DISCUSSIONS OF PAPERS PUBLISHED IN VOLUME LXXVIII

AN EXPOSURE RATING APPROACH TO PRICING PROPERTY EXCESS-OF-LOSS REINSURANCE

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DISCUSSION BY SHOLOM FELDBLUM

1. INTRODUCTION

Stephen Ludwig's paper provides numerous improvements to the exposure rating procedure first introduced by Ruth Salzmann. In particular, he

- provides up-to-date size-of-loss distributions,
- considers damages besides property losses,
- considers perils in addition to fire, and
- constructs size-of-loss distributions for commercial property risks.

Exposure rating methods are particularly important for pricing property excess-of-loss reinsurance treaties. This discussion provides a brief background and then comments on three topics addressed in Ludwig's paper:

- the relative advantages of exposure rating versus other pricing techniques for reinsurance excess-of-loss treaties;
- several variables affecting exposure rating procedures that Ludwig discusses: Size of risk, peril, deductibles, jurisdictional differences, and data availability; and
- the principles of exposure rating.

The importance of exposure rating for excess-of-loss reinsurance pricing is sometimes unnoticed, since the actuarial literature on this subject is sparse. Casualty actuaries have much to gain from the thorough analysis provided by Stephen Ludwig.

2. BACKGROUND

Property/casualty losses vary in severity, and the distribution of losses by size directly influences the pricing of insurance contracts. In life insurance, a $100,000 policy costs twice as much as a $50,000 policy, since the benefit is fixed. But in property/casualty insurance, a $100,000 policy costs less than twice as much as a $50,000 policy, since most claims are less than the policy limit.

Liability insurance ratemaking assumes that the distribution of losses by size depends on factors external to the insurance transaction: Factors such as the class of business, the hazard, and the state. The policy limit in the contract may curtail the amount of reimbursement, but it should not affect the size of the loss. The distribution of losses by size is therefore determined from dollar amounts. The policy limits purchased by insureds are sometimes used by pricing actuaries to adjust the distribution for truncation of benefits. They are not usually assumed to be correlated with the size of the claim.[1]

In property insurance, the size of the claim depends on the insured value in addition to other factors such as construction, protection (both internal and external), peril, and occupancy. If a building and its contents are worth $100,000, a fire cannot cause damage of $1 million. Thus, there are two influences on property size-of-loss distributions:

- since losses vary in severity, the distribution of insured losses by layer is not uniform; and
- since damages depend on the insured values, the distribution of insured losses varies by size of risk.

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[1] The prevalence of suits against "deep pockets" raises questions about this assumption: insureds with large assets are more likely to be sued for large amounts, and so they purchase high limit liability policies. Thus, the policy limit and the size of loss may indeed be correlated.

3. SALZMANN

To model the distribution of property losses by size, Ruth Salzmann [12] uses two assumptions:

1. The amount of insurance in homeowners policies is a good proxy for the "sound value," or the value of the building before the loss. She notes that
   - in the 1950s, most homeowners policies were on new buildings, for which mortgagees demanded full coverage; and
   - the replacement cost provision in the policy encouraged insureds to purchase amounts of insurance equal to at least 80% of the sound value.
2. The distribution of losses by size is directly proportional to the amount of insurance. If there is a 10% probability that a fire loss on a $50,000 building will exceed $25,000, then there is a 10% probability that a fire loss on a $100,000 building will exceed $50,000.

The first assumption seems valid, particularly for homeowners. Salzmann shows that the second assumption, although far from perfect, is reasonable, at least for fire losses on buildings (but see Hurley's review of Salzmann's paper, as well as the discussion below). She constructs loss distributions by percentage of amount insured for four classifications: frame-unprotected, frame-protected, brick-unprotected, and brick-protected. She notes that, "There may be few direct applications of the loss cost data, but such statistics could well serve as a useful yardstick in evaluating other fragmentary size of loss data" [12, page 18].

Enter the reinsurer.

As Salzmann comments, "In the reinsurance area, the potential for further exploration in rating by layer of insurance is tremendous." Reinsurers quickly began using "Salzmann Tables," or "first-loss scales," to price excess-of-loss property reinsurance treaties. Stephen

Ludwig has now provided us with a lucid description of the "exposure rating" method, along with significant improvements in the statistical tables and procedures.

4. PRICING EXCESS-OF-LOSS REINSURANCE TREATIES

Pricing excess-of-loss reinsurance is difficult, for both property and casualty coverages. American insurers that provided general liability coverage in the 1970s are facing unexpected asbestos and pollution claims, but the London reinsurers that provided excess-of-loss treaties are facing even more severe liabilities. The pricing difficulties are not just due to the low loss frequency in high layers. Equally important is the sparse information available to the reinsurer. The reinsurer may not know the mix of property business written by the primary carrier: Amounts of insurance, classes of commercial risks, types of construction, protection classes, and territories. Similarly, the London reinsurer may not be fully aware of liability standards being developed in American courts.

Reinsurers use a variety of pricing procedures: Experience rating, expected loss distributions, and exposure rating. Reinsurance experience rating, or the "burning cost" method, is called by Ludwig "the natural alternative to exposure rating." It is similar to experience rating used by primary companies. Historical losses are adjusted for trend and development and then related to an exposure base (subject premium) to provide a rate for the future treaty period. The adjustments must be made carefully, since both trend factors and development factors increase with the retention (Roberts [11]; Ferguson [1]; Pinto and Gogol [9]; and Gerathewohl, et al [2, pp. 269-278]). Three problems, however, limit the usefulness of experience rating:

1. *Credibility:* For high reinsurance layers (that is, layers above working covers), there may be little historical experience. Moreover, the observed loss frequency and severity in high layers are influenced by random loss occurrences, and they may not be good predictors of future losses. Experience rating plans used by primary carriers, such as the revised

National Council on Compensation Insurance workers' compensation experience rating plan, give little credibility to excess losses, even for large insureds (Venter [13]; King and Gillam [6]), so the manual (or class) rate is used to complement the insured's experience. But the reinsurer has no "manual rate" with which to credibility weight the historical experience, since each reinsurance treaty is different. As Ludwig notes, "Generally . . . experience rating is only useful on working layers."

2. *Information:* Since nominal loss amounts increase with inflation, a $100,000 loss one year may be a $150,000 loss several years later. Experience rating requires historical losses below the present retention if the trended value of these losses would exceed the retention during the future policy period (Gilmore [3]). If such data are not available to the reinsurer, and no adjustment is made, the treaty may be underpriced.
3. *Changes in Mix of Business:* Experience rating presumes that the hazards have not changed significantly between the past experience period and the future policy period. This assumption is often valid for workers' compensation, since workplace hazards in a given factory usually change slowly, or for general liability premises/operations risks, where hazards may also be stable. The assumption is poor for reinsurance treaties, since the primary carrier may have changed its underwriting philosophy or may be targeting different markets.

Another reinsurance pricing procedure uses expected loss distributions. These "curve-fitting" methods model claim frequency and claim severity to forecast future losses (Patrik and John [8], Patrik [7]). The reinsurance pricing actuary chooses a family of curves to represent the loss process and selects parameters to fit observed data. At low severities, there are enough observations to fit the curve. At high severities (the tail of the distribution), there may be few or no observations, but the fitted curve forecasts the expected loss amounts.

Two problems limit the usefulness of this technique:

1. *Subjectivity:* There are many curve families that can model the loss process (Hogg and Klugman [5]). Some actuaries use a Pareto curve to model loss severity; some prefer a lognormal; and some like a Weibull or an inverse Gaussian. The curves all seem to fit the observations well at low severities, but they provide different forecasts for the tail. Two actuaries using this technique may come up with vastly different rates for high excess layers.
2. *Complexity:* The pricing actuary must explain the derivation of the rate to the reinsurance underwriter, as well as to representatives of the primary carrier. Curve fitting methods are obscure to some actuaries and incomprehensible to many underwriters. The problem is exacerbated when different actuaries provide different rates, none of whose derivations can be understood by the layman.[2]

The third pricing procedure is exposure rating: First-loss scales for property insurance and increased limits tables for liability insurance. The method can be easily explained to non-technical underwriters and brokers. Size-of-loss distributions can be obtained from industry data or from carriers with large primary books of business, so the credibility problems are mitigated. Finally, the method uses information about the current mix of business, so changes in underwriting philosophy or marketing strategy should not distort the indicated rates.

Exposure rating, of course, is not without problems. Several issues are discussed below, and perhaps Ludwig can mention in an author's response how his company deals with each one.

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[2] Gilmore [3, page 351] cautions, "be wary of approaches which are too 'actuarial' in nature....If...the retention level has been set high on the theory that the business is well spread and not really subject to a significant catastrophe loss, it is difficult if not impossible to defend the wisdom of the decision after a large loss occurs."

5. SIZE OF RISK

The first-loss scales, or Salzmann Tables, presume that the distribution of losses as a percentage of the amount of insurance does not vary much by size of risk. Salzmann's data actually were sparse and showed counter-intuitive reversals, so she graduated her scales.[3] Ludwig does not show the actual distributions by size of risk for homeowners, though he provides exhibits for certain classes of commercial property.

Four years ago, I examined homeowners size-of-loss distributions, using a vast book of business, for the same purpose as Ludwig's: To update the first-loss scales for reinsurance treaty exposure rating. The data were divided by: a) Size of risk; b) construction class; c) protection class; d) peril; e) state; and f) policy year. The loss distributions by percentages of insured value were sufficiently similar across risks of different size to justify the use of first-loss scales for reinsurance exposure rating.

The difficulties arise with commercial property risks. The homogeneity of homeowners risks, both in size and in hazards, makes the distributions of loss by percentage of insured value sufficiently similar across different sizes of risk to allow exposure rating. Commercial property risks, even the small "businessowners" risks, are less homogeneous.

Small risks are more likely to have losses that are a large percentage of the insured value than large risks are. Head [4] provides several loss distributions to support this, and he concludes:

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[3] Salzmann [12, page 17] writes: "The actual data was then graduated by the method of adjusting second differences to an orderly downward progression. In addition, the brick-protected distribution was adjusted so that the increments in the upper portion of the distribution were no greater than those in the frame-protected distribution. This adjustment was made entirely on the basis of the author's judgment." Even so, reversals exist. Note particularly Exhibit A on page 20, where the $20,000 policy amount shows higher loss distribution percentages than either the $15,000 or the $25,000 policy amounts for both frame and brick construction.

> ". . . the probability of a loss of a given size is inversely related to its dollar size as well as to the fraction of full property value lost" (page 95), and
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> ". . . small properties tend to suffer a greater proportion of total or severe losses than do large properties" (page 99).

For commercial property risks, much of the damage is to contents, not just to the building. The flammability of the goods affects the distribution of losses by percentage of insured value: the more flammable the goods, the greater the likelihood that a fire will spread. I have not examined commercial property risks, since our treaties covered only homeowners. Ludwig notes that "the relationship between size of loss and insured value is not constant for any cause of loss." This is particularly true for wind losses, which are often small, regardless of the insured value. Perhaps Mr. Ludwig can comment further on

- the effects of size of risk and flammability of contents on the distribution of losses by percentage of insured value for commercial property risks, and
- the relative usefulness for reinsurance treaty pricing of distributions by percentage of insured value versus by dollar amounts of loss for perils (such as wind) or classes of business where the relationship between size of loss and insured value is not consistent.[4]

6. DEDUCTIBLES

First-loss scales work well when the average deductible in the policies from which the scale is formed is similar to the average deductible for the book of business covered by the treaty. (The "aver-

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[4] Gerathewohl, et al [2, pp. 296-305], in contrast, uses simulated experience in which the frequency of severe losses increases as the size of risk increases; see particularly his exhibit on page 299. Presumably, this is caused by higher average deductibles on large risks; see the following section of this discussion.

age deductible," as used here, refers to the percentage of insured value, not the dollar amount.) When the deductible level changes, exposure rating is distorted, for two reasons:

- If losses below the deductible are not reported to the insurer, the first-loss scales depend on the deductible level.
- The subject premium reported to the reinsurer, and from which the reinsurance treaty rate is derived, varies with the deductible level.

A first-loss scale uses "ground-up" losses. If the insured has a $500 deductible and incurs a $1,000 loss, the full $1,000 is used in the first-loss scale. If the same insured has a $200 loss, and so receives no indemnification from the insurer, the $200 must still be entered in the first-loss scale. But if the insured never files a claim for the $200 loss, since it is below the deductible, the first-loss scale compiled by the insurer depends on the deductible level.

Alternatively, the first-loss scale may use net losses, i.e., losses adjusted for the deductible. If so, a difference in the average deductible level as a percentage of insured value between the experience used for the first-loss scale and the book of business being reinsured impairs the accuracy of exposure rating.

The relationship of deductible to subject premium is a more severe impediment to exposure rating. The reinsurance cost for a $100,000 excess of $100,000 treaty does not depend much on the size of the deductible, as long as it is small. Whether the insured has full coverage, a $200 deductible, or a $1,000 deductible, there is little effect on the expected losses in the reinsured layer. But the subject premium varies greatly between full coverage and a $1,000 deductible. If a full coverage first-loss scale is used to exposure rate a block of business with an average $1,000 deductible, the reinsurance rate will be inadequate.

This problem is particularly severe for commercial property risks, where deductibles are large and vary widely among risks. Reinarz, et al [10, Vol. 2, p. 46], commenting on the problems of applying exposure rating to commercial property insureds, note that "this type of risk characteristically has a larger deductible, and the larger the deductible, the greater the segment of the premium charged for the catastrophic loss."

If the first-loss scale is derived from losses net of deductibles, and the deductible level has not changed between the policies used to derive the scale and the block of business for which the treaty rate is formed, the deductible problem does not arise. Unfortunately, it is not just a timing problem. The first-loss scale may be derived from the experience of one insurer and applied to the subject premium of another insurer. If the two insurers have different average deductible levels, the exposure rate may be distorted. Ludwig's paper does not explicitly address deductible problems in exposure rating. Perhaps he will comment on how he deals with this issue in pricing applications.

7. PERIL

Salzmann's 1963 paper dealt with fire losses only; Ludwig extends the analysis to other perils. Ludwig's results are consistent with my own study. Fire causes the greatest frequency of severe losses. The catastrophic perils, such as hurricanes and earthquakes, have a great effect on "per occurrence" treaties, but the average loss to the typical risk is often small.

Ludwig shows not just that windstorm losses are more concentrated at lower percentages of insured value than are fire losses. Even the distribution of losses from a severe catastrophe, such as those from the 1989 Hurricane Hugo, lies between the fire and windstorm distributions. Similarly, most earthquakes in California have caused only a small percentage of severe losses. To some extent, this reflects the time period and the jurisdiction:

- I used data from 1982 through 1987, so the 1989 earthquake was not included; and
- the California courts often endorse expansive interpretations

of policy language, allowing numerous small earthquake claims.

But the general observation remains true: earthquakes and hurricanes cause fewer total losses, as a percentage of all losses from the peril, than fires do.

8. JURISDICTION

The novice actuary might presume the following: the states with the highest primary homeowners rates should have the highest excess-of-loss reinsurance homeowners rates. In fact, the opposite is true: high primary rates are often associated with low excess-of-loss reinsurance rates.

The exposure base for the primary rate is the amount of insurance. Rate differences by territory are affected by the "claims consciousness" of the population and by the frequency of small losses, such as vandalism or small windstorm losses. In some areas, insureds file insurance claims for every loss, even when the coverage is of questionable legitimacy. In other locations, insureds file claims only when a true covered loss occurs. Similarly, small losses (theft, vandalism, malicious mischief) are common in some areas, but they are rare in other locations.[5]

The exposure base for the reinsurance rate is the subject premium. These small losses do not affect the reinsurance recoveries, but they increase the subject premium. Thus, the higher the primary rate, the lower the ratio of reinsurance recoveries to subject premium and the lower the reinsurance treaty rate.

9. INFORMATION

Both Salzmann and Ludwig note that the distribution of losses by percentage of insured value varies with construction class and protec-

[5] See Weisberg and Derrig [14] on build-up and fraud in Massachusetts automobile insurance claims.

tion class. Ludwig says that ideally the reinsurer should obtain the mix of business by construction class and protection class in the primary carrier's book to properly exposure rate the treaty.

As Ludwig comments, this information is not always available:

> ". . . reinsurers often have difficulty obtaining information regarding a ceding company's distribution of homeowners business by construction type or protection class."

Even the percentage of premium attributable to each peril is not always provided to the reinsurer. Generally, the primary carrier can provide the subject premium, the type of business (e.g., homeowners, small commercial property), and the location. Location is important because per-occurrence excess-of-loss treaties require geographic information. Primary carriers generally keep track of data by location when purchasing reinsurance.[6]

For exposure rating, construction class, protection class, and the premium attributable to each peril may be associated with location. In a certain section of one state, most homes may be frame, towns may have poor fire protection, and windstorms may be relatively frequent; in another section, most homes are masonry, municipal fire protection is good, and windstorms are rare. Different first-loss scales may be constructed for each state or section of a state. These are the first-loss scales that the reinsurer can use in actual treaty pricing.

Location is being used here as a proxy for other variables. In theory, the first-loss scales should depend on construction, protection, and peril; in practice, the only information the reinsurer may have is location. Perhaps Ludwig will comment on what information his

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[6] See Gilmore [3, page 362, Exhibit 2B] "Homeowners Direct Written Premium by County," for an example of data by location used in reinsurance treaty negotiations.

company has when it prices a property excess-of-loss reinsurance treaty, and what types of first-loss scales would be most helpful.[7]

10. PRINCIPLES OF EXPOSURE RATING

The discussion above may be summarized in the eight principles listed below. There are exceptions to every rule, though. The reinsurance actuary may begin with these principles, but he or she must then carefully examine the proposed treaty and the book of reinsured business to adjust the rate if necessary.

1. Size-of-loss distributions for a homogeneous book of homeowners business can be modeled as a percentage of insured value.
2. The less homogeneous the book, and the wider the range of insured values, the greater will be the disparity in distributions of loss by percentage of insured value across sizes of risk. In general, smaller risks have a greater proportion of severe losses than larger risks.
3. Higher deductibles increase the percentage of net losses in higher layers. As the deductible increases, the primary

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[7] The considerations of using the primary carrier's distribution and mix of business versus that of the industry are similar. Ideally, the reinsurer wants to know the premium attributable to each peril in the primary carrier's book of business. Ludwig recommends: "Obtain the ceding company's historical distribution of homeowners losses by cause of loss." In practice, the mix of premium for another insurer, or information for the members of a rating bureau, may be the only data available. Countrywide data for the industry's mix of business is not too helpful, since the reinsured's book may be concentrated in areas where certain perils are more common. But industry data, or data from another insurer, broken down by state and territory may be sufficient.

For deductibles, one needs data from the reinsured; another carrier's data are not appropriate. Deductible levels reflect underwriting practices, which vary widely by carrier. Average size of risk is similar: some carriers target high-priced homes, whereas others serve wider markets. The underwriting philosophy of the ceding company, its marketing strategy, and the types of risks it insures are discussed in the reinsurance treaty negotiations.

carrier's premium rate decreases and the reinsurance excess-of-loss treaty rate increases.

4. The relative rates by peril for per-risk excess-of-loss and catastrophe excess-of-loss are different. For instance, fire has a higher per-risk excess-of-loss rate than windstorm, but windstorm has the higher catastrophe excess-of-loss rate.
5. Primary rates depend greatly on claim frequency; reinsurance rates depend on claim severity. Jurisdictions with high claim frequency, and therefore high primary rates, often have low reinsurance excess-of-loss treaty rates.
6. Reinsurers rarely have all the information needed for ideal exposure rating. The reinsurance actuary must find proxies (such as location) for the attributes that influence the excess-of-loss treaty rate (such as construction class, protection class, and peril).

To these should be added two principles from Ludwig's paper:

7. The amount of insurance is not the limit for the size of the claim. To the amount of insurance for Coverage A (building) must be added the limit for contents losses, losses on other structures, and loss of use.
8. For small commercial property risks, first-loss scales vary by classification and occupancy. In general, "people-oriented" classes, such as restaurants, have a lower frequency of severe losses; properties with flammable contents have a higher frequency of severe losses.

As Ludwig's paper makes clear, exposure rating of excess-of-loss reinsurance treaties contains numerous pitfalls for the unwary actuary. Yet the advantages of exposure rating are strong: the method is sound and it can be explained to nontechnical underwriters and brokers. By considering the influences discussed above, the actuary can ensure the accuracy of the reinsurance treaty rate.

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