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Solvency In Sight - New tools for understanding the impact of investment decisions on capital

Background

Changes are underway in the asset liability management (ALM) practices of insurance companies globally. Challenging market conditions, in particular ultra-low interest rates, are motivating companies to consider major changes in asset allocation in a search for yield.

At the same time, the ongoing trend towards market-value based measurement of capital, such as the Solvency II regulatory measures in Europe, has resulted in solvency being an increasingly important consideration in the ALM process.

Market-value based solvency measures are naturally sensitive to market conditions and ALM assumptions. For example, a recent field test carried out by the Japanese Financial Services Agency reports the average economic solvency ratio across all Japanese life insurance companies falling from 150% (March 2015) to 104% (March 2016)[1]. This change can be attributed to the fall in Japanese government bond yields during this period, combined with an investment strategy whereby assets have a shorter duration than liabilities.

Solvency must be carefully managed as part of the ALM process, while balancing against other considerations such as the desire for higher expected returns.

The modeling challenge

An insurance company's ALM department must be able to understand the impact of management strategy on capital and solvency, not just today but also in the future, as market conditions change.

Most insurance companies find this requirement presents a significant modeling challenge. While many companies have effective models and processes in place to measure capital, such processes are designed for relatively infrequent (for example annual, semi-annual, or quarterly) reporting.

From an operational point of view, it is typically not straightforward to embed such calculations within broader decision-making tools. This is particularly challenging where solvency must be evaluated in real time, under many different management assumptions and different market conditions.

1. Field Tests of Economic Value-Based Evaluation and Supervisory Method (March 28, 2017), Financial Services Agency of Japan

A potential solution

Proxy modeling techniques provide a potential solution to this challenge. A proxy model is an approximating model that is straightforward to implement with decision-making tools, and is fast to run. A proxy model allows the ALM department to measure capital quickly, under different management assumptions, without having to access the 'heavy' model that is used to calculate capital for reporting purposes.

To illustrate the use of proxy models in decision-making, we consider a fictitious ALM department managing asset allocations for an annuity business. The ALM department can allocate assets among government bonds, corporate bonds of various ratings, and cash, and wants to understand the effect of changing asset allocation on the company's solvency ratio at a particular reporting date, December 31, 2016.

In this particular example, the calculation of available capital is relatively straightforward, at least in principle. Assets and liabilities can be valued simply by discounting future cash flows, given a set of risk-free and corporate yield curves, and mortality rates. Given market conditions at December 31, 2016, along with assumptions about the liability portfolio and leverage, we calculate that the available capital is £288,000.

Calculation of required capital is potentially far more complex. If the company is using an internal model, the asset and liability portfolios must be revalued many times under different risk scenarios, so that a full distribution of future available capital can be estimated. Typically more than 100,000 risk scenarios might be used for a single estimate of required capital. Each time a new asset allocation is considered, this entire calculation must be repeated, leading to the operational, and computational challenges described in the previous section.

Now suppose that the required capital can be written as a polynomial function of the allocations to the different candidate asset classes[2]:

$$\begin{aligned} RequiredCapital &= c + a_{10} \times CashAllocation + a_{20} \times CashAllocation^2 + a_{01} \\ &\times GovtBondAllocation + a_{11} \times CashAllocation \times GovtBondAllocation \ldots \end{aligned}$$

We can fit the coefficients of this polynomial function (c, a_{10}, a_{20} , and so on) to data produced by the internal model, using regression techniques. Although doing so requires us to run the internal model many times under different choices of asset allocation, the total number of scenarios required to fit the proxy function is typically small enough that the process is computationally feasible. In this particular example, the total number of scenarios used to fit the proxy function is 500,000, equivalent to five single runs of the internal model in terms of overall computation time.

The charts in Figure 1 show required capital under various asset allocations, compared to the available capital of £288,000, which is indicated by the sold black line.

The diamond indicates the required capital under a 'base' allocation of 10% cash, 30% government bonds, 48% investment-grade corporate bonds, and 12% high yield corporate bonds.

Under this particular choice of asset allocation, the required capital is £174,000, producing a solvency ratio of 165%. The different lines show the impact of reallocating assets away from this base position, either

2. In this example, nine candidate asset classes are considered: cash, government bonds, and corporate bonds rated Aaa, Aa, A, Baa, Ba, B, and Caa.

by changing a combination of allocation to cash and government bonds (relative to total bonds), or a combination of allocation to cash and investment grade corporate bonds (relative to total corporates). All this information was calculated in a fraction of a second simply by evaluating polynomials.

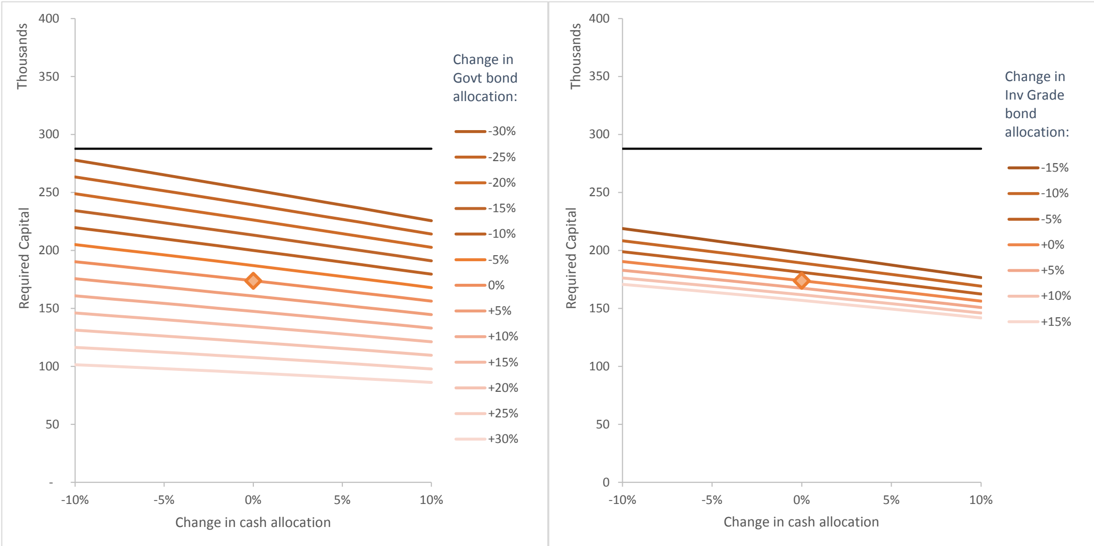

Figure 1: Required capital under various asset allocations, compared to the available capital

Such information allows the ALM department to understand the impact of changing asset allocation on required capital and solvency, under fixed market conditions, in this case, as of December 31, 2016.

However, as discussed earlier, capital and solvency can be extremely sensitive to market conditions. This information allows the ALM department to understand the range of possible asset allocations consistent with target solvency levels on December 31, 2016, but does not tell them how solvency might change in future.

To answer this question, we can extend the proxy model to include variables describing changes in market conditions[3] and asset allocations. In this example, we add variables describing the risk-free yield curve level and slope plus a single variable describing the level of credit spreads.

Figure 2 shows that the solvency ratio projected under 1,000 stochastic scenarios, starting from the base allocation at end-2016 and projecting over one year to end-2017. The proxy model allows the ALM department to understand the impact of changes in market conditions on solvency.

The first thing to note is that credit spread movements are the main risk factor affecting solvency of this business; with a 10% allocation in cash, the expected asset and liability cash flows are closely matched so there is little interest rate risk.

In the highlighted scenario where the 10-year A credit spread rises from 1.4% at the end of 2016 to 2.4% at the end of 2017, the solvency ratio falls from 165% to 102%. The business can choose to mitigate this market impact by raising more capital, or by reallocating into less risky assets.

3. We use the term 'market conditions' here to cover any factors that affect the company's capital position but which the company has no control over. This includes market risk factors such as yield curves and equity levels, but also non-market risk factors such as longevity curves, and pseudo-market risk factors such as the Ultimate Forward Rate.

Figure 2 also shows the effect of such change in asset allocation under this particular scenario. For example, the Solvency Ratio can be restored to its initial level, indicated by the dashed line, by increasing the allocation of government bonds (relative to total bonds) by around 23%.

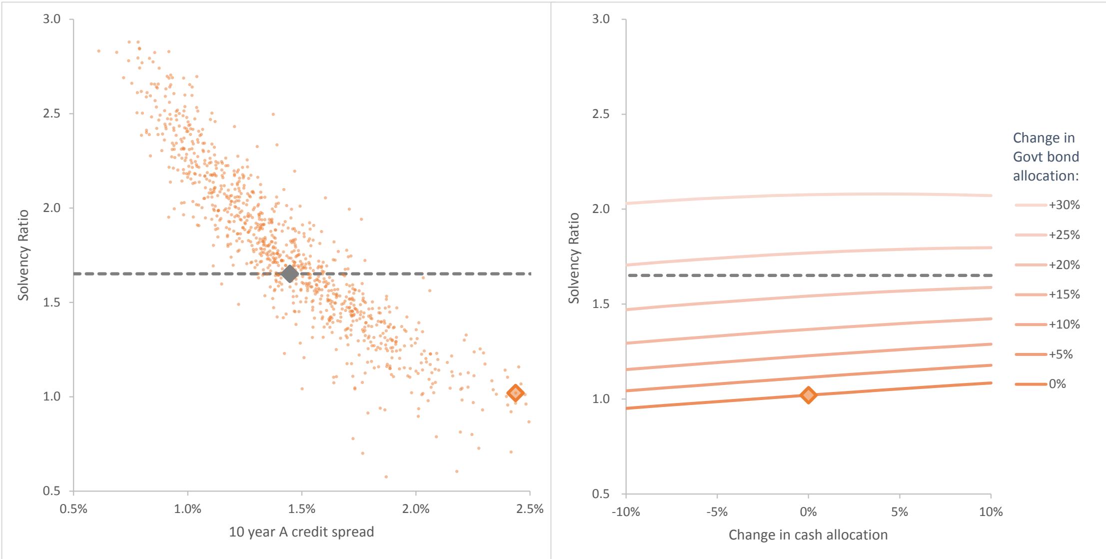

Figure 2: Solvency Ratio under various asset allocations, in scenario where credit spreads rise.

An alternative scenario, in which the A credit spread falls to 0.9%, is highlighted in Figure 3. In this 'good' scenario, the solvency ratio increases to 264%, potentially allowing the business to reallocate from government to corporate bonds.

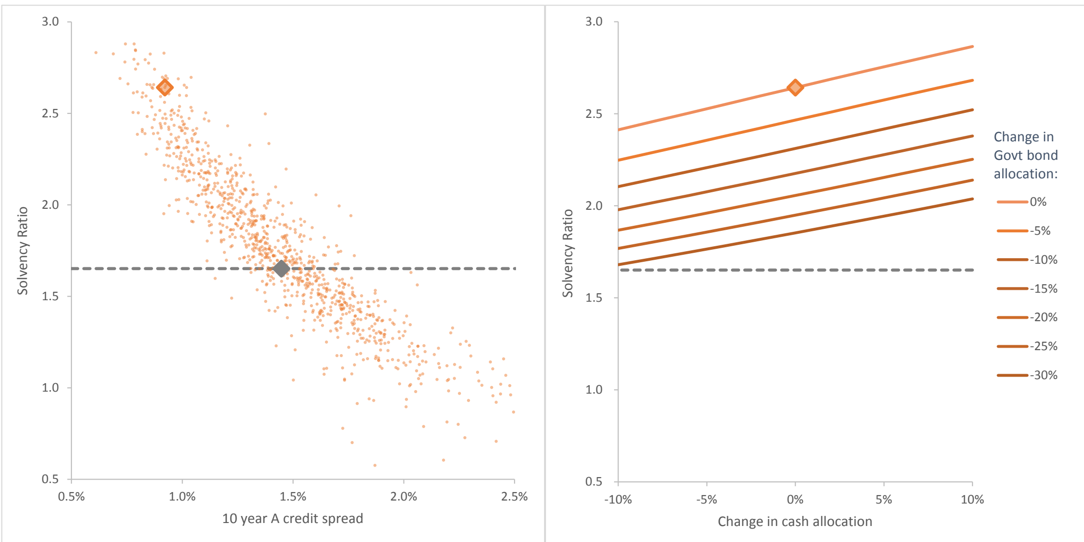

Figure 3: Solvency Ratio under various asset allocations, in scenario where credit spreads fall

Again, we can access this information – and more – extremely quickly via the proxy model. It would be impractical to access the same quantity of information by manually running the internal model under every possible asset allocation and market condition considered here.

Summary

Regulatory solvency is an increasingly important factor in insurance companies ALM decisions. Market-value based capital measures are naturally sensitive to market conditions and ALM assumptions and the resulting volatility must be measured and managed as part of the ALM process. Unfortunately, these capital measures are also complex to measure, being dependent on time consuming models and manual processes.

In this note, we have considered the use of proxy models as a way of overcoming some of the operational and computational challenges associated with measuring future solvency under different market conditions and ALM assumptions. As long as 'heavy' models are difficult to implement and slow to run, we believe that proxy models provide a useful alternative to help with ALM decision making.

SP47382/IND110A