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Bacinello, A. R. *Fair valuation of a guaranteed life insurance participating contract embedding a surrender option.* 461-487. In this article we deal with the problem of pricing a guaranteed life insurance participating policy, sold in the Italian market, which embeds a surrender option. This feature is an American-style put option that enables the policyholder to sell back the contract to the insurer at the cash surrender value. Employing a recursive binomial formula patterned after the Cox, Ross, and Rubinstein (1979) discrete option pricing model we compute, first of all, the total price of the contract, which also includes a compensation for the participation feature ('participation option', henceforth). Then this price is split into the value of three components: the basic contract, the participation option, and the surrender option. The numerical implementation of the model allows us to catch some comparative statics properties and to tackle the problem of suitably fixing the contractual parameters in order to obtain the premium computed by insurance companies according to standard actuarial practice.

Baranoff, E. G. & Sager, T. W. *The relations among organizational and distribution forms and capital and asset risk structures in the life insurance industry.* 375-400. This article is the first step toward integrating in a single framework two previously separate lines of research on major structural decisions of life insurers. The literature has previously studied the relation between capital structure and asset risk on the one hand, and the relation between organizational form and distribution system on the other hand, without integrating them. Using life insurer data for 1993-1999, we model the four key insurer decisions of capital structure, asset risk, organizational form, and distribution system as endogenous choices in a single interrelated set of simultaneous equations. The model assesses the nature of the interactions among these decisions. The model also assesses the impact of insurers' fundamental business strategy (treated as predetermined) on these choices. The business-strategy hypothesis views other key decisions as jointly determined and driven by the fundamental business strategy, once the latter is set in motion. Confirming previous studies, we find a positive relation between capital ratios and asset risk. We also find an association in the simultaneous context between stock ownership and brokerage distribution, which was not found in prior studies. Stock ownership is related to greater financial and asset risk taking, whereas brokerage distribution is associated with lower risk taking. These and other results are interpreted in light of several theories, including transaction-cost economics (TCE), agency theory, and regulatory and bankruptcy cost avoidance. Deriving from these theories, the finite risk paradigm emerges as the most comprehensive interpretation of the results, as opposed to the risk-subsidy hypothesis of the impact of guarantee funds. We also find support for the notion that the business strategy drives the capital and distribution decisions, as predicted by TCE.

Browne, S., Milevsky, M. A. & Salisbury, T. S. *Asset allocation and the liquidity premium for illiquid annuities.* 509-526. Academics and practitioners alike have developed numerous techniques for benchmarking investment returns to properly adjust seemingly high numbers

for excessive levels of risk. The same, however, cannot be said for liquidity, or the lack thereof. This article develops a model for analyzing the ex ante liquidity premium demanded by the holder of an illiquid annuity. The annuity is an insurance product that is akin to a pension savings account with both an accumulation and decumulation phase. We compute the yield (spread) needed to compensate for the utility welfare loss, which is induced by the inability to rebalance and maintain an optimal portfolio when holding an annuity. Our analysis goes beyond the current literature, by focusing on the interaction between time horizon (both deterministic and stochastic), risk aversion, and preexisting portfolio holdings. More specifically, we derive a negative relationship between a greater level of individual risk aversion and the demanded liquidity premium. We also confirm that, ceteris paribus, the required liquidity premium is an increasing function of the holding period restriction, the subjective return from the market, and is quite sensitive to the individual's endowed (preexisting) portfolio.

GARRATT, R. & MARSHALL, J. M. *Equity risk, conversion risk, and the demand for insurance.* 439-460. Existing insurance theory fails when applied to real property because it does not account for variations in the economic environment. The article studies optimal property insurance in the presence of two sources of variation: equity risk and conversion risk. Equity risk is randomness of the value of a property. It tends to raise demand for conventional insurance. In contrast, conversion risk is randomness in the value the property would have if, after severe damage, it were converted to the highest-valued use. It is distinct from equity risk because the highest-valued use is typically not the current one. Under independent conversion risk, the optimum upper limit is a compromise among underlying conversion thresholds. Absent independence, the optimum can be quite different. Conversion risk can raise or lower the demand for property insurance. Insurance contracts that fail to address conversion tend to undermine the orderly disposition of obligations and reduce the gains from reallocation of risks through insurance.

JENNINGS, W. P. & KINDERMAN, A. *The value of a life: new evidence of the relationship between changes in occupational fatalities and wages of hourly workers, 1992 to 1999.* 549-561. The Environmental Protection Agency and other government agencies use the willingness-to-pay concept in labor market studies to estimate the value of a life for evaluating regulatory policies and projects. This study uses new data from the Bureau of Labor Statistics for the period 1992-1999 on industry injury and illness rates and fatality rates to examine the relationship between changes in occupational mortality rates and in hourly wages. The analysis finds that there is no statistically significant evidence that changes in occupational mortality are associated with changes in wages and, thus, there is no empirical basis for using the willingness-to-pay concept as a reliable method for valuing a life or evaluating regulatory policies.

KUO, W., CHENGHSIEN, T. & CHEN, W.-K. *An empirical study on the lapse rate: the cointegration approach.* 489-508. We use the cointegration technique to reexamine the contending lapse rate hypotheses: the emergency fund hypothesis and the interest rate hypothesis. We find that the unemployment rate affects the lapse rate in both the long and short run, whereas the interest rate causes variations in the lapse rate mainly in the long run. This evidence seems to be in favor of the emergency fund hypothesis. However, according to the impulse response analysis of the estimated error-correction model, the interest rate overwhelms the unemployment rate on the overall impact on the dynamics of lapse rate. In other words, the interest rate hypothesis is favored against the emergency fund hypothesis in the sense that the interest rate is more economically significant than the unemployment rate in explaining the lapse rate dynamics.

VILLENEUVE, B. *Mandatory pensions and the intensity of adverse selection in life insurance markets.* 527-548. This article examines the impact of varying mandatory pensions on saving,

life insurance, and annuity markets in an adverse selection economy. Under reasonable restrictions, we find unambiguous effects on market size, participation rates, and equilibrium prices. The degree of adverse selection, whether a market is active or inactive, and social welfare are analyzed.

VISWANATHAN, K. S. & CUMMINS, J. D. *Ownership structure changes in the insurance industry: an analysis of demutualization.* 401-437. This article focuses on the demutualization process and investigates why certain mutuals undergo this organizational structure change. The primary motivation for conversion is access to capital. By statute, mutual firms are limited in their capital-raising activities while stock firms can attract funds through a variety of stock and debt offerings. By examining the financial characteristics of firms that demutualize, changes in business practices in the years surrounding conversion can be observed. Determinants of the conversion decision are explored through logistic regression. In the years before demutualization, converting property-liability mutuals exhibit significantly lower surplus-to-asset ratios. This capital constraint eases after demutualization. Converting life-health mutuals hold a significantly lower proportion of liquid assets; in addition, they have a higher proportion of separate accounts under management. This liquidity constraint and increased focus on a higher managerial discretion activity drive the demutualization decision. For both property-liability and life-health converting mutuals, support for the access to capital hypothesis is found.

VYNCKE, D., GOOVAERTS, M. J., DE SCHEPPER, A., KAAS, R. & DHAENE, J. *On the distribution of cash flows using Esscher transforms.* 563-575. In their seminal paper, Gerber and Shiu (1994) introduced the concept of the Esscher transform for option pricing. As examples they considered the shifted Poisson process, the random walk, a shifted gamma process, and a shifted inverse Gaussian process to describe the logarithm of the stock price. In the present article it is shown how upper and lower bounds in convex order can be obtained when we use these types of models to describe the stochastic accumulation factors for a given cash flow.

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BACINELLO, A. R. *Pricing guaranteed life insurance policies with annual premiums and surrender option.* 1-17. In this paper we analyze a life insurance endowment policy, paid by annual premiums, in which the benefit is annually adjusted according to the performance of a special investment portfolio (reference portfolio, henceforth) and a minimum return is guaranteed to the policyholder. In particular, we consider both the case in which the annual premium is constant and the case in which also the premium is adjusted according to the performance of the reference portfolio. Moreover, the policy under scrutiny is characterized by the presence of a surrender option, i.e., of an American style put option that enables the policyholder to give up the contract and to receive the surrender value. The aim of the paper is to give sufficient conditions under which there exists a (unique) fair premium. This premium is implicitly defined by an equation (or, alternatively, can be viewed as a fixed point of a suitable function) based on a recursive binomial tree à la Cox, Ross and Rubinstein (1979). An iterative algorithm is then implemented in order to compute it.

BROTHERS, L. S. *An individual's chosen retirement age: when is the economically feasible retirement age chosen over the anchor provided by known others?* 85-110. Do individuals make rational, well-planned retirement age decisions? Evidence is not conclusive; some decisions

seem to be quite reasonable, while others, including the long-term trends generated by these decisions, seem irrational. In order to be able to predict and influence this important decision, the process leading up to it needs to be better understood. The process an individual uses to make a retirement decision may be influenced by a rational allocation of money, time, and effort, as suggested by a utility-maximizing Household Production approach. Alternately, the decision process may be strongly influenced by an anchor, defined by the retirement ages chosen by friends, neighbors, relatives, and colleagues, as suggested by Anchoring and Prospect Theory. Studies investigating anchoring and risk-seeking or risk-aversion behavior, which results when a target is seen as a loss or a gain from the anchor, have found that individuals make irrational decisions under many different circumstances. A set of retirement decision propositions, which hypothesize that the heuristic of Anchoring and the resulting cognitive biases described by Prospect Theory will influence the chosen retirement age, are developed in this paper. Retirement information provided by the employer is a possible moderator that may reduce the influence of the anchor on the retirement decision; a set of moderator hypotheses are also developed in this paper. Propositions strongly supported by existing research predict that, unless sufficient information regarding retirement issues is used by an individual, s/he is likely to choose an inappropriate retirement age.

Cebrian, A. C., Denuit, M. & Lambert, P. *Generalized Pareto fit to the Society of Actuaries' claims database.* 18-36. This paper discusses a statistical modeling strategy based on extreme value theory to describe the behavior of an insurance portfolio, with particular emphasis on large claims. The strategy is illustrated using the 1991-92 group medical claims database maintained by the Society of Actuaries. Using extreme value theory, the modeling strategy focuses on the 'excesses over threshold' approach to fit Generalized Pareto distributions. The proposed strategy is compared to standard parametric modeling based on Gamma, LogNormal and LogGamma distributions. Extreme value theory outperforms classical parametric fits and allows the actuary to easily estimate high quantiles and the probable maximum loss from the data.

Chen, Y.-P. & Scott, J. C. *Gradual retirement: an additional option in work and retirement.* 62-74. Aging of the population raises many questions and issues for individuals, families, and society: economic, political, social, psychological, medical, ethical, moral, religious, and legal, all of which bear on the quality of life in its many dimensions. Economic security in old age is one rubric under which many of the problems and their possible solutions may be discussed. How a society arranges for its members to work and retire is an important facet in the provision for old-age economic security.

This article is concerned with the implications of demographic and labor force changes for work and retirement. It discusses the role of gradual (or phased) retirement in introducing flexibility into the range of choices between work and retirement.

Section 1 explains the rationale for gradual retirement. Section 2 spells out the barriers to implementing gradual retirement programs, including legal barriers and barriers relating to pension plan objectives. Section 3 discusses some possible solutions for implementing gradual retirement programs. Section 4 describes some selected examples of gradual retirement programs, and Section 5 contains concluding remarks.

Forman, J. B. & Scahill, P. L. *Issues for implementing phased retirement in defined benefit plans.* 75-84. The U.S. society is aging. The nature of work is changing from work that requires physical strength to work based on knowledge. As a result, workers are beginning to phase into retirement rather than going directly from full-time work to full retirement. From a retirement income perspective, many final average pay defined-benefit plans have features that make phased retirement difficult at best and detrimental at worst. U.S. pension law and regulations present barriers to phased retirement if the phased retiree wants to receive a portion of available pension benefits during phased retirement.

This paper discusses the reasons for the trend toward phased retirement and looks at the legal and actuarial aspects of phased retirement as they apply to a simple defined-benefit plan. The calculation of final average pay is critical to the impact of phased retirement on the ultimate pension benefit. The plan's early retirement reduction and late retirement increase can be set to maintain actuarial equity throughout phased retirement, and this paper demonstrates one way of achieving this equity. Phased retirement can impact participant and spousal protections.

This paper discusses some of those impacts and suggests possible safeguards. The tables in the Appendix show various retirement patterns and their impact on retirement benefits. They also show the impact of various final average pay definitions on the phased retiree's retirement benefits.

GERBER, H. U. & SHIU, E. S. W. *Geometric Brownian motion models for assets and liabilities: from pension funding to optimal dividends.* 37-56. In this paper, asset and liability values are modeled by geometric Brownian motions. In the first part of the paper, we consider a pension plan sponsor with the funding objective that the pension asset value is to be within a band that is proportional to the pension liability value. Whenever the asset value is about to fall below the lower barrier or boundary of the band, the sponsor will provide sufficient funds to prevent this from happening. If, on the other hand, the asset value is about to exceed the upper barrier of the band, the assets are reduced by the potential overflow and returned to the sponsor. This paper calculates the expected present value of the payments to be made by the sponsor and also of the refunds to the sponsor. In particular we are interested in situations where these two expected values are equal. In the second part of the paper, the refunds at the upper barrier are interpreted as the dividends paid to the shareholders of a company according to a barrier strategy. However, if the (modified) asset value ever falls to the liability value, which is the lower barrier, 'ruin' takes place, and no more dividends can be paid. We derive an explicit expression for the expected discounted dividends before ruin. From this we find an explicit expression for the proportionality constant of the upper barrier that maximizes the expected discounted dividends. If the initial asset value is the optimal upper barrier, there is a particularly simple and intriguing expression for the expected discounted dividends, which can be interpreted as the present value of a deterministic perpetuity with exponentially growing payments.

KAAS, R. & TANG, Q. *Note on the tail behavior of random walk maxima with heavy tails and negative drift.* 57-61. This note investigates the asymptotic tail behavior of maxima of a random walk with negative mean and heavy-tailed increment distribution. A simple proof is given to improve the related result in Ng *et al.* (2002) (ASTIN Bulletin 32, 43-55).