VARYING TREND FACTORS BY SIZE OF LOSS

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By Sholom Feldblum

Average loss costs per claim have risen faster than the associated economic inflation indices for most lines of business, indicating that economic inflation is not the only cause of increasing insurance prices. "Social inflation," meaning the heightened claims consciousness of the public, the evolution of new causes of action in lawsuits, and the increasing liberality of jury awards, accelerates claim cost trends beyond what might be expected from economic inflation. Social inflation is most clearly evident in exorbitant judgments in large liability cases. Several actuaries have therefore suggested that social inflation has a stronger effect on larger claims, and so claim cost trend factors should vary with the size of the loss.

In their 1981 paper, "Adjusting Size of Loss Distributions for Trend" (in Inflation Implications for Property-Casualty Insurance, 1981 Casualty Actuarial Society Discussion Paper Program, p. 458), Sheldon Rosenberg and Aaron Halpert present methods for determining whether claim cost trends differ by size of loss and for quantifying this difference. Their second method, which has received wide acceptance, is to (1) construct the loss distribution functions in two or more years, and then to (2) compare the loss sizes which have equivalent cumulative probabilities in these years. For example, suppose that in 1985, 20% of losses are less than $5,000 apiece and 80% of losses are less than $40,000 apiece; in 1986, 20% of losses are less than $5,500 apiece and 80% of losses are less than $50,000 apiece. For losses of $5,000 in 1985, loss cost inflation is +10%, but for losses of $40,000 in 1985, loss cost inflation is +25%. The example used by Rosenberg and Halpert, using actual Products Liability Bodily Injury data collected by ISO for policy years 1973 and 1977, is shown in Figure 1.

Figure 1: Loss Cost Trend Varying by Size of Claim:
Products BI data for policy years 1973 and 1977

(1) 1973 Value	(2) 1977 Value	(3) (2)/(1)	(4) Annual Trend: (3)**0.25 - 1
$ 10,000	$ 21,929	2.193	+21.7%
50,000	116,355	2.327	+23.5
100,000	255,310	2.553	+26.4
200,000	571,995	2.860	+30.0
500,000	1,692,052	3.384	+35.6
1,000,000	3,872,216	3.872	+40.3

Trends that vary by size of loss are particularly important for determining increased limits factors. Such factors increase if there is a positive trend, since losses that already exceed the basic limit show all their inflation increase in the excess layers, while losses that are just below the basic limit break this boundary because of inflation and increase the frequency of excess limits losses. If loss cost trend factors increase with the size of the claim, the increased limits factors climb even more steeply, since small claims have only a minor inflationary increase, but large claims have a more severe inflationary increase.

ISO has begun using loss cost trends that vary by size of loss in its general liability and increased limits reviews, using trend factors suggested by the Actuarial Research Committee. Figure 2 shows the results from the Hospital loss experience used in the 1986 increased limits review.

Figure 2: Loss Cost Trend Varying by Size of Claim:
Hospital loss experience used in ISO 1986 increase limits review

Loss Size	Actual Trend	Loss Size	Actual Trend	Loss Size	Actual Trend
$ 49,500	+ 2.9%	$ 593,800	+12.8%	$1,420,000	+17.9%
85,800	4.3	665,800	13.4	1,514,500	18.3
127,200	5.6	740,300	14.0	1,610,900	18.7
173,100	6.8	817,400	14.6	1,709,100	19.1
223,100	7.9	896,800	15.1	1,809,300	19.4
276,800	8.9	978,600	15.6	1,911,200	19.8
334,000	9.8	1,062,600	16.1	2,015,000	20.1
394,500	10.6	1,148,800	16.6	2,120,500	20.5
458,100	11.4	1,237,100	17.0	2,227,700	20.8
524,500	12.1	1,327,600	17.6		

Something is amiss here. The actual trends say that for losses below $100,000, hospital cost inflation has been about 3 or 4% per annum. In fact, for all loss sizes below $250,000, the trend factors seem unreasonably low.

Moreover, the actual trends by size of loss form an almost perfectly smooth progression. But social inflation affects losses in an erratic fashion, and one would hardly expect it to cause such a smooth increase in trend factors.

Finally, the ISO Surgeons and Premises/Operations experience data show **decreasing** trend factors as the size of loss increases. It hardly seems logical to suppose that social inflation affects small losses more than large losses.

Social inflation definitely increases loss frequency, but does it also increase the average loss size per claim? People often assume that "pain and suffering" awards are causing the escalation of private passenger automobile bodily injury claim costs. In truth, compensation for medical costs now form a higher percentage of total losses than 10 years ago, while the percentage formed by general damages has decreased slightly. (See the discussion in the forthcoming All-Industry Research Advisory Council automobile personal injury closed claim study for the data supporting this.) In sum, the Rosenberg-Halpert method of determining trend factors by size of loss warrants re-examination.

The Rosenberg-Halpert method is valid only if the loss frequency distribution does not change. If a change does occur, such as an increased frequency of small nuisance claims, a decrease in small claims due to a more widespread use of deductibles, an increase in large claim frequency due to higher reinsurance retentions, or any other such change, then there may be an apparent varying trend by loss size even when inflation affects all losses equally. This has a crucial effect on the determination of increased limits factors, as well as on various other business decisions.

Suppose an insurer records four claims during 1985, for $10,000, $20,000, $30,000 and $40,000. The same four events occur the next year as well, but economic inflation of +100% per annum affects all claims equally and causes the loss sizes to be $20,000, $40,000, $60,000 and $80,000. In addition, a new small claim of $10,000 is also recorded.

Cumulative probability values for small, discrete samples can be tricky. We use a particularly simple method for the illustration; any other method would produce similar results, though with slightly different figures. We match the endpoints of the 1985 distribution with the endpoints of the 1986 distributions. Since there are three intervals in the 1985 data, and four intervals in the 1986 data, each 1985 interval is equivalent to one and one third 1986 intervals. For instance, the $20,000 1985 loss should be matched with a weighted average of the $20,000 and $40,000 1986 losses, with the weights being 2/3 and 1/3, respectively. The loss cost trends by size of claim are shown in Figure 3.

Figure 3: Loss Cost Trend Varying by Size of Claim:
Effect of Increasing Frequency of Small Claims

1985 Claims	1986 Claims	Matched 1986 Claim Sizes	Annual Trend
	10,000		
10,000		10,000	+ 0.0%
	20,000		
20,000		26,667	33.3
	40,000		
30,000		53,333	77.8
	60,000		
40,000		80,000	100.0
	80,000		

Conversely, suppose the insurer introduced a $20,000 deductible in its 1986 policies. Then only three of the 1986 losses are recorded by the insurer: the $40,000, $60,000, and $80,000 claims. Using the "ground-up" figures, not the actual insurer payments, for the size of loss distribution, the loss cost trends by size of claim are shown in Figure 4.

Figure 4: Loss Cost Trend Varying by Size of Claim
Effect of Increasing Use of Deductibles

1985 Claims	1986 Claims	Matched 1986 Claim Sizes	Annual Trend
10,000		40,000	+300.0%
	40,000		
20,000		53,333	166.7
	60,000		
30,000		66,667	122.2
	80,000		
40,000		80,000	100.0

One may ask: "In any case, the shape of the loss distribution is changing over time. What difference does it make whether it is due to loss cost trends varying by size of claim or to changing loss frequency distributions by size of claims?" There are many differences: consider first the effect on increased limits factor calculations.

Suppose the basic limit is $25,000 per claim, and one must calculate factors for the $100,000 increased limit. Thus, for 1985, the factor is (10+20+30+40)/(10+20+25+25) = 1.250. Suppose also that the trend factors by size of loss indicated by the Rosenberg-Halpert procedure are as shown in Figure 3 above.

If there was indeed a varying trend by size of loss that produced the trend factors shown in Figure 3, then the 1986 loss sizes must have been $10,000, $26,667, $53,333 and $80,000. The total loss is $170,000, for an overall trend of +70%. Had each loss increased by 70%, the individual loss sizes would have been $17,000, $34,000, $51,000, and $68,000, and the increased limits factor would have been (17+34+51+68)/(17+25+25+25) = 1.848. Using the actual 1986 loss sizes ($10,000, $26,667, $53,333 and $80,0000) indicated by the varying trend, the increased limits factor for 1986 is (10+26.7+53.3+80)/(10+25+25+25) = 2.000. In other words, if the loss cost trend increases with the size of the claim, then the indicated increased limits factor is higher.

But suppose that the varying trend factors shown in Figure 3 were due to the addition of a small claim. Economic inflation is +100% per annum, and were this the only influence on the loss distribution, the increased limits factor would be (20+40+50+80)/(20+25+25+25) = 2.105. But the actual increased limits factor for 1986 should be (10+20+40+60+80)/(10+20+25+25+25) = 2.000. In other words, a higher frequency of small claims will also cause an apparent varying trend by size of loss but will indicate lower increased limits factors.

Of course, the final increased limits factors for the two cases are identical - because they required differing underlying inflation rates. If the numbers in Figure 3 are due to varying trends by size of loss, then the underlying inflation rate that would be measured **by an external index** is +70% per annum. This inflation rate would produce an increased limits factor of 1.848, but the varying trend by size of loss increases this to 2.000. If the numbers in Figure 3 are due to a change in loss frequency distribution by size of loss, then the underlying inflation rate that would be measured **by an external index** is +100% per annum. This inflation rate would produce an increased limits factor of 2.105, but the changed loss frequency distribution decreases this to 2.000.

In other words, if we expect the overall trend to be X% per annum, but the Rosenberg-Halpert method shows an apparent varying trend by size of loss, should the change in the increased limits factors be greater than or less than that indicated by a uniform X% trend? The answer depends upon the cause of the varying trend by size of loss.

Conversely, a loss cost trend that decreases with the size of the claim produces a smaller change in increased limits factors than would be indicated by a uniform trend. But if the decreasing varying trend is due to a more widespread use of deductibles, then a larger increased limits factor is required.

This paper does not argue that loss cost trend factors are uniform for all loss sizes. Rather, the varying trend by size of loss noted by many actuaries may be due simply to an increase in small nuisance claims, a more widespread use of deductibles, different reinsurance retention levels, or any other cause of a changing loss frequency distribution. An apparent decrease in trend by size of loss is not anomalous: it may be due to an increasing use of deductibles or a change in reinsurance retention levels, not the effects of social inflation.

A practical implication is in target marketing. If an increase in trend factors by size of loss is due to social inflation, then the low frequency high severity risks will become progressively less profitable than the high frequency low severity risks. But if the cause is an increase in small nuisance claims, then the low frequency high severity risks will become more profitable than the high frequency low severity risks.

Another practical implication deals with responses to the claim cost problem. If social inflation causes the varying trend by size of loss, then a change to a compensation system not based on tort liability may be warranted (as in Workers' Compensation and automobile no-fault insurance). If an increase in small nuisance claims is causing the varying trend by size of loss, then a change to a no-fault compensation system may accelerate this increase.

Clearly, one must distinguish the effects of social inflation and of changes in the loss frequency distribution. Three methods of doing so are suggested below.

First, social inflation affects primarily personal injury claims; nuisance claims and deductibles affect both personal injury and property damage claims. For example, both Rosenberg-Halpert and ISO find varying trend factors for Premises/Operations Bodily Injury. One should use the Property Damage coverage from the same body of data to see whether similar varying trends show up there as well. Changes in loss frequency distributions would account for any varying trends in the latter data, since social inflation has little effect.

Second, nuisance claims and deductibles affect the loss frequency distributions primarily for small claims. If one truncates from below the loss distribution of each experience year, one can remove most of the effect of nuisance claims and deductibles. The truncation point must be indexed: if the overall loss cost trend is +10% per annum, the truncation point may be $5,000 in 1985, $5,500 in 1986, $6,050 in 1987, and so forth.

Ideally, the indexed truncation point should be chosen such that the overall loss frequency ratio remains constant from year to year. This is not always possible, as the loss frequency ratio may be changing at all loss sizes. A non-uniform change in the loss frequency distribution at **any** loss size will cause a varying trend.

Third, one should examine loss cost trends by size of claim, where the claim size is **not** based on a dollar figure. For example, one may subdivide the personal injury claims by the number of days the claimant spent in a hospital: 0 days, 1-3 days, 4-7 days, and so forth. For each cell, one may determine the loss cost trend factor. The effect of changes in loss frequency distribution has been removed, but social inflation would still cause a varying trend by size of loss.

No matter what procedure is used, the data from the different experience years must be comparable. If one uses experience from different carriers for 1985 and 1986, the loss frequency distributions will probably differ, and varying trend factors are expected from the Rosenberg-Halpert test, regardless of whether they are truly present. This is a problem particularly for rating bureaus, which have different members by year, (sometimes) different statistical plans, and little control over deductible and marketing changes.

Dr. Glenn Meyers, a research actuary at the Insurance Services Office, has suggested another explanation for the apparent loss cost trends that vary by size of claim. Large claims have a longer average time to settlement than small claims do. If economic inflation affects loss payments between the accident date and the settlement date, as seems reasonable for General Liability claims, then different inflation rates affect large and small claims. A period of rising inflation rates would show loss cost trends increasing with the size of the claim, and a period of declining inflation rates would show loss cost trends decreasing with the size of the claim.

A simplified example should clarify this. Suppose a line of business has only two types of claims: small claims with a 1984 present value of $1,000 and large claims with a 1984 present value of $10,000. All small claims are paid one year after the accident date, and large claims are paid two years after the accident date. Loss cost inflation, affecting all claim sizes equally, is +10% from 1984 to 1985, +20% from 1985 to 1986, +30% from 1986 to 1987, and +20% from 1987 to 1988. Needless to say, these inflation rates are purely illustrative, and are not meant to reflect actual inflation in the U.S. during these years.

Figure 5 shows payments for large and small claims in each accident and settlement year. Small claims incurred in 1984, with a present value of $1,000, and paid in 1985 for $1,100. Similarly, small claims incurred in 1985 are paid in 1986 for $1,320, and small claims incurred in 1986 are paid in 1987 for $1,716. Large claim incurred in 1984 for a present value of $10,000 are paid in 1986 for $13,200. Similarly, large claims incurred in 1985 are paid in 1987 for $17,160, and large claims incurred in 1986 are paid in 1988 for $20,592.

Figure 5: Loss Cost Trend Varying by Size of Claim
Effect of Differing Inflation Rates by Year

Size of Claim	Accident Date	Present Value	Settlement Date	Paid Loss	Apparent Inflation
Small	1984	$1,000	1985	$1,100	
	1985	1,100	1986	1,320	+20%
	1986	1,320	1987	1,716	+30%
Large	1984	10,000	1986	13,200	
	1985	11,000	1987	17,160	+30%
	1986	13,200	1988	20,592	+20%

Assumed inflation rates:
1984-85: +10%; 1985-86: +20%; 1986-87: +30%; 1987-88: +20%.

In this illustration, inflation affects all losses equally. But between accident years 1984 and 1985, small claims show an apparent loss cost trend of +20%, and large claims show an apparent loss cost trend of +30%. Conversely, the apparent trends from accident years 1985 to 1986 are +30% for small claims and +20% for large claims.

As Dr. Meyers points out, the varying trend indications during the historical period provide no information about expected trends by size of claim during the forecast period. Although we can (and we must) quantify estimated inflation during the coming year or two, it is almost impossible to predict whether inflation rates will be increasing or decreasing in the future. Moreover, a higher inflation rate for claim liabilities generally corresponds to higher investment income rates for the assets supporting those liabilities (for a full discussion of this, see Robert P. Butsic, "The Effect of Inflation on Losses and Premiums for Property Liability Insurers," Inflation Implications for Property-Casualty Insurance, 1981 Casualty Actuarial Society

Discussion Paper Program, p. 58.) In the illustration above, the present values of the large and small claims at occurrence date do not show differing inflation rates. Thus, even if one knows that inflation would be increasing or decreasing in the future, and that large and small claims had different times to settlement, using differing loss cost trends by size of claim is inappropriate.

Frank Sullivan, of the ISO Actuarial Research Committee staff, has examined varying loss cost trend factors for the Products property damage (PD) line of business. Social inflation should have little or no varying effect on property damage losses by size of claim; rather, loss cost trends should be uniform for all claim sizes. Yet the Rosenberg-Halpert method produces just the opposite conclusion. The 1987 ISO General Liability Actuarial Committee (GLAC) indications for Products PD showed a varying trend increasing from +11% per annum at claim sizes below $2,000 to +21% per annum at claim sizes of $100,000 and +29% per annum at claim sizes of $900,000. The 1987 loss cost trends increased more steeply by size of claim for Products PD than for the bodily injury lines of business - a remarkable result.

However, Frank found that truncating the loss cost distribution from below with an indexed truncation point had little effect on the apparent loss cost trends varying with size of claim. First, he "purified" the ISO data by eliminating Composite Rated Risks. Then he obtained Rosenberg-Halpert indications for both the full distribution and for the truncated distribution. For the truncation points, he used $3,000 for policy year 1980 and a +5.1% per annum overall loss cost trend to give indexed points of $3,153 for 1981, $3,314 for 1982, and $3,660 for 1983. Both the unadjusted and the truncated distributions showed loss cost trends increasing from about 3% per annum at a claim size of $5,000 to +11% per annum at a claim size of $100,000.

During the 1980's, economic inflation rates have not varied significantly by year. Moreover, PD payment lags, unlike BI payment lags, do not differ that greatly between small and large claims; in other words, the hypothesis suggested by Dr. Glenn Meyers should have no effect. Thus, the explanation of the varying loss cost trends by size of claim for Products PD is unclear. As casualty actuaries, we have the ability to work with these figures and trends, and it behooves us to uncover the causes of these indications.

Innovations in actuarial science follow a strange course. Pure actuaries write theoretical papers; were it not for them, no changes in our procedures would emerge. Practical actuaries use the results, but their major concern about the procedures is simply that they be correct; were it not for them, no changes in our procedures would be required. Most needed, however, are researchers like the ISO Actuarial Research Committee Staff, who take the theoretical concepts and apply them to actual data. Were it not for them, the actuarial innovations would never find their way into the insurance world.

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Numerous people contributed the ideas in this paper. The ISO Actuarial Research Committee Staff, Dan Crifo, Mayer Riff, Noson Kopel, and Frank Sullivan, produced the varying loss cost trend analyses by line of business. Frank analyzed the most recent data, saw the anomalies in the results, and noted the problems of inconsistent data. Gary Koupf showed how a more

widespread use of deductibles could cause a decreasing varying trend, and Lee Steeneck suggested other causes of under-reporting of small losses that would have the same effect. Gary and Isaac Mashitz suggested used an indexed truncation point for the size of loss distributions to remove much of the effect of differing loss frequency distributions. Dr. Glenn Meyers suggested the alternative explanation in the text, different inflation rates by year, and he intends to empirically test this on the ISO General Liability data. Richard Woll first suggested to me that the standard explanations for the varying trend factors phenomenon may not be correct, and he encouraged me to examine the data for other possible causes.

SELECTED PRESENTATIONS FROM THE 1988 RATEMAKING SEMINAR