TITLE: ON PRICING MULTIPLE-CLAIMANT OCCURRENCES FOR WORKERS' COMPENSATION PER-OCCURRENCE EXCESS OF LOSS REINSURANCE CONTRACTS

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ABSTRACT:

This paper describes a method that can aid the underwriter in pricing the multiple-claimant occurrence exposure for workers compensation excess of loss reinsurance contracts. First, the current practices are described, and the necessary considerations for selecting a method are discussed. Next, a simulation model is described which uses all available information and judgments (actuarial, underwriting, claims, etc.) to produce pricing guidelines for the multiple-claimant occurrence exposure in these contracts. The steps required are presented, and an example is included in the paper to illustrate these steps. Finally, another application of the method is described which can be considered an enhancement to the present pricing procedures.

As is stressed in the paper, this method does not produce an actuarially "correct" rate for each reinsurance contract; the very nature of the multiple-claimant occurrences makes this difficult. The method should be considered a framework for producing pricing guidelines which incorporates relevant data and judgments, and which introduces consistency to the pricing process.

I. BACKGROUND

A. Current Practices

Over the past two years, I have informally surveyed over a dozen reinsurers to determine how companies presently price the multiple-claimant occurrence (MCO) exposure in excess of loss reinsurance contracts. I found that the majority of companies price on a payback basis, which essentially sets the reinsurance premium at a level sufficient to "fund" a total loss to the contract in some specified number of years. Some reinsurers admitted that they do not explicitly charge a premium for MCO's. Only one respondent claimed to have an analytical methodology for pricing MCO's, but refused to share any specific details.

B. Observations

MCO data does not appear to be generally available, according to conversations I have had with various National Council on Compensation Insurance (NCCI) personnel. In addition, any data which was available would likely be sparse and not fully credible for pricing purposes. Therefore, a payback method may be the best alternative currently available. Unfortunately, a payback method does not allow an underwriter to independently test the adequacy of the market price, nor does it aid in the risk selection process.

C. Considerations for Selecting a Method

A method should be capable of reflecting differences in MCO exposure based upon:

1. differences by hazard group
2. differences by injury type
3. differences by state
4. any interrelations among these three elements
5. differences by contract retention level

Since adequate data is not readily available at present to actuarially price MCO's, the goal must be to develop reasonable ranges of assumptions for each of these differences as well as the general underwriting standards of the reinsurer; using these ranges of assumptions, pricing guidelines can be developed that can be used by an underwriter in risk selection.

The results of the approach must be easy to use. This is of particular importance since there are 50 states and four hazard groups to be dealt with. In addition, the approach must be understandable; if underwriters are not comfortable with the approach, they will not use it.

Finally results must be properly interpreted in light of assumptions made. It is very important to note that the methodology to be outlined below does not yield an "actuarial" price for MCO's, but rather guidelines based upon relevant actuarial and underwriting information as well as the objectives

of the reinsurer. Its most important contributions to the underwriting process are that it is a comprehensive framework within which to incorporate relevant data and judgments (such as those described in the example in Section IV), and that it introduces consistency in pricing the MCO exposure.

II. THE METHODOLOGY - A SIMULATION MODEL

A simulation model is attractive because input from non-actuaries is essential to the success of this method. Simulation is easier to explain and understand than a more analytical approach requiring a background in more complicated mathematics.

Since all assumptions are explicitly introduced into the model, it will be easier to insure that all assumptions are being properly used, instead of "burying" these assumptions within the mathematics of the approach.

Although simulation is computer-intensive, the model is run based upon all assumptions and its results are then used as guidelines by underwriters, rather than being run for each individual contract being priced. There is no need to rerun the model until assumptions need to be changed due to new information. Therefore, the problem of computer time is mitigated.

With the advent of @RISK, an add-on to Lotus 1-2-3 developed by Palisade Corporation, the simulation process is as easy as running a Lotus 1-2-3 spreadsheet. Because of this, a series of spreadsheets can be designed by the actuary which can then be run by a clerk, making the entire process more cost-effective.

The steps to be followed in the simulation process are as follows:

Step 1: Make assumptions concerning the distribution of the number of claims per occurrence. Note that this is one of the most important judgments that must be made, and must be made jointly by all concerned, since "hard" data may not be readily available.

Step 2: Select relative frequencies by injury type, using the NCCI Statistical Abstracts, for example.

Step 3: For each state or group of states (where judged to be similar), select severity distributions by injury type and by hazard group. The severity distributions by injury type found in NCCI literature may be appropriate. Judgment may be required to vary these distributions by hazard group if desired.

Step 4: Make assumptions concerning the mix by injury type for MCO's. For example, one may choose the same distribution by injury type for each claimant in a MCO or may choose a different distribution for subsequent claims than for the first claimant.

Step 5: Using the selections and assumptions in steps 1-4, a set of ELPF-type tables can be simulated as follows:

a) Simulate an occurrence as follows:

1. Generate the number of claimants involved in the occurrence (Step 1).

2. For each claimant, generate the type of injury for each claimant in the occurrence (Step 2).

3. For each claimant, simulate a claim amount corresponding to the selected injury type (Steps 3, 4).

4. Add all claims together to get a total claim amount for the occurrence.

b) Run the desired number of trials (this should be a large number; for the example in Section IV, 25,000 trials were used).

c) Using these results, calculate ELPF-type tables. Pricing indications by retention level can then be determined.

Step 6: Repeat the process for all states or state groups selected.

An example is discussed in Section IV of this paper in an attempt to clarify the above steps.

Review of Actual Reinsurance Experience

Although a reinsurer's actual experience will likely not be fully credible, its use does avoid having to make the above assumptions which are based to a large extent upon judgment. Therefore, valuable additional data may be collected which may shed light on the reasonableness of the simulation model results.

There are certain problems with using actual experience which must be considered. These include:

1. Credibility problems due to:

   a. the small number of MCO's observed

   b. different retention levels in a reinsurer's book and any attempts to separate data by retention level

   c. a similar problem to b. with respect to class and state mix

2. One will probably have to use contracts which are mostly exposed by workers compensation losses, since this will result in more MCO's being studied; obviously, all clash losses due to other lines must be excluded. Alternatively, one may study contracts protecting large or specialty workers compensation writers. This may limit the utility of such data when more "typical" cedants are being priced.

3. Loss development must be addressed to develop actual experience to ultimate levels; judgment will be necessary.

4. Since we are interested only in MCO's, large medical claims must be excluded from the data,

again reducing the amount of data available for study.

III. RESULTS OF THE METHODOLOGY

The end product of the simulation model may be a series of pricing grids for use by underwriters. For example, for each of three assumption "scenarios" (low, middle, high), two-dimensional grids showing suggested rates for contracts in excess of each retention level by state group and by hazard group can be developed. The underwriter can then calculate a price for a given risk as a weighted average of the potential cedant's workers compensation book by state group and hazard group. Using the three assumption scenarios also gives a range of these weighted averages, and can be used to sensitivity-test the model with respect to the assumptions used.

This approach should be helpful in the risk selection process if a risk's characteristics are known as well as the reinsurance premium which the reinsurance market would support on a given contract.

Another way in which this method can be helpful in the risk selection process is to first assume that the reinsurer is willing to write workers compensation excess contracts at the

reinsurance market-driven price. One can then "normalize" the grids so that the market price is returned if the industry distribution of workers compensation business by state and hazard group is used in the weighted average mentioned above. These "normalized" grids can then be used in the risk selection. (See the example for further illustration of this use of the method.) Note that this application of the method can be viewed as an enhancement to the present payback method of pricing, and will serve to improve the present approach to pricing MCO's until a more analytical approach is possible.

IV. AN EXAMPLE

An example of the suggested approach is shown below. This example, however, is not intended to be used in any actual pricing situation. Admittedly, some of the assumptions are not realistic given the current body of knowledge on workers compensation. The purpose of this example is merely to illustrate the steps to be taken in developing the model. Also, only a "middle" scenario has been calculated for each hazard group/state group combination, for ease of presentation.

Step 1

For simplicity, it is assumed that all states can be mapped into three groups for purposes of estimating severity distributions: low, medium and high. It is also assumed that three hazard groups (instead of the usual four) are sufficient: low, medium and high. Instead of using the distributions found in the NCCI literature, the lognormal distribution was used. The following average severities were selected:

Type of Injury	Scenarios	Average Severity
Death, Perm Total	Low	140,000
	Medium	180,000
	High	220,000
Perm Partial	Low	15,000
	Medium	25,000
	High	35,000
Temporary Total	Low	1,250
	Medium	1,500
	High	2,000
Medical Only	Low	800
	Medium	1,000
	High	1,200

The shapes of various lognormal curves using the selected average severities for each injury type were then studied, and finally

variances were selected that produced the following coefficients of variation:

Type of Injury	Hazard Group		
	Low	Medium	High
Death, Perm Total	1.20	1.25	1.30
Perm Partial	1.60	1.65	1.70
Temporary Total	2.60	2.65	2.70
Medical Only	3.50	3.55	3.60

Step 2

The following relative frequencies were selected:

Type of Injury	Scenarios	Selected Relative Frequency
Death, Perm Total	Low	0.1%
	Medium	0.2%
	High	0.4%
Permanent Partial	Low	5.0%
	Medium	6.4%
	High	8.0%
Temporary Total	Low	15.0%
	Medium	18.3%
	High	22.0%
Medical Only	Low	79.9%
	Medium	75.1%
	High	69.6%

Note that for each scenario, these relative frequency selections sum to 100%.

Step 3

The following assumptions were made concerning the distribution of number of claims per occurrence:

Number of Claims	Probability, Hazard Group Low	Medium	High
1	95.0%	93.0%	89.0%
2	4.0%	5.0%	7.0%
3	0.5%	1.0%	2.0%
4	0.3%	0.6%	1.2%
5	0.2%	0.4%	0.8%
Expected #/Occurrence:	**1.067**	**1.104**	**1.178**

For simplicity, it was assumed that no differences in this distribution existed between the three state groups.

It should be noted that the maximum number of claims per occurrence (5) was selected arbitrarily. In fact, one may wish to include the possibility of a large number of claims per occurrence as is the case when a manufacturing plant explodes or a grain elevator collapses. This is one consideration which should be addressed when underwriting, claims, actuarial and other personnel select these distributions.

Step 4

It was assumed that all claimants in an MCO were subject to the same probability distribution by injury type, namely that selected in Step 2.

Step 5

Exhibit 1 shows the result of the first five steps for the medium state group/medium hazard group combination. The dollars of loss eliminated are shown on both an occurrence basis (including MCO's) and on a first-claimant only basis (essentially excluding the effects of the MCO). These two tables show the effects on an ELPF-type calculation of MCO's. By differencing these two tables (columns 5 and 10), a third table can be constructed which shows the dollars of loss eliminated due to the effects of the MCO (expressed as a percentage of premium, assuming a 62% loss ratio). This is based upon a simulation of 25,000 trials.

Similar tables were also calculated for the medium state-low hazard group and the medium state-high hazard group. For the low and high state groups, it was assumed that the dollars of loss eliminated will be 80% and 120% of the medium state group (assuming the same total dollars of loss) for each hazard group within the two state groups. These results are shown in Exhibit 2. (Note that the 80% and 120% figures are selected merely to

provide high and low state results for the illustrations in Exhibits 2 and 3, and are not based upon any specific data.)

To calculate a rate for a particular contract, the split of premiums by state group by hazard group is needed. For simplicity, a 62% loss ratio is assumed appropriate for each state group. An example for a $500,000 in excess of $500,000 layer is shown in Exhibit 3.

It is important to note that even if more actuarially "reasonable" severity distributions are used, and all available information (underwriting, actuarial, claims, etc.) is used to make the "best" assumptions possible to run the simulation model, the nature of the phenomenon being modeled is such that considerable uncertainty as to a "correct" rate will probably still exist. Furthermore, even if the model indicates that MCO contracts are undesirable at the rates the reinsurance market is supporting, it may not be possible to totally refuse all such contracts. The second application of the simulation model mentioned in Section III may be more useful in such cases.

Suppose one estimates that the reinsurance market will support a 0.75% rate for $500,000 excess $500,000 workers compensation MCO exposure. Further, suppose that the table in the example above produces a 1.0% rate if the industry premium split by state group by hazard group is input. By multiplying the results of the

model by 0.75 for any particular cedant, the underwriter can use the "adjusted" model result to do risk selection without relying on the absolute rate levels suggested by the "unadjusted" model.

V. CONCLUSION

Pricing MCO's is difficult due to both the paucity of data available and to the very nature of MCO's as infrequent but potentially severe phenomena. This paper has presented a model which attempts to aid in the pricing process. As mentioned above, the most important contributions of the model described are to introduce consistency to the pricing process as well as to serve as a comprehensive framework within which to incorporate relevant information for this purpose.

RESULTS OF THE SIMULATION MODEL

State:	Medium
Hazard Group	Medium
Expected Loss Ratio	62%
Number of Trials	25,000

Per Occurrence Basis (000's Omitted)

(1) Occurrence Size	(2) Loss Limited to Occurrence Size	(3) Loss Eliminated	(4) % Total Loss	(5) Rate As % of Premium
50,000	77,985	71,657	47.89%	29.69%
100,000	94,327	55,315	36.96%	22.92%
250,000	112,540	37,102	24.79%	15.37%
500,000	123,312	26,325	17.59%	10.91%
1,000,000	133,254	16,388	10.95%	6.79%
Unlimited	149,642			

(3) = (2) Unlimited – (2) Occurrence Size
(4) = (3)/(2) Unlimited
(5) = (4) x 0.62

First Claimant Only (000's Omitted)

(6) Occurrence Size	(7) Loss Limited to Occurrence Size	(8) Loss Eliminated	(9) % Total Loss	(10) Rate As % of Premium
50,000	80,083	69,559	46.48%	28.82%
100,000	96,063	53,579	35.80%	22.20%
250,000	114,172	35,470	23.70%	14.70%
500,000	124,551	25,091	16.77%	10.40%
1,000,000	133,740	15,902	10.63%	6.59%
Unlimited	149,642			

RESULTS OF THE SIMULATION MODEL

State:	Medium
Hazard Group	Medium
Expected Loss Ratio	62%
Number of Trials	25,000

MCO Rate By Retention

(11) Retention	(12) MCO Rate As % Premium
50,000	0.87%
100,000	0.72%
250,000	0.68%
500,000	0.51%
1,000,000	0.20%

(12) = (5) – (10)

MCO Rates as % of Total Premium

Per Occurrence Retention : $500,000

		Hazard Group:		
		Low	Medium	High
State Group:	Low	0.30%	0.41%	0.58%
	Medium	0.37%	0.51%	0.72%
	High	0.44%	0.61%	0.86%

Per Occurrence Retention : $1,000,000

		Low	Medium	High
State Group:	Low	0.12%	0.16%	0.22%
	Medium	0.15%	0.20%	0.28%
	High	0.18%	0.24%	0.34%

Rate $500,000 Excess $500,000

		Low	Medium	High
State Group:	Low	0.18%	0.25%	0.36%
	Medium	0.22%	0.31%	0.44%
	High	0.26%	0.37%	0.52%

Note: These rates are the differences between the 500,000 and the 1,000,000 retention tables above.

Exhibit 3

CALCULATION OF AN MCO RATE FOR CEDANT X

1) Rate $500,000 Excess $500,000 Contract

		Hazard Group:		
		Low	Medium	High
State Group:	Low	0.18%	0.25%	0.36%
	Medium	0.22%	0.31%	0.44%
	High	0.26%	0.37%	0.52%

2) Projected Premium Distribution, Cedant X

		Low	Medium	High
State Group:	Low	7.00%	20.00%	3.00%
	Medium	5.00%	30.00%	5.00%
	High	3.00%	20.00%	7.00%

3) Weighted Average : 0.318%

4) Premium on 100,000,000 Subject Premium : $318,000
(Ignore expenses of reinsurer)

5) Implied Payback Period : 1.57 Years
(500,000/(4))