A Stakeholder Approach to Risk Financing Programs

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Abstract
Most businesses that purchase property/casualty insurance design these programs using inappropriate analytical methods that result in inefficient insurance programs. Such programs often provide insurance to reduce variability that does not concern an entity's stakeholders, while offering no protection for the catastrophic losses that do concern them. This paper presents a new approach that orients the insurance program to the entity's overall stratetgies, and therefore to the key issues that concern its stakeholders. This approach can result in dramatically different programs than those used today.

The new approach combines financial analysis of the variability of an entity's key financial parameters, which determines risk retention thresholds, with actuarial analysis of an entity's relevant exposures, which determines appropriate individual retention levels for each relevant exposure. Thus, an entity's aggregate retention threshold is allocated optimally among the exposures.

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I. OVERVIEW

How should organizations best structure their insurance programs? This question has received increased attention over the past few years, and forms the foundation of this paper.

A. Limitations of Insurance

Most current commercial insurance programs have limitations. First, they do not reflect the true risk bearing capacity of the entity. Routinely, billion-dollar companies make decisions about risks that could cost them hundreds of millions of dollars. Oil companies, for instance, invest in potential reserves whose value can fluctuate by hundreds of millions of dollars in a single day based on a range of difficult-to-predict variables, such as interest rates, weather, or consumer demand. However, many large companies also purchase directors and officers liability insurance that has limits of a few million dollars, and deductibles under $100,000[1]. One sudden change in interest rates or currency values represents more risk than the most serious directors and officers claim imaginable.

Second, the entity frequently has greater financial strength than the insurer. The largest corporations are stronger, in terms of shareholder equity, than the largest p/c insurers.[2]

Also, many insurance programs are not sensitive to the actual exposure to loss that arises within an entity. An oil company confronts exposure to environmental damage that could run into the billions of dollars. However, the most insurance available for such an event is typically under $100 million.

These various factors result in inappropriate insurance programs for most large companies. They cannot purchase insurance that will truly help them, and instead buy insurance that they do not seem to need.

B. Available vs. Need-Based Financing

This situation appears to arise out of a flawed analytical perspective on the part of most entities. Most decisions related to controlling financial risk seem to begin with the assumption that an entity will purchase insurance for a given exposure. The entity then designs an insurance program that specifies the amount of loss that they can retain and the limits that they need to purchase.

The entity typically arrives at a retention level by analyzing the trade-off between a fully-insured program and one in which the entity assumes some of the risk of loss. They generally compare premiums saved from retaining risk to the additional claims costs that it must pay.

This is a unique perspective, relative to how companies purchase just about everything else that they buy. We can think of no other circumstance in which an entity assumes it will purchase something, and then justifies not having it. For most every other purchase of which we are aware, from coffee cups to capital financing, the entity identifies a potential benefit that it desires, then justifies a purchase that provides that benefit.

We propose a different, new approach that begins with the assumption that the entity does not purchase insurance. The entity then analyzes the benefit of having insurance, in terms of reduced costs and reduced variability in financial results. An entity that purchases insurance pursuant to this goal will automatically orient their insurance program to its other strategies. In particular, its financial structure and performance will dictate the retention levels that it assumes.

In this way, the entity purchases insurance only when it eliminates material variability in financial results. Such variability would cause stakeholders to question management's competence and its ability to operate the entity. This new way thus represents a stakeholder approach to risk financing programs, and results in a strategic risk financing program.

C. A Strategic Perspective

This paper explains this new analytical perspective, identifies the analyses needed to exploit it, and explores its implications. In doing so, a new perspective for structuring insurance programs is defined. A strategic risk financing program is a risk financing program that conforms to three strategic objectives:

- It takes a long-term view of the entity's financial goals and risk financing program.
- It is consistent with the entity's other financial and business strategies.
- It is need driven, not market driven, and dictates to the insurance market the precise structure of an entity's insurance retentions, rather than having them forced on the entity by the insurance market.

This strategic perspective relies on three separate analyses. First, a financial analysis of the entity determines its retention levels, in the form of an aggregate amount of risk that the entity can assume. Second, an exposure analysis quantifies the costs arising out of the exposures within the scope of the risk financing program. Third, a combined analysis determines the exact structure of the risk financing program, and optimally allocates the aggregate retention level among the exposures.

One implication is that with this perspective, entities will likely purchase much less insurance than they have in the past. Also, the structure of the insurance programs that they do purchase will depend on different factors than they do now, and retention levels will fluctuate with the entity's financial strength. We also discuss how this idea can apply to a variety of exposures outside of the property and casualty realm, with similar implications and applications.

We believe that the approach and analyses that lead to a strategic risk financing program work best for medium-sized and larger entities, including corporations, governments, and non-profit institutions. Also, we will use a case study to illustrate key points of this thesis. The remainder of this paper defines a few terms that are central to our thesis, explains the three analytical tools, and sets forth our overall conclusions.

II. KEY COMPONENTS

Our premise relies on defining what we mean by a strategic risk financing program. Below, we define the key terms within this premise.

A. Program

A risk financing program is a system of financial instruments with four key components:

- limits of insurance
- retention levels
- methods of financing
- cost

Limit is defined as the amount for a given exposure or exposures that these products will pay to the entity. Retention is the amount that the entity will pay before the financial products will begin to pay the specified limit. Methods of financing relate to the source of the financial instruments, such as insurance, bank financing, debt financing, or equity financing. Finally, cost is the amount paid by the entity to the providers of the financial instruments. Premium is the familiar term for the cost of insurance products.

This formal definition of risk financing program implies some important practical questions, the answers to which entities require when structuring the program. These include: what retention level to assume? what limits to purchase? what is a fair price for the insurance program? This paper seeks to provide a method to answer the retention level question completely and rigorously.

B. Exposure

Exposure is a source of claims or losses to the entity. It is a flexible term, and can be used narrowly, as in fire losses at a given plant site, or broadly, as in workers compensation claims for the entire entity. For most of this paper, we use it to refer to property and casualty claims or losses. As we will show later, we need not limit it to property and casualty sources. Exposures, whether broadly or narrowly conceived, define the scope of the risk financing program being analyzed.

C. Financial results

Financial results are the dollar-valued outcome of an entity's operations and management decisions. They are one measure of the success of an entity, tracked closely by various stakeholders. These stakeholders include shareholders, management, employees, analysts and other observers. They are frequently expressed in dollars, such as net earnings or total expense, or as various ratios, such as earnings per share, return on equity, or debt-to-equity ratio. Financial results can pertain to either a single or a set of fiscal periods.

Importantly, each entity has its own set of parameters. These are determined by the nature of its operations and its stakeholders' needs. Identifying and understanding the key parameters requires an understanding of the issues that concern stakeholders about the business.

D. Variability

The final concept needing definition is variability. Financial results, as explained here, can vary from fiscal period to fiscal period. Stakeholders expect some level of variability, and to a point variability in results is acceptable. However, too much variability raises concerns among stakeholders about management's competence and ability to operate the entity. An entity should seek to define how much variability it can withstand before stakeholders begin to worry.

There are two related ways to define that level. First, it can examine past levels of variability for a given parameter. It can review the past few years' values for the parameter, and determine the acceptable boundaries of variability given past results.

Second, it can also characterize current expectations of these results. Various stakeholders form these expectations. Analysts have projected financial results. Management has budgeted and planned results. Even external constraints become important, such as covenants in bank financing arrangements that restrict some financial result, such as earnings per share, to a particular range.

These two ways are related in that stakeholders frequently form current expectations of results based at least in part on past variability of those results.

Variability also has nuances. It typically involves a single large deviation from historic or expected levels of financial results in a given fiscal period, such as that related to a catastrophe claim. However, it can also entail a series of smaller deviations that aggregate to a large deviation, such as those related to an increase in workers compensation claim frequency. It can even include deviation from historic or expected levels in a few fiscal periods out of many, say, two out of five.

Much like the concept of financial results, variability is specific to a given entity. Understanding the level of acceptable and unacceptable variability requires information about past variability in the key financial parameters, and about what various stakeholders expect for the entity in the relevant fiscal period or periods.

III. FINANCIAL ANALYSIS

The first analysis needed to create a strategic risk financing program is an assessment of an entity's financial status. This financial analysis seeks to characterize the acceptable and unacceptable variability in the entity's financial results.

A. Identify Key Stakeholder Financial Parameters

The analysis requires the entity to identify its key financial parameters. In the case study, we have identified three key parameters: net income, earnings per share, and return on equity (Exhibit 1).

How does an entity identify these parameters? There is no single method or formula for doing this. We identified the three parameters through a review of the entity's annual report and during a discussion with executives of the key measures that they follow. Other sources of information include reports and analyses from stock analysts that follow the entity, and incentive compensation plans that determine executive bonuses based on various performance measures.

For each of these three parameters in Exhibit 1, we have provided ten years of data for the entity. For some parameters, the data has varied considerably over time. For others, there is minimal apparent variability.

We have also provided three simplified pro forma financial statement for the case study entity (Exhibits 2-4). These projected results represent a base case, and include a projected value for each of the three relevant parameters. We seek to understand and determine what level of deviation from this base case is acceptable to stakeholders. Importantly, this base case implicitly includes expected costs associated with the exposures within the risk financing program. The past actual cost of these exposures is included in past results, and incorporated into the values of the key parameters.

The projected results and the base case in the case study are taken from a single analyst report. Much deeper analysis is possible, incorporating a variety of analyst projections, possibly performing regression analyses of past parameter values, adding management's own projections and budgeted results, etc.

B. Characterize Acceptable Variability in Parameters

A key question becomes: how much variability in these parameters will stakeholders accept? As indicated above, we can think of two sources of information for answering this question: past results and current expectations. Past results help define the boundaries of acceptable and unacceptable variability. If an entity's parameters have varied widely over time, additional variability will not concern stakeholders much. However, if the entity's results have been very stable over time, additional variability will concern stakeholders.

Second, current expectations of results will help determine what variability is acceptable. If stakeholders have a wide range of expectations, based perhaps on their understanding of the current economic environment or other factors, relatively more variability within this range is more acceptable to them.

We have used both sources of information to determine an extreme level of variability for the three key parameters in the case study. The extreme level represents the most deviation from the base case estimate of each parameter that stakeholders will accept without becoming concerned about management's capacity to run the entity.

Also, the various parameters are not usually independent, and stakeholders may have concerns about the interactions of various parameters. For instance, a substantial deviation in one parameter may not concern stakeholders, as long as other parameters counteract that one parameter. Modeling the interaction of various parameters, perhaps using linear programming methods, would lead to a single base case, instead of base cases for each parameter.

For now we have defined variability as deviation from a base case in a single fiscal period. More sophisticated definitions are possible and needed. For example, stakeholders of a given entity may be concerned about a series of deviations over two or three years, instead of in a single year. Or, they may be concerned about two very bad years out of five. Using these more sophisticated definitions would require extending the base case over several years, and creating a multi-year projection of the entity's parameters.

We must remember that determining acceptable variability involves management's judgments and objectives. We assume implicitly that the entity is financially healthy, and that management seeks continued growth. Continuity of operations, or just pure survival in a market, may be a goal of certain undeveloped companies, and would be considered in assessing the appropriate level of risk tolerance.

C. Determine Level of Financial Tolerance

We can use the difference between the base case and extreme case to translate the variability in parameters into a level of financial tolerance. For each of the three parameters in the case study, we have converted the difference in the parameter between the base and extreme cases into a difference in entity expenses.

This conversion leads to a key assumption. We assume in this analysis that the variability we are studying arises out of an unplanned increase in expenses, rather than some other source, such as decreased revenues. This follows from our need to understand the impact that given exposures have on the entity. Such an increase can arise, for example, from unexpected losses arising out of exposures within the risk financing program.

The difference in entity expenses represents the margin for variability arising out of the entity's exposures. Recall that the base case implicitly includes the expected costs for the various exposures in the risk financing program. This margin represents the maximum deviation from these expected costs that the entity can withstand before stakeholders become concerned about the entity. It defines the magnitude of uninsured losses that the entity can absorb.

In the case study, the margin for the extreme case ranges from $2 million to $4 million for the three parameters. We judgementally use the level $3 million, taken as the approximate midpoint of that range, for the rest of this discussion (see Exhibit 5). This amount, plus the expected value of the aggregate loss distribution (discussed in next section), represent the aggregate amount of variability that the entity can withstand from all sources or exposures. Other approaches can be used to compute this margin of variability from among the various parameters in a more rigorous way..

IV. EXPOSURE ANALYSIS

The second analysis will be more familiar to casualty actuaries. Strategic risk financing pertains to various exposures. Management of the entity needs to understand the statistical and financial characteristics of these exposures, and integrate this understanding with the financial ability of the entity to absorb variability arising out of these exposures. This second analysis briefly discusses ways to understand these exposures.

Any risk financing program involves various exposures, each of which will have a distribution of potential outcomes, with an expected cost and a variance. The methods for computing the distribution will naturally vary by exposure. Traditional casualty actuarial techniques can be used for workers compensation or liability exposures. More sophisticated models would be needed for more complicated exposures, such as property exposures in earthquake zones.

Importantly, this analysis need not be confined to property and casualty exposures. Any "exposure", as defined above, can be included. The only requirement is that it has a distribution of outcomes with a mean and a variance.

In the case study, we have modeled four illustrative exposures (see box at top of Exhibit 6). The case study uses "unlimited" data for computing the mean and variance of the distribution for each exposure. The unlimited mean equals $7.0 million, while the standard deviation equals $7.1 million. Using the independent analysis described in Section III C. above, we derive a threshold level of tolerance of $7 million + $3 million = $10 million.

V. COMBINED ANALYSIS

The entity now has incorporated pieces of a financial and an actuarial analysis to determine a threshold level of tolerance (equal to expected losses plus a margin for extreme case losses). Below this point, it is willing to absorb all variability. The key question now becomes how to "manage" this aggregate fiscal period threshold to create an "optimal" risk financing program structure. Naturally, stakeholders would like to see the entity maintain its financial results within the defined level of tolerance, while also doing so at a minimum cost (i.e. get the most risk reduction for the money).

A. Options

One way to manage variability of loss exposures is to purchase insurance with per-occurrence retentions for each exposure low enough such that there is zero probability that the entity will exceed expected losses plus the margin ($10 million in this case). Our model will quantitatively show that this is always a suboptimal option.

One can also see why this is suboptimal using the following rationale. Assume that for a given level of known risk, it is always cheaper to self-insure than to insure. Much insurance literature has been devoted to comparing the costs of self-insuring to the expense and profit loading included in insurance premiums to justify whether this assumption holds. While validation of this assumption is obviously affected most heavily by pricing in the commercial insurance marketplace, both the studies, and the reality of the marketplace shift toward more self-insurance in the last ten years, have borne out the inherent savings capabilities of self-insurance. We will assume that insurance prices are set accurately, and that the non-loss cost portion of premium outweighs the above (and all other) costs of self-insuring. Therefore, if there is potential for the entity to assume more risk yet still be assured it will not exceed its aggregate risk threshold, it is wiser to do so.

Another way to manage the portfolio to stay below the threshold is to purchase some form of aggregate insurance product that will limit the entity's losses to exactly that level. However, we are not aware of any insurer that will provide an infinite limit of excess coverage above the specified retention, covering all sources of loss to the entity. We are therefore left with an entity that needs to structure an optimal balance of per occurrence risk retention and risk transfer mechanisms among the relevant exposures within the threshold and with a minimum cost.

B. Model Assumptions

The entity must consider three primary factors in forming its optimal risk financing structure:

- Expected cost
- Expected standard deviation or variance
- Probability of exceeding the risk threshold.

In other words, the entity aims to minimize its costs, to limit its variability, and to place a heavy emphasis on staying below its threshold for risk. To model these factors, we make the following assumptions:

1. Four independent exposures, with a combination of high frequency/low severity, low frequency/high severity claims.
2. Severity distributions of exposure i: X_i (random variables)
3. Frequency distributions of exposure i: N_i (random variables)
4. Per-occurrence limits for exposure i: L_i
5. Expected specific excess cost for exposure i: $f(L_i, R_i)$, which includes a risk load provision R_i, and a 10% load (of expected losses) for expenses.

C. Model Definitions/Simulations

Now we define the following cost function:

$$Y = [\, \Sigma \min (X_1, L_1) + \Sigma \min (X_2, L_2) + \Sigma \min (X_3, L_3) + \Sigma \min (X_4, L_4) +$$

$$f(L_1, R1) + f(L_2, R_2) + f(L_3, R_3) + f(L_4, R_4) \,],$$ where Σ is defined from 1 to N_i.

Some properties of Y are:

- Y is a random variable since it is dependent upon X_i and N_i, which are random variables.
- Y is a cost function (to be minimized).
- If the distributions for N_i, X_i, and R_i are known, Y will depend on L_i.

We have used the following theoretical distributions to model the cost function, though empirical data can be used as well:

N_i = Poisson, with parameters defined separately by exposure

X_i = Lognormal, with parameters defined separately by exposure

$R_i = \lambda \times \mu(X_i)$, where λ is defined to achieve a target return, and $\mu(X_i)$ is the average severity for X_i.

Then the distribution of Y can be defined by $F(\mu, \sigma^2)$, where:

$\mu = g_1 (L_1, L_2, L_3, L_4)$, the expected overall cost

$\sigma^2 = g_2 (L_1, L_2, L_3, L_4)$, the expected overall variance.

As described earlier, the entity must also be very concerned about exceeding its risk threshold ($10 million, in this case). Therefore, we can define:

$p = g_3 (L_1, L_2, L_3, L_4)$, where p is the probability that Y < risk threshold.

We now simulate Y over a number of L_i combinations to determine sample values for μ, σ^2, and p.

Then, we define a utility function that describes preferences in terms of the three main factors described above (cost, standard deviation, probability of exceedence).

For example : $U(\mu, \sigma^2, p) = -(k_1\mu + k_2\sigma + k_3p)$.

Now, simulate U to find the best set of L_i that maximize U (i.e. minimize the negative).

Exhibit 6 displays 14 sample simulation outcomes in deriving the utility function U. For the retention combinations shown, the retained mean, retained standard deviation, and probability of exceeding the threshold are calculated. The cost of excess insurance is then considered in three components. First, the expected excess losses are calculated by summing the excess losses a reinsurer would expect to incur over each per occurrence retention. Second, the excess insurer's expense loads are incorporated by assuming a 10% (of expected excess losses) load[3]. Finally, a risk load is added so as to make a reinsurer indifferent in its desire to offer coverage over any per occurrence retention. This load is calculated as a constant, lambda, times the sum of the variances of each per occurrence retention.

The total cost Y equals the sum of the retained mean plus the total cost of excess insurance. The utility function U is then derived by applying the respective k_i constants by the simulation results for the overall expected cost (μ), the standard deviation (σ), and the probability of threshold exceedence (p).

D. Analysis

Our objective is to choose various retentions that attempt to maximize the expected utility. Recall that the entity's perspective is to look to retain risk before insuring risk. Therefore, in analyzing Exhibit 6, we begin at the "unlimited" retention case, where the utility function is at a "worst case" point of \$-15.2 million. This is a scenario where all risk is assumed by the entity, and a heavy price is paid for the fact that there is an 11.2% probability that the \$10 million tolerance level will be exceeded.

Intuitively, one would believe that that the high severity/low frequency lines of business would have the higher variability, and should therefore become subject to lower retentions. One way we have proposed, of likely numerous ones[4], to arrive at optimal retentions, utilizes the cumulative distribution functions (CDFs) of each line of business (Chart 1). The basis for using the CDFs is confirmed by way of a mathematical concept called Stochastic Dominance[5].

The CDFs represent aggregate losses that the entity wants to minimize. The first rule of Stochastic Dominance states that if the CDF of Coverage (i) is "above" that of Coverage (i +1) for every level of aggregate loss, then (i) dominates (i+1). In other words, for a given cumulative probability, Coverage (i)'s aggregate losses will always be less than those of Coverage (i+1). Chart 1 shows the graphs of the four unlimited per occurrence distributions assumed in this analysis. This rule implies that one should choose to retain less of the coverage with a CDF that is to the right of (or below) all other CDFs (i.e. is being dominated by all others).

This rule is somewhat weak in the case of CDFs that intersect. In the case of intersection, one must also look at the curvature of the CDF to assess the dominance. Despite this complication, note that Coverages 1 and 2 are below Coverages 3 and 4 as the $10 million threshold is approached. This is an indication that Coverages 1 and 2 are less optimal to retain, and should be insured away.

The extent to which these are insured away can be visualized in Chart 2. Assume again that the entity starts the decision process of self-insuring vs. insuring at the rightmost point on the curve (full self-insurance). As we impose retentions upon the dominated coverages, we "move down" along this curve. This process continues until the marginal risk reduction benefit of lowering a retention level is offset by the cost of additional excess insurance paid. The utility curve "bottoms out" at this point, and it then begins to move upward toward the "full-insurance" utility value. At the minimum, no CDF dominates another.

Note, for example, on Exhibit 6 the retention options displayed on line 1 (Unlimited) and line 7 (1K, 1K, 5K, 5K). Each of these has a utility value that is lower than the optimal retention option of (100K, 100K, 5M, 5M), shown on line 3. On Chart 2, each of these falls to the right of the minimum point (i.e. too little insurance has been purchased/too much retained).

Recall also that an aggregate loss distribution that does not exceed the risk threshold is a suboptimal use of firm resources, given that self-insurance is always less expensive than insurance for a known level of risk. Note that this utility model justifies this mathematically in that retention combinations that aggregate to less than the risk tolerance level are of lower utility than those that equal or exceed the tolerance level (i.e. those to the left of the curve minimum on Chart 2). For example, the combination of (100K, 100K, 100K, 100K), which is shown on line 9 of Exhibit 6, is an example of this scenario where "too much insurance" is purchased.

The aggregate loss distributions represented by these retention options are illustrated on Chart 3. The option of (100K, 100K, 100K, 100K) is suboptimal, as it never reaches the risk threshold in the limit. The other two options shown fall far to the right of the curve of optimality (i.e. are dominated by it). The retention combination of (100K, 100K, 5M, 5M), however, hits the $10 million threshold at the 100th percentile of its aggregate loss distribution. Therefore, we can state that the minimum point on the utility curve in Chart 2 is the point where the aggregate risk retention level ($10 million) falls at the highest confidence level on the retained loss distribution. In other words, the set of optimal per occurrence retentions is the one that utilizes the risk threshold to its fullest capacity.

E. Other Comments

The retention combination of (100K, 100K, 5M, 5M) is optimal in this example, but these values have been rounded off for illustration. A more precise mathematical combination can be reached.

The importance placed on minimizing cost, minimizing variability, and/or minimizing the chance of exceeding the risk threshold will differ by entity, and will thereby alter the optimal choice of retentions. This is the purpose for developing a utility function; to allow risk preferences to be taken into consideration in determining a combination of risk retention and risk transfer.

The constants K_1, K_2, and K_3 were selected with judgment. Entities may view the goal of cost savings as more preferable to reduced variability, for example. Hence, K_1 should be scaled higher relative to the other K_i's. A change such as this directly affects the shape of the utility curve used as an example in Chart 2. While additional simulation runs can help assess the sensitivity of various parameter constants, a discussion of more scientific methods by which to determine their relative magnitudes is beyond the scope of this paper.

VI. CONCLUSIONS

These three analyses lead to a strategic risk financing program, one that meets three criteria. First, it meets the long-term needs of the entity, since it considers the entity's ability to withstand variability over time. The time horizon for the base case and extreme case can encompass a review of a number of years of historical results.

Second, it is consistent with the entity's other strategies. It orients the risk financing program to the central financial parameters of the entity, and helps keep those parameters within projected ranges. In this way strategic risk financing helps management to meet other strategic goals that also are reflected in these parameters.

Finally, the structure that strategic risk financing produces is tailored to the entity, rather than dictated by available insurance products. With an appropriate risk financing structure, the entity can determine the retention level that suits its needs, and the pricing that it should pay for the insurance that it does purchase. The entity can then assemble the needed financing, from a variety of sources, to meet its insurance needs at the indicated price.

What are the implications of this approach? First, entities will likely purchase less insurance than they have in the past. Most entities will find that the aggregate threshold translates into much higher retention levels for their existing insurance programs. Indeed, the aggregate threshold may even exceed the limits of insurance that they currently purchase for some exposures, such as low-limits crime insurance.

Second, the structure of an entity's insurance program will be based on quantifiable data, sound financial and actuarial analysis, and will utilize an entity's resources in an optimal manner. Retention level will become a function of the entity's financial strength and its ability (or desire) to tolerate variability, evaluated across all of its exposures. Companies of similar size and strength in different industries will be less likely to purchase insurance with dramatically different retention levels.[6]

Third, these analyses can apply to a variety of exposures. As long as the entity can estimate a mean and variance for the distribution of potential outcomes for an exposure, it can apply this process. In this way basic actuarial analyses can determine how an entity finances a variety of exposures, not just property and casualty types.

Finally, this process must be able to exist in an ever-changing environment. Entities will need to continuously monitor their program structure, and change it as their financial status and underlying loss distributions change. The constant interaction of risk managers, actuaries and financial officers will be essential to this endeavor.

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[1]Of companies with $1 billion or more in revenues, 90% purchase directors and officers liability insurance limits of no more than $100 million (*1994 Cost of Risk Survey*, published by Towers Perrin)

[2]The combined shareholders' equity of the top ten companies in the 1994 Fortune 500 was $193 billion (*Fortune*, May 15, 1995), while the combine surplus of the top ten property/casualty insurers in 1994 was $33.1 billion (*Best's Aggregates & Averages*, 1995 Edition)

[3]One will note that the inclusion of reinsurer expenses does not alter the selection of the optimal set of retentions; it is included here for completeness only.

[4]It is likely that there are many, including analyzing the marginal cost of risk reduction, using numerical analysis to iteratively solve for a solution, etc.

[5]Doherty, Neil A. *Corporate Risk Management*, 1985, p. 67

[6]We are familiar with a large retailer that maintains liability retentions of under $1 million, and with a similar-size oil company that maintains liability retentions of $50 million. While not definitive, these examples do illustrate how entities do not set retention levels based on their financial strength.

Case Study Entity Exhibit 1

Strategic Risk Financing Analysis

Summary of Threshold Values for 3 Chosen Parameters

All numbers in 000's except per share values

Item	Selected Value	Resulting Change in Expenses from Base Case
Net Income	$7,000	$2,086
ROE	10.5%	$3,086
Earnings Per Share	$2.75	$4,229
Selected Margin		**$3,000**

Note: Selected Value from Exhibit 5

Case Study Entity

Exhibit 2

Strategic Risk Financing Analysis

Financial Statement Projections-Net Income Before Taxes Basis

All numbers in 000's except per share values

Item	**1994**	**"Base Case" 1995**	**"Worst Case" 1995**	**Difference**
Total Revenues	121,448	126,560	126,560	0
Total Expenses	111,484	114,474	116,560	**2,086**
Income Before Taxes	9,964	12,086	10,000	-2,086
Income Taxes	2,808	3,626	3,000	-626
Net Income	7,156	8,460	7,000	-1,460
Shares Outstanding	1,985,560	2,000,000	2,000,000	0
Net Income Per Share	3.60	4.23	3.50	-0.73

Notes

Worst Case scenario assumes revenues and shares outstanding stay the same. The change in net income drives the resulting changes in expenses, income before taxes, income taxes, and net income per share.

Case Study Entity Exhibit 3

Strategic Risk Financing Analysis

Financial Statement Projections-Return on Average Shareholder's Equity Basis

All numbers in 000's except per share values

Item	1994	"Base Case" 1995	"Worst Case" 1995	Difference
Total Revenues	121,448	126,560	126,560	0
Total Expenses	111,484	114,474	117,560	**3,086**
Income Before Taxes	9,964	12,086	9,000	-3,086
Income Taxes	2,808	3,626	2,700	-926
Net Income	7,156	8,460	6,300	-2,160
Average Shareholder's Equity	55,908	60,000	60,000	15,000
Return on Avg. Sh. Equity	12.8%	14.1%	10.5%	
Shares Outstanding	1,985,560	2,000,000	2,000,000	0
Net Income Per Share	3.60	4.23	3.15	-1.08

Notes

Worst Case scenario assumes revenues, shares outstanding, and Average Shareholder's Equity stay the same. The change in Return on Average Shareholder's equity drives the resulting changes in expenses, income before taxes, income taxes, and net income.

Case Study Entity Exhibit 4

Strategic Risk Financing Analysis

Financial Statement Projections-Net Income Per Share Basis

All numbers in 000's except per share values

Item	1994	"Base Case" 1995	"Worst Case" 1995	Difference
Total Revenues	121,448	126,560	126,560	0
Total Expenses	111,484	114,474	118,703	**4,229**
Income Before Taxes	9,964	12,086	7,857	-4,229
Income Taxes	2,808	3,626	2,357	-1,269
Net Income	7,156	8,460	5,500	-2,960
Shares Outstanding	1,985,560	2,000,000	2,000,000	0
Net Income Per Share	3.60	4.23	2.75	-1.48

Notes

Worst Case scenario assumes revenues and shares outstanding stay the same. The change in net income per share drives the resulting changes in expenses, income before taxes, income taxes, and net income.

Case Study Entity
Strategic Risk Financing Analysis
Key Success Parameter Analysis

Exhibit 5

Parameter	10-year Avg	1994	1993	1992	1991	1990	1989	1988	1987	1986	1985
Net Income Before Taxes	$10,128	$9,964	10,028	4,012	8,140	13,640	10,780	13,228	10,000	6,160	15,324
Deviation from Average - $		(163.6)	(99.6)	(6,115.6)	(1,987.6)	3,512.4	652.4	3,100.4	(127.6)	(3,967.6)	5196.4
Deviation from Average - %		-1.6%	-1.0%	-60.4%	-19.6%	34.7%	6.4%	30.6%	-1.3%	-39.2%	51.3%
High Value											**15,324**
Low Value				**4,012**							
Analyst's 1995 Prediction	$10,000										
1995 Selected Worst Case	$7,000										
Earnings Per Share	$3.00	$3.60	3.66	1.71	2.36	3.77	3.12	4.00	2.65	1.45	3.71
Deviation from Average - $		0.6	0.7	(1.3)	(0.6)	0.8	0.1	1.0	(0.4)	(1.6)	0.71
Deviation from Average - %		19.9%	21.9%	-43.1%	-21.4%	25.5%	3.9%	33.2%	-11.8%	-51.7%	23.5%
High Value								**4.00**			
Low Value										**1.45**	
Analyst's 1995 Prediction	$3.25										
1995 Selected Worst Case	$2.75										
Return on Ave Shareholders Equity	11.8%	12.8%	13.7%	6.5%	8.4%	13.8%	11.9%	16.2%	11.6%	6.5%	16.2%
Deviation from Average - % points		1.0	1.9	(5.3)	(3.4)	2.0	0.1	4.4	(0.2)	(5.3)	4.4
Deviation from Average - %		8.8%	16.5%	-44.7%	-28.6%	17.3%	1.2%	37.8%	-1.4%	-44.7%	37.8%
High Value								**16.2%**			**16.2%**
Low Value				**6.5%**						**6.5%**	
Analyst's 1995 Prediction	12.5%										
1995 Selected Worst Case	10.5%										

Simulation Trials

Exhibit 6

	Frequency		Severity		
Covg	Distrib	Mean	Distrib	Mean	CV
1	Poisson	5	Lognormal	150000	25
2	Poisson	25	Lognormal	100000	10
3	Poisson	50	Lognormal	50000	5
4	Poisson	100	Lognormal	10000	2

1	K1
1	K2
10,000,000	K3

Aggregate Loss Distribution

	Per Occ. Coverage Retentions ($ millions)				(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
#	1	2	3	4	Retained Mean	Retained Std Dev	Pr((Sum Agg. Loss >$10M)	Total Cost of Specific Excess Insurance	10% Expenses in Excess Insurance	Lambda = 5.00E-08 Risk Load	Total Cost incl. Risk Load	Utility Function incl. Risk Load Result
1	Unlimited	Unlimited	Unlimited	Unlimited	6,968,480	7,145,920	11.2%	0	0	0	6,968,480	(15,234,400)
2	Full Insur	Full Insur	Full Insur	Full Insur	0	0	0.0%	6,968,480	696,848	4,983,301	12,648,629	(12,648,629)
3	0.1	0.1	5	5	4,234,498	1,263,253	0.32%	1,017,728	101,773	853,414	6,207,413	(7,502,666)
4	0.1	0.1	2.5	2.5	4,190,423	1,149,478	0.02%	1,261,784	126,178	942,991	6,521,377	(7,672,855)
5	0.1	0.1	0.5	0.5	3,806,012	738,104	0.00%	2,295,172	229,517	1,109,409	7,440,111	(8,178,215)
6	0.5	0.5	5.0	5.0	5,029,166	1,426,822	0.40%	869,824	86,982	836,261	6,822,233	(8,289,055)
7	1.0	1.0	5.0	5.0	5,408,266	1,603,453	1.20%	785,550	78,555	812,369	7,084,740	(8,808,193)
8	1	1	8	8	5,424,191	1,650,665	1.70%	785,550	78,555	812,369	7,100,665	(8,921,330)
9	0.1	0.1	0.1	0.1	3,029,630	428,840	0.00%	3,705,027	370,503	1,193,750	8,298,910	(8,727,750)
10	2	2	5	5	5,780,125	1,905,665	3.20%	694,915	69,492	769,366	7,313,898	(9,539,563)
11	10	10	10	10	6,438,322	3,163,210	11.20%	336,632	33,663	502,495	7,311,112	(11,594,322)
12	7	7	7	7	6,326,507	2,850,190	11.20%	583,761	58,376	662,652	7,631,296	(11,601,486)
13	25	25	25	25	6,682,503	4,242,538	11.20%	103,287	10,329	213,625	7,009,744	(12,372,282)
14	25	25	8	8	6,675,541	4,231,164	11.20%	356,559	35,656	303,414	7,371,170	(12,722,334)

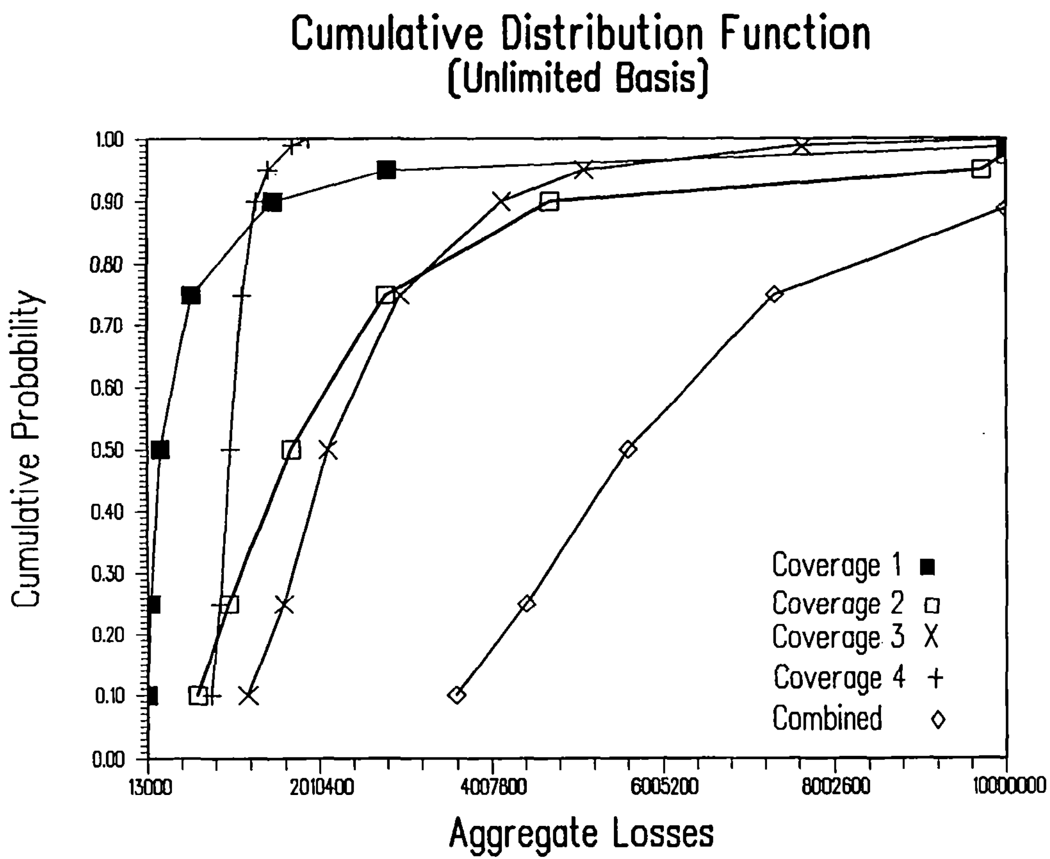
NOTES:

(4) Sum of expected costs excess the per occurrence retentions by coverage
(5) = (4) x 0.10
(6) = lambda x sum of variances of per occurrence distributions
(7) = (1) + (4) + (5) + (6)
(8) = - [(7)x k1 + (2) x k2 + (3) x k3)]

To the left of optimality point (ie. too much insurance) includes numbers 4, 5, and 9

To the right of optimality point (ie. too little insurance) includes numbers 6, 7, 8, 10, 11, 12, 13, and 14

CHART 1

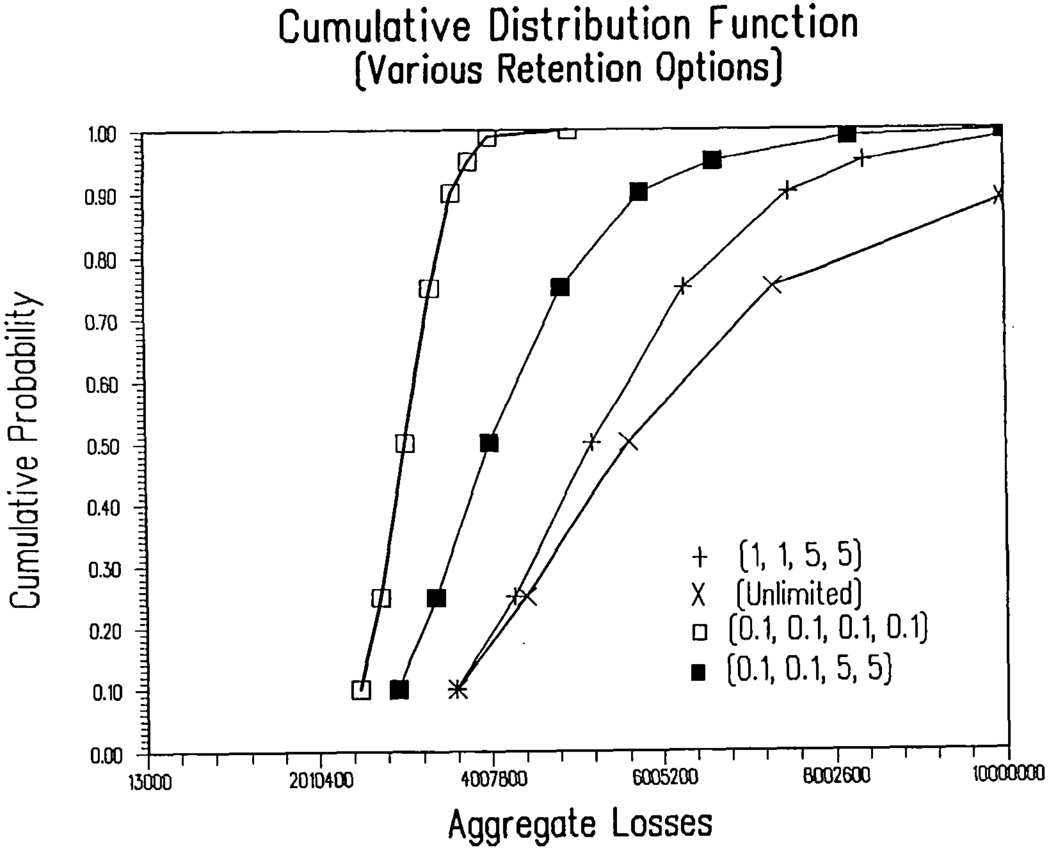


Cumulative Distribution Function
(Unlimited Basis)
Cumulative Probability
Aggregate Losses
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
13000
2010400
4007800
6005200
8002600
10000000
Coverage 1
Coverage 2
Coverage 3 X
Coverage 4 +
Combined

CHART 2

Utility Curve Output

CHART 3


Cumulative Distribution Function
(Various Retention Options)
Cumulative Probability
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
13000
2010400
4007800
6005200
8002600
10000000
Aggregate Losses
+ (1, 1, 5, 5)
X (Unlimited)
□ (0.1, 0.1, 0.1, 0.1)
■ (0.1, 0.1, 5, 5)