Reinsurance Involving Partial Risk Transfer
Addressing the Accounting Difficulties

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Abstract: The paper proposes a measure for risk transfer, the portion or percentage of risk transferred ("**PRT**") that varies between 0% and 100%. Such measure would provide a superior basis for a binary decision between reinsurance accounting and deposit accounting (with a likely critical value of 50%). A preferred approach would be to use **PRT** as the basis for continuous accounting. The paper differentiates between "natural" reinsurance contract provisions that do not limit risk transfer and "structural" contract provisions that may limit risk transfer. The **PRT** measures the risk-limiting impact of the structural provisions by comparing risk distributions before and after the application of structural provisions. **PRT** is 100% for contracts without structural provisions. The risk to be measured is defined as potential adverse deviation from the amounts reflected in accounting values. Fixed reinsurance contract provisions that are accounted for without uncertainty provide no potential for adverse deviation and do not affect **PRT**. The paper includes a discussion and critique of the FAS 113 definition of risk transfer, and finds two fundamental flaws: (1) the definition is based on an absolute measure of the riskiness of the ceded cash flows, so that reinsurance of low risk subject portfolios often fails even though nearly all the risk is transferred, while reinsurance of high risk subject portfolios often passes even though the risk transfer is severely limited; and (2) the focus on reinsurer profitability includes fixed amounts that are unrelated to risk, and thereby includes an implicit standard for reinsurance pricing that is an inappropriate role for accounting. The paper includes examples of the application of PRT and several other risk transfer measures to a range of underlying cash flows and reinsurance contract structures.

Introduction and Summary

Reinsurance contracts frequently contain any number of risk limiting provisions, which may call into question the validity of reducing net losses and premiums by showing them as having been ceded to the reinsurance, i.e. "reinsurance accounting". Many or most such contracts cede some, but not all of the relevant risk, which the author describes as partial risk transfer.[1]

There are concerns that some partial risk transfer contracts have been used to manipulate financial statements. Yet there are many legitimate uses of partial risk transfer, and more that may develop in the future as sophisticated tools for risk management. Furthermore, there may be risks for which reasonably priced reinsurance is available only with risk-limiting provisions. The author's view is that opportunities for financial statement manipulation arise from inaccurate accounting. The author's proposal for more accurate accounting would substantially eliminate opportunities for manipulation while allowing the legitimate use and further development of structured risk transfer techniques.

[1] More common terms are "structured risk" and "finite risk". The author prefers partial risk transfer, which corresponds more directly with the basis of the approach. Partial risk transfer includes many traditional risk sharing

Currently, the accounting choice is whether or not the contract in question has enough risk transfer to qualify as reinsurance, and therefore be eligible for reinsurance accounting. FAS 113[1], for U.S. GAAP, and SSAP 62[2], for SAP,[2] provide guidance for making this choice.

The author's central thesis is that the degree of risk transfer in a reinsurance contract can be described by a relatively simple and intuitive measure called "the percentage of risk transferred" or "***PRT***", which should be the basis for the above decision. The central provisions for defining risk transfer in FAS 113 are found to be fundamentally flawed.

Section I:

- develops the underlying basis for the central thesis,
- contrasts the approach with FAS 113,
- defines the approach specifically, and
- applies the approach, along with several others, to a range of hypothetical cash flow models and hypothetical reinsurance contracts.

The second aspect of the central thesis is that the two available accounting choices are appropriate for 100% risk transfer and 0% risk transfer, but that neither is truly appropriate for partial risk transfer. Section II illustrates how the measure developed in Section I can be used to develop appropriate accounting for partial risk transfer contracts.

[2] The relevant language is generally identical in FAS 113 and SSAP 62. For brevity, references hereinafter will be to FAS 113.

Outline

Section I - Defining and Measuring Risk Transfer in Reinsurance Contracts

1.1 Risk Transfer and Accounting

The effects of risk transfer accounting are subdivided into two basic categories:

- Effects on overall reported equity and income; and
- Effects on reported net premiums and losses.

1.1.1 Risk and Balance Sheets/Income Statements

In the most straightforward case, consider the reinsurance premium net of ceding commission to be the sum of the mean discounted ceded losses and the reinsurer's margin. The initial impact of reinsurance on balance sheets and income statements consists of a cost - the reinsurer's margin, and a gain - the difference between the ceded losses and their mean discounted value. While reinsurance accounting and deposit accounting differ on the timing of the recognition of the cost, our primary focus is on the gain, or more specifically, on the cession of incurred losses and loss reserves. The impact on incurred losses will be controlled by the impact on loss reserves.

Loss reserves for most P/C liabilities are recorded at estimated nominal (undiscounted) value, i.e., an estimate of the sum of future outgoing cash flows. It is important to distinguish the reserve from the liability itself. The liability is more complex, the sum total of the insurer's obligations under the relevant policies. The reserve is simply a valuation of the liability, possibly a surrogate for a market value.

If the same future cash flows were not estimates, but simply future payment obligations that were fixed in amount and timing, then it is clear that the value of those obligations would be the discounted value of the future payments, and the liability would be accounted for as such. The accounting difference between an at-risk insurance liability and the corresponding no-risk liability is precisely the discount. The (unrecognized) discount then is the required risk load. It exists precisely because the liabilities are subject to insurance risk and would not exist if they were not.

Under an "economic value" accounting concept (not currently applicable under U.S. GAAP or SAP), the implicit risk margin in the unrecognized discount may be replaced by an explicitly discounted reserve and an explicit risk margin. The issues to be discussed subsequently regarding ceding the reserve and its associated risk margin would be equally applicable if the risk margin were converted from implicit to explicit.

1.1.2 Risk and Net Premiums and Losses

For shorter tail business, where loss reserves and their implicit risk margin are small, the choice of accounting will have little impact on overall equity or income. However, the characterization of premiums and losses as having been ceded (or not) affects the reported net premiums, losses, and loss reserves. Various measures of capital adequacy used by rating agencies, regulators, and other publics use net premiums, net losses, net loss reserves, etc. as measures of the risk to which a company is exposed.[3] Accounting for premiums and losses as ceded when the corresponding risk has not been ceded, or has been partially ceded, distorts these measures.

1.1.3 Reinsurance Accounting vs. Deposit Accounting

When accounting for a ceded reinsurance contract (perhaps we should say a purported reinsurance contract), we currently have two options: reinsurance accounting or deposit accounting.

Under reinsurance accounting, reserves are ceded on the same basis that they are established: in most cases at undiscounted, and therefore implicitly risk-loaded, value. Since the net recorded liability for the ceded cash flows is reduced to zero, the underlying assumption is clear – that the liability itself has been ceded, both at the recorded estimate and at all other possible outcomes.

The risk load has been 100% eliminated, which is appropriate only if 100% of the risk has been ceded. Similarly, since premiums and losses have been 100% ceded, capital adequacy measures, regulatory ratios, etc. also assume a 100% cession of the related risk.

For contracts that do not qualify for reinsurance accounting, the AICPA Statement of Position 98-7[3] and SSAP No. 75[4] provide rules for deposit accounting under GAAP and SAP, respectively. The "interest method" is prescribed for all reinsurance contracts under SAP. Under GAAP, the same method is prescribed except for contracts that transfer underwriting but not timing risk, or that have indeterminate risk. The interest method assumes that no reinsurance transaction has occurred, in other words, that 0% of the risk has been ceded.

1.1.4 The Relevant Risk

For equity and income, the choice between reinsurance accounting and deposit accounting hinges on whether it is appropriate to eliminate (by cession) the risk load imbedded in the carried loss reserves. To discuss whether this risk has been ceded, we must define the relevant risk more precisely. What risk does this risk load provide for?

The author believes that it is fairly clear that the relevant risk is the risk of inaccuracy in the estimate that is on the balance sheet. If we consider only downside risk to be important, then it is the risk of inadequacy of the estimate. If we view the balance sheet value as a surrogate for market value, the risk load is the amount in addition to the discounted value required to fund the mean losses that an assumer of the liability would require to compensate for the risk of inadequacy in the mean estimate.

This description of risk is consistent with a concept of risk as related to economic or financial losses. The risk as defined above is the risk of the insurer realizing losses subsequent to the statement date related to the loss reserves to be ceded.

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[3] This paper does not necessarily endorse the validity of any particular capital adequacy measure. For example, capital adequacy measures that use net premiums as a surrogate for underwriting risk have a number of

While the previous paragraphs refer to loss reserves, we will normally view risk prospectively, i.e. at the inception of the reinsurance contract, before statement values are established. How do we define the risk of future losses? If the expected losses create an underwriting loss, then actual losses worse than expected create a future loss. If the expected losses create an underwriting profit, then actual losses worse than breakeven create a future loss.

All further analysis herein will be based on a definition of risk as adverse deviation from actual or expected statement values. For prospective losses, adverse deviation is measured relative to expected losses or underwriting breakeven losses, whichever is higher.

Note that fixed amounts, which create no accounting uncertainty as to their value, are not relevant. In particular, ceded premiums, to the extent that they are not contingent on losses, will be accounted for in their normal straightforward manner with no risk of accounting inaccuracy. The size of those fixed premiums, and therefore of the reinsurer's profit margin, does not affect the question of whether the insurer has retained or ceded the risk for its losses, only the question of at what cost. Whatever the cost, that cost will be expensed under normal accounting procedures, and therefore creates no additional risk for the insurer.

1.1.5 Partial Risk Transfer

Many reinsurance contracts have risk-sharing provisions (e.g., retrospective rating, adjustable commissions, profit sharing, refundable experience accounts), and/or risk limiting provisions (e.g., aggregate limits, sub-limits, additional premiums). These provisions may reduce, but not necessarily eliminate, the transfer of risk. In such cases, neither of the assumptions underlying the available accounting options – 100% risk transfer or 0% risk transfer – is precisely accurate.

The question before us is stated narrowly: Given that we have only these two options, which shall we use? A likely answer is: The one that is more nearly accurate. In other words, does the contract more nearly transfer 100% of the risk or 0% of the risk?

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imperfections and potential distortions that shall not be discussed further.

In order to answer this question, we need to estimate, for any reinsurance contract, the portion, or percentage, of the risk that has been transferred ("PRT"). In fact, a reasonable definition of PRT is fairly simple, and the modeling required to estimate the value is no more complex or difficult than the modeling required to perform risk transfer testing under FAS 113 as currently written. Both require the same risk model of the underlying cash flows.

Once the PRT has been estimated, the choice of accounting treatment can be decided by comparing the PRT to a critical value. A critical value of 50% would seem to best answer the question of which accounting treatment is more nearly accurate, though other critical values might be chosen.

The above test will provide a practical, intuitive answer to the narrow question which will, in the author's opinion, represent a significant improvement to current practice. It will minimize the degree of accounting inaccuracy to the extent possible under the constraint that we have only the two accounting treatments to choose from. Nonetheless, it must be recognized that neither of the available accounting treatments is in fact designed for partial risk transfer, and both will be inaccurate to some degree. The definition and estimation of the PRT can also provide the basis for practical accounting for partial risk transfer. While this is a larger change to current accounting practice, the difficulties that arise from inaccurate accounting for partial risk transfer cannot be eliminated until partial risk transfer reinsurance is formally recognized and appropriate accounting is promulgated.

A previous reference to measuring risk transferred by comparing "before" and "after" distributions is noted in the report of the CAS Valuations, Finance and Investment Committee ("VFIC") [5]. The reference is to an approach described for testing the basis risk in catastrophe derivatives [6].

1.2 The FAS 113 Definition of Risk Transfer – Discussion and Critique

The well known FAS 113 definition of adequate risk transfer is that it must be "*reasonably possible that the reinsurer may realize a significant loss from the transaction*" [1]. The determination must be based on all cash flows to the reinsurance contract, whether characterized as losses, premiums, expenses, etc., but transactional expenses and the reinsurer's expenses are not included.[4] The terms "*reasonably possible*" and "*significant loss*" are not specifically defined, but some guidance is given and the well known "10/10" rule is frequently applied to test whether a contract meets the FAS 113 definition.

The 10/10 rule has frequently been discussed and criticized and a number of potentially superior risk measures have been suggested. The author's critique is more fundamental: The FAS 113 definition of risk transfer is fundamentally flawed, not just because of problems with the risk measures, but because the wrong risk is being measured.

The two fundamental defects:

1. The definition of risk transfer does not contain the concept of risk transfer. Rather, the FAS 113 definition sets an absolute standard of the required level of assumed risk. A test of risk transfer requires a comparison of "before" and "after" risk. No single absolute standard can produce results that are meaningful regardless of the riskiness of the underlying cash flows.

2. The definition is influenced by fixed profit margins paid to the reinsurer. As discussed in the previous section, in determining proper accounting from the cedant's perspective, the relevant risk is the risk that the amounts carried in the cedant's financial statements are inadequate. Fixed profit margins are irrelevant. Furthermore, it is inappropriate for the risk transfer analysis to be influenced by the analyst's implicit second-guessing of the reinsurance pricing, which is unavoidably the case when applying the FAS 113 definition.

Each of these defects is further explored below:

1.2.1 Measuring Risk Rather than Risk Transfer

[4] While the definition is stated from the reinsurer's perspective, the exclusion of transactional and reinsurer's expenses actually convert it to the cedant's perspective. A more accurate expression would be "reasonably possible

A problem that may arise from the FAS 113 definition that has been frequently discussed by others is that obvious risk transfers of low risk portfolios may not pass. FAS 113 provides that obvious 100% risk transfer contracts need not be tested. The specific language is that the previous test would not apply if "*the reinsurer has assumed substantially all of the insurance risk relating to the reinsured portion of the underlying insurance contracts*" [1]. Unstructured quota-share contracts are generally accepted to fall within this "safe harbor". While such contracts need not be tested, it would nevertheless be desirable if such contracts would pass the test.

A number of practitioners have explored risk measures that should be superior to the 10/10 rule. Whatever the risk measure, a critical value must be selected, and "obviously risky enough" contracts should pass. Even with a fairly low threshold, unstructured quota-shares of stable, profitable business may still fail – the solution will still be imperfect and the exception will still be required.

But the corresponding problems at the other end of the risk spectrum, which have rarely been explored, may be even more significant. Imagine that the underlying ceded cash flows are extremely risky long-tailed payments. Because of the long tail, the distinction between discounted and undiscounted reserves (the implicit risk margin) is large and the choice of accounting treatment is highly material. Let us further assume that the reinsurance contract is highly structured so that only 20% of the risk is transferred. If we have set the critical value of the risk measure low enough so that a modestly risky quota-share will pass (as we must), then 20% of the risk on these extremely risky cash flows will also pass. If so, the cedant will be eligible for reinsurance accounting and will record on its books a 100% cession of the relevant reserves including a 100% elimination of the risk margin, even though in fact 80% of the risk has been retained -- a material accounting inaccuracy. This example is hardly purely hypothetical.

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that the *cedant* may realize a significant *gain* from the transaction."

The example demonstrates that there is no absolute standard of riskiness, no matter how good the risk measure, that can apply equally to all incoming cash flows which themselves contain various degrees of risk.

1.2.2 Re-Pricing the Reinsurance

The author has already presented a first principles case that the relevant risk is the risk in the cedant's financial statements, and that fixed premium amounts are irrelevant to the issue of whether the cedant's risk has been transferred. Risk relates only to uncertainty.

A significant problem with the FAS 113 definition is that the risk analysis in this approach inherently includes an opinion on the appropriateness of the reinsurance pricing. There should be no better measurement of value than the actual price agreed to by a willing buyer and a willing seller in a free market. Furthermore, there may be any number of valid reasons, in volatile and cyclical markets, for a buyer to agree to pay a more conservative price at any given time. Accounting should be concerned with properly recording the actual price paid, not passing judgment on it, and any inherent "re-pricing" of the reinsurance is undesirable.

For example, in the past year, we have seen several cases where risk transfer has been questioned by auditors for straightforward casualty excess-of-loss contracts without adjustable provisions. Assuming that the FAS 113 "safe harbor" does not clearly apply in this case, the auditors were simply diligently applying the provisions of FAS 113. In these cases, the FAS 113 test failed simply because the analyst's risk model implied that the reinsurance was overpriced. Apparently, the consensus of the assuming and ceding companies was otherwise.

1.3 The Percentage of Risk Transfer ("*PRT*") Approach

To define ***PRT's*** between 0% and 100%, we first require a definition of 100% risk transfer. The author presumes that the meaning of 0% risk transfer is self-evident, and no more discussion is necessary.

1.3.1 Defining 100% Risk Transfer: Natural vs. Structural Contract Provisions

Practitioners have a fairly good idea regarding the meaning of 100% risk transfer as well. The safe harbor provision of FAS 113 provides a starting point. Recalling that language, the reinsurer must have "*assumed substantially all of the insurance risk relating to the reinsured portion of the underlying insurance contracts.*" The definition may be adequate, but could be clarified. For example, it should be clear that a traditional per-claim excess-of-loss reinsurance contract is covered, even though the per-claim retentions and limits in the reinsurance contract do not necessarily correspond to provisions in the underlying insurance contract, and might not be considered as defining the "*reinsured portion.*" Yet per-claim retentions and limits are not generally believed to be risk-limiting structures.

To more specifically define 100% risk transfer, we introduce the concept of "natural provisions" of a reinsurance contract. These would be generally defined as provisions that do not limit the losses ceded to the contract in a way that the cedant's own liability, as it relates to premiums and losses that would be ceded to such contract, is not similarly limited. We introduce the term "structural provisions" to refer to provisions that involve risk-limiting or risk sharing. Any reinsurance contract containing only natural provisions would be deemed to contain 100% risk transfer.

The author's suggested list of natural provisions:

- Percentage multipliers (e.g. quota-share, surplus share);
- Deductibles, retentions, limits, on a per claim, per claimant, or per risk or per basis;
- Deductibles, retentions, limits, on a per occurrence basis in some cases;
- Exclusions applied on a policy or coverage basis;
- Deductibles or retentions in the aggregate for all or subsets of the subject losses.

We describe the losses that would be ceded to a contract applying only the natural provisions as being in their "natural form".

Structural provisions are those that limit the ceded losses in ways that the cedant's own liability for such losses is not similarly limited or that create additional cash flows contingent upon the natural form losses. Common provisions of this type include:

- Aggregate limits, applied to the total of natural form losses or sub-limits applying to a subset of the natural form losses;
- Corridors, whether applying to the total natural form losses or a subset;
- Limits on an occurrence basis in some cases;
- Exclusions on a type of claim basis;
- Additional premiums;
- Experience accounts and profit sharing provisions;
- Retrospective rating;
- Sliding scale commissions;
- Limited reinstatements;
- Reinstatement premiums.

Neither list is necessarily exhaustive, and new types of provisions may be developed. Ultimately, the determination of whether a provision is considered natural or structural will have to be made by applying the basic principles. Hopefully, it will usually be a fairly straightforward matter.

Note, for example, that per occurrence limits have been included in both lists. In the context of catastrophe reinsurance, occurrence limits are natural. There is no cession of premiums or losses that implies that a risk has been eliminated when in fact it has not. On the other hand, in the context of quota-share reinsurance, a catastrophe occurrence limit or exclusion is structural. Ceding premiums and losses under the quota-share implies that the risks associated with those premiums and losses are also ceded, and the provision limits the risk that is transferred.

Note that for the most part, aggregate provisions are considered structural. An exception has been suggested for aggregate deductibles or retentions as these are not viewed as risk-limiting.

The reader may notice that the list of structural provisions includes a number of risk-sharing and risk-limiting provisions that are common features of traditional reinsurance. In particular, limited reinstatements and reinstatement premiums are universal in catastrophe reinsurance and common in some other high risk reinsurance; nevertheless, they are technically structural as they limit ceded risk in a way that the cedant's own risk is not limited. However, as commonly practiced, the exhaustion of available reinstatements occurs only at very remote probabilities and reinstatement premiums are not typically a large percentage of ceded losses; therefore, the risk limiting effect of these provisions is not likely to be substantial.

Having now defined 100% risk transfer, we are ready to measure partial risk transfer, for contracts containing structural provisions.

1.3.2 The Applicable Cash Flows

Given that natural provisions are not risk-limiting, the analysis of risk transfer is an analysis of the impact of structural provisions. For ease of expression, we will use the familiar terms "gross", "ceded", and "net", relative to the structural provisions, with all values reflecting the natural provisions.

Let L be a random vector (i.e. a string of values) representing the cash flows for losses subject to a reinsurance contract.

Gross:

Let: $g(L)$ = the net present value of the losses that would be ceded to that contract applying only natural provisions, gross of structural provisions.

For convenience, we have combined the processes of applying the natural provisions and taking the net present value into a single function.

Ceded:

Let: $c(L)$ = the net present value of the cash flows ceded to the contract, applying all provisions, both natural and structural.

The ceded cash flows may include premium refunds or other favorable cash flows not accounted for as ceded losses, e.g. favorable commission adjustments (for compactness, we will refer to all such adjustments as refunds). For certain calculations we require these to be separately identified. Therefore, we define $c_r(L)$ as the net present value of refunds, and $c_o(L) = c(L) - c_r(L)$ as the net present value of other ceded cash flows, i.e. loss recoveries less unfavorable adjustments.

Net:

Let: $n(L) = g(L) - c(L)$ = the net present value of the net cash flows to the cedant arising from natural losses, i.e. the net cash flows due to structural provisions.[5]

Also, let $n_o(L) = g(L) - c_o(L)$, and $n_r(L) = -c_r(L)$. As for the ceded, we have separately identified the net cash flows arising from refunds.

FAS 113 requires that all cash flows, no matter how characterized, be included in the analysis. In the above, all such cash flows would be included in $c(L)$, and consequently in $n(L)$. That approach can be used here as well; however, fixed cash flows will have no impact. Only contingent cash flows, i.e. cash flows that can vary based on the value of L, are essential.

1.3.3 The Risk Model

[5] Sign convention: Ceded losses under $g(L)$ and $c(L)$ have positive values reflecting positive cash flows to the cedant. Positive values of $n(L)$ are unfavorable, reflecting decreased cash flows to the cedant due to the structural provisions. For example, if the structural provision is a loss limitation, then $c(L)$ will sometimes be smaller than $g(L)$. The resulting positive value of $n(L)$ indicates an unfavorable cash flow effect. If the structural provision is a premium refund, then $c(L)$ may sometimes exceed $g(L)$. The resulting negative value of $n(L)$ indicates a favorable cash flow effect.

As with FAS 113, we require a risk model giving the probability distribution of L and the resulting probability distributions of $g(L)$, $c(L)$, and $n(L)$.

Given the book of business that the insurer expects to write and intends to cede, and the reinsurer intends to reinsure, the goal of the risk model is to reflect all of the uncertainty in L, including the uncertainty in both the amount and timing of the payments.

Risk is often sub-divided into "process" and "parameter" risk.

Process Risk: Given that L is the result of a random process, the process risk refers to the risk arising from the randomness of that process. Typically, the random process will be described by a mathematical model which allows the analyst to calculate (often by simulation) the effects of the random process.

Parameter Risk: The remaining risk relates to the uncertainty about the model of the random process. The term "parameter risk" is often used to broadly describe this remaining risk. More generally, the risk relates to the uncertainty in both the parameters and the form of the risk model. For example, if the total of the payments in L is modeled as a lognormal distribution with a certain mean and variance, there will be uncertainty as to whether the parameters (i.e. mean and variance) are correct as well as whether the lognormal is the correct form for the distribution. The portion of the risk model relating to uncertainty in payment timing may be more complex and more uncertain in its parameters and form.

Underlying types of risk that contribute to parameter risk may include:

- Data Risks: The amount, stability, and applicability of available data.
- Market Risks: Uncertain market impact on pricing, underwriting, risk selection.
- Economic Risks: The impact of uncertain future inflation, employment, etc.

Actual risk model structures and estimation are beyond the scope of this paper.

An important exception is that it would be inappropriate to include the risk that the company will write a different from expected book of business, e.g., a different mix of classes, coverages, policy limits, etc. This is not a risk that reinsurance is necessarily expected to absorb. Reinsurers may include provisions, some of which may be structural in form, to protect them against the cedant altering its book of business. For example, a sub-limit on a hazardous class of business may be set at a level that is remote relative to the intended book, but would be significantly risk-limiting if that class were to grow dramatically. The impact of the provision is appropriately measured against the intended book only.

1.3.4 Adverse Deviation from Accounting Values

Adverse deviation is defined relative to the financial statements. Typically, financial statement values correspond to a single loss scenario. Accordingly, we define adverse deviation relative to a base cash flow scenario, corresponding to the expected losses or the underwriting breakeven losses, whichever is higher. Let a be the vector representing the base cash flow stream.

Base Values:

Gross: Define the base value for $g(L)$ as $b_g = g(a)$. Frequently $b_g = \mathbf{E}[g(L)]$, but not necessarily in all cases.

Net: Define the base value for $n(L)$ as $b_n = n_o(a)$ ***minus the carried asset for refunds*** under cash flow scenario a (assuming reinsurance accounting). Note that an asset has a negative sign relative to net losses. Here we are using the distinction between cash flows related to refunds (n_r) and other cash flows (n_o). The distinction is necessary since the carried asset for refunds is frequently less than $n_r(a)$ – see example 2 below. If $n_r(a)$ were included in the base, it would result in an adverse deviation whenever the refund was less than its expected value, even if no asset were carried for the refund.

Note that b_n will often be neither $n(a)$ nor $\mathbf{E}[n(L)]$, and may frequently be zero. Two examples for illustration:

1. The structural feature is an aggregate limit larger than $\sum a$. $n(L)$ is zero for $\sum L \leq$ the limit, and positive for $\sum L >$ the limit. $\mathbf{E}[n(L)]$ is therefore positive, but at scenario a, there are no net losses. $n_o(a)$ is zero, and thus $b_n = 0$.
2. The structural feature is a premium refund based on an experience account that accrues interest. At scenario a, a refund would be due, given accrual of interest, meaning that $n_r(a)$ would be negative. Further assume that no refund would be due at scenario a if accrual of interest were ignored. Under these circumstances, normally no asset is carried for the premium refund, and therefore $b_n = n_o(a)$ □ $n(a)$.

Adverse Deviation:

The adverse deviations for $g(L)$, $n(L)$, and $c(L)$ are defined as:

$d_g = g(L) - b_g$, if positive, and zero otherwise;

$d_n = n(L) - b_n$, if positive, and zero otherwise; and

$d_c = d_g - d_n$.

Negative values are eliminated for d_g to reflect the basic principal that risk is defined by adverse results only. A negative value for d_n indicates that the effect of structural provisions is more favorable than is reflected in the accounting values (typically a premium refund larger than the asset – if any – carried for it), which does not increase the cedant's downside risk. Negative values for d_n are eliminated so that favorable effects of structural provisions cannot decrease the risk transfer measure.

Note that:

$$g(L) = n(L) + c(L); \text{ and}$$
$$d_g = d_n + d_c.$$

Note also that if fixed cash flows have been included in $c(L)$ and therefore in $n(L)$, they will be identical in the base values and all other values and will not affect the adverse deviations.
In keeping with previously stated principles, these adverse deviations represent the relevant risk we intend to measure.

1.3.5 Risk Measures and Co-Measures I

Given a random variable, X, a risk measure, $r(X)$ is a function applied to the distribution of X that returns a single value.

Next assume that X is itself the sum of a number of random variables, i.e.:

$$X = \sum X_i.$$

For a broad class of risk measures, there are corresponding "co-measures" that can be applied to the sub-variables X_i.[6] The most common example of a risk measure and co-measure is variance and covariance. Co-measures provide a mathematically sound basis for allocating risk among sub-variables that may be dependant.

For risk measure $r(X)$, denote the corresponding co-measure applied to the sub-variable X_i as $r_i(X_i)$. The essential property of co-measures is additivity, i.e.:

$$r(X) = \sum r_i(X_i),$$

regardless of the nature of any dependencies among the X_i's.

[6] See Kreps [7].

In our specific case, $r(d_g) = r_n(d_n) + r_c(d_c)$. Thus, co-measures provide a basis for allocating the risk in the losses gross of structural provisions to the net and ceded losses after the application of structural provisions.

Another useful property of co-measures is that, for any constant k,

$$\text{if } X_i = kX, \quad \text{then} \quad r_i(X_i)/r(X) = k.$$

Thus, a co-measure applied to an x% quota-share is x% of the risk measure applied to a 100% share.

A more complete definition of co-measures along with examples of actual risk measures and co-measures follows the next section.

1.3.6 The Percentage of Risk Transferred ("*PRT*")

Simply stated, the *PRT* is the portion of the risk associated with the natural losses, gross of the structural provisions, which is still ceded after the application of the structural provisions. Specifically:

Let r be a risk measure with corresponding co-measure.

The percentage of risk transferred is then defined as:

$$PRT = 1.0 - \frac{r_n(d_n)}{r(d_g)}$$

or equivalently,

$$PRT = \frac{r_c(d_c)}{r(d_g)}$$

With PRT defined, adequate risk transfer to qualify as reinsurance would be defined as a value of PRT in excess of a selected critical value. A natural choice for the critical value may be 50%, as previously discussed.

1.3.7 Some Advantages of the *PRT* Approach

1. Risk transfer is reduced to a simple single number with an intuitive meaning.

2. Safe harbors for obvious risk transfer contracts are an integral part of the risk transfer definition, rather than exceptions.

3. The approach is equally valid regardless of the relative riskiness of the subject losses.

4. The approach is unaffected by profit margins and expenses. The approach avoids the second-guessing of the reinsurance pricing that is implicit in the FAS 113 definition.

1.4 Risk Measures and Co-Measures II

1.4.1 Definitions and Examples:

Define a risk measure r applied to a random variable X as:

$$r(X) = \mathbf{E}[\, w(X) \cdot l(X) \mid Condition\,(X)\,],$$

where l is a linear function and w is a weighting function. Note that the weights, w, may be a function of X and are unrestricted as to form. The condition may also be functionally dependant on X.

For a sub-variable X_i, the corresponding co-measure is:

$$r_i(X_i) = \mathrm{E}[\, w(X) \cdot l(X_i) \,|\, Condition\,(X)\,].$$ [7]

Note that the weights and the condition depend only on X, not X_i, and are identical to the weights and condition in $r(X)$.

As an example, consider variance:

$$Variance(X) = \mathrm{E}[(X - \mathrm{E}(X))^2] = \mathrm{E}[(X - \mathrm{E}(X)) \cdot (X - \mathrm{E}(X))]$$

In this form, the first occurrence of $(X - \mathrm{E}(X))$ can be considered the weight and the second occurrence the linear function. There is no condition.

Next, consider covariance:

$$Covariance(X_i,X) = Variance_i(X_i) = \mathrm{E}[(X - \mathrm{E}(X)) \cdot (X_i - \mathrm{E}(X_i))]$$

Note that the weight is dependant only on X and is identical to the weight used in variance, and the linear function is applied to X_i. Thus, covariance satisfies the definition of a co-measure relative to variance.

By adding a condition, we define the semi-variance:

[7] This is one formulation consistent with the framework presented in [7]. The separate condition is convenient for our use, but could have been subsumed in the weights.

$$\textit{Semi-variance}(X) = \mathrm{E}[\, (X - \mathrm{E}(X))^2 \mid (X > \mathrm{E}(X) \,],$$

with the average restricted to the values greater than the mean. The corresponding co-measure is:

$$\textit{Semi-variance}_i(X_i) = \mathrm{E}[\, (X - \mathrm{E}(X)) \cdot (X_i - \mathrm{E}(X_i)) \mid (X > \mathrm{E}(X) \,]$$

Again, the condition is based on X, not X_i.

1.4.2 Measures and Co-Measures Applied

We next consider actual applications, applied to the problem at hand.

Mean Square Adverse Deviation ("MSAD")

Define:

$$MSAD(d_g) = \mathrm{E}[\, d_g^2 \mid d_g > 0 \,].$$

Recall that $d_g = g(L) - b_g$ for positive values. Often, $b_g = \mathrm{E}[g(L)]$, in which case,

$$MSAD(d_g) = \textit{Semi-variance}(g(L)).$$

The corresponding co-measure applied to d_n is:

$$MSAD_n\,(d_n) = \mathrm{E}[\, d_n \cdot d_g \mid d_g > 0 \,]$$

The condition is again based on d_g rather than d_n. Therefore, the average may (and often will) include values of $d_n = 0$.

Expected Adverse Deviation ("EAD")

Eliminating the quadratic weight from ***MSAD*** leaves us with the simpler Expected Adverse Deviation:

$$EAD(d_g) = \mathrm{E}[\, d_g \mid d_g > 0\,],$$

with the corresponding co-measure:

$$EAD_n(d_n) = \mathrm{E}[\, d_n \mid d_g > 0\,].$$

Tail Value at Risk ("TVaR")

TVaR is a popular risk measure for capital adequacy. It is similar to ***EAD***, except the borderline condition is a percentile of the distribution. Normally, relatively high percentiles are used, reflecting a belief that the most significant risk is exposure to extreme events.

Define ***VaR-p*** (d_g), the "Value at Risk," as the p^{th} percentile of the distribution of d_g. Then,

$$TVaR\text{-}p(d_g) = \mathrm{E}[\, d_g \mid d_g > VaR\text{-}p(d_g)\,]$$

with the corresponding co-measure:

$$TVaR\text{-}p_n(d_n) = \mathrm{E}[\, d_n \mid d_g > VaR\text{-}p(d_g)\,]$$

Of the above three choices, the author's preference is for ***MSAD***.

TVaR and other tail-oriented measures are often used for measuring capital needs. In the context of measuring risk transfer, the measures have several drawbacks. One is that the selected percentile is arbitrary, which may not be desirable for a single measure to be widely applied. Another is that these measures, when used with relatively high percentiles, are responsive only to a small portion of the distribution, and many structural risk-limiting provisions may be ignored.

EAD is at the other end of the spectrum, considering the entire downside of the distribution without any greater weight to values in the tail. Most models for pricing risk assume that more extreme values have greater impact.

MSAD, like ***EAD***, includes the entire downside of the distribution, and will therefore be responsive to any risk limiting provisions. ***MSAD*** is quadratically weighted, so that values toward the tail of the distribution have more impact. It is a relatively conventional risk measure, closely related to semi-variance, with the difference that deviations are measured from an accounting value which may differ from the mean.

Some practitioners believe that the quadratic weighting of ***MSAD*** does not give sufficient weight to the tail. The structure of co-measures can accommodate more complex weighting schemes, including tail-heavier weights, as well as risk loading methods based on transformations of the probability distribution. The VFIC paper [5] discusses two such transforms, the Wang Transform [8], and an Exponential Transform [9]. While such transforms are normally applied to the entire distribution, they could applied as measures and co-measures to the distributions of d_g and d_n to develop corresponding ***PRT***'s.

1.5 Examples Comparing Risk Transfer Measures: *PRT* vs. "Absolute" Risk Measures

The following examples use four measures to evaluate risk transfer: ***PRT*** and three different "absolute" risk measures. The absolute measures in this case refer to risk measures applied to the distribution of reinsurer's profit, as defined by FAS 113. They are described as absolute measures since they apply to the riskiness of a single distribution, as contrasted with ***PRT*** which is based on a comparison of riskiness in "before" and "after" distributions. The measures are applied to four different illustrative models of underlying subject losses with different degrees of volatility, and up to five different reinsurance contract structures. All measures are based on 10,000 simulations.

1.5.1 The Risk Transfer Measures

In all cases below, the reinsurer's result is calculated according to the FAS 113 rules, i.e., the net present value of all cash flows to the reinsurer, however characterized, but without deducting transaction costs and without allowance for the reinsurer's internal expenses. All present values are at 4%. We will characterize a net loss to the reinsurer as a negative result.

1. **VaR-90**: The reinsurer's result as a percentage of ceded premium at the 90th percentile (adverse) of the distribution (given the above sign convention, this is actually the 10th percentile). Applying a critical value of -10% yields the "10/10" rule.

2. **TVaR-90**: The expected value of the reinsurer's result as a percentage of ceded premium, given reinsurer's result less than VaR-90. There is no standard critical value. 10% of the ceded premium has been suggested as a "more correct" 10/10 rule; however this is invariably less strict than the 10/10 rule. The VFIC paper suggests -25%, though this seems unusually high.[8] A range of -10% to -15% appears more in line with other measures.

3. **Expected Reinsurer's Deficit ("ERD")**: The expected value of the reinsurer's result as a percentage of ceded premium, given a reinsurer's result less than zero, multiplied by the probability that the reinsurer's losses are greater than zero. Equivalently:

$$ERD = \int_{x<0} xf(x)dx \Big/ NPV(Cededpremium)$$

[8] The VFIC paper calculates a TVaR-90 of 42% for a quota-share with 10% volatility, similar to one of the examples used herein. However, that quota-share may be under priced. A graph appears to indicate that the reinsurer's median discounted profit is zero, meaning that the reinsurer's mean profit will be less than zero, even before consideration of transaction costs or the reinsurer's internal expenses. This illustrates the difficulties with using risk transfer measures sensitive to the reinsurance pricing.

Again, there is no standard critical value. In subsequent discussion we will use a range of -1.0% to -2.0%.

4. ***PRT***, using ***MSAD*** as the risk measure.

1.5.2 The Subject Business Models

M1: Low volatility, short payment pattern.

M2: Modest volatility, modest payment pattern.

M3: Higher volatility, longer payment pattern (e.g., primary casualty).

M4: High risk, long payment pattern (e.g., excess casualty).

Table 1 summarizes the assumptions for the various models:

Table 1
Summary of Subject Business Models

		Model			
		M1	M2	M3	M4
Premium		$100	$100	$100	$100
Expenses		$30	$30	$30	$30
Expected Losses		$68	$69	$73	$83
CV		5%	10%	20%	40%
Underwriting Profit		2.0%	1.0%	-3.0%	-13.0%
Profit Including Discount		3.6%	4.3%	6.0%	11.3%
Payout	1	90%	50%	20%	1%
	2	10%	30%	20%	3%
	3		15%	10%	5%
	4		5%	10%	7%
	5			10%	7%
	6			10%	7%
	7			8%	7%
	8			6%	7%
	9			4%	7%
	10			2%	6%
	11				6%
	12				6%
	13				6%
	14				5%
	15				5%
	16				5%
	17				4%
	18				3%
	19				2%
	20				1%

In all cases, the aggregate loss distribution is presumed to be lognormal. Payment patterns are at fixed percentages for all scenarios.

The assumptions are illustrative, not based on any specific source. In the author's opinion, none of the subject business is assumed to be unusually profitable.

1.5.3 The Reinsurance Contracts

Quota-Share Contracts:

C1: With aggregate limit 35% over expected losses.

C2: With aggregate limit 10% over expected losses.

C3: With "corridor" (losses not covered) from 5% to 15% over expected losses and aggregate limit 35% over expected losses.

Table 2
Quota-Share Contracts

		Model			
Contract		**M1**	**M2**	**M3**	**M4**
C1	**Ceded Premium**	**$100**	**$100**	**$100**	**$97**
	Ceding Commission	**30%**	**30%**	**30%**	**30%**
	Loss Ratio at Limit	**103%**	**104%**	**108%**	**118%**
C2	**Ceded Premium**	**$100**	**$100**	**$97**	**$92**
	Ceding Commission	**30%**	**30%**	**30%**	**30%**
	Loss Ratio at Limit	**78%**	**79%**	**83%**	**93%**
C3	**Ceded Premium**	**$100**	**$99**	**$97**	**$94**
	Ceding Commission	**30%**	**30%**	**30%**	**30%**
	Loss Ratio at Limit	**103%**	**104%**	**108%**	**118%**
	Loss Ratio at Corridor Bottom	**73%**	**74%**	**78%**	**88%**
	Loss Ratio at Corridor Top	**83%**	**84%**	**88%**	**98%**

Note that the ceding commission rate has been set equal to the expense ratio on the subject business. Ceded premiums have been reduced from $100 proportional to the reduction in expected losses from limits and corridors.

Structured Aggregate Excess of Loss Contracts:

C4: Aggregate retention and limit;
Attaches within expected losses;
Upfront premium plus additional premiums as a percentage of ceded losses;
Fixed margin is deducted from upfront premium;
Refundable experience account accrues interest at 4%.

C5: Same as C4, plus another layer of additional premiums on subject losses extending beyond the policy limit.

Table 3
Structured Aggregate Excess of Loss Contracts

Contract		Model M3	Model M4
C4	Upfront Premium	$9.00	$5.50
	Margin	$3.00	$4.00
	Retention	63.0%	76.0%
	Loss Ratio at Limit	98.0%	136.0%
	A.P.Rate	59.0%	47.5%
	AP Attachment L/R	73.0%	83.0%
	AP Exhaustion L/R	98.0%	136.0%
C5	2nd A.P.Rate	12.5%	12.5%
	2nd AP Attachment L/R	93.0%	126.0%
	2nd AP Exhaustion L/R	113.0%	146.0%

These contracts have no ceding commission.

1.5.4 Risk Transfer Measures Applied to Subject Business

Before applying the risk transfer measures to the reinsurance contracts, it is interesting to first apply these measures to the subject business to be ceded (excluding ***PRT***, which is not defined in this case):

Table 4
Summary of Risk Transfer Measures
Applied to Subject Business

	Model			
	M1	**M2**	**M3**	**M4**
Loss Probability	14.15%	24.91%	28.97%	25.50%
VaR-90	-0.73%	-4.35%	-10.85%	-19.13%
TVaR-90	-2.46%	-7.98%	-19.54%	-38.73%
ERD	-0.26%	-1.09%	-2.85%	-5.13%

The difficulties with the absolute risk transfer measures can be anticipated. All measures produce values well below any likely threshold for M1. 10% volatility without unusual profitability seems like a level of risk that should "pass", but the 10/10 rule and **TVaR-90** fail for M2 as well, while the **ERD** passes only marginally at the low end of the range.

1.5.5 Risk Transfer Measures Applied to Quota-Share Contracts

We next apply the various measures to the three quota-share reinsurance contracts.

Table 5
Summary of Risk Transfer Measures
Quota-Share Contracts

Contract		Model M1	M2	M3	M4
C1	Loss Probability	13.83%	24.78%	29.27%	29.19%
	PRT-MSAD	100.00%	100.00%	94.85%	63.86%
	VaR-90	-0.71%	-4.17%	-10.88%	-17.77%
	TVaR-90	-2.43%	-7.94%	-17.78%	-21.60%
	ERD	-0.26%	-1.06%	-2.65%	-3.82%
C2	Loss Probability	13.83%	24.78%	34.86%	34.27%
	PRT-MSAD	98.98%	78.65%	51.44%	31.72%
	VaR-90	-0.70%	-4.35%	-6.49%	-7.24%
	TVaR-90	-2.33%	-5.40%	-7.48%	-9.95%
	ERD	-0.25%	-0.83%	-1.77%	-1.91%
C3	Loss Probability	13.83%	27.69%	34.86%	25.12%
	PRT-MSAD	67.99%	52.21%	62.16%	48.82%
	VaR-90	-0.68%	-1.53%	-5.65%	-14.22%
	TVaR-90	-1.26%	-2.38%	-12.60%	-17.72%
	ERD	-0.14%	-0.43%	-1.66%	-2.88%

The contract C1 aggregate limit 35% over the mean has no discernable impact when applied to the lower volatility M1 and M2 models. As the volatility increases with M3 and M4, the risk limiting impact of the aggregate limit increases. This effect can be seen as the percentage of risk transferred decreases to 95% for M3 and down to 64% for the volatile M4 model.

The C1 contract applied to M1 fails the risk transfer test for all of the absolute risk measures, even though substantially all the risk is transferred. For M2, most still fail or marginally pass. As the underlying business gets riskier in the M3 and M4 models, results on these risk transfer tests improve significantly, even as the aggregate limit becomes less remote and has more risk limiting impact. The tests based on absolute risk measures are more sensitive to the level of risk in the underlying business than to the degree of risk transfer.

The same pattern persists as we move to more significant risk limiting features. In each case, the risk limiting impact of the features becomes more significant when applied to the higher volatility cash flows, as is reflected in the declining *PRT*. In each case, the absolute risk measures increase due to the increased underlying risk, even though a smaller percentage of that risk is being transferred.

1.5.6 Risk Transfer Measures Applied to Structured Aggregate Excess Contracts

Next, consider the application of the highly structured reinsurance contracts C4 and C5 to the riskier cash flows of models M3 and M4.

Summary of Risk Transfer Measures
Structured Aggregate Excess Contracts

Contract		Model M3	Model M4
C4	Loss Probability	24.80%	21.16%
	PRT-MSAD	22.89%	18.35%
	VaR-90	-10.51%	-10.91%
	TVaR-90	-15.76%	-21.00%
	ERD	-2.53%	-3.09%
C5	Loss Probability	24.80%	21.16%
	PRT-MSAD	19.36%	13.19%
	VaR-90	-10.74%	-10.73%
	TVaR-90	-11.56%	-11.91%
	ERD	-2.17%	-1.94%

While risk transfer measures based on absolute risk levels may often "fail" a contract which transfers nearly all the risk when it is applied to relatively stable business, the effect is just the opposite when applied to higher volatility business. In these cases, contracts with features that eliminate most of the risk can still pass.

In the case of C4, only 23% and 18% of the risk is transferred for M3 and M4, respectively. Yet the 10/10 test is a marginal pass and the other tests would also appear to pass at likely critical values.

Even though less than 25% of the risk is transferred, the C4 contracts are fairly risky for the reinsurer, especially relative to their small margins. The accounting distortion is that the losses accounted for as ceded are oversized relative to the risk absorbed by the reinsurer.

The C4 contract leaves the reinsurer with substantial tail risk, which is addressed in C5. Another layer of additional premium attaches just above the 90th percentile and extends beyond the policy limit, protecting the reinsurer from the acceleration risk caused by worsening loss ratios beyond the policy limit. The technique succeeds in further risk reduction, now bringing the ***PRT***'s to 19% and 13%. Yet the 10/10 rule is unaffected (as intended in the design of the feature). The more sophisticated **TVaR** and **ERD** tests respond to the additional risk reduction, with the more tail-oriented **TVaR** showing the greater effect. Despite the additional risk limitations, the **ERD** still produces a passing score and the **TVaR** may as well, depending on choice of critical value.

1.5.7 Conclusion

In conclusion, the ***PRT*** test appears to logically and consistently identify the impact of structural features that limit risk transfer. The measures based on absolute standards invariably underestimate risk transfer for more stable subject business and overestimate risk transfer for more volatile subject business.

1.6 Examples Using *PRT* with Various Risk Measures and Co-Measures

The following tables present the results of *PRT*, applied to the same models and contracts as the previous section, with one exception. We have removed the aggregate limit from the 3rd contract (the corridor). We use the following risk measures (with their corresponding co-measures):

- *MSAD*
- *EAD*
- *TVaR-90*
- *TVaR-95*
- *TVaR-98*

The results are presented without a great deal of additional comment. With each risk measure, the pattern of *PRT*'s as the risk models and contracts change conform to a reasonable pattern of decreasing risk transfer as the risk-limiting provisions become more significant.

The results are not identical, however. The measures respond to the "heart" and the "tail" of the distribution to different degrees, consistent with their design.

Table 7 PRT's -- Comparison of Risk Measures Quota-Share Contracts		Model			
Contract		M1	M2	M3	M4
C1	MSAD	100.00%	100.00%	94.85%	63.86%
	EAD	100.00%	100.00%	97.92%	78.14%
	TVaR-90	100.00%	100.00%	95.84%	61.56%
	TVaR95	100.00%	100.00%	93.13%	52.25%
	TVaR98	100.00%	100.00%	85.94%	43.72%
C2	MSAD	98.98%	78.65%	51.44%	31.72%
	EAD	99.63%	87.82%	64.46%	43.90%
	TVaR-90	99.47%	76.45%	44.00%	29.53%
	TVaR95	99.16%	64.80%	38.16%	25.37%
	TVaR98	98.31%	54.41%	32.65%	21.27%
C3	MSAD	67.51%	40.25%	61.89%	83.62%
	EAD	79.97%	46.61%	55.05%	71.67%
	TVaR-90	71.55%	34.37%	64.16%	84.14%
	TVaR95	58.01%	34.00%	70.58%	87.42%
	TVaR98	46.51%	41.60%	75.93%	90.01%

Table 8 PRT's -- Comparison of Risk Measures Structured Aggregate Excess Contracts			
		Model	
Contract		**M3**	**M4**
C4	**MSAD**	22.89%	18.35%
	EAD	23.84%	17.93%
	TVaR-90	23.23%	19.27%
	TVaR95	21.76%	18.85%
	TVaR98	19.53%	17.50%
C5	**MSAD**	19.36%	13.19%
	EAD	21.71%	14.52%
	TVaR-90	18.97%	13.31%
	TVaR95	15.85%	11.35%
	TVaR98	12.82%	10.41%

Some observations:

- In most cases ***MSAD*** produces results similar to ***TVaR-90***.
- Aggregate limits affect only the tail of the distribution, and are most penalized by the more tail-oriented ***TVaR*** measures, for example the low aggregate limit of the C2 contract applied to the moderately high risk M3 model.
- The combination of low corridor and no limit (C3), when applied to high risk models M3 and M4, decreases risk more in the heart of the distribution than the tail. In this case, the least tail-oriented measure, ***EAD***, indicates the greatest reduction in risk transfer.
- The first highly structured contract, C4, dramatically reduces risk in the heart and the tail of the distribution and all measures are similar.
- The second highly structured contract, C5, has an additional feature that mitigates the tail risk. Especially for risk model M4, risk transfer is significantly lowered. The effect of the tail-protecting feature is the smallest for the EAD and the largest for the more tail-oriented measures.

In conclusion, ***PRT*** is demonstrated to work acceptably well with a variety of risk measures. Assuming that it is desirable to have a single measure to be used universally, the author's preference continues to be for ***MSAD***, which works consistently and appears to strike the best compromise between responsiveness to the whole downside of the distribution and emphasis on the significance of the tail.

Section II – Accounting for Partial Risk Transfer Reinsurance

2.1 The Case for Continuous Accounting

The problem addressed so far is to find the best possible solution given the significant accounting constraint that there are two types of accounting available – one that is appropriate for 100% risk transfer and another for 0% risk transfer – and that our only option is to choose one or the other. The difference between these approaches can sometimes be very large – and for large enough contracts it can be material to the company's financial statements.

If the difference between the two accounting treatments is material, then it is likely that half that difference is material as well. Regardless of which accounting treatment is used, the accounting for a contract with 50% risk transfer will be materially inaccurate, one way or another. The author's suggestion of a critical value of 50% to define adequate risk transfer is simply to cut the worst case inaccuracy to the lowest possible number.

Using the 50% critical value, there could continue to be motivation to design 51% risk transfer contracts to take advantage of the 100% risk transfer accounting. 49% risk transfer contracts are no less problematic. The cedant may get no credit in its financial statements or solvency tests for a significant reduction in risk. And a reinsurer that assumes a 49% risk transfer contract that is ineligible for reinsurance accounting will be assuming significant risk while its financial statements reflect that it has assumed none.[9]

Another significant problem is the point of discontinuity itself. If the difference in accounting treatment has a large impact, and the estimated PRT is close to the critical value, then a large material difference will turn on a decision requiring a precision of estimation that simply doesn't exist.

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[9] This last point illustrates that there is no such thing as a "safe", "conservative" choice for a critical value. Whenever deposit accounting is conservative for the cedant, it is aggressive for the reinsurer.

Thus, the binary choice between reinsurance accounting and deposit accounting may not be an adequate solution. A continuous solution would provide more appropriate accounting for partial risk transfer contracts. The availability of ***PRT*** can provide a basis for such a continuous accounting solution.

2.2 Goals of Partial Risk Transfer Accounting

The author has considered the following two goals of appropriate accounting for partial risk transfer:

- Income statements and balance sheets that are undistorted in total, i.e., accurate total income and equity; and
- Proper characterization of ceded premiums and ceded losses.

2.3 Bifurcation to Achieve Continuous Accounting

2.3.1 Proportional Bifurcation

The simplest approach, which would require no new development of basic accounting rules, is to apply a weighted average of the two accounting procedures already available, i.e. proportional bifurcation. The approach would be to simply divide all 100% values proportional to ***PRT*** and ***1-PRT***, with the amounts proportional to ***PRT*** accounted for as reinsurance and the amounts proportional to ***1-PRT*** accounted for using deposit accounting. For the deposit accounting, the "interest method," which corresponds best to zero risk transfer, would be most appropriate.

The First Objective -- Income and Equity:

As discussed much earlier, the income and equity effects of reinsurance are gains related to the cession of losses and costs related to the reinsurer's margin. Since there are no gains from ceding losses under deposit accounting, under proportional bifurcation using PRT, the initial gain from ceding losses would be reduced proportional to the reduction in risk transfer, exactly as intended. As for the cost of the reinsurer's margin, this is expensed up front under reinsurance accounting but implicitly expensed over the life of the cash flows under deposit accounting. Thus proportional bifurcation will cause a deferral of a portion of this cost. This is not necessarily our intent, and could be remedied with a slightly more complex solution. However, to the extent that this is considered an imperfection, it is not a serious one, and may not warrant the additional complexity.

The Second Objective -- Losses and Premiums:

Net losses under proportional bifurcation will be in proportion to the percentage of the risk retained, exactly as intended.

Net premiums resulting from the proportional subdivision of premiums will not be perfectly reflective of net underwriting risk retained, so the second objective will not be perfectly satisfied for net and ceded premium.

Two imperfections related to the proportional subdivision of premium: The first imperfection is that the reinsurer's margin would be expected to be reduced if the risk is reduced. It would probably be preferable to allocate the margin entirely to reinsurance accounting, rather than sub-divided. The second imperfection, related to over-funding, is in the opposite direction. As will be discussed in a subsequent section, income, equity, and ceded losses are not distorted by over-funding. However, if the reinsurance is over-funded with a refund provision, then the premium allocated to reinsurance accounting will be overstated to some degree.

In the author's view, none of the imperfections noted is likely to be significant, and simple proportional bifurcation will provide a major improvement in accounting accuracy compared with current practice. A modestly more complex solution can be devised for the income issue and the first premium issue discussed above, although the second premium issue is more difficult. In any case none of the imperfections are likely to be large enough to warrant the additional complexity.

2.3.2 What Contracts Should Be Bifurcated?

Bifurcation would increase accounting workloads and complexity and it makes sense to limit its application. Many reinsurance contracts have structural features that have modest risk-limiting effects. At the other extreme, there may be some contracts determined to have minimal risk transfer. In order to avoid unnecessary bifurcation, the author suggests that contracts with $PRT > 80\%$ or $PRT < 20\%$ be accounted for with reinsurance accounting or deposit accounting, respectively, with bifurcation limited to $20\% < PRT < 80\%$.

Such a threshold would also reduce the need for unnecessary testing. It will be fairly obvious in some cases that structural provisions will not reduce risk transfer by more than the threshold value, and minimal testing may be required.

2.3.3 Should Risk Transfer Be Reevaluated?

If PRT were to become an explicit factor in reinsurance accounting, the PRT would presumably be evaluated at the inception of the reinsurance contract and that value would become fixed for accounting purposes at the inception of the contract. The issue of possible reevaluation of the PRT would not be retrospective from inception, but only prospectively relating to remaining loss reserves. To the extent the PRT changed, that change would affect only the remaining loss reserves, not any previously accounted for amounts, such as premiums or loss payments.

In the author's view, this idea is cumbersome and impractical and would appear to be an idea to be avoided. However, the discussion is included for the theoretical completion of the concept.

The amount of remaining risk transferred for ceded loss reserves will change as the contract progresses over time. The change in the remaining risk transferred can be illustrated with a simple aggregate limit example. Suppose that an aggregate limit set above the expected loss ratio is originally estimated to have a 40% risk-limiting effect (i.e. 60% ***PRT***). Two years later, the ultimate losses are known with much more accuracy and have developed below the original expected losses. The aggregate limit now appears quite remote and 95% of the remaining risk is transferred. Or conversely, losses have developed much worse than the original expected losses and ultimate losses are now estimated to be at the aggregate limit, leaving no more coverage available. To the extent that there are still ceded reserves, almost none of the risk related to the remaining reserves is transferred. While these situations may be realistic, it would be hard to imagine that the increase in accounting accuracy would warrant reevaluating risk transfer on all contracts.

But perhaps it should be considered in a few special cases. An obvious candidate is a multi-line contract combining long and short tail business. For example, assume that such a contract, mixing property and casualty but not readily bifurcated in the more traditional sense, is estimated at its inception to transfer 50% of the risk and is accounted for with a 50% proportional bifurcation. Let us further assume that almost all the risk comes from exposure to property catastrophes, and that at the end of the year there has been no such catastrophe. There may be a significant cession of casualty reserves at a discount, but little or no risk transfer remaining. Conversely, if property catastrophe losses have occurred, a much larger degree of risk may be ceded on the remaining casualty reserves.

2.4 Comments on Related Topics

2.4.1 Over-Funding

A common technique for reducing risk to the reinsurer is over-funding, i.e., charging a conservative premium with refund provisions. The refund may be based on an "experience account" which includes interest credited on ceded funds. This technique may allow a reinsurer and cedant to come to terms without resolving differences of opinion on likely losses, or may simply be used to lower the risk premium charged.

Over-funding may be accomplished by charging a large upfront premium, through a contingent additional premium feature, or a combination of the two. To the extent that contingent additional premiums are charged, the outgoing cash flows will be included in the calculation of ***PRT*** and the value of ***PRT*** will be reduced.

To the extent that over-funding is accomplished through an increase in upfront premiums, it will probably have no effect on ***PRT***, as only downside risks are measured, and premium refunds usually have no impact. This may appear counterintuitive, as over-funding clearly reduces the risk to the reinsurer.

Nevertheless, contingent refunds cannot cause a future loss for the cedant. To the extent that the risk related to ceded losses is covered by the reinsurance, it is appropriate to cede the losses and their associated risk margin, i.e. to apply reinsurance accounting. Whether the risk related to the ceded losses is covered from funds provided by the cedant or risk taken by the reinsurer is immaterial. As long as the cedant has expensed the premiums ceded, there is no increased risk of inadequacy in the financial statement values.

Under current accounting, the cedant records an asset for future refunds only to the extent that the current ceded loss estimate indicates that a refund will be due *without including future investment income credited to an experience account.* This asset, when applicable, prevents over-funding from causing a deferral of income. The exclusion of future investment income is also necessary – including it in the calculation of the asset would have a similar effect to discounting the loss reserve while retaining the risk.

In conclusion, premium refunds are not important when determining ***PRT*** since they do not affect downside risk. When reinsurance accounting is applied to reinsurance that includes over-funding, the net effects on balance sheets, income statements, and ceded losses are not significantly distorted.[10]

2.4.2 Underwriting Risk and Timing Risk

Both GAAP and SAP require the separate consideration of whether underwriting and timing risk have been transferred, as well as whether the overall degree of risk transfer is adequate. The approach herein is focused only on the overall risk. In the author's view, the distinction between underwriting and timing risk is often artificial. If a continuous approach to risk transfer accounting were adopted so that the degree of risk transfer were specifically reflected, perhaps the distinctions between underwriting and timing risk would be unnecessary.

2.4.3 Accounting for Retroactive Reinsurance

There are substantial restrictions in GAAP and Statutory accounting when the liabilities ceded are related to losses incurred in the past, e.g., loss portfolio transfers ("LPT's"). In fact, GAAP essentially applies deposit accounting to all retroactive reinsurance, as if no risk transfer is possible. This punitive accounting undoubtedly has its historical roots in past abuses, but otherwise appears to have no sound basis.

LPT's are often legitimate risk transfer motivated reinsurance contracts. There are any number of valid motivations, such as moving risky liabilities to better diversified and capitalized companies. LPT's are still done despite punitive accounting. But it would be hard to imagine that the accounting is not suppressing the market for legitimate retroactive reinsurance.

As we have demonstrated in the examples, FAS 113 is not effective in preventing financial engineering for prospective reinsurance, nor would it be effective for retroactive reinsurance if the present restrictions were eliminated. The improved accounting recommended herein would

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[10] Overall equity and income will be undistorted, as will ceded losses and loss reserves. Ceded premiums may be overstated to some degree. As with other imperfections on the premium side, this problem may not be significant enough to warrant a more complex procedure.

effectively prevent the type of abuses that were committed long ago, and the punitive accounting, which is itself highly inaccurate, could be eliminated.

2.4.4 Policing

Punitive accounting for retroactive reinsurance under GAAP might be considered an example of policing by accounting – the idea is not to account accurately, but to prevent abuse. Regulators have more direct police powers. Insurance executives may have to increasingly describe the intent of reinsurance transactions. While improved disclosure by financial executives is beneficial, the author is not entirely comfortable with police powers to regulate intent.

With more accurate accounting, regulation of intent would be less necessary. Bad behavior will still be possible; policing will still be needed. But with better accounting rules, policing can be about following the rules.

References

[1] FAS 113

[2] SSAP No. 62

[3] AICPA Statement of Position 98-7

[4] SSAP No. 75

[5] CAS Valuation, Finance, and Investments Committee, "Accounting Rule Guidance Statement of FAS No. 113 – Considerations in Risk Transfer Testing", Casualty Actuarial Society Forum, Volume: Fall, 2002, pp. 305-338

[6] AAA Index Securitization Task Force, "Evaluating the Effectiveness of Index-Based Insurance Derivatives in Hedging Property/Casualty Insurance Transactions", October 4, 1999

[7] Kreps, Rodney, "Riskiness Leverage Models", to be published in the Proceedings of the Casualty Actuarial Society.

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[9] Kreps, Rodney and Oakley E. Van Slyke, "When Is Risk "Significant" in a Reinsurance Contract," an unpublished paper.