

Solvency II and Portfolio Replication

Speed and accuracy are important as European insurers comply with new regulations.

By Curt Burmeister



Around the globe, insurance companies are moving toward managing their economic capital by integrating liabilities and assets in a coherent and consistent manner. At the same time, insurance regulations such as Solvency II are pushing companies to assess their risks in a market-consistent manner. As industry best practices and regulations converge, companies are choosing to adopt the same approach for calculating and managing both economic and regulatory capital. The early movers will be in a position to make better decisions about capital

allocation and thereby exploit competitive advantages.

Over the past 12 months, portfolio replication has become the method of choice for insurance companies building out the next generation of economic capital models. The methodology allows them to create an integrated view of assets and liabilities that can be used to perform a detailed analysis of the joint market risk on both sides of the ledger. Aggregating non-market risks such as credit risk, operational risk, and mortality risk, which are computed in other sys-

tems, can be achieved using a Gaussian-copula approach.

The early adopters of portfolio replication have primarily been large European multinationals. These firms are looking to build their new economic capital models with a system that will also serve as a basis for their Solvency II internal model. Today, most of the major European insurers have initiated studies to evaluate the methodology, and a handful of companies are well down the path toward implementation. Interest among North American insurers and in Asia has increased in 2008 but lags behind Europe by 12 to 18 months.

Speed and Accuracy

The primary motivators for building a new economic capital system are speed and accuracy. In other words, firms want to compute economic capital figures quickly and accurately enough to be able to use them confidently in their business decision-making. Typically, this translates into economic capital numbers that are calculated using 50,000 or more economic scenarios and that are available two to three weeks after the end of each quarter. A more specific list of goals and/or objectives for a new system usually includes the following:

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- Reducing the time required to calculate economic capital from 10-plus weeks to under four weeks;
- Improving the accuracy of economic capital calculations over the existing system;
- Developing a system that is fully auditable and Sarbanes-Oxley compliant, allowing economic capital numbers to be disclosed in annual reports and other public documents;
- Meeting the disclosure requirements of International Financial Reporting Standard No. 7, *Financial Instruments: Disclosures*;
- Providing a single framework that can also generate the additional risk measures that are required by Solvency II;
- Increasing the market-risk capabilities available to many business units, particularly business units in regional or emerging markets;
- Creating better benchmarks that can be used by both internal and external investment managers.

Economic capital systems using a portfolio replication approach are able to achieve the primary goals of speed and accuracy because they eliminate the complex and computationally intensive problem of simulating all the liabilities over 50,000 economic scenarios. Instead, they create a proxy portfolio consisting of standard capital market products that replicate the scenario-dependent payoffs generated by the company's existing liability projection systems. As this replicating portfolio is composed of capital market products, the valuation of liabilities through proxy is consistent with the valuation on the asset side of the balance sheet.

There are six main steps in building a replicating portfolio:

1. Define a set of economic scenarios to be used in the replication process. Typically, the total number of scenarios is between 500 and 2,000 and consists of a combination of risk-neutral scenarios, real-world scenarios, and stress-test scenarios.

2. Use the existing liability-projection systems to generate the liability cash-flow projections across the defined set of economic scenarios.

3. Aggregate the liability cash flows based on criteria such as product type or business unit. The choice

of the aggregation grouping is determined by the final analysis. Are we allocating capital at the level of product type or business unit? Are we hedging a particular guarantee?

4. Choose the universe of replicating assets. The universe typically includes vanilla interest-rate products, market indexes, and options/futures on interest products and market indexes. Generate the asset cash-flow projections across the defined set of economic scenarios.

5. Solve an optimization problem to determine the portfolio of assets (from the universe of replicating assets) that best tracks the liability cash flows across the defined economic scenarios.

6. Use the replicating portfolio as a proxy for the liability portfolio in economic, regulatory, hedging,

or other asset-liability management analyses.

The advantage of this approach is that the liability projection systems need only project and output cash flows from a small scenario set. It also allows for the integration of cash flows from multiple liability-projection systems in a consistent manner and reduces the computational requirement to run large stochastic-on-stochastic projections. On the other hand, it's impossible to drill into the replicating portfolios or re-aggregate

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the liabilities using different grouping criteria. The diagram on Page 42 outlines the conceptual architecture for a portfolio replication system.

Conceptual Architecture for Portfolio Replication System

Actuarial expertise and judgment are required throughout the replication process. Initial decisions must be made on the set of replicating scenarios (how many and what types) and the universe of replicating assets (which types, maturities, and strikes). After the cash flows are generated, there are a number of considerations to assess when configuring the optimization engine (whether to minimize absolute deviations or squared deviations, how to bucket cash flows and under what constraints). All of these decisions affect the final results. However, the results are typically very

stable for mature products. After determining a successful strategy for replicating a block of business, the strategy will hold for many quarters and possibly for years.

A Single Consistent Framework

An economic capital system based on portfolio replication can be adapted to compute the additional risk measures required by Solvency II and, with regulatory approval, lead to a single consistent framework to measure both economic and regulatory capital. In addition to the cost savings of having one system, firms that

start early have a much better chance of meeting Solvency II timelines because, as with large banks and Basel II, a just-in-time approach to implementation can be both problematic and expensive.

In order to address audit and reporting requirements, a production economic capital system must contain elements that are common in mission-critical systems. By providing the processes and controls around the calculation engines, a complete system can be constructed that is compliant with both Sarbanes-Oxley and International Financial Report-

ing Standards. Some key features the system must provide include:

- Automation tools that allow the process to run without intervention;
- Security and logging that control access to data and results;
- Data management tools and support for enterprise databases;
- Disaster recovery capabilities;
- The ability to archive results and inputs so that calculations can be rerun at a later date;
- Interfaces that allow communication with external systems.

Globally, there are a handful of companies that have already begun to implement new economic capital systems based on portfolio replication. The firms that are in production first will be able to achieve a number of potential benefits—they will be able to make better and faster decisions about capital allocation and will be in a position to take advantage of any market inefficiencies. Potentially, this could give firms a significant competitive advantage in areas such as product development and pricing. Furthermore, by investing in a market-consistent framework that can be adapted to calculate multiple risk measures, these firms will also be positioned to address the new regulatory capital requirements under Solvency II. ■

Curt Burmeister is vice president, risk solutions, at Algorithmics. He can be reached at info@algorithmics.com.

