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Case Study: Economic Capital Analysis at Guardian (The Early Years)

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The management of The Guardian Life Insurance Company of America (Guardian) decided during 2006 to perform an economic capital (EC) analysis, with results to be delivered in the spring of 2007. A second generation EC analysis (EC 2.0) was conducted from fall 2007 through spring 2008. This article describes EC 2.0.

GUARDIAN IS A MUTUAL LIFE INSURANCE COMPANY, with several subsidiaries, operating in numerous lines of business, including individual life insurance, individual disability insurance, retirement products and services (individual and institutional) and group medical and non-medical business.

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In 2008, total premiums for all lines of business, while not in one company, were approximately $7.2 billion. Reserves totaled $32.7 billion; liabilities were about $35.4 billion; and total assets were $39.1 billion.

GENERAL APPROACH: SHORT- OR LONG-TERM?

Guardian first had to decide on the approach for the EC analysis. Two basic approaches were considered.

1. Short-Term

The short-term approach generally looks at a one-year time horizon. An economic basis is used for assets and liabilities so that the long-term impact of the one-year events can be captured. EC is the amount of capital required so that the probability of insolvency is less than the target level, such as 0.5 percent.

Many European insurance companies and their U.S. subsidiaries have used this approach.

2. Long-Term

The long-term approach uses a multi-year time horizon. Thirty years might be a typical horizon. The statutory accounting basis is generally used. Projections are performed using a large number of stochastic scenarios for the primary risk factors. The conditional tail expectation at the x% level, CTEx, is calculated as the average of the worst (100-x)% of the results. This defines the required EC.

The result of each 30-year projection is not quantified by the present value of profits for all 30 years (PV30). Rather, the greatest present value of loss (GPVL) is calculated as the worst of the 30 values calculated by taking the present value of the earnings for the first year only, then the first two years, then the first three years… continuing up the PV30 present value for all of the projection years. If there is no loss (the GPVL is greater than zero) the GPVL is set equal to zero.

For purposes of CTEx calculations the value of "x" might be anywhere from 60 percent to 99 percent.

A few European companies, and some U.S. companies, have used this approach. One of the major rating agencies (Fitch) has developed its own EC model system using this long-term approach.

GUARDIAN'S CHOICE

Guardian chose to use the long-term approach for the following reasons:

- The long-term approach using CTEx is consistent with several other calculations being performed and/or discussed for U.S. insurers, such as C3-Phase II and VAC-ARVM for variable annuities as well as principle-based reserves and capital for individual life insurance.
- Since Guardian is a mutual company, the primary focus is upon statutory values. Guardian's focus is also more on long-term capital needs than on short-term fluctuations.
- The short-term approach must calculate liabilities on an economic basis to reflect the impact of the one-year events. Guardian had not already established a basis for the calculation of liabilities on an economic basis.
- Guardian believed that long-term EC approach using statutory values would be better understood and accepted by the senior management of the corporation and the lines of business, and in the future, the analysis can be incorporated into the way the business is managed.

"The distribution of results for individual risk factors had to be combined into a composite distribution reflecting all of the risks."

Guardian's Process

After initial consideration of the project, we concluded that external resources would be required, both for conceptual assistance and for computing capacity. Consultants from Milliman were selected to provide the required assistance in performing the EC analysis.

The analysis was divided into four primary components, as follows:

1. Business Risk
2. Operational Risk
3. Strategic Risk
4. Capital Analysis

BUSINESS RISK

Guardian operates in four primary lines of business (LOBs).

1. Life—primarily par whole life plus term and universal life.
2. Individual Disability Income.
3. Group—medical and non-medical businesses, comprising dental, life, short-term and long-term disability.
4. Retirement Products and Services—fixed annuities, variable annuities and group pension annuities.

The following chart shows the primary risk factors modeled for each line of business. An "S" indicates that stochastic scenarios were used. A "D" indicates that variations in lapse rates were dependent on changes in other risk factors.

Risks Modeled by Line of Business

	Life	IDI	Group	Retirement
Mortality	S			S
Morbidity		S	S	
Lapse	S		D	D
Interest	S	S	S	S
Credit	S	S	S	S
Market				S

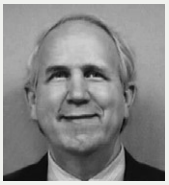
MG-ALFA™ and MG-Hedge™ were used to make 30-year projections, except for Group, where a proprietary stochastic model was developed.

Risks were assumed to be independent, with the following exceptions. Dependent lapse rates were used for some LOBs. Interest rate and market risk scenarios were generated together reflecting correlation between the two risk factors.

After-tax portfolio earned interest rates were used for the discount rates.

Baseline best estimate assumptions were established for each risk factor in each LOB. After-tax profits were projected for 30 years using the baseline assumptions. The present value of these profits was calculated (PV30).

Sets of 1,000 stochastic scenarios were generated around the baseline assumptions for the risk factors marked with an "S" in the chart above. After-tax profits and PV30 were calculated using the stochastic scenarios for each risk factor and LOB, varying one risk factor at a time. A "delta" value was calculated for each scenario as the difference between the scenario PV30 and the baseline PV30.



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The distribution of results for individual risk factors had to be combined into a composite distribution of results reflecting all of the risks. A large number (250,000 was selected) of observations from the composite distribution was created by choosing 250,000 uniformly independent random integers between 1 and 1,000 for each of the stochastic risk factors. For each of the 250,000 observations, the sum of the deltas for the selected scenario number for each risk factor was calculated. This aggregate delta was an estimate of the delta from the baseline PV30 for a projection reflecting the randomly selected scenarios, based on the assumption that the risks are independent.

For example:

Assume that observation number 10,000 was assigned the following random numbers for the stochastic risk factors:

Mortality	142
Morbidity	038
Lapse	871

CONTINUED ON **PAGE 28**

Case Study: Economic Capital Analysis at Guardian… | from Page 27

Interest/Market	413
Credit	910

Then the aggregate delta for observation 10,000 would be calculated as follows:

Life delta for projection using mortality scenario	142 +
Life delta for projection using lapse scenario	871 +
Life delta for projection using interest scenario	413 +
Life delta for projection using credit scenario	910 +
IDI delta for projection using morbidity scenario	038 +
IDI delta for projection using interest scenario	413 +
IDI delta for projection using credit scenario	910 +
Etc.	

Sorting the aggregate deltas allowed for the identification of the composite observations in the adverse tail of the composite distribution. Guardian chose to use CTE99 as the basis for calculating EC, so the worst 2,500 observations were needed. Because the aggregate deltas assume that the risks are independent, and this is not entirely true, the worst 5,000 composite observations were selected for further analysis. This measure made it reasonably certain that all of the worst 2,500 results were included in the sample.

For each of the worst 5,000 observations, a projection was made for each LOB using the combination of scenarios indicated by the randomly selected scenario numbers for that observation. The annual profits for all LOBs were summed to give a 30-year aggregate profit stream for the observation and PV 30 was calculated. The PV30s for all 5,000 observations were sorted and the worst 2,500 defined the worst 1 percent tail of the composite distribution to use in the calculation of CTE99. The GPVL was calculated for each of the worst 2,500 observations, and the average of these 2,500 GPVL values equaled the CTE99 value of the EC for the combination of Guardian and its subsidiaries.

And what is the result?

The "corporate" EC for business risk was less than 0.1 percent of beginning surplus.

There are several reasons that the corporate EC for business risk is very low.

- *The dividends paid on the par whole life business can be adjusted to reflect changes in experience*. The EC projections calculated adjusted dividends to reflect changes in portfolio earned interest rates. The dividends could have been adjusted to reflect adverse experience in mortality and credit, but Guardian elected not to make these adjustments in the model, resulting in extra conservatism. The cushion resulting from the adjustability of the par dividends allows a well-run mutual company to absorb wide fluctuations in experience without the extreme adverse impacts that might be found in other companies.
- *The Group business is repriced annually to reflect emerging experience.* The EC projections assume that repricing is done annually and that pricing changes impact the persistency of the business.
- *There is a significant diversification benefit when the profit streams of the four LOBs are combined to get the aggregate profit stream.* Everything does not go bad at the same time, so bad experience in one risk factor requently can be offset by good experience in other areas of the business.

OPERATIONAL AND STRATEGIC RISKS

In addition to the business risks, an analysis also was performed for both operational risk and strategic risk.

Leaders within each line of business, along with the operational risk officer, identified the primary operational risk scenarios for their business. For each scenario, two estimates of frequency and severity were made. One estimate represented a low cost with a high frequency, and the other estimate represented a high cost with a low frequency.

A copula model was used to develop the aggregate distribution for the combination of all of these risk scenarios, allowing for judgments to be included for the correlation of the scenarios. The EC for operational risk was calculated to be less than 3 percent of surplus.

Strategic risk analysis was based on a brainstorming session moderated by Milliman consultants. The senior corporate management team developed an extensive array of possible strategic events. The Milliman consultants then used their strategic risk model to develop a grid showing the interrelationships of the strategic events and to identify the most significant clusters of risks. The EC for strategic risk was calculated to be less than 5 percent of surplus.

> "In addition to analysis of corporate EC, Guardian performed EC analysis for each line of business as if it were a stand-alone entity."

When the losses for operational and strategic risk were combined with the annual profits for each of the tail observations of business risk, the resulting aggregate EC for business, operational and strategic risks combined was less than 3 percent of surplus.

CAPITAL ANALYSIS

Guardian performed an extensive analysis of the distribution of future performance of the existing surplus. Much of the surplus is invested in common stocks, protected by a sophisticated dynamic hedge program. The purpose of this analysis was to demonstrate that a large portion of the beginning surplus of $3.7 billion would be available to support the aggregate risks, even in the tail of the distribution.

OTHER ANALYSIS USING EC PROJECTIONS

Guardian expanded the basic EC analysis in a variety of ways.

- *By LOB*—In addition to the analysis of corporate EC for business risk, Guardian performed the EC analysis for each LOB as if it were a stand-alone entity. Only the risk factors for the target LOB were used to define the composite distribution for that LOB. Profits from other LOBs were not available to offset losses in the target LOB. The sum of the EC results for the four LOBs was less than 2 percent of surplus, compared to the corporate EC for business risk that was less than 0.1 percent of surplus.
- *New business*—EC analysis is generally performed on the closed block of business in force on the effective date of the analysis. Guardian also performed the analysis by including five years of new business along with the in-force business. As expected, losses in writing new business generated larger GPVLs. The sum of the EC results, including new business, for the four LOBs was less than 7 percent of surplus.
- *Reduction in PV30*—EC at the CTE99 level measures the amount of capital required to cover the average losses in the adverse 1 percent tail of the distribution. This produced some very interesting information, and management was happy that EC was not a large amount (less than 0.1 percent of surplus). However, amounts very close to zero are difficult to use in evaluating the impact of actual events or potential management actions. Another point of view would be to consider the total baseline PV30 for all LOBs to be a component of the value of the enterprise. Then the reduction in PV30 in the 1 percent tail would show how much value is lost in these extreme adverse environments. The average of the PV30s, including new business, over the 1 percent tail of the distribution was about 75 percent of the baseline PV30. The business is still generating significant value, even in the 1 percent tail of the distribution, but this 25 percent reduction provides a significant base so that the impact of actual or proposed actions can be evaluated.
- *Stress tests*—During 2008, senior management and the board asked questions about the impact on Guardian regarding various possible future scenarios. Two of the questions related to the impact of a long recessionary environment along with a Japanese-like bear market scenario. The EC analysis was used to answer these questions by identifying observations from the composite distribution that combined sets of scenarios for the individual risk factors that were consistent with the target environments. The results for these observations were combined and analyzed to provide meaningful answers to the questions.

PLANS FOR THE FUTURE

As we look at future expansion of the EC analysis, there are several modeling enhancements, as well as tactical goals, to be considered.

First, we expect to perform expanded analysis for the entire distribution of results, rather than focusing primarily on the 1 percent tail of the distribution. Second, we want to enhance the Group stochastic model to refine the handling of timing and effectiveness of repricing actions. Third, we want to improve the sensitivity of the dependent variables for each line of business.

Tactically, we will eventually bring the modeling capabilities in-house, and we are currently in the process of building out our grid computing capability. More importantly, we want to expand the uses of the EC modeling, including performance measurement of the businesses.

We at Guardian have just scratched the surface in developing our EC modeling and analysis. The next important step is to decide how to incorporate the results of the analysis into the decision-making process in the organization. ✦