

Integrating assets and liabilities

Curt Burmeister and Martin Sher consider alternative ways to align and integrate their approach to modelling assets and liabilities in the insurance industry.

Increased regulatory requirements, including the forthcoming Solvency II regulations, and increased management focus on enterprise risk management, are leading insurance companies to rethink their strategies for enhancing their liability projection systems. Currently, many insurance companies are investigating ways to align and integrate their approach to modelling assets and liabilities within a robust, scalable, and auditable enterprise risk management system that can handle increasingly sophisticated and computationally intensive calculations.

Historic silos

Traditionally the two sides of the insurance business – assets and liabilities – have largely operated in separate silos. Each side has had its own methodologies, systems, and practices. For example, in recent years many insurance companies have enhanced, and in some cases rewritten, their actuarial projection systems to apply modern approaches to valuing their liabilities on a market-consistent basis. However, this is largely implemented in isolation of the enterprise asset risk management systems employed by the asset management units within the company.

Such enterprise asset risk management systems are typically server-based, IT-controlled and daily-scheduled mission-critical systems that are used by and provide ‘real-time’ reporting to the full organisation through a ‘risk dashboard’. Through this dashboard users can view high-level aggregated company-wide results

across all areas of risk (market, credit, collateral, and operational) and can break down into highlighted areas of concern, determine economic capital measures, perform ALM analyses, portfolio optimisations and other ‘what-if’ type investigations.

These historically separate silos, areas of risk coverage and technological deployment are illustrated as the bottom-left and top-right boxes in figure 1.

Future integration

Insurance companies realise that in order to allocate and manage economic capital more effectively, they need to bring assets and liabilities into a similar framework, so that both sides of the business are valued consistently and, equally importantly, so that assets can be strategically allocated against the company’s liabilities.

Today, many firms are starting to design and implement the next generation of financial projection and enterprise risk management systems with this goal of integrating assets and liabilities into a consistent framework. Some key objectives for these new systems include the ability to:

- ◆ apply a consistent framework across multiple product lines, business units, and geographies;
- ◆ provide an interactive risk dashboard that can be used by actuarial and non-actuarial users across the entire organisation;
- ◆ leverage the existing liability projection calculations and client-specific implementations;
- ◆ facilitate the modelling of increasingly sophisticated asset instruments, and incorporate dynamic hedging strategies within liability capital projections;
- ◆ allow for stress testing both assets and liabilities with a variety of scenarios across market, credit, demographic, and operational risk factors;
- ◆ integrate with the asset management function and allow fund managers to optimise asset allocations and track asset returns against the company’s liability profile;
- ◆ comply and be consistent with corporate IT standards.

This article explores four conceptual approaches to meeting these objectives, which are illustrated in figure 1:

- ◆ extend liability projection systems to support

market, credit, and operational risk measurement within an enterprise risk management system;

- ◆ extend asset risk management systems to include liability projections;
- ◆ implement an integrated asset and liability risk management system that utilises liability projection system output within an asset enterprise risk management framework;
- ◆ implement replicated portfolio techniques that create a proxy portfolio consisting of standard capital market products to replicate the scenario-dependent pay-offs generated by the company’s existing liability projection systems.

Under all these approaches, because the same scenarios and consistent market-based methodologies are used in valuing both the assets and the liabilities, the enterprise risk system can aggregate the results together in a reporting dashboard.

1: Extend liability projection systems

One option is to enhance existing liability projection systems by extending the asset modelling capabilities, providing infrastructure for scalability, and building enterprise-wide dashboard and reporting capabilities. This approach leverages company investment in existing liability models but requires a significant functionality increase to cover market, credit, and operational risks. In addition, a significant development effort is required to build up the enterprise level infrastructure and reporting capabilities.

2: Extend asset risk management systems

At the other end of the spectrum, asset-focused enterprise systems within the organisation could be enhanced to model liability product cashflows, thereby producing an integrated asset and liability system. This approach leverages the reporting capabilities, robustness, and scalability of the asset-centric enterprise risk systems, but requires significant extension to cover liability product cashflow generation. However, by directly projecting liability cashflows this approach would not leverage company investment in existing liability models.

3: Integrated asset and liability risk management system

In contrast to the previous two approaches, this approach seeks to maximise the functionality and company investment in both company liability projection and asset risk management



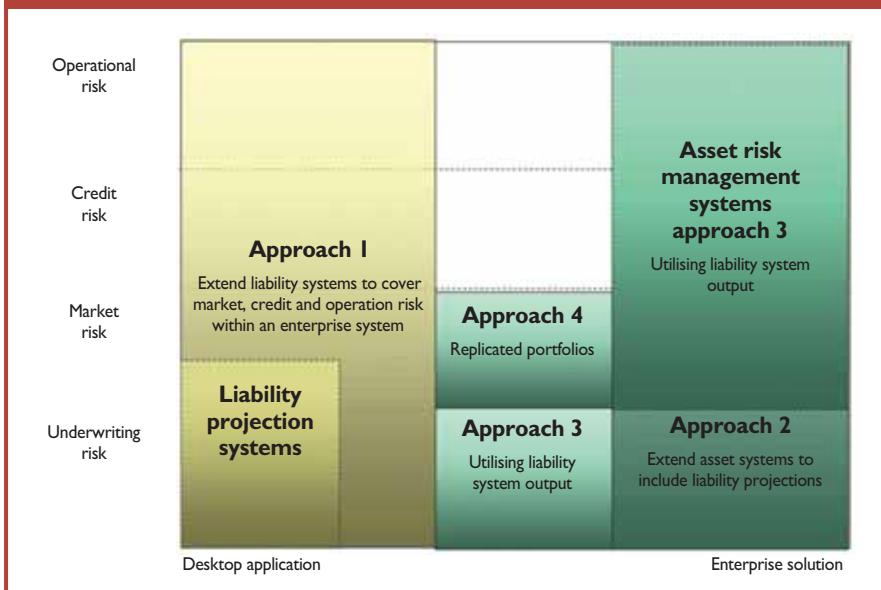
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in a consistent framework

Figure 1 Current insurance industry asset and liability system silos



systems by utilising liability projection pre-generated cashflows within the asset enterprise-wide risk management system.

By projecting the liability cashflows under the same economic scenarios as those used by the asset risk management calculation engine, the full enterprise-wide economic capital and ALM profile can be measured and reported by the enterprise risk management dashboard. However, this approach requires the liability projec-

tion system to project and output the full set of liability cashflows across all required scenario sets within an enterprise-level system.

4: Replicating portfolios

An extension of the previous approach is the replicating portfolio approach whereby capital market products are used to replicate the liabilities. The idea here is to create a proxy portfolio consisting of standard capital market

products that replicate the scenario-dependent pay-offs generated by the company's existing liability projection systems. As this replicating portfolio is composed of capital market products, then by proxy the valuation of the liabilities is consistent with the valuation of the asset side of the balance sheet.

There are five main steps in the process to build a replicating portfolio:

- Use the existing liability projection systems to generate the liability cashflow projections across the defined set of economic scenarios.
- Aggregate the liability

cashflows 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?

- Choose the universe of replicating assets. The universe typically includes vanilla interest rate products, market indices, and options/futures on interest products and market indices.

- Solve an optimisation problem to determine the portfolio of assets (from the universe of replicating assets) that best tracks the liability cashflows across the defined economic scenarios.

- Use the replicating portfolio as a proxy for the liability portfolio in economic, regulatory, hedging, or other ALM analyses.

The advantage of this approach is that the liability projection system need only project and output cashflows from a subset of the full scenario set. It also more easily allows for integration of cashflows 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 is impossible to break down the replicating portfolios or re-aggregate the liabilities using different grouping criteria.

Technical considerations when implementing replicating portfolio methodologies

Traditional tools for financial markets optimise by defining objective functions and constraints with respect to distributional statistics – standard deviation and tracking error or, more recently, tail measures such as value at risk or expected shortfall. However, in the insurance world, value distributions are unlikely to conform to simple distributional assumptions such as normality or even more sophisticated assumptions that attempt to capture skewness and kurtosis. For example, figure 2 shows the projected cashflows in year 10 for a liability portfolio across 500 economic scenarios.

Due to the asymmetric shape and long right tail of the distribution, it is preferable to optimise across scenarios. For example, consider a proxy portfolio of assets containing treasury bonds, swaptions, market indices, futures on the market indices, and calls and puts on the market indices. To create a replicating portfolio from the proxy portfolio, we define the objective function to minimise the sum of the norms representing the differences between the proxy portfolio and the liability portfolio across all

Figure 2 Cashflow projections

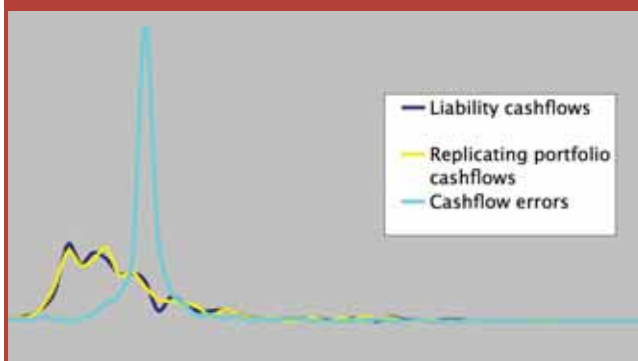
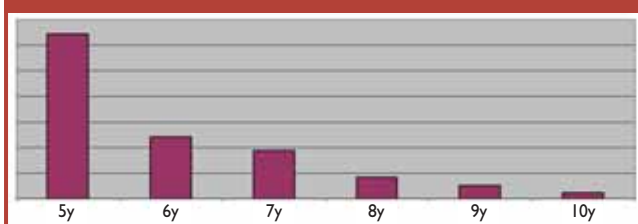


Figure 3 Cashflow errors through time



500 economic scenarios. Figure 2 also shows the 10-year future cashflows for the replicating portfolio across the same scenarios.

Continuing this example, the mean of the difference between the 10-year future value cashflows of the liability portfolio and the replicating portfolio is about 2% with a standard deviation of 3.5%. The distribution of the cashflow errors is more symmetric but does have a couple of large errors in the right tail.

Another consideration is the time horizon for matching cashflows. In the example, we attempted to match the future 10-year cashflows. However, there can be large errors between the replicating portfolio and liability portfolio in other years. Figure 3 shows how the mean cashflow error decreases as time approaches the target 10-year time horizon.

A better match at all dates can be obtained by incorporating multiple tracking dates with the same tracking attribute into the optimisation problem. However, decreasing the error at multiple dates may come at the expense of a marginally higher error at the single tracking date of 10 years.

Conclusions

Insurance companies are actively exploring methods for integrating assets and liabilities in a consistent framework for the purpose of calculating economic and regulatory capital and for producing other ALM reports. We have outlined four conceptual approaches that are being implemented to various degrees at a number of institutions. There are trade-offs to each approach, but all provide a platform that allows firms to improve profitability by improving the manner in which they manage and allocate assets against liabilities. □

Jargon buster

'Solvency II' is the name of the directive under development by the European Commission that will provide a comprehensive new framework for insurance supervision and regulation. It is intended to introduce across the EU a more sophisticated, risk-based approach to supervision and capital assessment, using modern techniques for market-based valuation of assets and liabilities.

Source: ABI, March 2007