TOTAL INTEGRATIVE RISK MANAGEMENT: A PRACTICAL APPLICATION FOR MAKING STRATEGIC DECISIONS

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ABSTRACT

Until recently, insurance companies were forced to evaluate business decisions at the functional level. For example, Actuarial and Underwriting departments focused on the liability side of the operations, Investment departments concentrated on the risk and rewards of alternative asset strategies and asset classes, Treasury evaluated capital allocation decisions, and the Reinsurance unit explored the impact of various reinsurance treaties. With the advancement in computing power and understanding of advanced financial mathematics, company's are now able to integrate all of the various operational functions into a total company model, and evaluate the impact of various business decisions on the total company's risk/reward profile. The risk management process developed at Falcon Asset Management, called FIRM™, is an example of a total company model that uses sophisticated techniques and gives management the ability to analyze problems at the total company level in a completely integrative framework (combining liabilities, assets and economic factors). As a result, management can analyze their key profit/cost centers, such as the investment, corporate finance/capital management, underwriting and reinsurance functions, on a consistent basis. The model uses simulation analysis of the aforementioned business functions and their key drivers to develop a comprehensive risk/reward profile for the company.

Many articles and papers have been written showing the benefits of including an insurance company's liabilities into its asset allocation decisions, including Sweeney and Correnti (1994) and Carino, et al. (1994). This paper will demonstrate, via a case study, of how an integrative risk management process can be used to evaluate various strategic decisions for a hypothetical property casualty insurance company.

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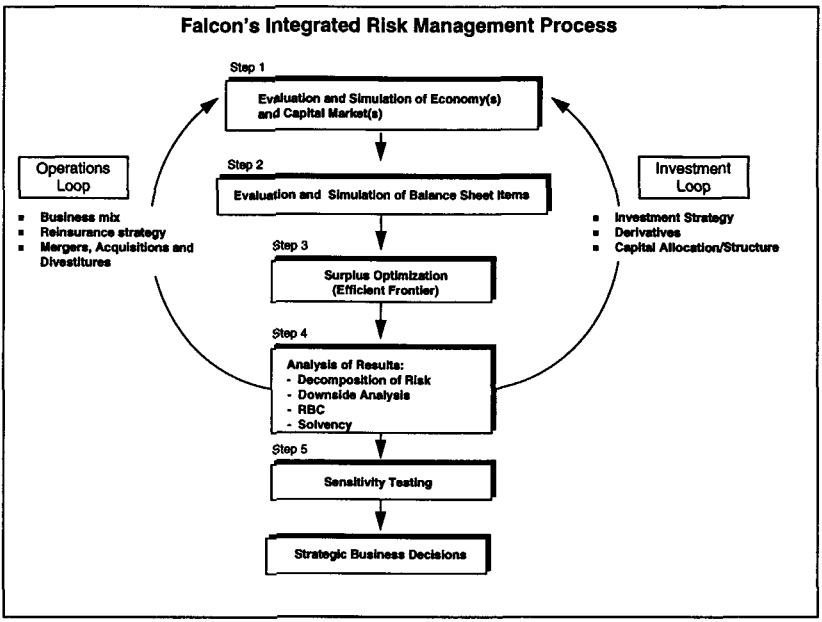
Until recently, insurance companies were forced to evaluate business decisions at the functional level. For example, Actuarial and Underwriting departments focused on the liability side of the operations, Investment departments concentrated on the risk and rewards of alternative asset strategies and asset classes, Treasury evaluated capital allocation decisions, and the Reinsurance unit explored the impact of various reinsurance treaties. With the advancement in computing power and understanding of advanced financial mathematics, company's are now able to integrate all of the various operational functions into a total company model, and evaluate the impact of various business decisions on the total company's risk/reward profile. The risk management process developed at Falcon Asset Management, called FIRM™, is an example of a total company model that uses sophisticated techniques and gives management the ability to analyze problems at the total company level in a completely integrative framework (combining liabilities, assets and economic factors). As a result, management can analyze their key profit/cost centers, such as the investment, corporate finance/capital management, underwriting and reinsurance functions, on a consistent basis. The model uses simulation analysis of the aforementioned business functions and their key drivers to develop a comprehensive risk/reward profile for the company.

Many articles and papers have been written showing the benefits of including an insurance company's liabilities into its asset allocation decisions, including Sweeney and Correnti (1994) and Carino, et al. (1994). ***Figure 1*** expands on these concepts and gives a schematic view of an integrative risk management process. Total integrative risk management builds on traditional asset/liability analysis in that it explicitly considers strategic decisions impacting both operations and investment activities within a holistic framework . Once the key factors contributing to the overall risk of the company are identified and quantified, management has the ability to "loop" through the process by selecting either the investment loop (asset allocation, derivatives and capital allocation) or through the operations loop (business mix, reinsurance strategy and merger & acquisition analysis). Traditional asset/liability analysis has been used to explore asset issues relating to asset allocation and derivative strategies only. The integrative risk management approach combines a more complete set of asset, liability, economic and capital market factors at the total company level giving management the ability to investigate the risk/reward tradeoffs of a wide range of alternative strategic business decisions. In addition the company is able to evaluate the joint impact of multiple strategic decisions through their interrelationships on the total company risk/reward profile.

For example, management can now evaluate various reinsurance strategies and quantify their impact on the company's financial objectives. The cost for the reinsurance protection can be compared to the reduction in risk provided by the reinsurance program and decisions concerning the appropriate level of reinsurance can be made. In addition, the integrative risk management approach provides management with a consistent framework to access the myriad of problems that they face. Whether deciding on an appropriate asset allocation strategy, reinsurance programs or corporate finance issues, management can use the integrative risk management process to perform the necessary analysis under a consistent risk/reward framework.

Figure 1



The remainder of this paper will illustrate how such a total integrative risk management process can be used by a property/casualty insurance company to evaluate alternative investment and reinsurance strategies. The case study will build up from a basic asset-only analysis to incorporate the company's liability profile as would be necessary for traditional asset/liability analysis. Finally we will touch upon the benefits of a total integrative risk management system by incorporating a catastrophe reinsurance program overlaid onto the various strategic asset allocations under consideration. Finally the process will be used to evaluate both strategic decisions on a solvency and GAAP income basis.

Case Study

This case study will illustrate the power of a total integrative risk management system in assessing the cost/benefit tradeoffs of the numerous strategic business decisions made by the senior management of an insurance company. We concentrate our case study on two such strategic decisions; 1) asset allocation and 2) reinsurance. While many insurance companies utilize models to help in each of these important strategic decisions, they will typically be designed to deal exclusively with the specific decision under consideration. Thus many important questions are often left unresolved. How will a decision resulting from such a model impact the risk/reward profile of the entire company? Are there alternative strategies within the company's control that can offer the same or greater benefit at lower cost? Will a

strategic change in one area of the company adversely impact the strategic direction of another area?

While myopic models that deal exclusively with one aspect of an insurance company's business are useful in gaining insights and a better understanding of that particular business segment they are not appropriate tools for making corporate business decisions. This is reflected in the paradigm that the whole is greater than the sum of the parts. Clearly it is more important to maximize the whole corporation than it is to maximize the sum of the corporations business segments. That is the challenge and ultimately the reward of a total integrative risk management system and what our case study will demonstrate.

We start our case study with a look at the asset allocation strategy for a diversified property/casualty insurance company. Five asset allocation strategies are explicitly considered as shown in ***Figure 2***. These five strategies are first analyzed in an asset-only environment and compared to an asset-only efficient frontier. Next the analysis is made more realistic by examining the strategies in an asset/liability environment that incorporates the company's liability structure. This is a necessary step in developing a total integrative risk management framework. We will end our case study by incorporating the companies reinsurance program and comparing and contrasting various combinations of reinsurance and asset allocation strategies on the corporate risk/reward profile. For illustrative purposes we will be dealing with a gross and net reinsurance positions although similar analysis could be performed on any alternative reinsurance programs.

Figure 2

	Portfolio				
	Short	Intermediate	Long	Intermediate 10% Equities	Intermediate 30% Equities
Cash	100%	10%	0%	9%	7%
Equities	0	0	0	10	30
1-5 yr bonds	0	25	0	23	18
5-10 yr bonds	0	45	0	40	31
10-20 yr bonds	0	10	0	9	7
20+ yr bonds	0	10	100	9	7
Total	100%	100%	100%	100%	100%

While we stop our case study with the reinsurance decision an integrative risk management model of the type we are using for this analysis can consider such things as a company's business mix or merger/acquisition and divestiture activities. The important message that we wish to communicate is that major strategic business decisions should be made using a consistent platform and that changes in one business unit's strategic direction can impact or even be better implemented by changes in another business unit's strategic direction.

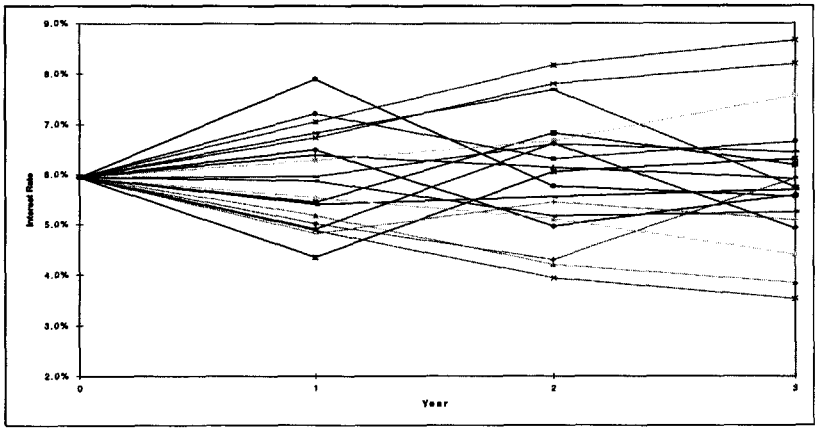
Asset-Only Analysis

The first step in evaluating the asset allocation for an insurance company is to evaluate the economy and the capital markets. This is also Step 1 in the integrative risk management framework presented in Figure 1. For asset-only analysis over a single time period

mean/variance models can be used effectively. These models require inputs concerning the mean, standard deviation and correlations related to a particular set of asset categories being considered in the analysis. While effective for single period, asset-only analysis, these models are not adequate for more advanced asset/liability analysis or for use within a total integrative risk management framework. This is due to the fact that there is no explicit modeling of the underlying economic environment such as interest rates and inflation. The implicit economic environment that underlies a mean variance model leads to interest rates that both explode to unreasonably high levels and even more undesirable, become negative.

Asset/liability management relies on the consistent relationship of both asset and liability movements to the underlying economic environment. Thus it is critical to model the economic variables explicitly to ensure reasonable future economic projections. The best models available for this purpose are models that utilize stochastic differential equations to describe the dynamics of the interest rate and inflation rate movements. For a more complete discussion of stochastic diffusion models see Mulvey and Thorlacius (1997). ***Figure 3*** shows twenty simulations corresponding to a three year projection of short-term interest rates that were generated from a stochastic diffusion model. This picture shows the year to year movements of the short-term interest rates together with the range of potential interest rate levels.

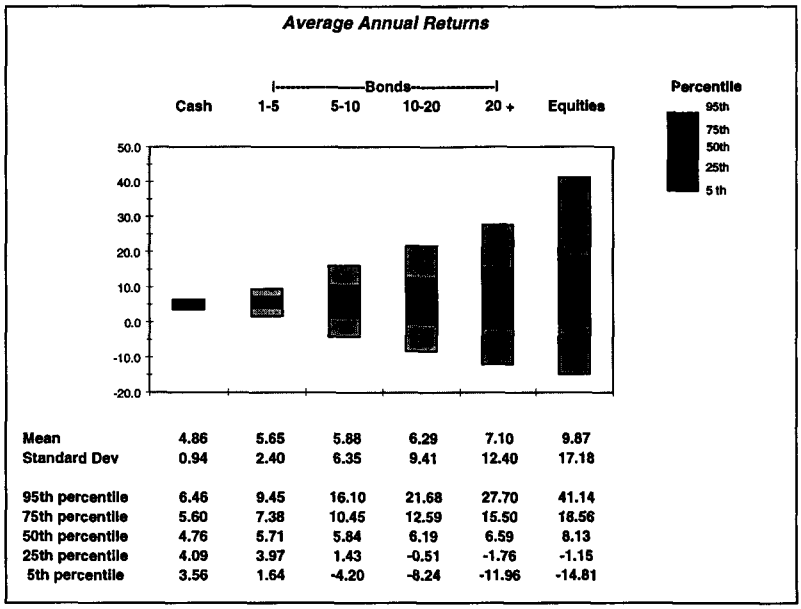
Figure 3



Capital market returns are next modeled such that they are consistent with the movements of these underlying economic variables. The resulting returns can be summarized using the same mean, standard deviation and correlation statistics that are typically used as inputs to a more simple mean/variance model. In addition, the same economic variables that are used to generate the capital market returns can be used to project the premium, loss and expense cash flows that will be required for the asset/liability analysis. This is the type of asset modeling system that we use for this case study and in the integrative risk management system presented in Figure 1.

To ensure consistency between the asset-only analysis and the asset/liability analysis that will be presented in the following section we will use the more advanced stochastic diffusion asset model for the following asset-only analysis. ***Figure 4*** shows the 5th through the 95th percentile results corresponding to the average annual returns for each of six asset categories that are being used in this case study. As expected, over a annual holding period, cash returns show the smallest annual average return range while equities show the largest return range.

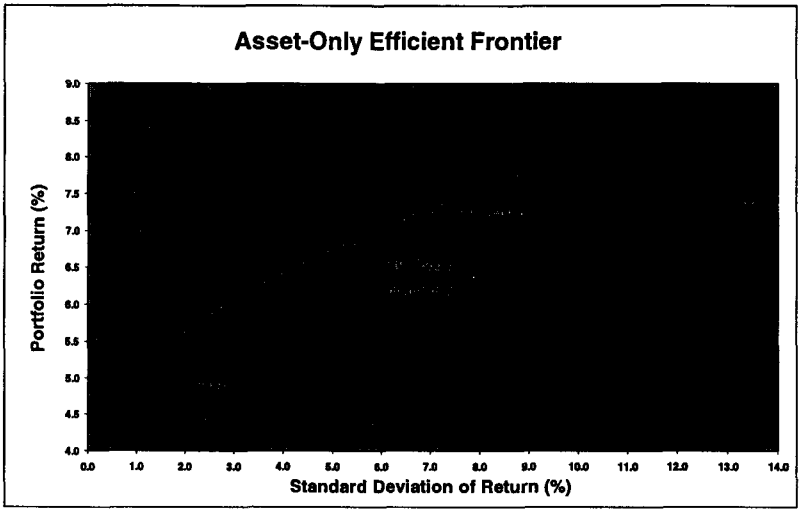
Figure 4



	Cash	1-5	5-10	10-20	20 +	Equities
Mean	4.86	5.65	5.88	6.29	7.10	9.87
Standard Dev	0.94	2.40	6.35	9.41	12.40	17.18
95th percentile	6.46	9.45	16.10	21.68	27.70	41.14
75th percentile	5.60	7.38	10.45	12.59	15.50	18.56
50th percentile	4.76	5.71	5.84	6.19	6.59	8.13
25th percentile	4.09	3.97	1.43	-0.51	-1.76	-1.15
5th percentile	3.56	1.64	-4.20	-8.24	-11.96	-14.81

The return and standard deviation statistics can be calculated for each of our five asset allocation alternatives and compared with the asset-only efficient frontier. The efficient frontier represents a series of investment strategies that maximize return for a given level of risk. ***Figure 5*** plots the five candidate asset allocations against the efficient frontier generated by an asset-only efficient frontier generator.

Figure 5

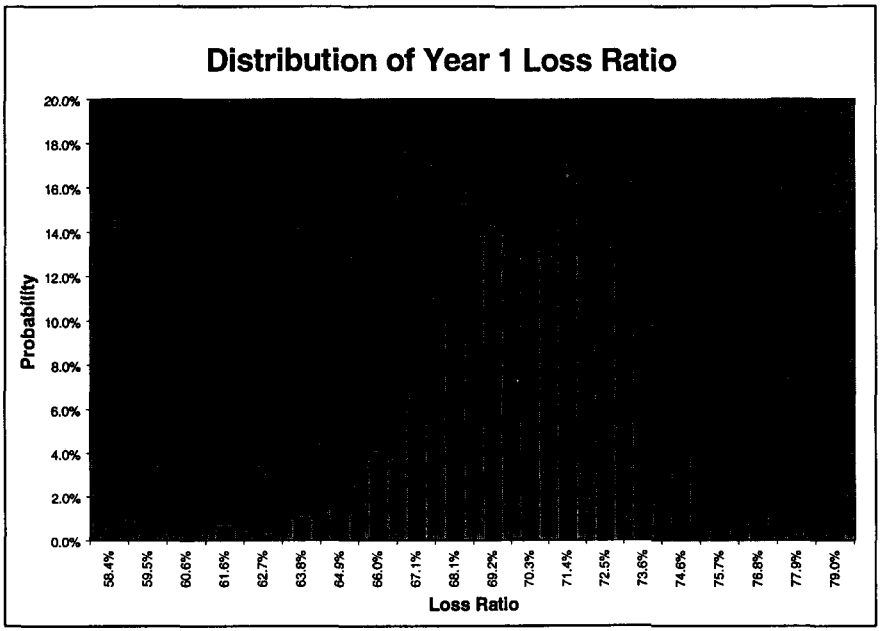


Asset/Liability Analysis

The next step in the integrative risk management process is the evaluation and simulation of the company's balance sheet and financial statement items. This stage involves modeling the balance sheet prospectively. Existing reserves as well as the company's new business plan are incorporated into the model to capture the dynamic and ongoing nature of the insurance business. Two liability simulation models are used to produce stochastic or random scenarios that enable management to analyze and evaluate the degree of uncertainty in future cash flows. One model will simulate the cash flows arising from the non-catastrophe book of business. The second, a CAT model, is used to simulate losses arising from catastrophes. Combined, these two models produce simulations that represent the total distribution of liability cash flows.

To model the non-cat book of business, the company splits its liabilities into cash flows arising from existing reserves and cash flows arising from its new business forecast. Both sets of data are split by line of business to capture the unique characteristics of the various lines. Existing reserves are modeled by using a monte carlo sampling approach. The company can choose an appropriate distribution type (such as normal or lognormal), and simulate future cash flows by multiplying the simulated reserve by the calendar year payout pattern. Correlations between various lines of business are included in the simulation process. Finally, the cash flows are adjusted for inflation consistent with the economic simulations described above. ***Figure 6*** illustrates the simulated distribution of the company's existing reserves.

Figure 6



Modeling the new business cash flows requires the following input parameters (by line of business) attained from the company's three year forecast:

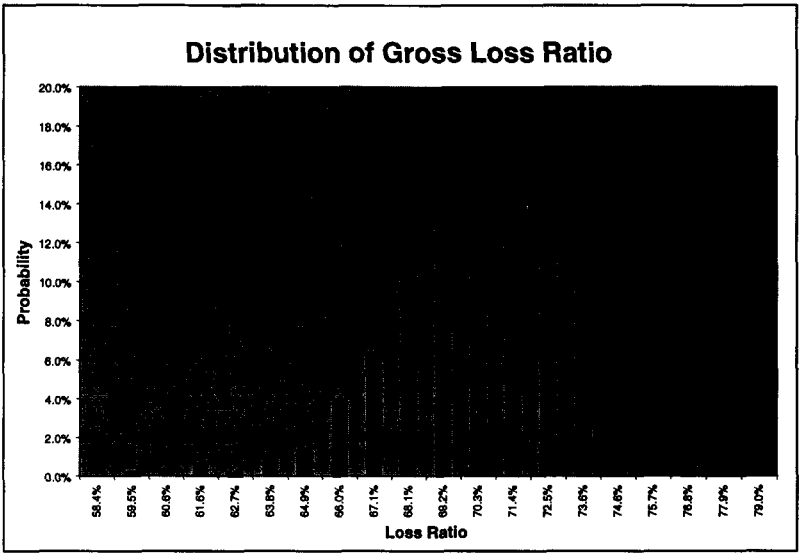
- Written and earned premiums,
- Expenses, broken into a non-production (or overhead) component and a production-related component (commissions, etc.),
- Accident year payout patterns,
- Correlations,
- Inflation sensitivity parameters.

Loss ratios are simulated by employing one of two methods. The first assumes future loss ratios follow a mean reverting random walk process combined with a stochastic "non-cat" adverse shock component. The alternative method uses a probabilistic approach to future loss ratios. If the frequency and severity of losses is known, the user can simulate losses by entering a loss ratio with its associated probability. In either case, future cash flows are determined by multiplying the simulated loss ratio by the earned premium, and then by the line of business' accident year payout pattern.

The low frequency/high severity nature of catastrophes requires more precise modeling techniques to predict catastrophic events and the resulting cash flows. There are several cat models available in the marketplace today (e.g. AIR, EQE, RMS, etc.). Cash flows attributed to catastrophes are modeled using one of these simulation models and merged with the non-cat losses described above to produce the company's overall loss ratio distribution. ***Figure 7***

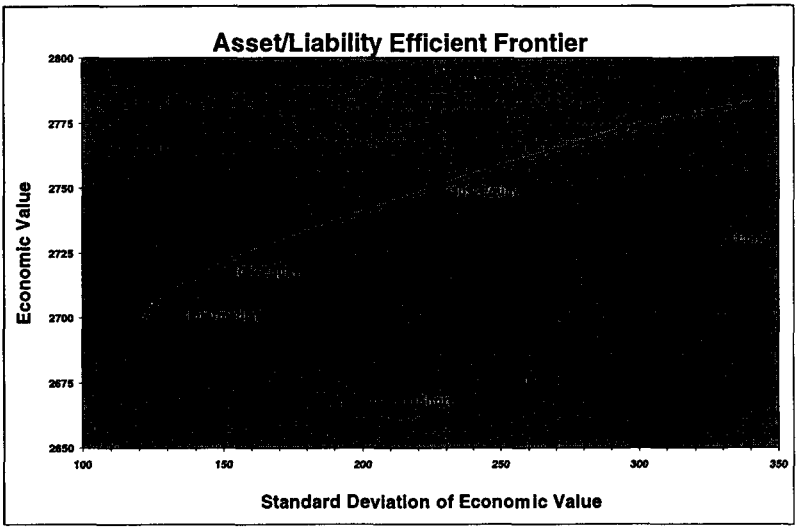
shows the distribution of the company's simulated year 1 loss ratios before the placement of any catastrophe reinsurance programs.

Figure 7



The simulated economic scenarios and capital market conditions are now combined with the simulated liability cash flows and fed into a non-linear optimization module to produce the ALM efficient frontier. The ALM efficient frontier represents a series of investment strategies that maximize a client's reward objective subject to a given level of risk. For this case study, the company's main concern is its economic value, defined as the market value of assets less the present value of liability cash flows discounted at a market rate of interest. The ALM efficient frontier uses the expected economic value as the reward measure, and the standard deviation of economic value as the risk measure. Alternative risk/reward definitions can be employed depending on the company's financial objectives. The ALM efficient frontier is shown in ***Figure 8***, along with the 5 investment strategies the company is considering.

Figure 8



By comparing figure 8 with figure 5, one can observe that a different result emerges once the liabilities are introduced into the analysis. The short portfolio, which was the least risky investment strategy in the asset-only analysis, is very inefficient when viewed in an integrative asset-liability framework. The least risky of the five investment strategies is the intermediate bond portfolio since the duration of the portfolio is similar to the ongoing duration of the company's liabilities. When interest rates are decreasing, the capital gains in the bond portfolio offset the increase in economic reserves. Similarly, for the increasing interest rate scenarios, the decrease in the market value of the bond portfolio is offset by discounting the liability cash flows at the higher interest rates. It is important to note that if the goal of the investment department is to minimize the economic risk of the company, and if it acts without due consideration of the liabilities, it will choose the incorrect short investment strategy. Clearly ALM is the appropriate framework for making asset allocation decisions.

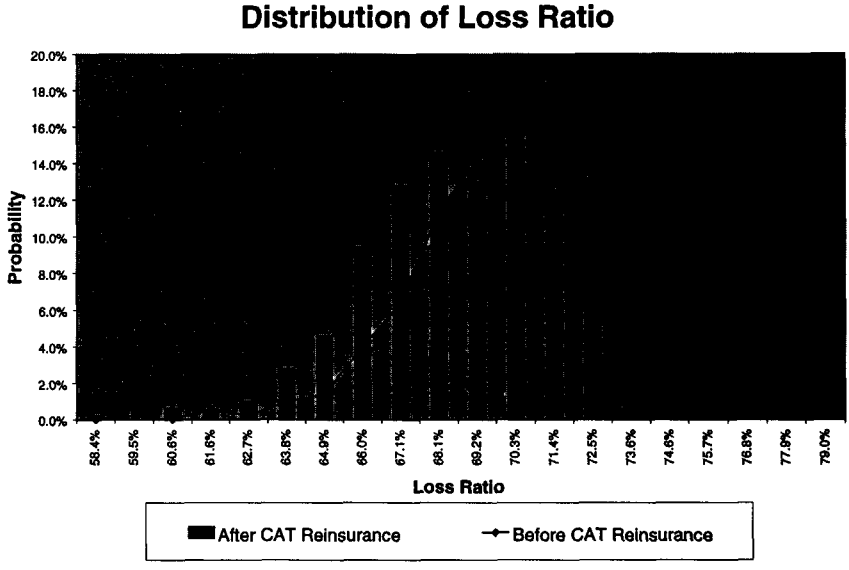
Reinsurance Strategy

Traditional asset/liability analysis would stop here and the insights gained would be used to make decisions regarding the appropriate asset allocation strategy for the company. A total integrative risk management framework goes a step further and allows a company to evaluate the asset allocation decision against other corporate decisions such as the company's reinsurance strategy. To illustrate this we will incorporate the company's catastrophe reinsurance decision into our analysis and examine some potential tradeoffs that can be made between asset allocation and reinsurance strategy.

Up to this point we have been examining different asset allocation strategies against the liability position of the company (i.e. before any catastrophe reinsurance programs). We

would now like to look at the same asset strategies under a net liability structure that results from putting various catastrophe reinsurance excess of loss treaties into place. To do this we take the exposures and losses that were generated by the catastrophe modeling work and overlay each of the separate reinsurance treaties that make up the companies catastrophe reinsurance program. This results in new cashflow patterns for premiums, losses and expenses. These new cashflow are combined with the non-catastrophe related cashflows to produce the net total company cashflows. ***Figure 9*** shows the total company loss ratio distribution for year 1 both before and after the application of the company's catastrophe reinsurance program.

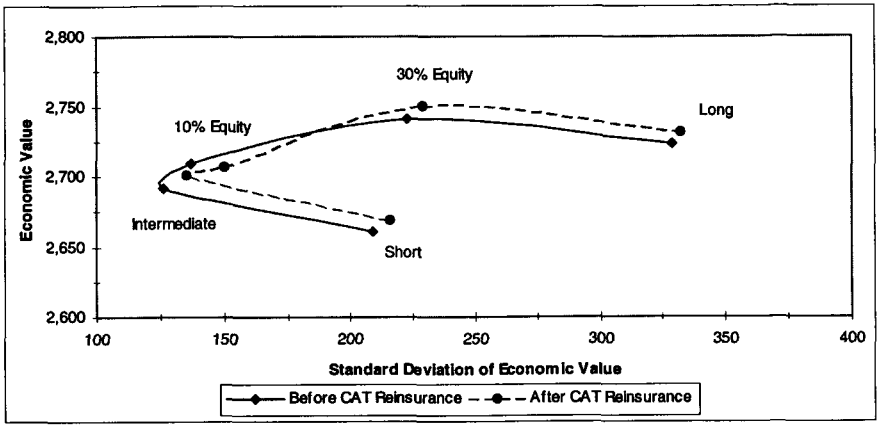
Figure 9



Total Integrative Risk Management

The next phase of the analysis is to explore the implications of alternative reinsurance programs when combined with various investment strategies. The integrative risk management process is able to evaluate different reinsurance strategies similar to the asset allocation strategies that were evaluated in the previous section. This example will focus on only one reinsurance option to illustrate the benefits of using an integrative risk system. ***Figure 10*** illustrates our five investment strategies under the two reinsurance programs being analyzed.

Figure 10



It is interesting to observe that a 10% equity allocation with catastrophe reinsurance produces similar economic results to the intermediate bond allocation with no catastrophe reinsurance.

	Intermediate Bonds No CAT Reinsurance	10% Equity With CAT Reinsurance
Economic Value	2,701	2,709
Standard Deviation	135	137

This implies that the company can add asset risk by increasing its equity exposure while decreasing its liability risk by adding catastrophe reinsurance so that, in combination, the overall economic risk/reward position to the company is unchanged. This tradeoff between two different strategic operating decisions is exactly the type of analysis that can be performed using a total integrative risk management system. As can be seen from the example above, both the asset allocation decision and the reinsurance decision can be made simultaneously using a consistent set of decision criterion. This allows management to determine the most cost effective way of meeting its operating objectives.

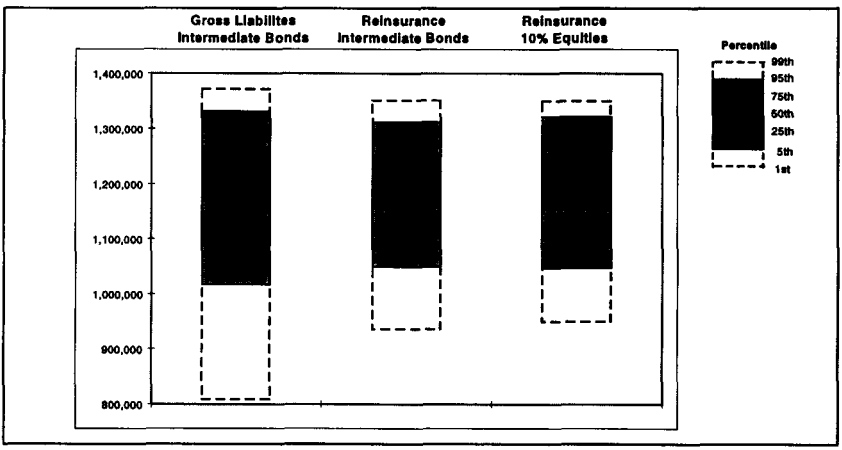
Final Analysis

Should management be indifferent between the choice of intermediate bonds and no catastrophe reinsurance versus 10% equities with reinsurance? GAAP earnings, rating agency expectations and solvency constraints are some examples of the types of objectives that management must consider before making strategic business decisions. The following table and chart show the statistics and distribution for statutory surplus at the end of year 1 for the intermediate bond strategy and no catastrophe reinsurance, the intermediate bond strategy with reinsurance, and the 10% equity portfolio with reinsurance.

Figure 11

Statutory Surplus Results	Intermediate Bonds No CAT Reinsurance	Intermediate Bonds With CAT Reinsurance	10% Equity With CAT Reinsurance
Statutory Surplus	1,205,141	1,198,898	1,198,322
Standard Deviation	123,602	91,320	103,831

Distribution of Statutory Surplus



The cost of the reinsurance protection is approximately $6.2 million dollars. However, for that protection, the company can cut its losses below the 5th percentile dramatically. In addition, the company can increase its equity position to 10% of its investment portfolio without increasing its risk of insolvency when compared to the intermediate bond strategy with reinsurance. As noted above, the 10% equity portfolio with catastrophe reinsurance has approximately the same economic risk/reward profile as the intermediate bond with no catastrophe reinsurance. If solvency risk is a concern to the company, they may want to consider buying the reinsurance and increasing their equity holdings to 10%.

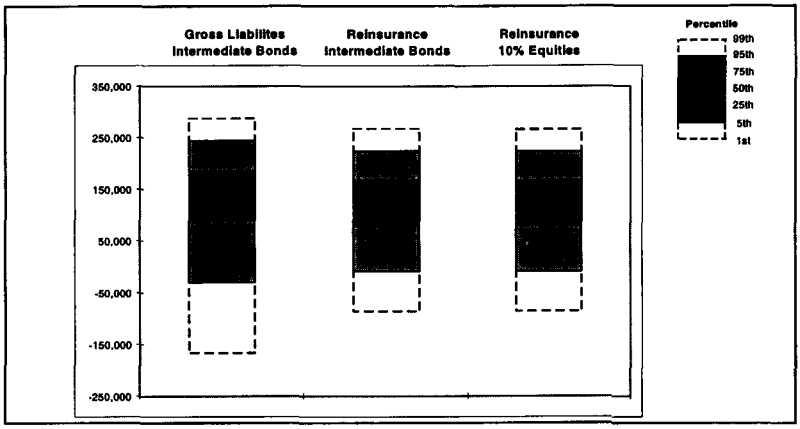
A second and equally important constraint that the insurance company operates under is its accounting results. Shareholders and investors expect a certain level of GAAP income and

growth. The table and figure below show the distribution of GAAP income for the three alternatives.

Figure 12

GAAP Income Results	Intermediate Bonds No CAT Reinsurance	Intermediate Bonds With CAT Reinsurance	10% Equity With CAT Reinsurance
GAAP Income	127,066	118,815	118,512
Standard Deviation	100,960	76,628	84,684

Distribution of GAAP Income



Again one can determine the cost to purchasing reinsurance. GAAP income levels are higher through the 10th percentile for the no reinsurance option. However, the reinsurance program protects the company from catastrophic losses, saving over $100 million in GAAP income below the 1st percentile level. Overall, the volatility of GAAP earnings is decreased when catastrophe reinsurance is purchased. There is also a GAAP cost of investing in equities. Since unrealized capital gains do not flow through the income statement, investing in equities will reduce the amount of investment income earned. The annual investment income giveup is approximately $300 thousand dollars. So although the intermediate bond strategy with no catastrophe reinsurance has the same economic value as the 10% equity with catastrophe reinsurance, there is a GAAP income hit of $8.5 million ($8.2 for the reinsurance, $0.3 million for the investment income giveup). Management must weigh the benefits of lower volatility of GAAP earnings and reduced catastrophe exposure against that of higher expected GAAP income.

Conclusion

The holistic integrative risk management approach described above allowed management to measure the impact of simultaneously changing business strategies on alternative financial objectives. By increasing its equity investment exposure while simultaneously purchasing reinsurance, the company can improve its solvency position without sacrificing the company's economic value. However, by choosing that strategy, management must be willing to take an $8.5 million hit to GAAP income. Alternative reinsurance programs and investment strategies could be evaluated until the company finds the pair that best suits it financial objectives. The integrative risk management process allows the company to find strategies that have the best economic results with the most desirable accounting objectives.

End Notes

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