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Economic Capital—

Recent Market Developments and Trends

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Economic Capital (EC) has received increasing interest recently, both from the insurers as well as from regulators and rating agencies. This article is designed to provide some insights into this topic, by describing some of the work of the EC subgroup of the SOA's Risk Management Task Force (RMTF).

Background

Life insurer's capital has come under increased scrutiny as of late. Three years of equity market declines and a drop of interest rates to levels not seen since the 1950s have led to dramatic falls in revenues.

The quest for higher yields has led life insurers to invest in riskier fixed income assets, leading to a record \$18.7 billion of realized capital losses in 2002. Excluding capital contributions from parent organizations and shareholder dividends paid

out, the life industry's aggregate capital has stagnated since 1998. Many companies have seen downgrades in their financial strength ratings over the last six months.

At the same time, regulatory bodies are introducing new capital and reserving requirements for products with equity guarantees which will lead to increased strain on capital. Given this background, it is not surprising to find a growing number of companies paying greater attention to calculating the appropriate level of capital for their business.

EC Subgroup within the RMTF

One of the ten subgroups existing within the SOA's RMTF deals with the topic of EC Calculation and Allocation (ECCA). Founded in the spring of 2002, this subgroup has more than 120 people registered on its listserve. Approximately 10-12 of these have been actively participating in the subgroup's work over the past year, including:

- Regular conference calls
- Developing and interpreting an industry survey on EC, conducted in the fall of 2002 and
- Developing an EC Specialty Guide.

The remainder of this article will focus primarily on the work of the EC subgroup.

Highlights of Industry Survey on EC

An e-mail survey was sent to members of the International, Financial Reporting and Investment Sections of the SOA in July of 2002. There were 491 participants, including 44 percent from multinationals, 32 percent US-based, 8 percent North American and 4 percent from Canadian companies. 57 percent of participant companies had assets greater than \$20 billion; 68 percent were stock companies.

The following strawman definition of EC was proposed: At the enterprise level, EC is typically defined as "sufficient surplus capital to meet negative cash flows at a given risk tolerance level." Eighty-one percent of respondents agreed with this simplified definition. However, we also received a significant number of write-in text answers. These were included with the expanded definitions provided in the EC Specialty Guide (page 7).

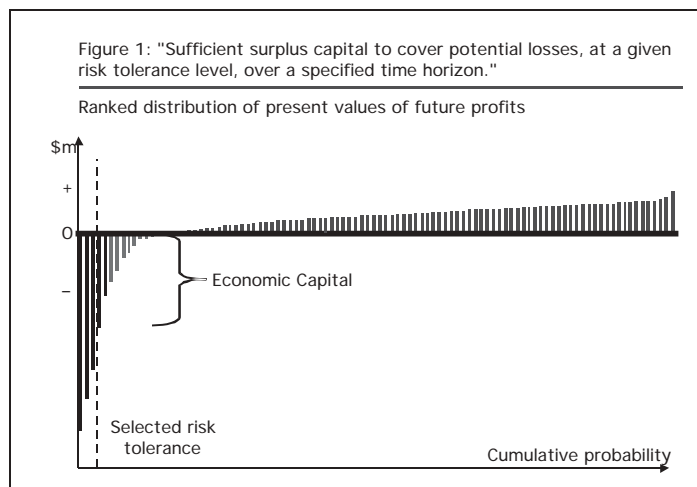
Most respondents also agreed that EC should cover various types of risks, including:

- Interest rate risk (96 percent)
- Pricing risk (93 percent)
- Credit risk (92 percent)
- Equity market risk (91 percent)
- Liquidity risk (86 percent) and
- Operational risk (79 percent).

Almost half of the respondents (45 percent) have been using the concept of EC in their work.

When determining EC, various risk tolerance measures are currently in use. Sixty percent of respondents use specified percentile measures (e.g. 98th percentile), while 17 percent use a multiple of standard deviation. 15 percent use a Conditional Tail Expectation (CTE) measure, and 9 percent indicated they use other methods. In particular, the CTE measure is also used for setting regulatory capital as part of the new C-3 Phase II proposal for regulatory capital on variable products ("RBC C-3 Phase II"). The proposed capital standard would be based on the average required surplus for the worst 10 percent of outcomes using a set of stochastic scenario's (CTE 90). This is further explained in the EC Specialty

Sufficient surplus capital to cover potential losses, at a given risk tolerance level, over a specified time horizon.



Guide. However, at the time of the survey, only 38 percent were aware of the new RBC C-3 Phase II requirements.

The main reasons for companies implementing EC to date have included risk and performance measurement. Forty-four percent of respondents cited risk management as the key reason, 32 percent cited performance measurement, and 59 percent have established a formal framework for the calculation of EC. Going forward, we expect the impetus to come more from competitive forces and rating agency pressures.

For measurement of EC, less than half of respondents (43 percent) use stochastic models. Thirty-one percent of participants use formulaic approaches, 28 percent use deterministic models, and 18 percent use a mean-variance-covariance model.

A majority of companies expect EC to have greater significance going forward.

Overview of EC Specialty Guide

Currently, the ECCA subgroup is working on completing a specialty guide on EC. By the time this article is printed, a completed draft version of the guide will have been posted to the subgroup's Web site (www.soa.org/sections/rmtf/rmtf_ecca.html).

The Specialty Guide is designed to be a source of information for practitioners interested in:

- Learning more about the subject of EC
- Finding out about current market practices in this area and
- Reviewing a list of available literature on this topic.

The specialty guide addresses the following topics:

- Definition of economic capital
- Uses of economic capital in the current marketplace
- Tie-in of economic capital to regulatory/rating agency capital
- Current approaches to calculating economic capital and
- Current approaches to allocating economic capital.

A summary of the answers obtained from the industry survey, as well as a review and discussion of available literature is provided in the appendix to the guide. Each of the main sections is briefly described below.

Definition of EC

First of all, we would like to distinguish economic capital from regulatory or rating agency capital. Economic capital is based on calculations which are specific to the company's risks, while regulatory or rating agency capital formulas are based on industry averages which may or may not be suitable to any particular company.

The subgroup has since refined the definition of EC as follows, "EC is defined as sufficient surplus capital to cover potential losses, at a given risk tolerance level, over a specified time horizon." However, it has quickly become apparent that there is no one consistent definition of economic capital in use in the marketplace. Potential definitions are numerous, but the following three composite definitions, developed from the many responses to our survey, demonstrate the main themes of the alternatives:

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Table 1 Alternative Definitions of Economic Capital	
Definition #1	Economic capital is defined as sufficient (statutory) surplus to meet potential negative cash flows and devaluation of the balance sheet at a given level of risk tolerance, over a specified time horizon.
Definition #2	Economic capital is defined as the excess of the market value of the assets over the fair value of liabilities required to ensure that obligations can be satisfied at a given level of risk tolerance, over a specified time horizon.
Definition #1	Economic capital is defined as sufficient (statutory) surplus to maintain solvency at a given level of risk tolerance, over a specified time horizon.

Table 2 Current and Planned Uses of EC *	
35%	Using now; anticipate same or greater significance in the future.
29%	Not using now; anticipate it will have greater significance in the future.
25%	Uncertain about future role.
9%	Not using now; not anticipating to use in the future.
1%	Using now; anticipate less significance in the future.

* Source: EC Survey (2002)

While definitions #1 and #3 refer to “sufficient surplus”, Definition #2 instead focuses on the characteristics of the assets (market value) and the liabilities (fair value) that define this surplus.

Each definition presents a different expression for the adverse outcome that the economic capital is intended to protect against. Definition #1 refers to “potential cash flows and devaluation of the balance sheet.” Definition #2 is concerned only that “obligations can be satisfied.” The goal of Definition #3 is to “maintain solvency.” These broad definitions seem to imply that all risks are to be taken into account.

Uses of Economic Capital

Three questions on the recent industry survey addressed the use of EC by today’s actuaries. The most basic question—whether you have “been using the concept of EC at your company or in your consulting work”—saw a nearly even split between

Yes and No, with slightly less than half of the 500 respondents reporting that they are currently using EC. Among those who used EC, their main reasons for using EC included, “To provide management with the knowledge that risks were being adequately managed and sufficient surplus was available.” (45percent) and “better measurement of the performance of different business units” (33 percent). Less than 15 percent of the respondents said that they were using EC primarily for due diligence analysis or to discuss excess capital with regulators and rating agencies. EC thus seems to be used more as an internal management tool than as a tool to communicate with external audiences.

Comparing answers to whether the respondents currently use EC and what the plans are in the future reveals a definite increasing trend in the use of EC, as shown in Table 2 above.

The heaviest users of EC are in diversified financial institutions, followed by life and annuity writers.

EC seems to have greater acceptance and application in the non-insurance financial world and is still establishing a foothold with pure insurers. Consultants indicate they use EC concepts in their work comparatively less than the insurance employees; they are also less likely to indicate anticipation of greater use in the future.

Given this overview of how prevalent the general use of economic capital is, we now examine its specific uses and applications. The following list taken from the EC Specialty Guide is not intended to be exhaustive, but does capture the major uses of economic capital in today's insurance industry environment, according to the views of the ECCA subgroup:

- Company/product risk profile
- Capital budgeting
- Evaluation of required capital in M&A situations
- Insurance product pricing
- Risk tolerances and constraints
- Asset/liability management
- Financial reporting
- Performance measurement
- Incentive compensation
- Rating agency and regulatory discussions

More details on each of these uses are provided in the EC Specialty Guide.

Tie-In of Economic Capital to Regulatory/Rating Agency Capital

Regulatory and rating agency capital requirements are motivated fundamentally by solvency concerns. Rating agencies are also concerned with the level of financial strength and general creditworthiness of an organization. These ratings provide a prospective evaluation of an insurer's financial security to its policyholders and debt holders. Capital requirements are generally targeted using simplified methods (eg. factor approaches) at levels appropriate for the aggregate industry and cannot reflect the nature of the company's risks to the degree to which can be achieved through a customized internal model.¹

The motives behind calculating Economic Capital concern the "appropriate" allocation of capital to the risks undertaken by the company. The level should be sufficient for a going-concern entity and reflect the degree of contribution of risk to the company. Holding too little economic capital threatens the ability of the company to meet its obligations;

holding too much economic capital will unnecessarily reduce return on equity, and potentially distort rational economically based decision-making.

A recent trend has been for external measures of economic capital to adopt more complex (and hopefully more meaningful/realistic) methods. For example, the NAIC RBC calculation is in a two-phase process of enhancing its C-3 risk measurement. Also, A. M. Best is moving towards an "Enterprise Risk Model" to supplement its Capital Adequacy Ratio.

Standard & Poor's has created a dynamic model called "Financial Product Capital (FPC)" to measure the required economic capital. This dynamic model has been applied to non-insurance "books" (e.g. GIC, MTN programs, credit derivatives), quantification of financial and credit market risk mitigation strategies (e.g. OTC and exchange traded market and credit derivatives), certain "one off" structured capital market transactions and financial product company subsidiaries or credit enhanced vehicles. The capital adequacy determined by the FPC model is intended to replace the capital adequacy requirement historically derived using the Standard & Poor's capital adequacy model for the specified "book."

The main rationale for these new models and methodologies are: (1) increased sophistication of risk management practices at insurance companies; (2) failure of factor-based approaches to properly deal with risks inherent in current products and investment strategies; (3) inquiries from companies seeking quantitative recognition of risk management practices including quality of their product structures; and (4) pressure on companies to optimize their capital base.

Capital levels required by the regulator and rating agencies create an overall constraint as to the amount of capital held by the firm. The EC Specialty Guide describes several methods a company may consider in recognizing the differences between economic and regulatory/rating agency capital requirements, and allocating them to various lines of business or the corporate line.

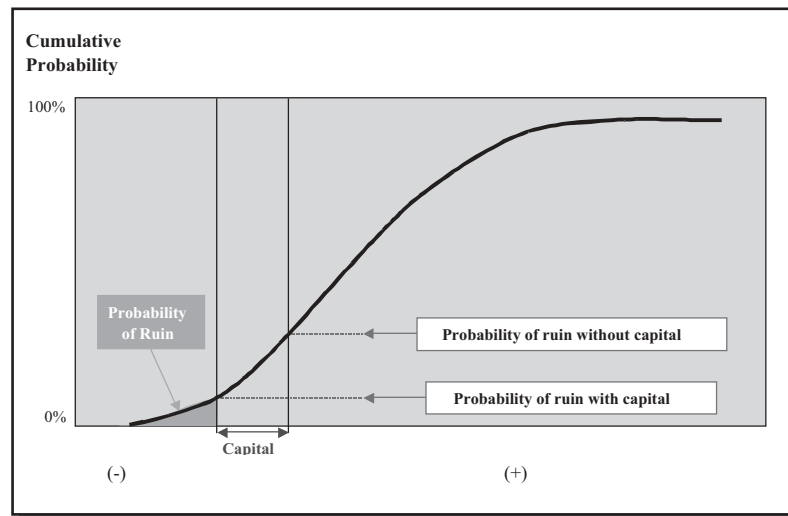
Calculation of EC

There are various methods for determining economic capital. A common methodology is to base EC on the probability of ruin. Probability of (statutory) ruin is the probability that liabilities will exceed assets on a present value basis at a given future valuation date, resulting in technical insolvency. It can be calculated from the probability density function of the present

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¹ There are some emerging trends in regulatory capital to be based on methods linked to internal models. These will closer align regulatory and economic capital levels.

Figure 2: The Probability of Ruin can be calculated from the probability density function by measuring the area under the curve corresponding to the section where liabilities exceed assets on a present value basis



value of future surplus by measuring the area under the curve corresponding to the section where liabilities exceed assets. This is shown in Figure 2 as the shaded area. Alternatively, it can be calculated from the cumulative distribution function similar to Figure 1 on page 7 by determining the probability point (on the y-axis) where liabilities equal assets (on the x-axis). These probability graphs are generated by running computer simulations of liabilities and assets using a stochastic financial model.

Economic capital based on the probability of ruin is determined by calculating the amount of additional assets needed to reduce the probability of ruin to the probability target specified by management. The target probability of ruin is set by management in consideration of several factors, primary among them the solvency concerns of policyholders—usually expressed in terms of the minimum financial strength rating that management desires from the rating agencies. The EC Specialty Guide provides several examples for calculating EC.

Allocation of EC

Having determined the appropriate capital requirement at the enterprise level to satisfy policyholders' interests, it is necessary to fairly attribute capital to each segment in a way that reflects its contribution to the enterprise-wide capital requirement. This attribution allows the proper evaluation of the performance of each business segment.

There are several methods for attributing capital to each business unit. These methods differ primarily by the choice of risk measure used to estimate the capital requirement of each segment in relation to risk.

One such method is to attribute capital across business segments in proportion to the present value of expected customer payments. Under this method, each product is assumed to contribute to the risk of insolvency in proportion to the economic value of commitments to customers—and thus all products are assumed to involve the same degree of risk. Since this is not the case in most situations, less risky products provide a capital subsidy to the more risky products. The resulting unfairness may result in business decisions that destroy economic value.

To attribute capital fairly across segments, capital requirements must be determined in relation to the riskiness of each segment. Since, at the most intuitive level, policyholders, regulators and insurance executives can see that the level of risk is directly related to the probability of ruin of the company, it is often suggested that probability-of-ruin or Value-at-Risk (VAR) constraints be used to drive the capital attribution process. However, both probability of ruin and VAR have a drawback if they are used to attribute capital to business segments or to determine the capital of merged or combined operations: when two or more risky portfolios are combined, the capital based on these measures for the combined portfolio may turn out to be equal to or more than the sum of the capital for each portfolio determined separately.

Combining risky portfolios should, however, decrease total risk, and therefore capital, due to risk diversification. Under certain conditions then, these risk measures may suggest incorrectly that combining portfolios increases the level of risk.

To summarize, the attribution process requires completion of two steps.

1. Calculation of stand-alone capital requirements:

The objective of this step is to determine the minimum amount of capital that is needed by each individual segment to meet the corporate level risk constraint, expressed as a probability of default, for example. Note that adding up the stand-alone capital requirements calculated above will result in a capital requirement that is greater than the aggregate capital requirement of the enterprise. The difference between the two amounts represents the capital saving achieved by diversification. This benefit needs to be allocated to business segments.

2. Allocation of the diversification benefit to segments:

The allocation of the diversification benefit to segments needs to reflect the contribution of each segment to aggregate enterprise risk. It involves calculation of the marginal capital requirement of each segment, i.e., the amount of capital needed by the enterprise to add the segment to the enterprise. The difference between this marginal capital requirement and the stand-alone capital requirement calculated in the preceding step represents the maximum amount of diversification credit associated with any segment. The actual amount of credit given to any segment will be less than this maximum. It will be derived by use of any one of several possible algorithms that are designed to make the resulting allocation fair across segments.

It is important to note that capital attribution results can be highly sensitive to the risk measure and risk constraints that are selected. In particular, there are situations in which using a probability-of-ruin constraint can lead to erroneous conclusions about capital requirements and to inappropriate attribution of capital across business segments (especially in property/casualty insurance companies). These difficulties can be avoided by using CTE measures or (for P/C companies) the Economic Cost of Ruin (ECOR) ratio as measures of risk and selecting an

appropriate target as a risk constraint. This is further described in a monograph from Tillinghast – Towers Perrin on Enterprise Risk Management available through the following link:

http://www.tillinghast.com/tillinghast/publications/reports/Creating_Value_through_Ent_Risk_Mgmt/2002051306.pdf

Outlook

EC was discussed at the recent SOA Spring Meeting in Washington, DC in several sessions. Interest among the participants on the ECCA listserve is high, as is evidenced by the fact that the ECCA website had the highest number of hits in April among all the RMTF Web sites. Also, actuaries and governing bodies in other parts of the world are showing an increasing interest in the subgroup's work on Economic Capital.

There are a number of questions which still need to be addressed, including, for example:

- What should economic capital be for credit default swaps?
- Should investment market-implied assumptions be used to "price" economic capital?
- Can I use economic capital to set issuer and concentration limits?
- Does economic capital lead to nontraditional asset allocation decisions? For instance, should insurers/pensions invest in commodity futures, and why or why not?
- Can I estimate a company's economic capital from public information about its securities, and use it in a buy/sell decision?
- What does internally calculated economic capital tell management about how best to raise capital by issuing securities?

The EC Subgroup will continue to address current issues, such as the ones identified above, in the coming months. Anybody interested in actively contributing to the subgroup's work should contact the author of this article. People generally interested in the developments of this subgroup should contact Julie Young (JYoung@soa.org) and ask to be added to the ECCA listserve. ☺



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