Measuring the Impact of "Locked Collateral" on Collateralized Reinsurance Returns

Research Series: New Topics in ILS

200 Edgewater Drive Suite 289
Wakefield, MA

Tel +1 781 213 6272

milliman.com

Prepared by:

Aaron C. Koch, FCAS, MAAA

April 25, 2016

TABLE OF CONTENTS

I. INTRODUCTION

Yields on traditional insurance-linked securities (ILS) such as catastrophe bonds are currently near all-time lows. In this environment, *collateralized reinsurance* has become an essential tool for catastrophe-focused investment managers (ILS managers). These private, customizable deals can provide exclusive investment opportunities; however, they also require specialized underwriting expertise and a network of relationships not every ILS manager possesses.

Collateralized reinsurance deals are generally less liquid than catastrophe bonds, and investors must assess the negative impacts of this illiquidity. In particular, it is important to recognize that collateralized reinsurance contracts are multiple-year commitments even if the risk period is only one year long, due to the potential for *collateral lockup* in the event of a loss. To date, we have seen few attempts by the market to quantify the “drag” that collateral lockup has on returns. We find this drag to be significant, representing around **15% to 20%** of returns on commonly seen deals (and up to 33% in extreme cases).

Without proper understanding and estimation of the locked collateral phenomenon, investors in collateralized reinsurance have an increased chance of failing to meet their long-term return objectives.

II. WHY IS COLLATERAL LOCKUP IMPORTANT?

Full collateralization of the insurance limit allows unrated entities to participate in the insurance market. However, full collateralization comes at a cost: Once a sum of money is devoted to supporting a particular insurance deal, it is unavailable for reinvestment until all obligations on that contract have been settled.

In many cases, this is a relatively minor issue. The majority of collateralized reinsurance deals are written on short-tail property business which rarely suffers a loss, resulting in little to no collateral lockup. Nevertheless, losses *do* occur over the long run, particularly because ILS managers are increasingly writing deals that suffer frequent losses (such as whole account quota shares).

As a result, using a contract-length return horizon (i.e., a one-year period for most deals) in the pricing process will tend to overstate the actual long-run returns. Instead, a multi-year return model is needed.

Such models are rare in the industry as they require a stochastic simulation utilizing both financial and actuarial modeling concepts. In the remainder of this paper, we will design such a framework, which we call the Time-Adjusted Return (TAR) model. The TAR model is based on an internal rate of return (IRR) framework coupled with actuarial loss development patterns. It is highly scalable and flexible enough to handle the complexities of actual reinsurance contracts.

III. THE TAR MODEL: FINANCIAL AND ACTUARIAL THEORY

Aside from basic contract parameters such as the premium, expenses, and required collateral, there are three key loss-related assumptions needed to parameterize the TAR model. They are:

1) The frequency of loss payments
2) The severity of loss payments
3) The timing of loss payments

The theoretical considerations for modeling each of these assumptions are discussed below.

A. Modeling assumptions: Frequency and severity of loss payments

We group the frequency and severity assumptions together because they are generally modeled together in existing analyses. For instance, catastrophe model outputs such as event loss tables (ELTs) and year loss tables (YLTs) provide a stochastic expectation of ultimate, or fully developed, loss outcomes. The ultimate loss is derived by simulating both the occurrence of events (frequency) and the severity of each simulated event.

For contracts that are exposed to non-catastrophe losses, actuarial pricing models can be used to project the frequency and severity of loss. These models will consider various trends (e.g., inflation, exposure growth), the cedent's loss history, and relevant industry data among other factors.

B. Modeling assumption: Timing of loss payments

Once an ultimate loss has been estimated, the loss and loss-related payments (e.g., loss-free refunds, etc.) must be temporally placed over the life of the contract. Out of the three key assumptions, the timing of loss payments is the least frequently modeled; however, it is of central importance to the TAR model.

Note that a one-year collateralized reinsurance contract[1] represents a one-year commitment where the purchasing party (the insured) has the contingent right to extend the length of the collateral commitment (in the event of loss). In many cases, collateral can be locked for up to several years after the conclusion of the risk period. During this time, the reinsurer makes a series of loss payments that are uncertain in both size and timing.

The key insight of the TAR model is to parameterize these variable cash flows using an actuarial loss development framework. Once the loss payments have been parameterized, the long-term IRR of a contract can be estimated.

[1] Although not discussed in this paper, multiyear collateralized reinsurance contracts necessitate only small adjustments to the TAR model.

IV. CASE STUDIES

We will present two case studies to show the TAR model in action:

1. A catastrophe excess-of-loss contract
2. A whole-account quota share contract

The purpose of these two case studies is to show a set of simple variations on the basic TAR model. In addition, the case studies will show which types of contracts suffer from the most “drag” on return due to locked collateral provisions.

A. Case Study 1: Catastrophe excess-of-loss contract

Consider a hypothetical one-year reinsurance contract. For simplicity, assume that the contract can take one of four loss scenarios:

1) No loss
2) A “precautionary loss notice” that does not reach the insurance layer, but represents 80% of the attachment point and therefore requires temporary collateral lockup (due to its proximity to insurance layer).
3) A “partial loss” to the insurance limit (50% of limit)
4) A “full loss” to the insurance limit (100% of limit)

To start, we assign a 10% chance of a precautionary loss notice, 10% chance of partial loss, and a 5% chance of full loss.

In the no loss scenario, we assume that collateral is returned to the investor at the end of the contract (one year).

In the “precautionary loss notice” scenario, we assume that the investor will receive a full return of collateral, but that collateral return is delayed for an additional year until it is determined that the loss will be contained below the attachment point (and therefore not affect the insurance layer).

Finally, in the “partial loss” and “full loss” scenarios, we assume that final settlement of all losses occurs three years after the inception of the contract. This represents the length of time required to litigate and settle claims.

We assign expense and profit parameters to the contract as shown below. All parameters are hypothetical and shown for illustration purposes only.

Case Study 1 - Excess-of-Loss Contract

(1) Basic Contract Parameters

a.	Written Insurance Limit	500
b.	Premium	100
c.	Expenses	24.5
d.	Collateral Provided by Investor = *a* - *b* + *c*	424.5
e.	Length of Contract	1 Year

(2) Loss Parameters

a.	Probability of No Loss	75%
b.	Probability of Precautionary Loss Notice (0 Ult. Loss)	10%
c.	Probability of Partial Loss (250 Ult. Loss)	10%
d.	Probability of Full Loss (500 Ult. Loss)	5%
e.	Average Expected Loss	50

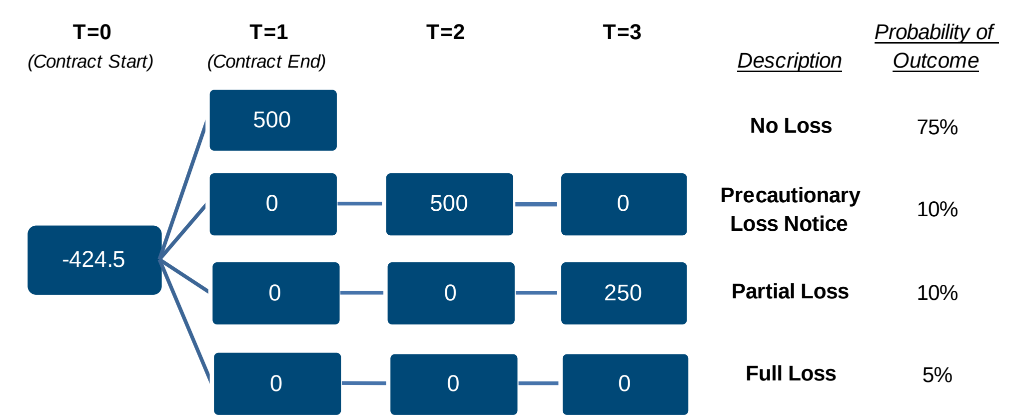
(3) Profitability Metrics

a.	Rate on Line	20%
b.	Expected Combined Ratio	74.5%
c.	Average Expected Simple Profit	25.5
d.	Simple Average Annual Return (as % of Collateral)	6.00%

If an investor assumes a one-year investment time horizon for this hypothetical contract, it will expect a return of **6.00%** (= 25.5 ÷ 424.5).

We will now assess the average expected annual return under the TAR model. To do so, we use a multinomial tree to model the cash flows on the contract. The cash flows progress down one of four paths of the tree, depending on the eventual loss outcome. Negative numbers represent the initial investment into the contract (that is, the investors' collateral contribution), while positive numbers represent return of collateral to the investor.

Case Study 1 - Investor Cash Flow Diagram



Cashflows shown from perspective of investor:
Negative represents outflow (including collateral pledge), positive represents inflow (including collateral takedown)

Based on the simple model above, we obtain an estimated annual IRR for this contract. Under the TAR model, the estimated annual average return for the investor is thus **4.91%**, or a reduction of 109 basis points (approximately **18%**) from the estimated 6.00% return under the single-year model.

We then repeated Case Study 1 for a variety of hypothetical excess-of-loss treaties with a 6.00% return profile, each with a slightly different frequency of loss. These sample treaties, along with their expected TAR result, are shown below.

Case Study 1 - Range of Results
Contracts Priced at a 6.0% Single-Year Net Return (after Expected Loss)

Chance of Precautionary Loss Notice	Chance of Partial Loss	Chance of Full Loss	Est. Annual Net Return "Single-Year" Model	Est. Annual Net Return TAR Model	Difference
1.00%	*1.00%*	*0.50%*	6.00%	5.88%	**12.5** bps
2.00%	*2.00%*	*1.00%*	6.00%	5.78%	**22.2** bps
5.00%	*5.00%*	*2.50%*	6.00%	5.43%	**56.8** bps
10.00%	*10.00%*	*5.00%*	6.00%	4.91%	**108.7** bps
15.00%	*15.00%*	*7.50%*	6.00%	4.44%	**156.5** bps
20.00%	*20.00%*	*10.00%*	6.00%	4.00%	**200.5** bps

There are a few key results above. First, the overestimation of returns by using the single-year model is directly proportional to the frequency of loss. Contracts with frequent loss will have a greater “drag” on returns (up to 33% in the most extreme scenarios) due to the fact that they are more likely to suffer collateral lockup.

Second, the drag on returns for excess-of-loss contracts is generally moderate, but can be up to a third of expected yields on contracts with a very high chance of loss.

B. Case Study 2: Whole-account quota share contract

Case Study 1 showed that contracts with a higher probability of loss have a higher “drag” on expected returns. A significant instance of this phenomenon occurs on whole-account quota share treaties, where the quantity of underlying contracts covered by the quota share makes it highly likely that some amount of losses will occur.

Modeling a quota share contract is particularly complex because of two reasons. First, the accumulation of several loss events means that a wide range of loss outcomes is possible for the contract. Second, the increased prevalence of loss reserves makes it more important to accurately model the collateral requirements associated with the reserves. This challenge is made even more difficult if the contract has a “roll-over” provision that transfers the existing loss reserves over to the next year’s renewal contract on an ongoing basis.

For the purposes of this case study, we will assume that the quota share is priced to yield a **10.0%** “simple return” (that is, the return derived from using a one-year time horizon). The parameters used to accomplish this return are the following:

Case Study 2 - Quota Share Contract		
(1) Basic Contract Parameters		
	a. Written Insurance Limit	450
	b. Premium	200
	c. Expenses	50
	d. Collateral Provided by Investor = *a* - *b* + *c*	300
	e. Length of Contract	1 Year
(2) Loss Parameters		
	a. Percent of loss paid in 12 months	27%
	b. Percent of loss paid in 24 months	66%
	c. Percent of loss paid in 36 months	81%
(3) Profitability Metrics		
	a. Expected Combined Ratio	85%
	b. Average Expected Simple Profit	30
	c. Simple Average Annual Return (as % of Collateral)	10.00%

Instead of assuming hypothetical scenarios at which loss payments are made at specific times, we instead use an actuarial *loss development pattern* in order to estimate the timing of monthly loss payments. We model the mean loss estimate assuming that it follows the selected loss development pattern.[2] In addition, we assume that the full amount of collateral is held throughout the first year after which it is then reduced to the estimate of outstanding loss plus a 50% “safety margin.”

As a result, we find that the estimated annual return under the TAR model is **7.96%** or a reduction of 204 basis points (**20.4%**) from our initial estimated return. This represents a significant drag on expected returns due to collateral lockup provisions. In fact, this result may still understate the amount of “drag” on returns because the development patterns assume a relatively short-tailed line of business. If the contract instead covers medium- to longer-tailed lines of business such as liability insurance, then the impact may be larger due to the need to hold reserves for a longer period of time (conversely, certain quota shares may have “commutation” clauses for non-catastrophe losses that help shorten the tail of the loss development pattern).

[2] Although not shown in this case study, this model can easily be expand to also stochastically model the ultimate loss on the contract.

V. CONCLUSION

On certain collateralized reinsurance deals, the presence of *collateral lockup* can create a significant "drag" on expected results due to the opportunity cost of having investors' collateral tied to an expired contract. Simple pricing models often fail to realize this cost as their time horizons are often one year to match the length of most collateralized reinsurance contracts.

In order to more accurately estimate the annual return on collateralized reinsurance contracts, we have created a multiple-year, TAR model. The TAR model combines financial and actuarial modeling to provide an unbiased view of returns.

Although the case studies shown in this paper are simplified, the model is easily scalable to provide a fully stochastic view of returns for more complex contracts. Even so, the case studies shown illustrate the major impact of collateral lockup provisions and the need for more nuanced modeling in the ILS market.