The Consideration of Loss Timing for Risk Transfer Analysis

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Abstract

Motivation. An important consideration in a risk transfer analysis is the potential variability of loss timing. By excluding this variability, a risk transfer analysis could lead to materially different results, thereby causing users to draw different conclusions about risk transfer.

Method. This paper specifically illustrates the variation in payment patterns commonly found in paid loss and allocated loss adjustment expense development patterns (payment patterns) then provides an example of one method that can be used to model this payment pattern volatility. The impact of modeling this payment pattern volatility is illustrated with Expected Reinsurer Deficit (ERD) results under a hypothetical reinsurance structure. Important model considerations also reflected are correlation and discount rate assumptions. The ERD test is also used to illustrate the sensitivity of these modeled assumptions.

Results. The change in the results of a risk transfer test such as the ERD test can be material after consideration of payment pattern timing.

Conclusions. Modeling the variation of payment patterns is important for a broad spectrum of actuarial analyses. When evaluating reinsurance risk transfer test statistics it is important to keep in mind features that are sensitive to the variation of loss payment timing. The loss payment timing may have a significant impact on the present value of losses ceded to a reinsurer. At the very least the variation in timing will have an impact on the present value of losses used in the ERD test statistic, particularly with larger discount rates. Correlation of payment timing (or duration) with ultimate loss and allocated loss adjustment expense (ALAE) modeled is also an important consideration that can impact the results of the ERD test. The results below show the sensitivity of changes in correlation and discount rates combined with modeling the variation in the payment timing of ceded paid loss and ALAE.

Keywords. Risk Transfer, Timing Risk, ERD test, Correlation, Sensitivity of Assumptions.

1. INTRODUCTION

The timing of all cash flows between a primary insurer and reinsurer is an important consideration when assessing a reinsurance structure for risk transfer. This paper specifically looks at the timing of losses associated with variations in loss and ALAE development patterns. We will illustrate the potential impact loss timing variability can have on risk transfer test statistics such as the ERD.

1.1 Research Context

Reinsurance contractual features and the variability in loss and ALAE development patterns can have a material impact on the results of traditional risk transfer tests such as the ERD test statistic. Discount rate and correlation between simulated payment pattern and ultimate loss and ALAE are important assumptions to consider and can impact the results of the ERD test.

1.2 Objective

The intent of this paper is to provide high level insight into the importance of capturing loss and ALAE payment timing risk in models used to assess risk transfer. This is accomplished by providing illustrative examples of the variation in paid loss and ALAE timing, a simple model to simulate this timing, and the results of the ERD test under various assumptions.

1.3 Outline

The remainder of the paper proceeds as follows. Section 2.1 will discuss the risk transfer requirements under the guidance in the Statement of Financial Accounting Standards No. 113 (FAS 113). Section 2.2 will briefly discuss the Expected Reinsurer Deficit (ERD) test statistic for evaluation risk transfer. Section 2.3 will illustrate an example of the actual timing difference commonly found in loss development patterns. Section 2.3 will also give an example of a correlation analysis and simulated payment pattern. Section 2.4 shows the sensitivity of ERD results to payment pattern timing (i.e., variable versus fixed), correlation, and discount rates under a hypothetical reinsurance program.

2. BACKGROUND AND METHOD

2.1 Requirements for Risk Transfer

Timing of losses is a fundamental component of the "significant insurance risk" requirement under the guidance in the Statement of Financial Accounting Standards No. 113 (FAS 113). To summarize FAS 113: There are *two requirements* that must be met for a short duration contract to be considered as "*indemnifying the cedant*".

1. Reinsurer assumes significant insurance risk under the reinsured portions of insurance contracts; and
2. It is reasonably possible that the reinsurer may realize significant loss from the transaction.

Note: Contracts are exempt from risk transfer requirements when the reinsurer assumes *"substantially all"* of the insurance risk relating to the reinsured portions of the underlying insurance contracts (e.g., straight quota share contracts). It is still good practice to test this type of reinsurance deal for risk transfer and thoroughly understand the contract terms. This includes understanding the potential limitations that certain terms may have on the reinsurer's ultimate underwriting performance compared to the cedant.

To evaluate requirement (1), there must be a possibility of significant variation in the amount or timing of cash flows between assuming and ceding companies. When developing a stochastic loss model to evaluate the variation in the amount or timing of cash flows, consideration should be given to the distribution of probable loss outcomes and the timing of losses ceded to the reinsurer. To evaluate requirement (2), the present value of all cash flows between the reinsurer and the cedant under reasonably possible scenarios must be evaluated.

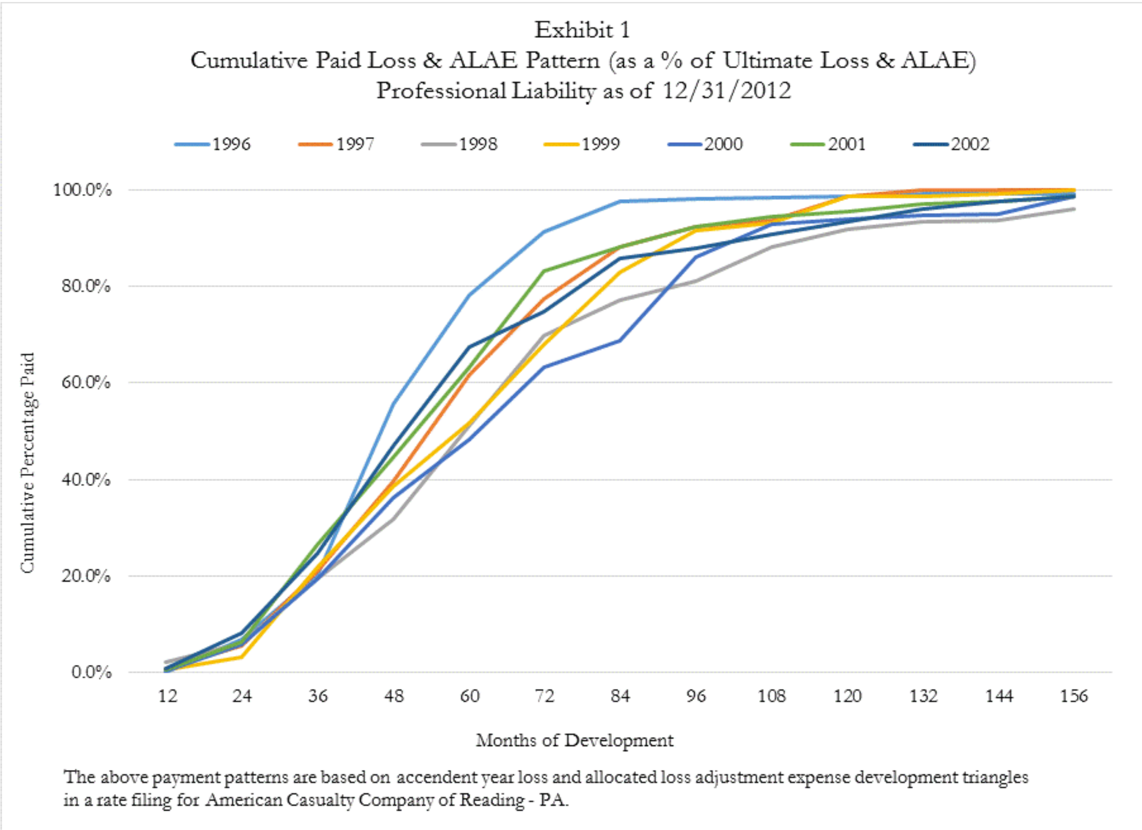
2.2 ERD Risk Transfer Test

The ERD test statistic reflects the probability of a net present value underwriting loss for the reinsurer multiplied by the net present value of the average severity of the underwriting loss. In this context, underwriting loss is the amount by which the present value of losses plus expenses exceeds the present value of premium as of the effective date of the reinsurance policy. The average severity in this context is the average underwriting loss (as a percentage of premium). A commonly accepted but not endorsed ERD threshold is 1% where an indicated ERD % greater than 1% passes risk transfer. This is consistent with the 10-10 test's 10% probability times a 10% underwriting loss (i.e., at least a 10% chance of an underwriting loss ratio of at least 110%), however the ERD test also considers severity of underwriting loss. It is important to note "ERD has not been explicitly endorsed by any professional body. However, while the CAS Working Party paper stopped short of endorsing the ERD, they prefer its use as the de facto standard over the 10-10 rule." [1] The risk transfer results illustrated Exhibit 5 below only consider the ERD test. Once one considers the timing risk associated with the potential variation in paid loss and ALAE the conclusions of risk transfer could potentially change.

2.3 Timing Differences in Historical Cumulative Loss Patterns

The sensitivity of risk transfer can be assessed by looking at risk transfer statistics such as the ERD test statistic and gross versus ceded cash flows at various probability levels. The variation in payment timing can be better understood after an investigation of historical data that has had time to develop to full maturity. Consider the following cumulative paid loss and ALAE percentages (as a percentage of ultimate loss and ALAE) for policy years 1996 through 2002 for a professional liability insurer[2]. Note this time horizon extends across only seven accident years of data, but illustrates the loss timing differences commonly found in other long tailed lines of insurance reviewed by the author.

2.3.1 Actual Example of Timing Differences in Paid Loss and ALAE Data



The variation in cumulative paid loss and ALAE percentages as of 60 months of development ranges from 48% to 78% for the 7 accident years of data displayed above. The relationship of this potential variation in payment pattern timing and the variation in ultimate loss and ALAE settlements for a policy period is an important consideration when assessing a reinsurance contract for risk transfer. Consider the following section as a potential analysis in assessing this relationship.

2.3.2 Correlation of Loss & ALAE Payment Timing and Ultimate Loss and ALAE Data

Exhibit 2
Correlation of Payment Pattern Timing
and Ultimate Loss and ALAE

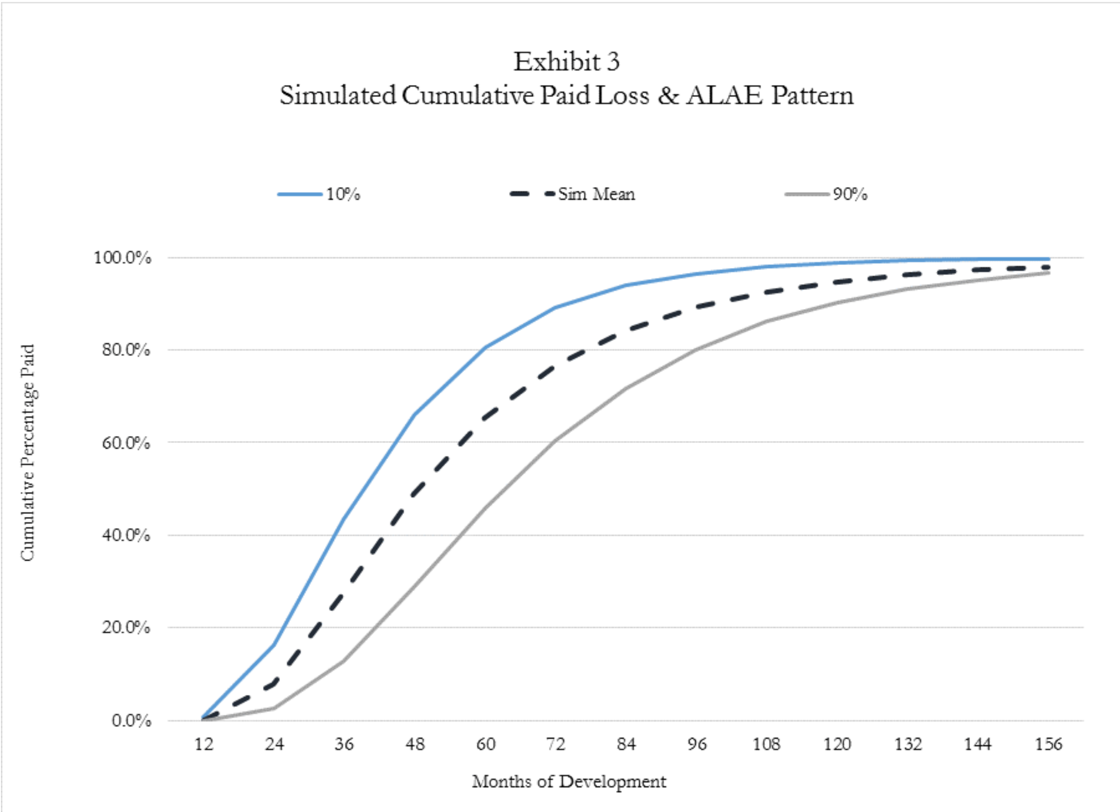
Loss Year	Selected Ultimate Loss & ALAE	Cumulative Paid Loss & ALAE at 60 Months of Dev	Cumulative Paid Loss & ALAE % at 60 Months of Dev [1]	Duration [2] of Paid Loss & ALAE (in Years)
1996	16,893	13,216	78.2%	4.0
1997	22,113	13,600	61.5%	4.6
1998	27,316	14,004	51.3%	5.3
1999	29,292	15,121	51.6%	4.9
2000	32,160	15,292	47.6%	5.3
2001	45,879	29,124	63.5%	4.5
2002	50,889	34,397	67.6%	4.6
2003	66,981	43,100	64.3%	4.7
2004	58,066	34,926	60.1%	4.9
			Correlation to Ult Loss & ALAE	Correlation to Ult Loss & ALAE
		Correlation 96'-02'	-4.6%	10.4%
		Correlation 96'-03'	7.6%	5.5%
		Correlation 96'-04'	6.1%	9.5%

(1) As a percentage of Ultimate Loss & ALAE
(2) Duration is based on a discount rate of 2% and payments occurring mid-year

The indicated correlation between selected ultimate loss & ALAE and the payment pattern timing is not highly negative or positive based on the professional liability rate filing data[2] illustrated in Exhibit 2. Note this is based on a limited number of mature loss years of data and further research based on a longer horizon of mature data may lead to different conclusions. Also, note historical exposure/policy counts underlining the selected ultimate loss & ALAE is unknown and trending ultimate loss and ALAE for changes in exposure could lead to different correlation indications. In the author's opinion, it is likely that the duration of the payment pattern generally has a small positive correlation to ultimate loss and ALAE. As such, the sensitivity of the ERD test results will be shown under several correlation scenarios. First, let us consider a model to simulate the payment pattern timing seen in Exhibit 1.

2.3.3 Fitted Payment Pattern

Exhibit 3 shows the simulated cumulative paid loss percentages by maturity at the 10th percentile, mean and 90th percentile. These percentages are fitted to the professional liability filing loss patterns illustrated in Section 2.3.1 above. As such, these simulated outcomes reflect payment pattern variation consistent with the actual variation in historical cumulative payment patterns. The author selected the lognormal distribution with a fitted mean and coefficient of variation to produce the simulated mean payment pattern shown in Exhibit 3. To produce the simulated mean pattern shown in Exhibit 3, the author selected the lognormal distribution based on the results of Excel Solver. The lognormal distribution produced the best fit (i.e., the lowest MSE) after considering several other continuous distributions such as the beta and gamma. Further, the author allowed the mean parameter to vary uniformly between a selected min and max thereby resulting in the distribution of paid loss and ALAE patterns shown below. The selections were made using best fit and judgment.



The variability in the above simulated payment patterns is consistent with actual historical paid loss and ALAE development patterns for the long tailed lines of business that the author has observed, such as professional liability, medical malpractice, workers' compensation, mortgage insurance, etc. Note the range of 10% to 90% in Exhibit 3 above represents 80% of simulated accident year events in the reinsurance risk transfer analysis. The variability in loss timing can lead to materially different ERD test results especially after considering the combined correlation and discount rate assumptions.

2.4 Illustrative Example of ERD Results

To illustrate the potential impact of timing risk under various assumptions of payment pattern timing, correlations, and discount rates, first consider the following hypothetical captive reinsurance program and set of assumptions.

- The primary insurer cedes $260,000 in premium on January 1, 2014 to the captive reinsurer with a 30% ceding commission;

- The captive reinsurance program attaches on an aggregate excess of loss basis where primary insurer loss and ALAE for policy year 2014 above $475,000 is covered by the reinsurance policy and reinsures loss and ALAE up to a limit of $225,000. This equates to a maximum underwriting loss ratio to the reinsurer of approximately 16.5% (i.e., [($225,000 + 30% x $260,000) / ($260,000)] -1;
- Coverage is provided on an occurrence basis for policy year 2014 for professional liability;
- Direct ultimate policy-year losses of the primary insurer follow a lognormal loss distribution with an expected loss of $550,000 and a coefficient of variation of 40%;
- Based on the correlation analyses in Exhibit 2 above, a 0% correlation is assumed when modeling the correlation between the duration of simulated paid loss and ALAE and ultimate paid loss and ALAE;
- The timing of paid loss and ALAE is modeled with a lognormal distribution using a fitted mean and standard deviation; and
- A discount rate of 2% is selected based on current U.S. treasury yields. Discussion of the interest rate selection is beyond the scope of this paper.

Exhibit 4 shows ERD results under the assumptions above:

Exhibit 4
ERD Test Cash Flow and Results
(Discount: 2.0%, Simulated Payment Pattern, Correlation: 0.0%)

Cumulative Probability Distribution %	Present Value Ceded Loss	Present Value Ceding Commission	Present Value Ceded Premium	Underwriting Deficit
99%	$ 210	$ 78	$ 260	10.74%
98%	$ 209	$ 78	$ 260	10.32%
95%	$ 207	$ 78	$ 260	9.46%
90%	$ 203	$ 78	$ 260	8.13%
80%	$ 192	$ 78	$ 260	3.78%
70%	$ 132	$ 78	$ 260	0.00%
60%	$ 75	$ 78	$ 260	0.00%
50%	$ 31	$ 78	$ 260	0.00%
	Average Underwriting Deficit (ERD Ratio)			1.64%

The results above are based on 10,000 Monte Carlo simulated trials using the simulation software Oracle Crystal Ball. After considering these results let us now consider the sensitivity of the ERD ratio in assuming a fixed payment pattern (i.e., not simulating the payment pattern). As shown in Exhibit 5, the ERD ratio produced by assuming a static or fixed payment pattern decreases slightly under this reinsurance structure and modeled assumptions. Exhibit 5 also shows the results of the ERD test across various combinations of correlation and discount rate assumptions.

Exhibit 5
ERD Test Results Under Various Scenarios [1]

Correlation[2]	Discount Rate	ERD % Simulated Payment Pattern	ERD % Fixed Payment Pattern
0%	2%	1.64%	1.53%
25%	2%	1.50%	1.53%
50%	2%	1.36%	1.53%
0%	4%	0.32%	0.14%
25%	4%	0.21%	0.14%
50%	4%	0.11%	0.14%

(1) The above results illustrate how the results of the ERD test are sensitive to modeled assumptions of correlation, discount rates, and variability in payment pattern timing.
(2) Reflects correlation between simulated ultimate loss and ALAE and the average duration of the simulated payment pattern. Correlation assumption does not affect the ERD results for the fixed payment pattern.

Exhibit 5 illustrates how the ERD result is sensitive to the assumptions of payment pattern timing, correlation, and discount rate. Other reinsurance structures are likely more or less sensitive to these assumptions depending on the contractual terms, economic environment, line of business reinsured, etc. The variability in the timing of losses is affected by numerous events, including but not limited to government moratoriums, economic trends, claims practice changes, changes in TPA, changes in reserving practices, and changes in the distribution of business written. Reinsurance contractual features sensitive to the timing risk component of risk transfer such as commutation options, fixed coverage periods, and working covers should also be considered.

3. CONCLUSIONS

Modeling this variation in loss timing is important for a broad spectrum of actuarial analyses. This includes pro forma analyses, risk transfer analyses, and premium deficiency reserve analyses. When evaluating reinsurance risk transfer statistics it is important to keep in mind features that are sensitive to the variation of loss payment timing, particularly when the ERD result is near a threshold where risk transfer is questionable. In addition to payment pattern timing, discount rate and correlation are assumptions that can have a material impact on the result of the modeled ERD statistic. It is important to understand the sensitivity of those assumptions as they may change under different economic environments, reinsurance structures and lines of business reinsured. The loss variation may have a significant impact on the amount of losses ceded to a reinsurer. At the very least, the variation in timing will have an impact on the present value of losses used in the ERD test statistic, particularly with larger discount rates.

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4. REFERENCES

[1] D. Freihaut and P. Vendetti, "Common Pitfalls and Practical Considerations in Risk Transfer Analysis," *Casualty Actuarial Society E-Forum, Spring* **2009**.

[2] Based on a Medical Malpractice rate filing for American Casualty Company of Reading – PA.

Abbreviations and notations

ALAE, allocated loss adjustment expense
Dev, development
ERD, expected reinsurer deficit
MSE, mean squared error
Ult, ultimate

Biography of the Author

Peter J. Johnson is a consulting actuary at Bartlett Actuarial Group, Ltd. in Charleston, SC. He is responsible for reserving, pricing and risk transfer analyses. This includes work in property & casualty traditional lines of insurance including workers' compensation and medical malpractice as well as the captive marketplace. He has a degree in Applied Math & Computer Science from the University of Wisconsin - Stout. He is a Fellow of the CAS and a Member of the American Academy of Actuaries. He participates on the CAS examination committee and the Committee on Reinsurance Research.