure of smoothness of a surface has been defined. This has been incorporated in 2-dimensional Whittaker graduation to effect the necessary smoothing. The details of this are worked out in Section 4. The procedure is illustrated by numerical example in Section 5. The Bayesian interpretation of this form of spatial smoothing is discussed, and used to assist in the selection of the Whittaker relativity constant.

USABEL, M. A. *Ultimate ruin probabilities for generalised gamma-convolutions claim sizes.* 59-79. A method of inverting the Laplace transform based on the integration between zeros technique and a simple acceleration algorithm is presented. This approach was designed to approximate ultimate ruin probabilities for ⌈*-convolutions* claim sizes, but it can be also used with other distributions. The stable algorithm obtained yields interval approximations (lower and upper bounds) to any desired degree of accuracy even for very large values of u (1,000,000), initial reserves, without increasing the number of computations. This last fact can be considered an interesting property compared with other recursive methods previously used in actuarial literature or other methods of inverting Laplace transforms.

WALHIN, J.-F. & PARIS, J. *The mixed bivariate Hofmann distribution.* 123-138. In this paper we study a class of mixed bivariate Poisson distributions by extending the Hofmann distribution from the univariate case to the bivariate case. We show how to evaluate the bivariate aggregate claims distribution and we fit some insurance portfolios given in the literature. This study typically extends the use of the bivariate independent Poisson distribution, the mixed bivariate negative binomial and the mixed bivariate Poisson inverse Gaussian distribution.

WU, X.-Y. *The natural sets of Wang's premium principle.* 139-145. Recently, Wang's premium principle (Wang, 1995, 1996) has been discussed by many authors. Considerable attention has been given to the conditions under which Wang's premium principle can be reduced to the standard deviation premium principle. In this paper, we have got two results on this problem. One is that the natural set is a location-scale family if Wang's premium principle can be reduced to the SD premium principle for all subjective distortions. The other is that the natural set is a location-scale family for all power distortions.

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AUSTRALIAN ACTUARIAL JOURNAL

Volume **7** (3), 2001

INSTITUTE OF ACTUARIES OF AUSTRALIA, DISCOUNT RATE TASK FORCE. *A coherent framework for discount rates.* 435-572. Actuaries have a strong professional reputation for the valuation of liabilities in a number of commercial areas, most notably general insurance, life insurance and superannuation. Increasingly, actuaries are valuing liabilities in other areas. Furthermore, the range of contexts and purposes of these valuations are expanding over time, and the emphasis underlying the calculations is undergoing change. The objective of this paper is to

facilitate discussion within the actuarial profession on this important subject with the aim of defining, with as much consistency as possible across the actuarial practice areas, a basis for the determination of discount rates for calculating liability values for the main valuation contexts identified. However, the paper is not limited to consideration only of existing actuarial practice areas. The paper seeks to achieve a coherent and logical framework which spans from the most simple to the most complex liabilities. The paper proposes the development of an across-practice area guidance note on discount rate determination.

INSTITUTE OF ACTUARIES OF AUSTRALIA, LIFE INSURANCE PRACTICE COMMITTEE, LEGISLATION AND TAXATION SUB-COMMITTEE. *Discussion drafts: Harmonisation Project*. 649-657.

INSTITUTE OF ACTUARIES OF AUSTRALIA, FINANCIAL SERVICES REFORM BILL DISCLOSURE TASK FORCE, FINANCIAL SERVICES REFORM BILL LICENSING TASK FORCE. *Financial Services Reform Policy Proposals.* 587-613. On 26 April 2001 ASIC issued a series of Policy Proposal Papers in relation to the Financial Services Reform Bill. On 15 June 2001 the IAAust made a submission to ASIC making comments on a number of issues regarding licensing and disclosure.

INSTITUTE OF ACTUARIES OF AUSTRALIA, GENERAL INSURANCE PRACTICE COMMITTEE. *Insurance Act Amendment Bill 2001: Submission.* 575-582. On 18 May 2001 the IAAust wrote to the Department of Treasury in response to the Discussion Paper on the Insurance Act Amendment Bill 2001. The IAAust sought amendments to the Bill in relation to the role of the Valuation Actuary, obligations to give information to APRA and other matters.

INSTITUTE OF ACTUARIES OF AUSTRALIA, SUPERANNUATION AND EMPLOYEE BENEFITS PRACTICE COMMITTEE. *Possible Amendments to the Superannuation (Resolution of Complaints) Act 1993.* 583-585.

INSTITUTE OF ACTUARIES OF AUSTRALIA, GENERAL INSURANCE PRACTICE COMMITTEE. *Proposed General Insurance Prudential Framework, Draft Prudential Standards and Guidance Notes.* 615-648.

INSTITUTE OF ACTUARIES OF AUSTRALIA, HEALTH PRACTICE COMMITTEE. *Draft Health Privacy Guidelines.* 659-663. On 13 May 2001 the Federal Privacy Commissioner released Draft Health Privacy Guidelines for public comment. On 20 July 2001 the IAAust sent a Submission to the Office of the Federal Privacy Commissioner making comments on the use of de-identified data for research and statistical purposes.

INSTITUTE OF ACTUARIES OF AUSTRALIA, MORTALITY COMMITTEE. *TPD experience by occupation and gender.* 667-679.

INSURANCE: MATHEMATICS & ECONOMICS

Volume **29** (3), 2001

ALBRECHER, H., TEUGELS, J. L. & TICHY, R. F. *On a gamma series expansion for the time-dependent probability of collective ruin.* 345-355. In the framework of the extended classical risk model with constant force of real interest i, we investigate when it is suitable to represent the probability of collective survival $U(x, t)$ of an insurance company with initial capital x

and time horizon t as a gamma series. Moreover, we derive exact analytical solutions for exponentially distributed claim sizes and integer values of λ/i, where λ is the risk parameter. As a by-product we observe that numerical procedures for estimating $U(x, t)$ are very accurate.

DICKSON, D. C. M. & HIPP, C. *On the time to ruin for Erlang(2) risk processes.* 333-344. In this paper, we consider a Sparre Andersen risk process for which the claim inter-arrival distribution is Erlang(2). Our purpose is to find expressions for moments of the time to ruin, given that ruin occurs. To do this, we define an auxiliary function ϕ along the lines of Gerber and Shiu [NAAJ 2, p.48] and Gerber and Landry [IME 22, p.263]. Our method of solution differs from that of Willmot and Lin [IME 25, p.570; 27, p.19] who consider this problem for the classical risk model, in that we first solve for the auxiliary function ϕ.

FROSTIG, E. *Comparison of portfolio which depend on multivariate Bernoulli random variables with fixed marginals.* 319-331. Consider a portfolio consisting of n risks. An individual risk is a product of two random variables: (1) a Bernoulli random variable which is an indicator for the event that claim has occurred; (2) the claim amount, which is a positive random variable.

In the first part of this paper, we extend the results of Hu and Wu [IME 24, p.323] and Dhaene and Goovaerts [IME 19, p.243] for the case of exchangeable Bernoulli random variables. In the second part, we introduce a new partial ordering between multivariate Bernoulli distributions with identical marginals. We apply this new ordering to compare the stop-loss premium of different portfolios.

IGNATOV, Z. G., KAISHEV, V. K. & KRACHUNOV, R. S. *An improved finite-time ruin probability formula and its* Mathematica *implementation.* 375-386. An improved version of a ruin probability formula due to Ignatov and Kaishev [SAJ 2000-1, p.46], allowing for the exact evaluation of the finite-time survival probability for discrete, dependent, individual claims, Poisson claim arrivals and arbitrary, increasing premium income function is derived. Its numerical efficiency is studied, using the *Mathematica* system. Numerical results are provided and computational aspects are discussed. A *Mathematica* module, realizing the Picard and Lefèvre [SAJ 1997-1, p.58] formula has also been developed and used for numerical investigations.

MILEVSKY, M. A. & PROMISLOW, S. D. *Mortality derivatives and the option to annuitise.* 299-318. Most U.S.-based insurance companies offer holders of their tax-sheltered savings plans (VAs), the long-term option to *annuitise* their policy at a pre-determined rate over a pre-specified period of time. Currently, there is approximately one trillion dollars invested in such policies, with guaranteed annuitisation rates, in addition to any guaranteed minimum death benefit. The insurance company has essentially granted the policyholder an option on *two* underlying stochastic variables; future interest rates and future mortality rates. Although the (put) option on interest rates is obvious, the (put) option on mortality rates is not. Motivated by this product, this paper attempts to value (options on) mortality-contingent claims, by stochastically modelling the future *hazard-plus-interest* rate. Heuristically, we treat the underlying life annuity as a defaultable coupon-bearing bond, where the default occurs at the exogenous time of death. From an actuarial perspective, rather than considering the force of mortality (hazard rate) at time t for a person now age x, as a number $\mu_x(t)$, we view it as a random variable forward rate $\tilde{\mu}_x(t)$, whose expectation is the force of mortality in the classical sense ($\mu_x(t) = E[\tilde{\mu}_x(t)]$). Our main qualitative observation is that *both* mortality and interest rate risk can be hedged, and the option to annuitise can be priced by locating a replicating portfolio involving insurance, annuities and default-free bonds. We provide both a discrete and continuous-time pricing framework.

VALDEZ, E. A. *Bivariate analysis of survivorship and persistency.* 357-373. Voluntary non-payment of premiums leads to policy termination. When policies are terminated, it is costly to several parties of insurance contracts. These costs include the inability of the insurance company to recover acquisition expenses, loss of income from renewal premiums by the insurance agent, and the loss of premiums paid and insurance coverage by the contractholder. While most of these costs can be directly accounted for, there is the additional hidden cost resulting from mortality selection. This refers to the tendency of contractholders who are generally healthier to select against the insurance company by voluntarily terminating their policies. This paper explores a methodology to quantify the cost of mortality selection and to examine for the presence of such selection. While standard actuarial models of survivorship and persistency consist of specifying distributions for times until death and withdrawal, the typical assumption is that these random times are independent. We will use a more general approach of specifying the bivariate distributions using copulas for these random times without having to assume independence. We demonstrate procedures to estimate parameters in the model, and we show how one can use these estimates to predict more accurate future cash flows.

JOURNAL OF RISK AND INSURANCE

Volume **67** (4), 2000

BOURGEON, J.-M. & PICARD, P. *Reinstatement or insurance payment in corporate fire insurance.* 507-526. This article characterises the optimal corporate fire insurance contract when the insured firm has private information about the economic value of damaged assets. It is shown that the indemnity should be lower when the firm receives insurance money than in case of reinstatement, but there should be partial coverage even when reinstatement is chosen. When a risk of arson exists, the insurer may only reimburse reinstatement costs. Finally, the optimal contractual arrangement specifies that, in order to discriminate among firms, the insurer may use a (randomly exercised) reinstatement option as a screening device.

BROWN, J. R. & POTERBA, J. M. *Joint life annuities and annuity demand by married couples.* 527-553. This article summarises the range of joint-life annuity products that are currently available to married couples, and it explores the potential utility gain that such couples receive from access to actuarially fair annuity markets. It is more difficult to estimate this utility gain for couples than for individuals because a couple's value of annuitisation will depend in part on the survivor benefits that are available after one spouse has died but while the other is still alive. Valuing joint and survivor annuities also requires recognition of the potentially important interactions between the members of a married couple, such as joint consumption, interdependent utilities, and correlated mortality rates. This article considers each of these issues. It develops an annuity valuation model for married couples and it estimates their 'annuity equivalent wealth', the amount of wealth that couples would need in the absence of actuarially fair annuity markets in order to achieve the same utility level that they receive when such markets are available. The utility gain from annuitisation is smaller for couples than for single individuals. Since most potential annuity buyers are married, this finding may help to explain the limited size of the market for single premium annuities in the United States.

CHIU, W. H. *On the propensity to self-protect.* 555-577. Defining propensity to self-protect as the maximum amount an individual is willing to pay for a one-unit reduction in the probability of loss, this article studies its basic behaviour and its relationship to the

individual's degree of risk aversion and the initial loss probability. It is shown that if the initial loss probability is below a threshold, a more risk-averse individual has a higher propensity to self-protect, and the threshold is controlled by individual's aversion to general downside risk increases and aversion to overall riskiness measured in variance.

LAI, G. C., WITT, R. C., FUNG, H.-G., MACMINN, R. D. & BROCKETT, P. L. *Great (and not so great) expectations: an endogenous economic explication of insurance cycles and liability crises.* 617-652. The causes of insurance cycles and liability crises have been vigorously sought, claimed, and debated by academic investigators for years. The model provided here partially synthesizes several strands of this literature and provides an additional cause. In addition to causes such as the loss-shocks and interest-rate changes included as explanations in the literature, this model posits changing expectations about the parameters of corporate net income as causes of cycles and crises. Since both sides of the market form expectations about losses and interest rates, changes in both demand and supply in the market are incorporated in the explanation. Changing expectations during the crises reduced supply and made it more inelastic. The same changing expectations increased demand and made it more inelastic and so amplified the effect due to a change in supply. The model predicts an increase in the equilibrium premium, when the mean and variance of losses increase. The model also predicts an increase in the equilibrium premium when the mean interest rate decreases and variance increases. The empirical results of cross-sectional regression and time-series analyses are consistent with the predictions. The analysis then provides some insight on how to dampen future cycles and reduce the effect of future liability crises.

WAMBACK, A. M. *Introducing heterogeneity in the Rothschild-Stiglitz model.* 579-591. In their seminal work, Rothschild and Stiglitz (1976) have shown that in competitive insurance markets, under asymmetric information, pooling contracts cannot exist in equilibrium, firms make zero profit, and, under some circumstances, equilibrium does not exist. In the present work, the model is extended by introducing unobservable wealth in addition to the differing risks. The study shows that if the differences in wealth are small, different wealth types are pooled while different risks are separated. For large wealth differences, partial risk pooling contracts, in which one type chooses different contracts in equilibrium, are feasible. Furthermore, equilibria with profit-making contracts can exist. Complete risk pooling contracts can occur only under very restrictive assumptions. The effect of the extra dimension of asymmetric information on the nonexistence problem is ambiguous.

WARD, D. & ZURBRUEGG, R. *Does insurance promote economic growth?: Evidence for OECD countries.* 489-506. This article examines the short and long-run relationships exhibited between economic growth and growth in the insurance industry for nine OECD countries. This is achieved by conducting a cointegration analysis on a unique set of annual data for real GDP and total real premiums issued in each country from 1961 to 1996. Causality tests are also conducted, which account for long-run trends within the data. The results from the tests suggest that in some countries, the insurance industry Granger causes economic growth, and in other countries, the reverse is true. Moreover, the results indicate that these relationships are country specific and any discussion of whether the insurance industry does promote economic growth will be dependent on a number of national circumstances.

WILLENBORG, M. *Regulatory separation as a mechanism to curb capture: a study of the decision to act against distressed insurers.* 593-616. Because of state-based regulation, single-state insurers are subject to oversight by a unique, domiciliary regulator (ie regulatory integration), whereas in the case of multi-state insurers, regulatory responsibilities are spread across several regulators (ie regulatory separation). In this study, the author draws upon recent theoretical literature pertaining to incentive problems and governmental organization to motivate an empirical study of the regulatory closure decision in insurance. Specifically, the

author investigates whether there is evidence of the effect of regulatory separation and, if so, whether it appears to mitigate certain capture problems in the US property-liability business. For a population of distressed companies, the author finds that the likelihood of solvency-related regulatory action is significantly-positively related to the number of states in which the insurer operates, whereas there is no evidence of a negative relation between closure and size. In contrast, for distressed single-state insurers the author finds evidence of a significant-inverse relation between closure and size. For companies subject to regulatory separation, as proxied by whether they write business in more than one state, these results do not support regulatory capture in the form of leniency towards larger distressed insurers (ie too-big-to-fail).