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Insurance Risk Transfer and Categorization of Reinsurance Contracts

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This research paper develops a simple, affordable, and robust regulatory method that can help insurance regulators to categorize financial reinsurance contracts as reinsurance or financial instruments. By reviewing real examples of different categorization methods, this paper explains how the proposed method standardizes such categorization. It also summarizes the existing pertinent literature on the subject with the view to helping insurance regulators to first apply some simple indicators to flag the main issues with financial reinsurance contracts that may need further reviews.

Having identified the suspicious reinsurance contracts, supervisors may consider several solutions provided by the authors and, in some cases, requiring further quantitative testing of risk transfer contracts for categorization purposes, supervisors may also consider adopting the Standardized Expected Reinsurer's Deficit approach to contract testing presented in this paper. The approach advocates the use of a simple standardized stochastic method that would allow market participants and regulators to perform robust quantitative tests quickly and at an affordable cost. Besides addressing the obvious drawbacks of the "10-–10" test, the proposed alternative method allows a great reduction in the technical challenges posed to the users of the Expected Reinsurer's Deficit approach based on full stochastic models with only a minimum loss of predictive accuracy.

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Contents

Introduction

Financial reinsurance, often referred to as finite risk reinsurance or just finite reinsurance[4], is a form of transaction between a reinsurance company and its client which mainly focuses on purely financial effects such as capital management, solvency relief, influencing financial and earnings position, etc. rather than on the transfer of insurance risk as is the case in traditional reinsurance. Very often financial reinsurance contracts combine features of both, a financial effect oriented financial instrument and a risk transfer oriented traditional reinsurance transaction. Categorization of such mixed financial reinsurance contracts and their eventual acceptance for supervisory purposes often becomes rather challenging and technically complex.

Despite the existence of several approaches to categorize financial reinsurance contracts, their technical complexity makes them practically unusable for insurance supervision purposes, particularly in developing countries. As a consequence, proper categorization of reinsurance contracts continues to remain a major challenge for many market players and insurance regulators, leaving ample room for mistakes, potential abuses, and malpractice.

The paper aims to address this problem by first providing a thorough overview of the existing categorization methods, and then presenting a simple and easy-to-implement quantitative regulatory method. The proposed method is much simpler and less costly than the current ones used in the market. The structure of the paper is as follows:

- Section I describes why a correct categorization of reinsurance contracts matters.
- Section II defines how to categorize contracts as reinsurance.
- Section III assesses existing quantitative risk transfer tests.
- Section IV proposes a new easy-to-use approach for performing quantitative risk transfer tests.
- Section V summarizes main points and provides several policy recommendations.

Section I. Why a Correct Categorization of Reinsurance Contracts Matters

Besides transferring insurance risk, usually to a limited extent, financial reinsurance contracts also address other objectives, like financing or smoothing the profit and loss results. Therefore, from the outset one has to determine if the contract is transferring insurance risk at all, or only deals with financial risks. For example, a contract that protects only the investment results of a client does not transfer any insurance risk. Also loans, even if written as reinsurance contracts, by their economic nature will still remain financial instruments despite their disguise.

While the existing common international accounting guidelines, like IFRS[5] or US-GAAP[6], already provide guidance on how to distinguish between financial and insurance contracts,

[4] Financial reinsurance is also known as non-traditional reinsurance, limited risk reinsurance or structured reinsurance. Historically the term "financial reinsurance" was used. However, as some fraudulent transactions took place in the past, the term "financial reinsurance" got a negative reputation. Therefore, the industry had established the new tern "finite risk" or just "finite" to make clear that these contracts have sufficient risk transfer.

[5] IFRS: International Financial Reporting Standards

sometimes a contract may contain both elements, i.e. financial and insurance risks, thus making the application of existing guidance more difficult. In such cases the contract may have to be separated into individual elements (so-called "unbundling") to enable the application of the guidelines.

If it can be demonstrated that a contract transfers insurance risk, an assessment has to be made of the amount of insurance risk transferred to a reinsurer. Depending on the contractual content and the accounting environment, those contracts that fail to prove enough risk transfer are categorized as financial instruments under "deposit accounting"[7] and must be recorded under the investment results, with no effect on underwriting results.

In most countries with well-developed insurance regulatory regimes, insurance companies are required by law to differentiate between traditional and financial reinsurance contracts in their statutory financial reporting.[8] Those contracts that do not transfer enough risk to a reinsurer disqualify the cedant from obtaining solvency capital relief. Such adverse practical implications of regulatory categorization decisions underscore the importance of developing an accurate and easy to administer categorization method.

As has been already mentioned, in the use of financial reinsurance, there might be cases of malpractice. The most common are the attempts to disguise self-financing (or borrowings) as a legitimate risk transfer for obtaining solvency relief or for smoothing the underwriting results. Therefore, for regulatory purposes, it is important to define methods which would provide for adequate categorization of such contracts as either reinsurance or financial instrument (deposit accounting).

The key to the categorization of reinsurance contracts lies in estimating the proportion of risk transfer obtained by a cedant through a given reinsurance transaction. To determine the extent of risk transfer in a reinsurance treaty, regulators may need to conduct quantitative tests. The main problem with the application of quantitative tests is their technical complexity, which considerably impairs their wide-spread use by the market and insurance regulators. Often, (re)insurance companies and regulatory bodies cannot perform quantitative tests on their own due to the lack of specialized technical resources. As a result, they may have to employ specialized actuarial consulting companies, which may be expensive or, in the case of developing countries, simply not available.

According to the International Association of Insurance Supervisors (IAIS) [9], reinsurance is a key instrument for insurers and supervisors to conduct risk management. The insurance industry has significantly benefited from many product innovations. However, often these innovations bring along complex definitions of reinsurance contracts which affect not only insurers' risk management practices and capital management, but also their economic solvency and the regulatory treatment of solvency relief typically sought after by insurers under reinsurance contracts [9].

To date, there is no globally accepted definition of financial reinsurance. However a typical transaction in many cases would include risk limiting features like a self-retention of some

[6] US-GAAP: US Generally Accepted Accounting Principles
[7] An US-GAAP accounting method for the recognition of (re)insurance contracts with not significant insurance risk transfer allows that only the reinsurer's margin is reported in the profit and loss statement, i.e. no premiums, commissions or incurred losses are recorded. In the balance sheet also only a net asset or liability is reported.
[8] For example the EU Directive 2005/68/EC on reinsurance established a definition and some general criteria for financial reinsurance. The EU Directive 2005/68/EC allows home member states to lay down specific provisions concerning the pursuit of financial reinsurance activities, like mandatory contract components, administrative and accounting procedures, internal control mechanisms, risk management requirements, accounting, prudential and statistical information requirements or rules relating to the available solvency margin. [21]

risk by the insurer structured as a loss corridor, loss cap or an aggregate limit of liability. Adjustable commissions, like sliding scale or profit commissions, or experience refunds in case of a positive or negative performance are also often used for aligning the interests of insurers and reinsurers. Financial reinsurance contracts are also often set up for multiple years and/or multiple lines of business to reduce volatility and aggregate risk. Although the IAIS [9] lists these and some other characteristics of finite reinsurance contracts[9], it also points out that these could be also present in traditional reinsurance, thus rendering this guidance impractical in some cases.

Under the EU directive 2005/68/EC Art. 2, paragraph 1/q financial reinsurance is defined as follows: "'finite reinsurance' means reinsurance under which the explicit maximum loss potential, expressed as the maximum economic risk transferred, arising both from a significant underwriting risk and timing risk transfer, exceeds the premium over the lifetime of the contract by a limited but significant amount, together with at least one of the following two features:
(i) explicit and material consideration of the time value of money,
(ii) contractual provisions to moderate the balance of economic experience between the parties over time to achieve the target risk transfer" [21].

As there can never be an exclusive list which defines the contract's categorization, risk transfer assessments should always be conducted on a case by case basis. In the absence of a standardized approach there is ample room for misinterpretations, misrepresentations, and abuses (e.g. avoiding ratings downgrades by employing financial smoothing instruments, saving taxes, circumventing creditor lending conditions by disguising new borrowings as reinsurance, or avoiding or delaying supervisory intervention to prevent breaches of solvency) [9]. As a result, there is an urgent need for a standardized practical approach to a robust regulatory classification of risk transfer contracts.

Section II. How to Categorize Contracts as Reinsurance?

As a first step it has to be analyzed if the reinsurance contract transfers insurance risk (e.g. a book of motor or liability insurance policies is reinsured) or if it transfers financial risks.[10] If under the relevant local statutory and accounting provisions, a contract can be seen as transferring financial risk only, no further categorization is required. Such a contract cannot be considered as reinsurance and has to be accounted for under the investment result.

If the contract transfers insurance risk it has to be determined if the risks transferred are sufficient to allow for reinsurance accounting. However, not every reinsurance contract

[9] The IAIS list of most common features of risk financing instruments vs. reinsurance contains the following characteristics: a) insurance risk transfer and financing are combined, b) assumption of limited risk by the reinsurer (e.g., aggregate limit of liability, blended cover, sliding scale and other adjustable commissions, loss corridors and limits or caps), c) transfer of volatility (e.g., multiple lines of business, multiple years of account and multiple year contract terms), d) inclusion of future investment income in price of contract (recognition of time value of money with funds withheld), e) potential profit sharing between parties (e.g. profit-sharing formulas, experience accounts), f) pricing determined by ceding insurers' results and not reinsurance pricing cycle, g) terms and pricing are typically determined in advance for the whole a block of new or in-force business (i.e. administration of reinsurance is done on a bulk basis rather than on a traditional seriatim policy-by-policy basis).[9]

[10] For example IFRS 4 Appendix A defines financial risks as: "The risk of a possible future change in one or more of a specified interest rate, financial instrument price, commodity price, foreign exchange rate, index of prices or rates, credit rating or credit index or other variable, provided in the case of a non-financial variable that the variable is not specific to a party to the contract." [3]

must be tested. Under US-GAAP and the NAIC[11] regulations, the so-called "reasonably self-evident exception" or "safe harbor exception" has become common practice.[12] It says that reinsurance contracts that contain only traditional contractual components do not have to be tested for a sufficient amount of risk transfer. Only in case a contract includes some characteristic risk transfer limiting features, a quantitative testing has to be performed.

Reasonably Self-Evident Contracts

While the notion of "reasonably self-evident" is often not explicitly referenced in the accounting standards, it became common practice. In essence, "reasonable self-evident" means that the given reinsurance contract can be seen as traditional reinsurance. For such contracts an explicit evaluation of risk transfer is not required. They are seen as "per definition" transferring a sufficient amount of risk transfer. Obviously, evaluating risk transfer for each contract, irrespective if the contract classifies as traditional or as financial reinsurance, would be costly and time consuming.

"Reasonably self-evident" only requires a minimum level of technical analysis and documentation to demonstrate the compliance with the accounting standards. This opinion is widely shared by the insurance industry, auditors, and regulatory authorities.

Currently, there are no uniform criteria for categorizing a reinsurance contract as "reasonable self-evident" or, in other words, for distinguishing between traditional and financial reinsurance. Usually the regulators or accounting standards only stipulate some minimum criteria and the companies have to apply their own more detailed list of internal criteria. However, this also gives companies some room for abuse.

Besides the criteria of the IAIS [9] and the EU directive [21] the document "Reinsurance Attestation Supplement 20-1: Risk Transfer Testing Practice Note" [11] prepared by the American Academy of Actuaries' Committee on Property and Liability Financial Reporting, provides some more detailed examples on how a checklist for financial reinsurance could look like. Also the EIOPA has recently published a draft paper on the Solvency II treatment of financial reinsurance, which also includes a list of eligibility criteria[13] [22].

There are several important characteristics of such contracts where risk transfer is "reasonably self-evident". According to the above mentioned Risk Transfer Testing Practice Note prepared by the AAA [11], these are as follows:

[11] The concept of "reasonably self-evident" was codified by the NAIC during 2005 as part of the Reinsurance Attestation Supplement 20-1. It addresses contracts for which a risk transfer test has to be carried out and also where detailed risk transfer testing is not required in order to conclude that that the contract allows for reinsurance accounting ("For each such reinsurance contract entered into, renewed, or amended on or after January 1, 1994, for which risk transfer is not reasonably considered to be self-evident, documentation concerning the economic intent of the transaction and the risk transfer analysis evidencing the proper accounting treatment, as required by SSAP No. 62—Property and Casualty Reinsurance, is available for review").

[12] See Annex I for a detailed overview of the accounting treatment under SSAP 62 and FAS 113 applicable to reinsurance contracts. [1] [2]

[13] The CEIOPS' Advice for Level 2 Implementing Measures on Solvency II: SCR standard formula - Article 111 f Allowance of Reinsurance Mitigation Techniques [22] includes a list of possible criteria: "Some of the following characteristics may be present within reinsurance contracts: • Insurance risk transfer, for example: - excess of loss reinsurance, which provides indemnification to the ceding insurer for each covered risk up to a predetermined limit. The ceding insurer is required to meet the obligations of the claim up to a preset amount before the reinsurer becomes liable; or - the insurer and the reinsurer share in an agreed ratio, all premiums, losses, and loss expenses arising out of the original business covered under the reinsurance agreement. There are two forms of proportional reinsurance: quota share and surplus share; or - catastrophe bonds issued to manage peak risks and embedded value securitisation to help undertakings manage their capital more efficiently. • assumption of significant but limited risk by the reinsurer (e.g., aggregate limit of liability, blended cover, sliding scale and other adjustable commissions, loss corridors and limits or caps); • transfer of volatility (e.g., multiple lines of business, multiple years of account and multiple year contract terms); • inclusion of future investment income in price of contract (recognition of time value of money); • potential profit sharing between parties (e.g. profit-sharing formulas, experience accounts); • bulk reinsurance or treaty reinsurance (i.e. administration of reinsurance is done on a bulk basis rather than on a traditional policy-by-policy basis, for a block of new or in-force business). Certain features can sometimes reduce the effective risk transfer considerably under the reinsurance contract. For example, this may be the case for certain finite reinsurance arrangements."

There are reinsurance contracts that, in effect, comply with the “reasonably self-evident” principle by virtue of their belonging to a particular classification of reinsurance contracts.

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- For example, risk transfer is reasonably self-evident for straight quota shares with fixed terms, e.g. no risk-limiting or any other variable terms like sharing positive or negative contract experience and with a fixed reinsurance commission that adequately compensates the ceding company for all acquisition costs[14].
- Also for most traditional per-risk or per-occurrence excess of loss reinsurance contracts (both treaty and facultative) risk transfer is reasonably self-evident if for a predetermined amount of premium the reinsurer assumes all or nearly all of the potential variability in the underlying losses, and it is evident from reading the basic terms of the contract that the reinsurer can incur a significant loss.[15]
- Also for single year property catastrophe and casualty clash covers it can be demonstrated that these contracts fall under “reasonably self-evident” if no risk limiting features, like sub-limits, retrospective premium adjustments or other exclusions apply.

In general, it is less likely that risk transfer is reasonably self-evident, when most risk is retained by the ceding company and if certain experience-based contractual features, such as experience accounts, variable commissions or premium adjustments, are included in the contract.

When considering if non-proportional contracts fall under the “reasonably self-evident”-exemption it is also worth mentioning the “rate-on-line-criterion”[16]. Even if no risk limiting features are included in the contract, a high premium (rate on line) can disqualify the contract from meeting the exemption rule. If the premium approaches the present value of the limit of coverage, risk transfer is usually no longer deemed to be reasonably self-evident, even if a contract has no risk-limiting features [11]. However, usually these kinds of contracts have other characteristic features like contingent commissions (to allow the ceding company to participate in positive experience of the contract) and which would violate “reasonably self-evident” anyway.

In Annex I, we provide an overview of the accounting treatment and risk transfer testing standards applied by different accounting standards or professional and regulatory bodies. Even though the topic has been in the discussion for several decades, the definition of the risk transfer still remains ambiguous. This discovery only underscores the importance of formulating a simple standardized approach to categorize financial reinsurance contracts.

Not-Reasonably Self-Evident Contracts

In case a contract does not meet the criteria of “reasonably self-evident” exemption, the contract falls into the “not-reasonably self-evident” category. For such contracts there are some commonly used quantitative criteria that allow to analyze the amount of insurance risk

[14] A less restrictive, but generally accepted exception is the case of a straight quota share reinsurance contract with no risk-limiting features, other than a very high loss ratio cap with negligible effect on the economics of the transaction.
[15] In many cases, there is no aggregate limit on the reinsurer’s loss. However few practitioners would feel the need for a detailed probabilistic cash flow analysis to reach the conclusion that risk transfer is reasonably self-evident.
[16] “Rate on line” is defined as the premium paid to reinsurer divided by the amount of reinsurance coverage.

transferred under a reinsurance contract. In Section III, we will describe the most relevant of such quantitative criteria.

It is important to note that a failure to satisfy the "reasonably self-evident" standard does not necessarily mean that a contract does not qualify as reinsurance contract. It simply means that more analysis, usually a quantitative risk transfer test, may be required to arrive at a contract categorization.

The categorization approach under these quantitative methods can be summarized as follows. For a given reinsurance transaction to be categorized, each method calculates the value of a specific parameter which provides a quantitative measure for the amount of risk transferred by the reinsurance transaction. The resulting value is then compared with a specific parameter threshold value which corresponds to the minimum level of risk transfer required by the method. If the parameter value is higher than the threshold, i.e. the transaction is transferring more risk than minimally required, then the transaction is categorized as reinsurance and accounted for as such.

Although there may be exceptions, contracts that falls under "not-reasonably self-evident", (i.e. not automatically qualify for reinsurance) typically would have the following characteristics [11]:

- Non-proportional per risk, per occurrence or aggregate excess of loss contracts if the premium approaches the present value of the coverage provided and/or the contracts contain significant risk-limiting features or other variable features, e.g. profit commission;
- Contracts with experience accounts, i.e. sharing positive or negative experience of the contract, or similar provisions with a significant impact on the contract's economics;
- Multi-year contracts with such provisions and/or provisions that adjust the contractual terms in later years, based on contractual experience in earlier years;
- Proportional quota share contracts with risk-limiting features such as loss ratio caps, loss participations/corridors or sub-limits or other variable features sharing positive or negative contract experience, like sliding scale commissions

In such cases, for accounting and regulatory purposes, the company will need to evaluate the amount of risk transferred by the underlying contract. Risk transfer analyses may range from very simple premium to limit approaches, to highly sophisticated stochastic methods. In most cases, the rigor of the analysis is likely to be inversely correlated with the amount of risk transferred under the contract (e.g. the less risk is transferred the more technical effort is required to determine the true extent of such transfer). In addition, internal processes have to be established as the regulator usually would request the company to present supporting documentation for the business rationale of the contract categorization.

Contracts That Meet the "Virtually Equivalent" Condition

Under some regulatory regimes, contract categorization is entirely driven by the quantitative methods mentioned above. However, some more advanced accounting or regulatory regimes practice a more nuanced approach which maintains that if the economic positions of the cedant (before risk transfer) and reinsurer (after risk transfer) are virtually equivalent for the ceded part of the underlying risk exposure, then the contract can be accounted for as reinsurance even if a quantitative risk transfer test is not fulfilled.

In essence, virtual equivalence means that substantially all insurance risk relating to the reinsured portions of the underlying contracts has been assumed by the reinsurer. This condition is met if only some insignificant amount of insurance risk remains with the ceding enterprise on the reinsured portions of the underlying insurance contracts and the economic position of the reinsurer is equivalent to having written the underlying policies directly.[17] In such contracts, the reinsurer de facto acts as the original insurer. For example, this exception can be found under US-GAAP and US-Statutory. [18]

Therefore, even if the chosen quantitative methods fail to prove the sufficient level of risk transfer, the contract can be accounted for as reinsurance given the economic positions of the reinsurer and the cedant are virtually equivalent. In this case the proven low level of risk transfer just means that the original cedant's risk for the ceded part of the underlying exposure had been already low before the transfer to a reinsurer.

The virtual equivalence based categorization analysis is typically supplemented with a transaction study to establish whether the contract includes some specific features aimed at limiting the extent of risk transfer to reinsurers, such as loss caps, loss participations, loss corridors, sliding scale commissions, experience accounts, etc.

Proving virtual equivalence for "not-reasonably self-evident" contracts is a challenging task, which mainly entails comparing the risk retained by the cedant with the risk transferred to the reinsurance company. An approach is suggested in [5][19]. Further to comparing the risk exposure, also the profit position of the cedant and the reinsurance company under the reinsurance contract needs to be compared as well. For this an analysis needs to be performed if significant positive contract experience is shared with the cedant as mentioned in the Risk Transfer Practice Note [11] by AAA's COPFLER or in the AICPA document "Evaluating Risk Transfer in Reinsurance of Short-Duration Contracts" [12].

For some reinsurance contracts, e.g. non-proportional contracts, virtual equivalence is difficult to demonstrate. If the virtual equivalence cannot be demonstrated, the contract would not qualify under this exception.[20]

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[17] However, note that the introduction of risk limiting features to a quota-share contract, such as a loss ratio cap (other than one that is so high its effect on the economics of the contract is de minimis), a loss retention corridor, or a sliding scale commission, often prevents the contract from qualifying for the exception.

[18] FAS 113 par. 11 and 67 states [1]:

11. If, based on this comparison, the reinsurer is <u>not exposed to the reasonable possibility of significant loss</u>, the ceding enterprise shall be considered indemnified against loss or liability relating to insurance risk only if <u>substantially all of the insurance risk</u> relating to the reinsured portions of the underlying insurance contracts has been assumed by the reinsurer.[4]

Footnote 4: This condition is met only if <u>insignificant insurance risk is retained</u> by the ceding enterprise on the reinsured portions of the underlying insurance contracts.

67. Under very limited circumstances, the reinsure need not be exposed to the reasonable possibility of significant loss for a contract to meet the conditions for reinsurance accounting. For example, applying the "reasonable possibility of significant loss" condition is problematic when the underlying insurance contracts themselves do not result in the reasonable possibility of significant loss to the ceding enterprise. The Board concluded that, when the reinsurer has assumed <u>substantially all of the insurance risk</u> in the reinsured portions of the underlying policies, even if that risk does not result in the reasonable possibility of significant loss, the transaction meets the conditions for reinsurance accounting. In this narrow circumstance, <u>the reinsurer's economic position is virtually equivalent to having written the insurance contract directly.</u> The risks retained by the ceding enterprise are insignificant, so that the reinsurer's exposure to loss is essentially the same as the insurer's.

For easier reference the new FASB Accounting Standard Codification is only attached in the appendix. FAS 113 par. 11 and 67 can now be found under FASB ASC 944-20-15-51 through 15-53 and FASB ASC 944-20-55-55.

[19] "Because "substantially all" is less than "all", if the EUD faced by the reinsurer is within a small tolerance of the expected underwriting deficit faced by the cedent, say, within 0.1%, then we would also say the "substantially all" test is met."[5]

[20] see US-GAAP: EITF D-34 Q&A 24; FASB ASC 944-20-55-56

Summary of relevant reinsurance contract categorization steps

1. Reasonably Self-Evident: The first step in the categorization approach is to determine whether the contract belongs to the "reasonably self-evident" category. For contracts from this category, no quantitative risk transfer test is required. Such contracts are considered to transfer a sufficient amount of insurance risk by virtue of the class and/or individual contract characteristics. Such contracts are classified as "traditional reinsurance."[21]

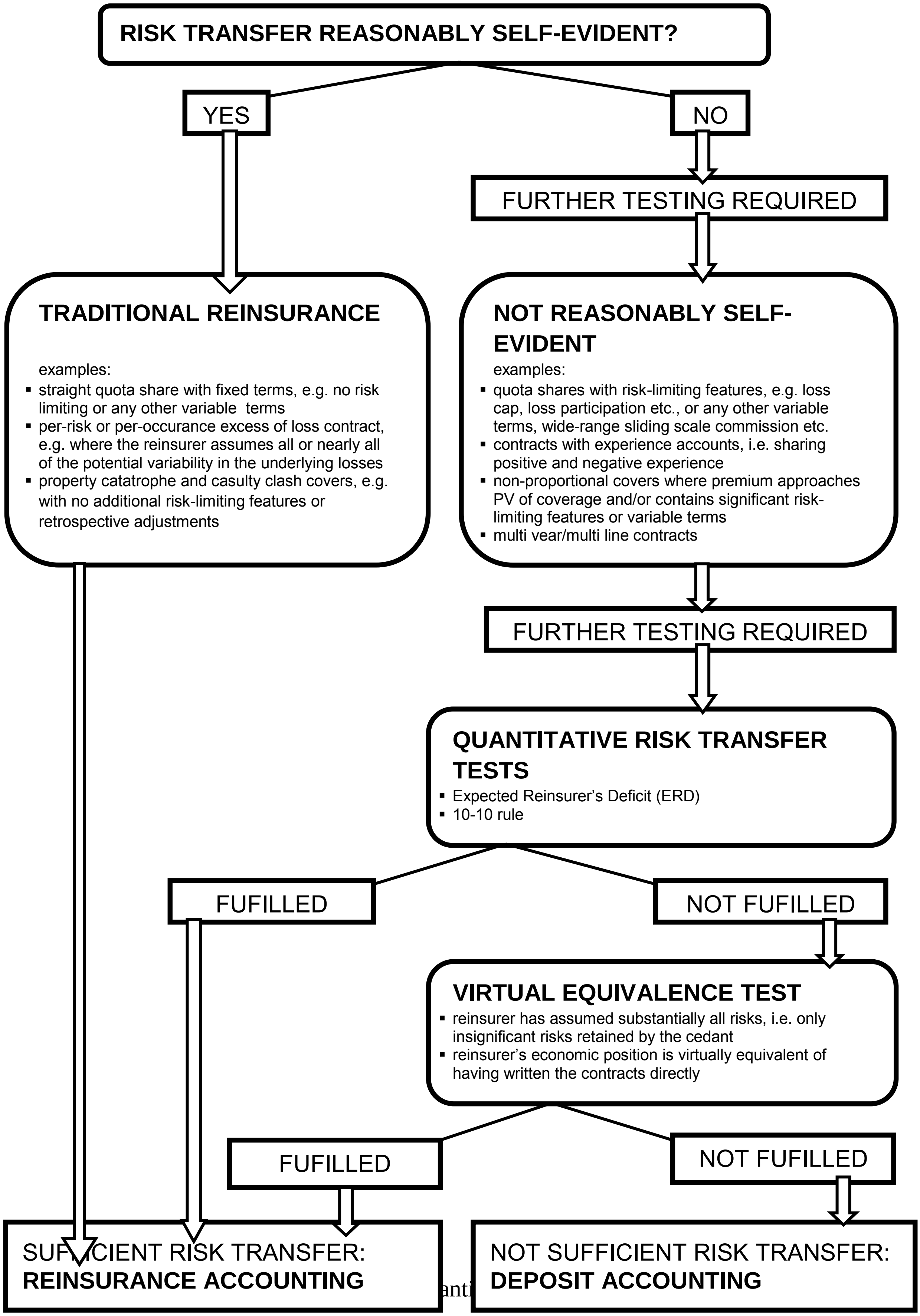
2. Not Reasonably Self-Evident: Some type of quantitative cash flow analysis must be performed to assess the extent of risk transfer.

3. Substantially all/virtually equivalent: Even if not reasonably self-evident or a significant risk transfer test is met, reinsurance accounting might be applicable depending on the economic impact of the contractual features.[22] By placing contracts in one of these three categories one can considerably reduce the amount of technical work by focusing only on those contracts that require further testing. To that end, Figure 1 below provides a schematic illustration of the categorization process.

[21] Depending on the local accounting or regulatory bodies, companies might have to implement internal criteria for defining "reasonably self-evident". Some examples can be found in the appendix of the Risk Transfer Practice Note by AAA's COPFLER [11].

[22] Depending on the local accounting or regulatory bodies, companies might have to implement internal thresholds for defining "substantially all risks" and "virtually equivalent".

Figure 1. Categorization of Financial Reinsurance Contracts



Section III. Existing Quantitative Risk Transfer Methods

While most reinsurance contracts are designed to protect the ceding company from adverse financial effects of one or more insured events by transferring the risk to a reinsurer, there are situations when the positive economic effect of a reinsurance contract on the ceding company cannot be easily determined. In such cases, a quantitative testing of a reinsurance contract must be performed to prove the existence and the extent of risk transfer, assuming relevant data are available.

Quota share reinsurance with its characteristic risk transfer limiting elements such as sliding scale commission, loss participation, loss ratio cap, experience refund is an example of a financial reinsurance contract which needs to be subjected to further quantitative testing for the purposes of categorization. Computer models that perform scenario testing may be required in such cases to perform the tests. Relevant data are either based on historical results of the business in question or similar business. Scenario testing can either be deterministic or stochastic. Stochastic approaches might comprise a comprehensive set of possible stochastic scenarios (often called stochastic models) or its subsets.

Risk transfer testing is essentially a discounted cash flow test [16] for the assumed scenarios. Most of the risk transfer testing approaches can be broken down into the following three steps:

Step 1. Analysis of the underlying risk exposure and defining the loss scenarios.

In this step, the underlying risk exposure needs to be analyzed with the objective to define the characteristic loss scenarios.

Step 2. Analysis of the reinsurance transaction and modeling the resulting cash flows.

All terms and conditions of the contract relevant for the cash flow between the cedant and the reinsurer should be taken into account. Based on this analysis and scenarios defined in the Step 1, all cash flows between the cedant and the reinsurer, as defined by the reinsurance contract, should be modeled for each scenario. These include claims, premiums, commissions, loss participations, experience based premium provisions, etc. The timing of any cash flow should be taken into account as well. Also all amounts should be deemed to be paid, i.e. the analysis should be performed irrespective if funds are transferred or not (so-called deposit retained or funds withheld).

Step 3. Cash flow analysis and deriving a quantitative measure of risk transfer.

In this step, the cash flow modeled under Step 2 should be analyzed. This analysis includes discounting with suitable interest rates, often risk-free rates for different maturities depending on the timing of each cash flow. Alternatively, one single risk free rate can be used instead of different rates for different maturities. In this case, the duration of the interest rate should be chosen approximately equal to that of the net cash flows. Then, for each scenario, all considered cash flows should be summed up to the total discounted positive and negative cash flows from the reinsurer's perspective. Finally, through taking into account all considered scenarios with their total positive and negative cash flows, each method will determine if there is a reasonable possibility of significant loss to the reinsurer based on the method's specific underlying quantitative risk transfer parameter and threshold.

Below, we describe the most common quantitative methods used by reinsurance practitioners to assess the extent of risk transfer in a financial reinsurance contract.

Most Common Quantitative Risk Transfer Methods

The most common quantitative risk transfer testing methods are the "10-10" rule and the Expected Reinsurer's Deficit (ERD). Both have been well described in the pertinent literature [6][7][16]. These are briefly summarized below. Another, less common method is the Premium to Limit of Coverage Ratio.

Premium to Limit of Coverage Ratio: Under this criterion, the contract is unlikely to be a risk transfer, if the value of the ratio approaches or exceeds 1. This easy-to-apply method which is not scenario based and therefore does not require an in-depth analysis of the underlying exposure might be used as a quick first test. However, in many cases the method may generate inaccurate results when the ratio is slightly below 1 indicating that the degree of risk transfer is insufficient. Also in case when the Premium to Limit of Coverage ratio is substantially under 1, the objective of the contract might still be purely financial even though according to the method the contract should be categorized as reinsurance.

The "10-10" rule: The "10-10" rule was loosely derived from the accounting standard language that required that a reinsurer faced a "reasonable possibility of a significant loss."[23] According to the "10-10" rule, a reinsurance contract exhibits significant risk transfer characteristics if there is at least a 10% probability of an at least 10% loss relative to the cash inflows of the reinsurer (usually reinsurance premiums).[24]

Even though the "10-10" rule does translate risk transfer into an easy-to-apply benchmark, its potential to be applied in practice has substantial shortcomings (as described in [5][7]).

For instance, some conventional reinsurance contracts that normally would be classified by regulators and reinsurance practitioners as traditional reinsurance do not pass the "10-10" rule. This is, for example, the case with excess of loss property catastrophe contracts which fail to pass the "10-10" rule because the frequency of major catastrophes is so low that there may not be a 10% chance of a loss for a reinsurer. Yet, despite much lower odds of the loss, the reinsurer may potentially end up paying the full amount of the treaty limit. Moreover, even ordinary quota share reinsurance treaties designed for transferring high frequency but low severity losses from insurers' portfolios may also fail the "10-10" test. However, it was common practice not to disqualify catastrophe excess of loss contracts or favorable quota share treaties as reinsurance because "10-10" was not met. For low severity-high frequency

[23] Also known as 9a/b-test under US-GAAP. FAS 113 par 9a/ b states:
"a. The reinsurer assumes significant insurance risk under the reinsured portions of the underlying insurance contracts.
b. It is reasonably possible that the reinsurer may realize a significant loss from the transaction."
Guidance also available under FASB ASC 944-20-15-41.

[24] FAS 113 par. 10 states: " The ceding enterprise's evaluation of whether it is reasonably possible for a reinsurer to realize a significant loss from the transaction shall be based on the present value of all cash flows between the ceding and assuming enterprises under reasonably possible outcomes, without regard to how the individual cash flows are characterized. The same interest rate shall be used to compute the present value of cash flows for each reasonably possible outcome tested."
FAS 113 par 11 states :"Significance of loss shall be evaluated by comparing the present value of all cash flows, determined as described in paragraph 10, with the present value of the amounts paid or deemed to have been paid to the reinsurer."
Guidance also available under FASB ASC 944-20-15-49 through 15-54.

contracts the aforementioned “substantially all/virtually equivalent” criterion was applied. For high severity-low frequency contracts, however, no accounting guidance was applicable.

Furthermore, we must mention at least two more other major shortcomings of the “10-10” rule. First, the “10-10” rule ignores the risk in the tail of distribution beyond the 90^{th} percentile. Only the present value loss at the 90th percentile (*VaR*) is taken into account. However, in the right tail of the distribution the loss potential for catastrophe covers can be significant. Second, we must point out that the selected parameters for frequency and severity in the “10-10” test are completely arbitrary and can be replaced by a “5-20” test or a “1-100” test. Because of this shortcomings a new test, the so-called “*product rule,*” was developed. Every combination which would lead to an at least 1% (10%*10%) threshold could also be applied for testing sufficient risk transfer. This “product test” was shortly replaced by the Expected Reinsurer’s Deficit, although the “product test” did solve the shortcomings for high severity-low frequency or high severity-low frequency contracts.

However, in fairness to the “10-10” rule or the “product rule”, we must point out that these tests were never intended to become a universally applicable risk transfer test. These tests had emerged as informal quantitative methods of experienced practitioners to determine whether reinsurance contracts contained sufficient risk transfer.

Expected Reinsurer’s Deficit Method (ERD). Another common measure of risk transfer that has gained acceptance among regulators and reinsurance practitioners is the ERD. In 2002, the CAS Valuation, Finance, and Investments Committee published the paper “Accounting Rule Guidance Statement of Financial Accounting Standards No. 113—Considerations in Risk Transfer Testing” which discussed the shortcomings of the “10-10” rule and introduced the ERD [6]. The ERD overcomes the shortcomings of the “10-10” rule by including the right tail of the distribution in the risk transfer test. In addition, one single measure was developed that allowed same treatment for low frequency-high severity, high frequency-low severity, and moderate frequency-moderate severity contracts.

However, conducting an ERD test represents a considerable technical challenge due to the need to generate a realistic distribution of reinsured losses that are likely to be incurred by the cedant during the life-time of the reinsurance contract. In the case of reinsurance contracts that provide coverage for more than one line of business, the technical challenge of drawing numerous loss distributions and combining them into one single loss distribution at the portfolio level can be even more daunting.

Mathematically, the ERD test can be defined as follows (see [4,5,7] for more details):

$ERD = p * T / P \geq A,$

Where:

p = probability of net economic loss;
T = expected (average) severity of net economic loss (present value), when it occurs;
P = expected reinsurance premium (present value) or more general the cash inflows to the reinsurer.
A = a threshold above which a contract is considered to have provisionally “passed” the “significant” risk transfer test and below which it is considered to have “failed”; usually, A is set at 1% which has become an international best practice standard.

Since the *ERD* incorporates information about both the frequency and severity of the reinsurer's downside risk into one single measure, it allows utilizing a combined numeric threshold for significant risk transfer (A) rather than defining it separately in terms of frequency and severity.

Whereas the above definition of ERD test provides a good intuitive understanding of the motivation behind the ERD test, in the scenario based ERD calculation framework, it often more convenient to rephrase the definition in the form of the following equation:

$ERD = (\sum_{i=1}^{N} p_i \cdot S_i) / P \geq A$

Where:

The expression in brackets calculates the expected severity of the net economic loss to the reinsurer among all considered scenarios 1 to N. The probability p_i denotes the occurrence probability of the scenario i and S_i the severity of the net economic loss to the reinsurer in the corresponding scenario (present value). If for a given scenario, net economic result of the reinsurer is positive, i.e. this scenario produces a net economic profit, then for this scenario S_i is equal to zero. Obviously, for S_i we can state:

S_i = – min (0; "Present Value of the Reinsurer's Net Result)

Please notice that in the above definitions the severity of net economic loss and therefore also ERD is always positive or zero. In the last formula, this is achieved by setting the minus sign before the min function.

Further, please note that each contract that qualifies as risk transfer under the "10-10" rule also fulfills the ERD test at 1% threshold of ERD (a 10% loss multiplied by a 10% probability is a 1% ERD). However, not every contract which fulfills the ERD test (say, a 100% loss multiplied by 1% probability is also a 1% ERD) would also meet the "10-10" rule, cf. the discussion of the shortcomings of the "10-10" rule presented above.

A simple example below illustrates the use of ERD test:

Assume, for a reinsurance contract, the following holds:

Reinsurance premium P = 10 million.

Probability of net result (p)	Present value of net result (m)	Severity of net economic loss (m)
96.0%	5	0
2.5%	-30	30
1.0%	-72	72
0.5%	-200	200

The aggregate probability of net economic loss is calculated as

p = 2.5% + 1% + 0.5% = 4%

The expected severity of net economic loss under the condition that it occurs:

T = (2.5% * 30 + 1% * 72 + 0.5% * 200) / 4% = 61.8m

Then, according to the first variant of the calculation formula given above, we obtain

$ERD = p * T / P$ = 4% * 61.8 / 10 = 24.7%

We also could apply the second variant of the calculation formula which of course leads to the same result

ERD = $\left(\sum_{i=1}^{4} p_i \cdot S_i\right) / P$ = (96% * 0 + 2.5% * 30 + 1% * 72 + 0.5% * 200) / 10 = 24.7%

Obviously, in this example the resulting ERD is well above the threshold of 1% and thus according to the ERD test, the reinsurance contract transfers enough risk to be classified as a reinsurance transaction.

The simplified example above only uses a premium in the denominator as a fixed variable. However, in practice, premiums sometimes are not fixed upfront but depend on the contract's loss experience or result. In such cases, the premiums in the ERD calculation should be considered at their expected values for which different approaches are possible and used by the industry. Among other aspects, the choice of an approach may also depend on contract conditions, especially if with the increasing contract loss the premium increases or decreases (the latter case is rather rare but can be seen in practice as well; such contracts are often called contracts with inverse character).

In developed markets, market participants utilize either full or partial stochastic models of the underlying loss exposure for calculating the ERD. Both the partial and full stochastic models are based on the loss scenarios with occurrence probability assigned to each scenario. Whereas a full stochastic model tries to capture a possibly comprehensive set of loss scenarios, a partial stochastic model works with its suitable subset. Obviously deriving a partial stochastic model is easier. However in practice, often partial stochastic models may be insufficient for proving the desired ERD threshold, thus necessitating the use of a full stochastic method.

A full stochastic model of the underlying loss exposure will usually differentiate between the basic loss exposure (losses below a certain threshold), individual large loss exposure, and event based catastrophe loss exposure. If for a reinsurance transaction one of the three loss categories does not seem relevant, then the loss exposure model can be abandoned. The full stochastic method nevertheless must still account for the total annual, individual or per event loss scenarios with the probabilities assigned to each loss scenario. These loss scenarios are then tested through a mathematical model of the underlying reinsurance transaction which produces a stochastically generated set of cash flows between the reinsurer and the cedant resulting from the underlying reinsurance transaction. These cash flows are then discounted to the present point in time and recalculated into the values of the discounted reinsurer's deficit per each scenario.

To illustrate how this method works, we provide a more detailed numeric illustration of the ERD method for a typical quota share reinsurance treaty with elements of finite risk transfer in Box I below.

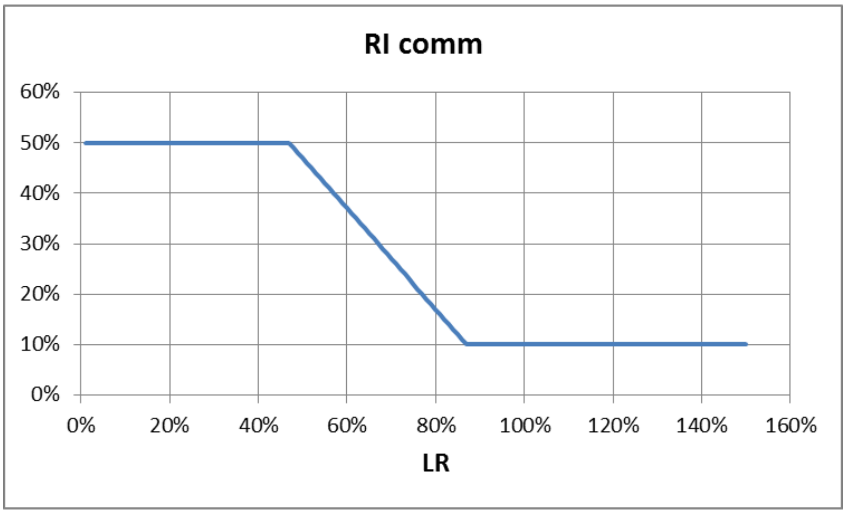
Box I: ERD calculation for a Financial Quota Share (FQS) reinsurance contract

Contract details

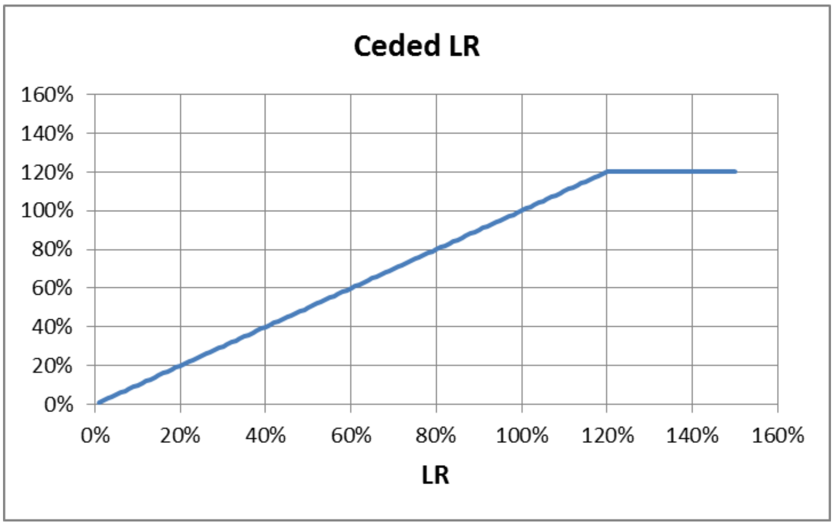
- Proportional quota share contract for motor third party liability (MTPL) business
- Ceded premium = € 100m
- Sliding scale reinsurance commission:

  Loss Ratio (LR) <= 50% ➔ Reinsurance commission (RI) = 47%
  Loss Ratio (LR) >= 87% ➔ Reinsurance commission (RI) = 10%

  For LRs between 50% and 87%, RI commission drops by 1% for any LR increase of 1%.



- Loss ratio is capped at 120%
  This feature means that the reinsurer does not accept any loss arising from the underlying contract beyond a 120%. The original losses beyond this loss ratio are not ceded into the underlying reinsurance contract "ceded LR" = min (LR, LR cap)



- Cedant's loss participation of 20%.
  This means that in case the reinsurer has a financial loss from the underlying contract, the cedant will reimburse the reinsurer for 20% of the loss;
  "Loss participation" = – 20% * min(0; 100% – "ceded LR" – "RI commission")

  For example, if the LR = 80%, then the Ceded LR = 80%, RI commission = 17% and we calculate

“loss participation” = – 20% * min(0; 100% – 80% – 17%) = – 20% * min(0; 3%) = 0
If on the other hand, LR = 125%, Ceded LR = 120%, RI commission = 10%, there will be some non-zero loss participation:
“Loss participation” = – 20% * min(0; 100% – 120% – 10%) = – 20% * min(0; –30%) = 6%

Please note that with this definition, the reinsurer’s loss participation is always positive or zero.

When modeling the risk exposure for this contract, we differentiate between basic losses below certain threshold and individual large losses above this threshold. Whereas basic losses are modeled on the annual aggregate basis, large losses are modeled individually through a combination of loss frequency and loss severity probabilistic assumptions. For the sake of simplicity, we assume that there are no loss development patterns, i.e. losses are fully settled within one year. Hence, loss discounting effects do not play any role.

Let’s assume that from the analysis of loss and premium statistics from the previous years, we can derive the following assumptions:

<u>Basic losses</u>

- Losses below the threshold of € 3m
- Distribution assumption: ultimate LR follows a lognormal distribution
- Expected ultimate basis loss ratio = 80%
- Standard deviation of the ultimate basic loss ratio = 12%

<u>Individual large losses</u>

- Losses above the threshold of € 3m
- Distribution assumptions: number of losses p.a. (loss frequency) follows a Poisson distribution, loss severity follows a truncated Pareto distribution
- Expected number of individual large losses above € 3m (Poisson Lambda) = 0.5
- Shape parameter of Pareto Distribution (Pareto Alpha) = 2.4
- Lower threshold of Pareto distribution = € 3m, upper threshold = € 100m

To calculate ERD we carry out a Monte Carlo simulation which generates 100,000 scenarios for the total ultimate loss ratio. The realization probability for each scenario is equal 1 / 100,000 = 0.001%. For each scenario we then apply the contract conditions to calculate the reinsurer’s ultimate result and then the severity of reinsurer’s net economic loss (if any).

First we calculate reinsurer’s ultimate result which is the reinsurer’s result after the insured loss has been settled, i.e. has achieved its ultimate value.

Reinsurer’s ultimate result = 100% - “ceded LR” – “RI comm” + “loss participation”

Now, we recalculate the ultimate result into its present value.

Present value of reinsurer’s result = “Reinsurer’s ultimate result” + “discounting adjustment”

Please notice, that according to our previous assumption, the loss will be fully settled within one year, i.e. there will be no loss development over the time and the resulting discounting adjustment can be assumed to be zero. However, for the sake of completeness we provide the formula for a general case.

Finally, we recalculate the present value of reinsurer’s result into the severity of reinsurer’s net economic loss

Severity of reinsurer’s net economic loss (as percentage of the ceded premium)
= – min (0; “Present value of reinsurance results”)
= – min (0; 100% – “ceded LR” – “RI comm” + “loss participation”)

The following example for both loss scenarios Ultimate LR = 80% and Ultimate LR = 125% will illustrate the above formula.

As explained above, for the Ultimate LR = 80% Ceded LR = 80%, RI Commission = 17% and loss participation = 0;

and for the Ultimate LR = 125%, Ceded LR = 120%, RI Commission = 10% and loss participation = 6%

Then, for both scenarios, we calculate for the Reinsurer's deficit as follows:

Severity of reinsurer's net economic loss (as percentage of the ceded premium) for the loss scenario LR = 80%
= – min (0; 100% – 80% – 17% + 0) = min(0; 3%) = 0.

Severity of reinsurer's net economic loss (as percentage of the ceded premium) for the loss scenario LR = 125%
= – min (0; 100% – 120% – 10% + 6%) = min(0; – 24%) = – 24%.

Out of the resulting scenario set for severities of reinsurer's net economic loss, we can easily calculate a reliable estimate for the expected reinsurer's deficit (ERD), cf. the table below.

Table III.1. Stochastic model for calculating ERD, 100,000 scenarios

Scenario N	A. Realization probability	B. Loss Ratio	C. Reinsurance commission	D. Ceded LR	E. Loss participation	F = 100% - B - C + D Reinsurer's result	G = - min(0; F) Severity of Reinsurer's net economic loss
1	0.001%	77.6%	19.4%	77.6%	0.0%	22.4%	0.0%
2	0.001%	69.0%	28.0%	69.0%	0.0%	3.0%	0.0%
3	0.001%	104.3%	10.0%	104.3%	2.9%	-11.4%	11.4%
4	0.001%	90.8%	10.0%	90.8%	0.2%	-0.7%	0.7%
5	0.001%	65.3%	31.7%	65.3%	0.0%	3.0%	0.0%
6	0.001%	102.1%	10.0%	102.1%	2.4%	-9.7%	9.7%
7	0.001%	79.4%	17.6%	79.4%	0.0%	3.0%	0.0%
8	0.001%	80.1%	16.9%	80.1%	0.0%	3.0%	0.0%
9	0.001%	109.8%	10.0%	109.8%	4.0%	-15.9%	15.9%
10	0.001%	74.7%	22.3%	74.7%	0.0%	3.0%	0.0%
11	0.001%	62.8%	34.2%	62.8%	0.0%	3.0%	0.0%
12	0.001%	78.7%	18.3%	78.7%	0.0%	3.0%	0.0%
13	0.001%	89.1%	10.0%	89.1%	0.0%	0.9%	0.0%
14	0.001%	61.2%	35.8%	61.2%	0.0%	3.0%	0.0%
...	...	...	...	...	...	...	...
99,999	0.001%	85.5%	11.5%	85.5%	0.0%	3.0%	0.0%
100,000	0.001%	89.9%	10.0%	89.9%	0.0%	0.1%	0.0%

This stochastic model has been obtained from the Monte Carlo simulation for the underlying risk exposure (cf. Column A) and applying the terms and conditions of the reinsurance contract (Columns C, D and E). The reinsurance result for each scenario (Column F) is then recalculated into the severities of reinsurer's net economic loss (Column G).

Obviously, for calculating ERD we are only interested in the economic loss severities in Column G. Working with 100,000 scenarios might be somewhat inconvenient. To reduce the number of scenarios to be considered we can now round up the severities to the full percentage digits and aggregate realization probabilities for the scenarios resulting in the same value of the (rounded) loss severity. The results can be found in the following table.

Table III.2 Stochastic model for calculating ERD, aggregated scenarios

Scenario N (aggregated scenarios)	A. Realization probability	B. Severity of reinsurer's net economic loss	Scenario N (aggregated scenarios)	A. (continued) Realization probability	B. (continued) Severity of reinsurer's net economic loss
1	75.4%	0%	14	0.6%	13%
2	2.8%	1%	15	0.6%	14%
3	2.5%	2%	16	0.5%	15%
4	2.3%	3%	17	0.4%	16%
5	2.0%	4%	18	0.4%	17%
6	1.9%	5%	19	0.3%	18%
7	1.7%	6%	20	0.3%	19%
8	1.5%	7%	21	0.2%	20%
9	1.3%	8%	22	0.2%	21%
10	1.2%	9%	23	0.2%	22%
11	1.1%	10%	24	0.1%	23%
12	1.0%	11%	25	0.8%	24%
13	0.8%	12%	26	0.0%	>=25%

Then, ERD can be calculated as the total of the row-wise products of the columns A and B

$$ERD = \sum_{i=1}^{26} A_i \cdot B_i = 1.9\%$$

Obviously, with this result the underlying contract successfully passed the ERD risk transfer test.

END OF BOX

In addition to the "10-10" rule and the ERD, other risk transfer methods have been developed; however none of them has become as well accepted as the 10-10 rule and later the ERD test. For more details on these other methods please refer to [8,16,17].

To summarize, despite the existence of numerous approaches to categorization of reinsurance contracts, including ERD, which currently is viewed as best practice, none of them can be easily performed. Even for leading global international (re)insurers, performing the quantitative risk transfer tests represents a substantial technical burden, let alone small insurance companies and regulatory bodies in developing markets. This creates room for mistakes, misuse, and malpractice. Therefore, the need for a simple but robust risk transfer categorization method still remains.

Section IV. The SERD Method: Standardized ERD Test

As described in the previous section, the main drawback of the ERD is the technical complexity of its application. To address this problem, we developed a method that can be followed by insurance regulators to carry out the ERD test without employing complex actuarial techniques.

The proposed *Standardized ERD (SERD) method* aims to help regulators and insurers in developing countries to apply the ERD method at an affordable cost. The SERD relies on the ERD method applied to proportional reinsurance contracts. In a nutshell, the SERD represents a simplified approach to exploiting a full stochastic model of the underlying risk exposure for calculating ERD. However, instead of developing an individual model for each given case, the SERD utilizes a standardized model template which needs to be fed with only a few relatively easy-to-obtain parameters, without imposing a significant technical burden on a user. With this approach, the SERD method follows the logic of the European Solvency II approach that allows an insurance company to apply a "simplified" approach by using the Standard Formula instead of a Full or Partial Internal Model, if the latter represents a heavy technical (and cost) burden for the company. Hence, the SERD can be seen as the "Standard Formula" method of the ERD calculation framework.

The level of method's customization can be adjusted depending on how much information about the individual risk exposure to be modeled is available to the method's user. For example, the volatility parameters of the chosen probabilistic loss distributions or the loss development patterns can be either used at their default values which will be suggested by the SERD method, or, if available, at their unique values for a given individual case. The default parameter values have been taken from the Solvency II (QIS5) and Swiss Solvency Test frameworks; see Annex II for more details.

Based on the user inputs as well as the default values of risk exposure parameters, the SERD method then provides a comprehensive set of probabilistic scenarios (stochastic model) for the severity of the reinsurer's net economic loss (similar to the format of Table III.2 above) and finally automatically calculates the ERD based on the obtained probabilistic scenarios.

The SERD method comprises the following four modules:

1. Loss modeling module
2. Reinsurance transaction module
3. Loss development patterns module
4. Scenario generating and ERD calculating module

Below we provide a short description of these modules and the results for the Example of the Financial Quota Share (as introduced in Section III) obtained with the SERD method. More technical details on the modules and on the calculation for the Example Financial Quota Share can be found in Annex II.

1. Loss modeling module

The user will be given the possibility to choose the line of business covered by the contract from the list comprising the main standard non-life lines of business. Following the approach of Solvency II and Swiss Solvency Test [18, 19], the SERD method allows for assuming some correlation between basic losses in different lines of business. However, no correlation is assumed between basic, large and catastrophe loss exposures.

In the loss modeling module the SERD tool allows to differentiate between basic, large and cat loss burdens. The basic loss modeling is based on the assumption that the loss ratio of the basic loss aggregated over the annual contract term is distributed according to the lognorm distribution. With this choice we follow the Solvency II (QIS5) approach [18]. The user will be asked to enter the expected ultimate loss ratios[25] for all lines of business covered by the contract. Further, the user will be given the choice to use the individual user defined values of the volatility per line of business or to use the default values imported by the SERD method from the Solvency II framework.

[25] The term "ultimate loss ratio" is used to describe the ratio between the ultimate loss attached to an annual contract term period after its full development and the insurance premium belonging to this annual term period.

The modeling of the individual large loss burden is based on the recognized international best practice assumption that the number of individual large losses per line of business is distributed according to the Poisson distribution and the loss severity according to the Pareto distribution. The user will be asked to provide the expected number of individual large losses per annum as well as lower and upper loss thresholds for each line of business covered by the contract. For the shape parameter of the loss severity distribution ("Pareto alpha"), the user will be given the option to provide its own unique value, if available, or to use a standard default value. The default values can be derived from the industry experience in other more mature markets. The choices used in SERD method draw on the values of Pareto alpha suggested in the Swiss Solvency Test Standard Model [19].

If there is a catastrophe loss exposure, the user will be asked to provide a loss exceedance curve describing the exposure. At a later stage, the SERD method can be supplemented with catastrophe risk modeling modules for various natural catastrophe scenarios, which will undertake assessments of natural catastrophe risk based on sum insured aggregates (to be provided by the user) instead of a loss exceedance curve. This will further reduce the technical burden on the user while improving the accuracy of calculations.

2. Reinsurance transaction module

This module captures the risk transfer effect of the reinsurance transaction taking into account its main features such as reinsurance and profit commissions, loss participations and loss corridors, loss caps, etc. For each value of the underlying exposure's loss ratio, this module encapsulates the corresponding value of the reinsurance result as percentage of the reinsurance premium. Together with modules 1 and 3, module 2 will be the basis for obtaining stochastic scenarios for the severity of the reinsurer's net economic loss and finally for calculating the ERD in module 4.

3. Loss development patterns module

Based on the loss development patterns for each line of business covered by the contract, SERD method calculates the discounting adjustments in the present value of the reinsurer's net economic loss required for calculating ERD. The user will be asked to provide loss development patterns for each line of business. In those cases when the patterns are not available, the SERD method will provide default market patterns for each line of business. For the reinsurance premium and all kinds of commissions, the SERD method assumes the full payment within one year (no development after the first year).

4. Scenario generating and the ERD calculating module

In this module, the SERD method generates probabilistic scenarios for the severity of the reinsurer's net economic loss and then, based on these scenarios, calculates ERD and cumulative probabilities for different severity values in the same manner as shown above for the example Financial Quota Share. Behind the scenario generating module is a stochastic Monte Carlo simulation which is carried out automatically based on the user specific and default parameters as defined in modules 1, 2 and 3. This automatic simulation engine represents one of the main strengths of the suggested method. In a conventional ERD calculation framework, stochastic Monte Carlo simulation usually is one the most technically challenging parts which often is a too heavy burden for many market participants and regulators. The suggested SERD method fully automates the most difficult part of the calculation so that the user does not need to worry about it, the method does it automatically.

To illustrate our approach, we applied the suggested SERD method to the Financial Quota Share example shown in Section III where the full-fledged stochastic model was applied, and then compared the ERD results obtained with both methods.

As a more detailed description of the SERD method for this example has been provided in Annex II, below we provide only the results of the SERD Module 4 – the probabilistic scenarios for the severity of the reinsurer's net economic loss and the resulting ERD. Table IV.1 below shows the results of the SERD method in the same format as the results of the conventional ERD calculation in Section III.

Table IV.1. SERD method, results for the Financial Quota Share example

Scenario N (aggregated scenarios)	A. Realization probability	B. Severity of reinsurer's net economic loss	Scenario N (aggregated scenarios)	A. (continued) Realization probability	B. (continued) Severity of reinsurer's net economic loss
1	78.6%	0%	14	0.4%	13%
2	3.0%	1%	15	0.4%	14%
3	2.6%	2%	16	0.3%	15%
4	2.3%	3%	17	0.3%	16%
5	2.1%	4%	18	0.2%	17%
6	1.8%	5%	19	0.2%	18%
7	1.4%	6%	20	0.1%	19%
8	1.4%	7%	21	0.1%	20%
9	1.2%	8%	22	0.1%	21%
10	0.9%	9%	23	0.1%	22%
11	0.8%	10%	24	0.1%	23%
12	0.7%	11%	25	0.3%	24%
13	0.6%	12%	26	0.0%	>=25%

ERD calculates to

$$ERD = \sum_{i=1}^{26} A_i \cdot B_i = 1.4\%.$$

As we see, with the ERD value of 1.4% resulting from the SERD method, the contract still fulfills the ERD test, however this value deviates from the value obtained with a full stochastic model (1.9%), cf. Table III.2. The reason for this deviation is that the default value for the standard deviation of the basic loss ratio deviates from the specific value used when deriving the full stochastic model. Default value is 10% and in the full model we worked with 12%. Also for the shape parameter of the severity distribution for the individual large loss exposure (Pareto alpha) there has been a difference between the value used in the full stochastic model (2.4) and the default value in the SERD method (2.5). The observed differences in results demonstrate that with the default values selected by the user under the SERD approach the contract shows less risk transfer. This can be seen from the higher probabilities of the lower loss severities in the Table IV.1 compared to the Table III.2 and of course from the lower resulting ERD value of the SERD method compared to the full stochastic method. This deviation in results is the price one has to pay for omitting the technical burden of the full stochastic model.

It is worth noting however that if all unique distribution parameters were available, our proposed SERD method would produce the same result as the full stochastic ERD method.

Consequently, we believe that the suggested SERD method is considerably less costly to implement, which makes it a robust alternative to the ERD which relies on full-fledged unique stochastic models of the risk.

In conclusion, we would like to note that other quantitative risk transfer tests, such as, for example, the 10-10 rule, could also be automated in the same manner as the suggested SERD method automates the ERD test. Therefore, the approach to calculating the ERD values proposed in this paper can be also viewed as a methodological framework applicable to a wide range of risk transfer tests used by insurance regulators and the insurance industry.

Section V. Summary

Despite the existence of numerous quantitative approaches to the categorization of financial reinsurance contracts, often insurance regulators may find the practical implementation of the task to be technically challenging. To simplify the categorization process, in this paper we first conveniently summarize the existing pertinent literature on the subject with the view to helping insurance regulators to first apply some simple indicators to flag the main issues with financial reinsurance contracts that may need further reviews. Some of such obvious "red flags" are [9]:

- Contracts, including clauses, that change the nature of how risks are transferred
- Contracts including different and diverse lines of business, making it difficult to assess the risk and exposures of the transfer
- Contracts where cedants do not follow formal processes or guidelines
- Signed contracts near financial year end covering past periods or earlier years; or, when contracts are backdated (i.e. replicating a retroactive coverage)
- Contracts combining financial reinsurance with traditional reinsurance contracts, making it difficult to assess the two contracts separately.

Having identified the suspicious reinsurance contracts, supervisors may consider (a) conducting on-site inspections of reinsurance programs and risk management practices, (b) requesting annual attestations from the management on risk transfers reporting accuracy, (c) further expanding actuaries' responsibility to cover the analysis of risk transfer content in reinsurance contracts when submitting reinsurers' system assessments, (d) reviewing companies' annual reinsurance plans, and (e) implementing reinsurance "whistle blower" programs mainly focusing on actuaries and auditors.[9]

In some cases, requiring further quantitative testing of risk transfer contracts for categorization purposes, supervisors may also consider adopting the SERD approach to contract testing presented in this paper. The approach advocates the use of a simple standardized stochastic method that would allow market participants and regulators to perform robust quantitative tests quickly and at an affordable cost. Besides addressing the obvious drawbacks of the "10-10" test, the proposed alternative method allows to greatly reduce the technical challenges posed to the users by the ERD approach based on full stochastic models with only a minimum loss of predictive accuracy.

Annex I. Summary of Accounting Treatment and Relevant Literature of Risk Transfer Contracts

There are different methods to categorize risk transfer contracts. In this Annex, we summarize pertinent accounting treatments and regulatory interpretations of risk transfer contracts as provided by relevant accounting standard setters, professional and regulatory bodies. These are as follows:

US-GAAP Financial Accounting Standards (FAS)
In 1992, the Financial Accounting Standards Board issued FASB Statement No. 113[26] attempting to provide a guidance that defines risk transfer and to avoid potential abuses in US-GAAP standards [1]. The standard specified that the following conditions must be met by a contract to be categorized as risk transfer:

FAS 113 par. 9. Indemnification of the ceding enterprise against loss or liability relating to insurance risk in reinsurance of short-duration contracts requires both of the following, unless the condition in paragraph 11 is met:
a. The reinsurer assumes significant insurance risk under the reinsured portions of the underlying insurance contracts.
b. It is reasonably possible that the reinsurer may realize a significant loss from the transaction.

FAS 113 par. 10. The ceding enterprise's evaluation of whether it is reasonably possible for a reinsurer to realize a significant loss from the transaction shall be based on the present value of all cash flows between the ceding and assuming enterprises under reasonably possible outcomes, without regard to how the individual cash flows are characterized. The same interest rate shall be used to compute the present value of cash flows for each reasonably possible outcome tested.

FAS 113 par. 11. Significance of loss shall be evaluated by comparing the present value of all cash flows, determined as described in paragraph 10, with the present value of the amounts paid or deemed to have been paid to the reinsurer. If, based on this comparison, the reinsurer is not exposed to the reasonable possibility of significant loss, the ceding enterprise shall be considered indemnified against loss or liability relating to insurance risk only if substantially all of the insurance risk relating to the reinsured portions of the underlying insurance contracts has been assumed by the reinsurer.[27]

FAS 113 par. 67. Under very limited circumstances, the reinsurer need not be exposed to the reasonable possibility of significant loss for a contract to meet the conditions for reinsurance accounting. For example, applying the "reasonable possibility of significant loss" condition is problematic when the underlying insurance contracts themselves do not result in the reasonable possibility of significant loss to the ceding enterprise. The Board concluded that, when the reinsurer has assumed substantially all of the insurance risk in the reinsured portions of the underlying policies, even if that risk does not result in the reasonable possibility of significant loss, the transaction meets the conditions for reinsurance accounting. In this narrow circumstance, the reinsurer's economic position is virtually equivalent to having written the insurance contract directly. The risks retained by the ceding enterprise are insignificant, so that the reinsurer's exposure to loss is essentially the same as the insurer's.

In 2009 the FASB Accounting Standard Codification was implemented, superseding all previous FASB pronouncements and other authoritative literature.

The risk transfer rules can now be found under FASB ASC 944-20-15-41 through15-54 and FASB ASC 944-20-55-50 through 55-58.

[26] See FAS 113 "Accounting and Reporting for Reinsurance of Short-Duration and Long Duration Contracts" . Other relevant US-GAAP accounting guidance can be found under FAS 5, FAS 60, EITF-93-6, EITF 93-14, EITF D-34, EITF D-35, EITF D-54 and SOP 98-7.

[27] This condition is met only if insignificant insurance risk is retained by the ceding enterprise on the reinsured portions of the underlying insurance contracts.

For US Statutory purpose there are similar risk transfer rules codified under Statement of Statutory Accounting Principles No. 62 Property and Casualty Reinsurance (SSAP 62).[2]

In the United States, neither FAS 113, the FASB Accounting Standards Codification nor Statement of Statutory Accounting Principles No. 62 gives further descriptions on the definition of the terms “reasonably possible”, “significant loss” or “substantially all” or any quantitative guidance. Because of this gap, different practice rules (like the “10-10” rule) were developed.

If not sufficient risk is transferred for short-term contracts (underwriting and/or timing risk[28]), US-GAAP introduced Statement of Position 98-7 Deposit Accounting: Accounting for Insurance and Reinsurance Contracts That Do Not Transfer Insurance Risk (SOP 98-7). This guidance can nowadays be found under FASB ASC 340-30. Any income or expense (so-called “income or expense from deposit”) should be recorded as other income or expense and not under the investment or underwriting result. Also in the balance sheet separate items (“deposit asset” and “deposit liability”) should be recorded.

In 1993, Ernst and Young published the accounting guide “Financial Reporting Developments, Accounting and Reporting for Reinsurance of Short-Duration and Long-Duration Contracts”. This paper was recently updated including the new FASB Codification. This paper gives detailed guidance on accounting for reinsurance contracts including contracts with limited risk transfer.[23]

Also an essential guide for professional accountants are the two publications of Coopers & Lybrand of 1993 and 1996 (Implementing FASB Statement 113: A Management Guide: Accounting for Reinsurance Contracts, 1993 and Reinsurance Accounting Update 1995, A Management Guide – A Supplement to Implementing FASB Statement 113, January 1996). [24] [25]

International Financial Reporting Standard (IFRS)

Outside the United States, IFRS 4 (“Insurance Contracts”) [3] narrows the scope on the definition of significant insurance risk by saying that “insurance risk is significant if, and only if, an insured event could cause an insurer to pay significant additional benefits in any scenario, excluding scenarios that lack commercial substance (i.e., have no discernible effect on the economics of the transaction). If significant additional benefits would be payable in scenarios that have commercial substance, the condition in the previous sentence may be met even if the insured event is extremely unlikely or even if the expected (i.e. probability-weighted) present value of contingent cash flows is a small proportion of the expected present value of all the remaining contractual cash flows” (IFRS 4 B23). In addition, IFRS 4 B24 states that the “additional benefits described in paragraph B23 refer to amounts that exceed those that would be payable if no insured event occurred (excluding scenarios that lack commercial substance).” For IFRS 4 only sufficient underwriting or timing risk is needed that a contract qualifies as reinsurance (IFRS 4 B2). Also under IFRS no quantitative guidance is given to define the term “significant”.

[28] FASB ASC glossary defines the terms insurance risk, underwriting risk and timing risk as follows:
Insurance risk: The risk arising from uncertainties about both underwriting risk and timing risk. Actual or imputed investment returns are not an element of insurance risk. Insurance risk is fortuitous; the possibility of adverse events occurring is outside the control of the insured.
Underwriting risk: The risk arising from uncertainties about the ultimate amount of net cash flows from premiums, commissions, claims, and claim settlement expenses paid under a contract.
Timing risk: The risk arising from uncertainties about the timing of the receipt and payments of the net cash flows from premiums, commissions, claims, and claim settlement expenses paid under a contract.

If under IFRS the contracts fails risk transfer, it has to be recorded under IAS 39 or IAS 18 (IFRS 4 B20), depending on the applicable standard. Please note, that therefore in practice the disclosure of an contract not meeting sufficient risk transfer can differ under IFRS and US-GAAP.

American Institute of Certified Public Accountants (AICPA)
The AICPA publishes the paper "Evaluating Risk Transfer in Reinsurance of Short-Duration Contracts" [12] in 2003. The study mainly focuses on the risk transfer test. The paper discusses the definition of a contract, whether a single contract should be bifurcated, determining significant insurance risk and the criteria to meet substantially all/virtually equivalent. As this paper includes different views on some specific questions it is helpful to interpret the guidance of the FASB. In addition, it gives some examples on risk limiting features.

In 1994 the AICPA issued a paper entitled "Putting Away for a Rainy Day AICPA Case 94-08" [20]. This paper gives some practical examples for funding covers, i.e. a contract where a certain amount is paid into an experience account that will be used to pay for future or past losses.

Casualty Actuarial Society (CAS)
In 2002, the Valuation, Finance, and Investments Committee (VFI Committee) of the Casualty Actuarial Society (CAS) published the research paper "Accounting Rule Guidance Statement of Financial Accounting Standards No. 113 – Considerations in Risk Transfer Testing" [6]. This paper discusses the terms "reasonable possibility" and "significant loss" and the shortcomings of the "10-10" test. This paper introduces the Expected Reinsurer's Deficit as a method to overcome the existing shortcomings for high severity – low frequency or vice versa contracts. It also gives some practical advice on the cash flows analysis and the handling of certain contract components, e.g. internal expenses or brokerage.

In 2005, the CAS Research Working Party on Risk Transfer Testing published a report entitled "Risk Transfer Testing of Reinsurance Contracts: Analysis and Recommendations" [5]. This paper was prepared in response to a call from the American Academy of Actuaries' (AAA) Committee on Property and Liability Financial Reporting (COPLFR), in which COPLFR requested ideas about how to define and test for risk transfer in short duration reinsurance contracts as required by FAS 113 and SSAP 62. This paper discusses the shortcomings of the "10-10" rule in more detail and gives examples for the Expected Reinsurer's Deficit test (ERD) and a test based on the right tail deviation (RTD). Also the main part of the document discusses which contracts would meet the "substantially all"-exemption.

American Academy of Actuaries (AAA)
In August 2005, the paper "Risk Transfer in P&C Reinsurance: Report to the Casualty Actuarial Task Force of the National Association of Insurance Commissioners" [7] by AAA's COPLFR (Committee on Property and Liability Financial Reporting) was published. It contains a survey, carried out by the NAIC's Casualty Actuarial Task Force, of current industry practices regarding risk transfer. In addition, alternative approaches to evaluating risk transfer are discussed. This report and its appendices are a compilation of insurance

company responses and ideas on the topic of risk transfer with reinsurance contracts. This report also includes the above mentioned CAS working paper report on risk transfer.

In November 2005, AAA's COPFLER published the paper "Reinsurance Attestation Supplement 20-1: Risk Transfer Testing Practice Note" [11] in respect to the Property and Casualty Annual Statement Instructions for 2005 issued by the National Association of Insurance Commissioners (NAIC). The objective of the note was "to provide advisory, nonbinding guidance to property/casualty actuaries regarding testing for risk transfer". In January 2007, COPFLER published another update of the Practice Note including an Appendix providing sample checklists provided by individual companies. These checklists provide some details on how companies address their internal compliance monitoring regarding evaluation and documentation of sufficient risk transfer. These checklists contain specific questions and helpful details to develop a company specific checklist to identify contracts which have to be tested further regarding sufficient risk transfer and their documentation.

International Association of Insurance Supervisors (IAIS)

In October 2006, the International Association of Insurance Supervisors (IAIS) published a "Guidance Paper on Risk Transfer, Disclosure and Analysis of Finite Reinsurance" [9]. This paper gives a brief overview on the history and the current developments of financial reinsurance. It also analyses general functions of reinsurance and the specific reasons for choosing finite. This paper also includes some specifics for life and non life traditional and financial reinsurance. It also gives a brief overview on different accounting standards, like US-GAAP and IFRS, and their risk transfer requirements. It summarizes the different definitions of "finite reinsurance" developed by accounting standard boards or professional and regulatory bodies. Examples of supervisory approaches to finite reinsurance in different international supervisory regimes are included and recommendations for supervisors are provided.

Canadian Institute of Actuaries (CIA)

The Canadian Institute of Actuaries (CIA) issued the "Report of the CIA Task Force on the Appropriate Treatment of Reinsurance" in October 2007 [10]. This document summarizes the accounting treatment under US-GAAP, IFRS and Canadian GAAP and defines some finite specific terms. This paper gives some guidance on assessing risk transfer including a list of risk limiting features.

Other publications

In 2009, Vendetti [13] and DesRochers [15] published two most recent papers on risk transfer. The Freihaut and Vendetti's paper [13] discusses several practical considerations with risk transfer analysis by providing guidance on how to address them based on publications from the American Academy of Actuaries (AAA) and the Casualty Actuarial Society (CAS). DesRochers [15] provides an overview on all relevant accounting and actuarial aspects of risk transfer assessments by also adding a taxation perspective.

Annex II. SERD Method for the Financial Quota Share Example

In this Annex, we provide details of the suggested SERD method and show its application to the Financial Reinsurance Quota Share example presented in Section III where the ERD was calculated conventionally with help of a full stochastic model. To carry out the calculations with the suggested SERD method, we applied a prototype SERD tool which developed by the authors. The figures provided in the Annex II show the input and output interfaces of this tool. Furthermore, we provide the explanation on how to work with these interfaces.

The starting point of the SERD method is to choose one or more line of business contributing to the overall risk exposure covered by the contract, cf. Figure 1 below. With this set, we follow the Solvency II QIS5 approach for Non-life and non-SLT Health [18].

Figure 1. SERD Tool: Line of Business Interface

Line of Business	
Motor vehicle liability	x
Motor, other classes	
Marine, aviation, transport (MAT)	
Fire and other property damage	
Third-party liability	
Credit and suretyship	
Legal expenses	
Assistance	
Miscellaneous	
Medical expense	
Income protection	
Workers' compensation	

For the Financial Quota Share example, we choose the line of business "Motor Vehicle Liability" by marking the corresponding line in the blue area (in this and all following figures depicting the tool interfaces, blue color marks the input fields).

The SERD method consists of the following four modules[29]:

1. Loss modeling module
2. Reinsurance transaction module
3. Loss development patterns module
4. Scenario generating and ERD calculating module

Modules 1 and 3 assess the overall contract risk exposure, Module 2 examines the risk transfer effect of the reinsurance transaction and finally Module 4 calculates the ERD value. In Modules 1, 2 and 3, the SERD tool requests the user to enter some parameters and specific characteristics of the underlying risk exposure and the reinsurance contract, cf. the detailed description of the modules provided below.

[29] Please note that the approach described below applies for proportional reinsurance contracts. As non-proportional contract usually do not provide any substantial solvency capital relief, their regulatory treatment and categorization as reinsurance or financial instruments usually do not include any solvency capital requirements related aspects.

1. Loss modeling module

(a) Basic loss

In the loss modeling module, the method allows for differentiating between basic, large and cat loss burdens. The basic loss modeling is based on the assumption that the loss ratio of the basic loss, aggregated over the annual contract term, is distributed according to the lognorm distribution. With this choice, we follow the Solvency II (QIS5) approach [18]. The user is asked to enter the expected ultimate loss ratios for all lines of business covered by the contract.

The figure below shows the Basic loss interface of the ERD tool for the Financial Quota Share example. In the first blue column, the user provides the expected ultimate loss ratio of 80% as valid for this example.

Figure 2. SERD Tool: Basic Loss Interface

Chosen LoB's	Expected LR	Use USP for LR Std Dev?	USP	LR Std Dev
Motor vehicle liability	80%	NO		10.0%

In the second input column, the user specifies whether he/she would use unique parameters of the insurance undertaking (following Solvency II framework we call these parameters USP – Undertaking Specific Parameters) for the standard deviation of the ultimate loss ratio or standard default values. If the USP values are used, these values are provided in the third blue column. Otherwise, the tool will use the default standard deviation values, as shown in the table below. These values are taken from [18] (Solvency II QIS5, cf. QIS5 Technical Specification, Par. SCR.9.25, SCR.8.72).

Even though, in the Financial Quota Share example presented in Section III, the value of 12% was available for the standard deviation, in the SERD calculation example this USP value was omitted and the default value for the underlying line of business was used instead, cf. Figure 2. This was done to demonstrate the approach for a case when USP value were not available and also to examine the effect of using default values instead of the USP values on the resulting ERD later on.

Table 1. Default values of the ultimate LR standard deviation by line of business

Line of Business	Loss Ratio Std Dev.
Motor vehicle liability	10.00%
Motor, other classes	7.00%
Marine, aviation, transport (MAT)	17.00%
Fire and other property damage	10.00%
Third-party liability	15.00%
Credit and suretyship	21.50%
Legal expenses	6.50%
Assistance	5.00%
Miscellaneous	13.00%
Medical expense	4.00%
Income protection	8.50%
Workers' compensation	5.50%

Following Solvency II and Swiss Solvency Test [18][19], the SERD method assumes some embedded correlations among different lines of business covered by the contract in their basic loss exposure. However, no correlation is assumed among the loss categories basic, large and catastrophe losses.

(b) Large loss

Following the inputs in the Basic loss section, the user proceeds to the next large loss section. The user will be asked to provide the expected number of the individual large losses per annum as well as the lower and upper loss thresholds for each line of business covered by the contract. The figure bellows shows these data inputs for the Financial Quota Share example (cf. first, second and third blue columns).

Figure 3. SERD Tool: Large Loss Interface

Chosen LoB's	Expected number of large losses p.a.	Lower loss threshold	Upper loss threshold	Use USP for Pareto alpha?	Pareto alpha
Motor vehicle liability	0.5	3,000,000	100,000,000	NO	2.5

The modeling of the individual large loss burden is based on the recognized international best practice assumption that the number of individual large losses per line of business is distributed according to the Poisson distribution and the loss severity according to the Pareto distribution. The parameter "Pareto alpha" describes the shape of the loss severity distribution.

Similar to the Loss Ratio standard deviation in the Basic loss section, the user is given an option to provide the USP values for Pareto alpha when available or to use the standard default values. These default values can be derived from the industry experience in other more mature markets. The choices used in our tool draw on the values of Pareto alpha suggested in the Swiss Solvency Test Standard Model [19]. Also for Pareto alpha, we omitted providing the USP value and worked with the default value instead. The reason is the same as in case of the standard deviation, to demonstrate the approach in the case when USP value were not available and to examine the effect of using default values instead of the USP values on the resulting ERD later on.

Table 2. Pareto alpha by lines of business (Swiss Solvency Test Standard Model)

Line of business	Lower loss threshold = CHF 1m	Lower loss threshold = CHF 5m
MVL (Motor vehicle liability)	2.5	2.8
MVC-hail (Motor vehicle comprehensive hail)	1.85	1.85
Property	1.4	1.5
Liability	1.8	2
UVG incl. UVGZ	2	2
Health Collective and Individual	3	3
Transport	1.5	1.5
Finance and surety	0.75	0.75
Others	1.5	1.5

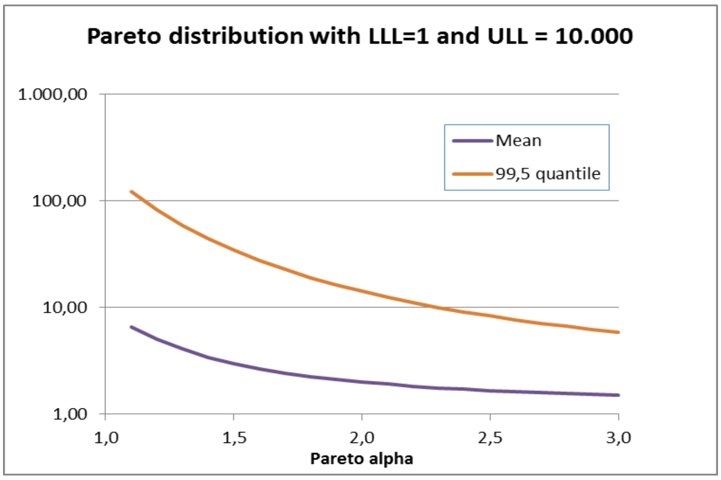
With this reference from the Swiss Solvency Test at hand, we selected the following parameters for our line of business classification, cf. Table 3 below:

Table 3. Default values of Pareto alpha by line of business

Line of Business	Pareto alpha
Motor vehicle liability	2.5
Motor, other classes	1.8
Marine, aviation, transport (MAT)	1.5
Fire and other property damage	1.4
Third-party liability	2
Credit and suretyship	0.75
Legal expenses	1.8
Assistance	1.5
Miscellaneous	1.5
Medical expense	3
Income protection	0.75
Workers‘ compensation	2

Please note, that the lower the parameter alpha the more prone the distribution is to higher losses as illustrated by the below diagram.

Diagram 1. 99.5-Quantile of Pareto distribution for different values of alpha parameter



(c) Catastrophe loss

If there is a catastrophe loss exposure, the user is asked to provide the loss exceedance curve describing the exposure. The corresponding tool interface is shown in Figure 4. For the Financial Quota Share example, we assumed that there is no exposure to natural catastrophe losses. Hence the input field is left empty.

Figure 4. SERD Tool. Natural Catastrophe Loss Interface

Return period, yrs	PML
5	
10	
20	
30	
40	
50	
100	
200	
300	
400	
500	
600	
700	
800	
900	
1000	

At a later stage the SERD method can be supplemented with catastrophe risk modeling capabilities to carry out assessments of natural catastrophe risk based on the sum insured aggregates instead of substituting them with a loss exceedance curve. This will further reduce the technical burden of the calculation when using the SERD method.

2. Reinsurance transaction module

This module captures the risk transfer effect of the reinsurance transaction taking into account its main features such as reinsurance and profit commissions, loss participations and loss corridors, loss caps, etc. For each value of the underlying risk exposure loss ratio, the user is asked to provide the corresponding value of the transaction result from the reinsurer's perspective (as percentage of reinsurance premium), cf. the first blue column in the figure below.

Further, the user will be asked to provide the value of reinsurance premium, cf. the second blue column in Figure 5.

For the Financial Quota Share example, the calculation of the reinsurer's result depending on the ultimate loss ratio has been already explained in detail in Section III when the example was introduced. Hence, here we only repeat the calculation formula:

Reinsurer's ultimate result (as [%] of the reinsurance premium)
= 100% – "ceded LR" – "RI comm." + "loss particip." + "discounting adjustment",

where "ceded LR", "RI comm." and "loss particip" are to be calculated according to the formulae provided in Section III.

With help of the above formula, the present values of the reinsurer's result can be easily calculated for different values of the ultimate loss ratio, cf. the first blue column in Figure 5.

Figure 5. SERD Tool. Reinsurance Transaction Interface.

Loss ratio	Reinsurer's ultimate result as [%] of the reinsurance premium	Reinsurance premium
1%	49%	100,000,000
2%	48%	
...	...	
46%	4%	
47%	3%	
48%	3%	
...		
87%	3%	
88%	2%	
89%	1%	
90%	0%	
91%	-0.8%	
92%	-1.6%	
...	...	
120%	-24%	
...	...	
200%	-24%	

Together with Modules 1 and 3, Module 2 will form the basis for obtaining stochastic scenarios for the severity of the reinsurer's net economic loss and ultimately for calculating ERD in Module 4.

3. Loss development patterns module

In this module, the user is asked to provide loss development patterns for each chosen line of business (on the cumulative paid basis). In cases when the USP patterns are not available, the SERD method will provide default market patterns for each line of business. For the reinsurance premium and all kinds of commission, we assume the full payment within one year.

Based on the development patterns, the SERD tool calculates the discounting adjustment factors for each line of business. These adjustment factors are used to calculate the present value of the reinsurer's net economic loss required for calculating ERD.

For the Financial Quota Share example, we assume that the loss is fully developed, i.e. reaches its ultimate value within one year and hence there is no discounting adjustment. According to our assumption, 100% is entered for the first year and zeros for all following years, cf. Figure 6 below.

Figure 6. SERD Tool. Loss Development Patterns Interface

Chosen LoB's	Use UP for loss development pattern	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7	YR 8
Motor vehicle liability	NO	100%	0%	0%	0%	0%	0%	0%	0%
Default pattern		40%	30%	20%	5%	2%	1%	1%	1%

4. Scenario generating and ERD calculating module

In this module, the SERD method generates the probabilistic scenarios for the severity of the reinsurer's net economic loss and then based on these scenarios finally calculates ERD and cumulative probabilities for different possible severities of the net economic loss. Behind this calculation is a stochastic Monte Carlo simulation which is carried out automatically based on the user specific and default parameters provided in Modules 1, 2 and 3. This automatic simulation engine represents one of the main strengths of the suggested method. In a conventional ERD calculation framework, a stochastic Monte Carlo simulation usually represents one the most technically challenging parts which often is a too heavy burden for many market participants and regulators. The suggested SERD method eliminates the need for having the user perform this most difficult part of the calculation by running it automatically. For example, in the case of the Financial Quota share, the result shown in Figure 7 was obtained automatically from the tool.

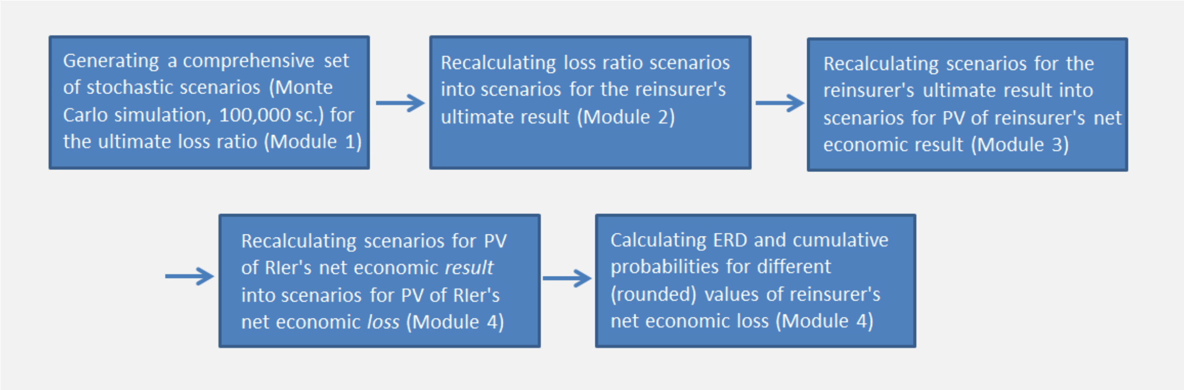
Figure 7. SERD Tool. ERD Output Tableau

A. Realization probability	B. Severity of reinsurer's net economic loss (as [%] of the RI premium)	ERD = sumproduct (Col A, Col B)
78.6%	0%	1.4%
3.0%	1%	
2.6%	2%	
2.3%	3%	
2.1%	4%	
1.8%	5%	
1.4%	6%	
1.4%	7%	
1.2%	8%	
0.9%	9%	
0.8%	10%	
0.7%	11%	
0.6%	12%	
0.4%	13%	
0.4%	14%	
0.3%	15%	
0.3%	16%	
0.2%	17%	
0.2%	18%	
0.1%	19%	
0.1%	20%	
0.1%	21%	
0.1%	22%	
0.1%	23%	
0.3%	24%	
0.0%	25%	
0.0%	26%	
0.0%	27%	
0.0%	28%	
0.0%	29%	
0.0%	30%	

As explained above, due to our previous assumption on the development patterns for the Financial Quota Share example, no discounting adjustment has been made. In a generic case, the discounting adjustment, based on the loss development pattern, as calculated in Module 2, would be taken into account when calculating the reinsurer's net economic loss in Module 4. In this example, the estimated ERD is 1.4%.

In conclusion, below we provide a flow chart which summarizes all the intermediate steps of the SERD method as implemented in the above described prototype tool.

Figure 8. Flow chart SERD method with the prototype tool



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