

FINANCIAL MODELLING – THE HUMAN DIMENSION

Whether it's for planning and budgeting, ALM or valuation purposes, sophisticated analyses that are critical to managing life insurance companies rely on advanced financial modelling techniques. Integrated financial modelling platforms link assets, liabilities and management decisions on a stochastic or deterministic basis. In practice, these decisions are neither analytically specified nor formulaic and a considerable amount of management discretion can be exercised to handle a particular situation. This *Update* will focus on those areas in financial modelling where the human element may currently be under-represented and unintentionally sidelined, and suggest an alternative method to tackle this issue. Our case study of a Norwegian life insurance company provides a unique insight into the issue raised, especially in light of new legislation being introduced for traditional with-profit businesses in Norway.

Linking financial models to day-to-day decision making is undoubtedly a challenge that many actuarial and risk management experts have struggled with. In bridging this gap, the ability to demonstrate that a financial model is projecting reasonable management actions can be a considerable asset.

The market value of liabilities for traditional business, calculated for IFRS, MCEV, Solvency II or hedging purposes greatly depends on how management actions are taken into account and directly affects a company's capital requirement. Thus control of management actions in financial models is important in order to achieve robust capital management.

CURRENT STATUS

Life insurance company strategies are usually described qualitatively and involve statements such as 'long-term financial security', 'stability of the pricing basis', 'prudent investment management'. Management actions implemented in financial models do not yet fully capture these qualitative targets or constraints, and are influenced by considerations related to finding a workable technical solution. This means that the management decisions which are modelled may at times significantly differ from the decisions the company's management would have taken under the same set of circumstances. For example, modelling a company's bonus policy on factors already observed, such as current surplus and the solvency ratio, leads to a considerable restriction of available decisions, since the final decision is also based on expectations regarding future surplus.

This situation arises as a result of model evolution rather than a conscious decision to simply settle for a partial solution. As companies took the steps from deterministic to stochastic analyses or from either asset or liability only to asset and liability combined, several obstacles had to be overcome, most notably:

- Finding the necessary skilled resources, time and budget;
- Learning how to use new software; and
- Communicating results and educating key stakeholders.

UPDATE

These difficulties, coupled with the challenges inherent in developing internal stochastic modelling capability, such as the need for solid financial economics skills, led practitioners to opt for the most manageable solution to start with. Qualitatively described internal policies had to be translated into a workable mathematical relation or sequence of actions that could be modelled and perform predictably. Regulations specifying the boundaries, but not the rules within, were also handled in a similar manner in order to gain control over a variable and uncertain financial modelling world. The decision to constrain variable modelling aspects made it possible to get models up and running, produce and publish results that could be reasonably compared to methods employed thus far as well as move entire organisations to a new level of quantitative decision making. The industry's improved awareness, insight and appreciation of financial risks has been impressive.

In order to better understand the discretionary nature of the life insurance business, existing financial models can be modified to reflect management actions more accurately. These modifications do not require extensive reprogramming and can produce tangible gains in terms of improved insight and decision-making capability. Solvency II provides further impetus for undertaking such an exercise, since the underlying cash flow projections are to be based on realistic management actions and commercial practice.

RELAXING THE RULES

Rigid structures reflecting management actions were introduced in order to deal with the vagueness in laws, regulations and company policies. In many cases, the best way to reflect these actions in financial modelling is not to create even more complicated quantitative rules, subject to even more boundaries and limitations. Instead, it is better to replace these rules with a simple and intuitive cause and effect framework. This should be closely tied to the qualitative targets or constraints management faces in real-life decisions. Defining such a framework requires practitioners to obtain overall decision making principles from senior management.

An example of decision making principles in practice is that of a driver with the objective to 'stay close to the speed limit'. Let's assume that the driver thinks only of the following two factors:

- Current deviation from the prescribed limit; and
- Acceleration or deceleration.

These factors combine into intuitive cause and effect rules, such as: 'If I am exceeding the speed limit a lot and the vehicle is currently accelerating, I should press the brake'. A full set of decision making rules can be specified in this manner, associating actions to the combination of speed limit deviation levels (under or over: marginally, medium, a lot) and acceleration levels (speeding up or slowing down: marginally, medium, a lot). In the driver's mind these rules translate into an exact action, such as applying the brake with a certain force. Starting from a vague set of inputs, an exact decision is made that works well in practice.

This simple example must of course be extended to better emulate the human mind, since driving behaviour is affected by more factors, such as visibility, distance to the vehicle ahead, road conditions, weather etc. But this added complexity does not affect the underlying cause and effect structure. The only requirement is to associate more conditions to a corresponding action or introduce modifiers; rain would be a suitable example in the driving context.

Senior management has to make decisions in a similar manner, yet with the added challenge that the information needed is not always as complete as in the example above. While returns in a given period, the company's capitalisation level or current interest rates are fully known, other parameters, such as likely competitor actions or future returns are at best educated guesses. Good financial models should project the known key decision parameters and process their relative informational content according to a cause and effect schematic that is aligned with actual management actions and intentions. There are several benefits associated with this approach, since practitioners can:

- Create a more universal set of rules in financial models that offer greater stability in extreme scenarios and limit the emergence of unrealistic solutions;
- Eliminate the hidden subjectivity of 'exact' rules;
- Reflect management reaction to the entire set of decision parameters rather than to each one in turn;
- Facilitate model modifications based on new experience; and
- Provide a basis for comparing strategies rather than approximate formulaic representations of strategies.

QUALITATIVE REASONING IN PRACTICE

Smooth decision making* is used in engineering to control systems that are too complicated, uncertain or difficult to understand. It is successfully applied in operational risk management to translate expert opinions into tangible measures such as expected losses, since historical data is either unavailable or cannot be relied on to produce estimates of future loss events. At the heart of smooth decision making lie constructs known as ‘membership functions’ that assign values on a scale between zero and one to describe the degree to which an object possesses an attribute.

Just as in the above driving example, the key parameters for a financial decision can be suitably classified; available capital and return expectations correspond to speed and acceleration, respectively. Furthermore, rules can be established that link the parameter categories to a decision. This will be illustrated in the case study of a Norwegian traditional life insurance company below.

CASE STUDY: NORWEGIAN TRADITIONAL LIFE INSURANCE COMPANY

From 2008 Norwegian life insurance companies writing traditional with-profits business will operate under a unique new legislative framework. This framework is mainly characterised by book value accounting for assets and the separate pricing of insurance product components, investment, mortality, morbidity and administration. Apart from certain exceptions the new regime virtually eliminates the possibility for cross financing.

Buffers: There are two major types of buffer capital on Norwegian life insurance company balance sheets. Unrealised gains (URG) and additional statutory reserves (ASR). The former are the difference between the market value and cost basis of assets and are not directly allocated to policyholders. They can be used in their entirety to cover a return shortfall versus the minimum guaranteed return (MGR). ASR are allocated to policyholders and can only be used to cover a shortfall up to one time the minimum guaranteed return.

Financial guarantee premium:

Insurance companies are entitled to charge on an up front basis for providing policyholders with a minimum guaranteed return. The level of this premium depends on the level of the aforementioned buffers, the company’s investment strategy and interest rates. Furthermore, the only investment profits an insurance company is permitted to distribute to shareholders are limited to those arising from the financial guarantee premium. Any excess return, apart from return on assets backing shareholder equity, is to be fully allocated to policyholders. Any shortfall will have to be financed by claims against shareholder equity.

Alongside investment income, insurance companies can realise capital gains to generate returns. The key reasons for realising these gains are:

- Cover the shortfall vs the guaranteed minimum return;
- Increase the level of ASR; and
- Distribute bonus to policyholders.

It will probably come as no surprise that managing buffer capital is not a mechanical process that is neatly reflected in a formula. Companies face the challenge of weighing up the interests of shareholders and policyholders, striking a commercially and financially viable balance. Shareholders want to reduce the risk of equity capital having to be used to cover losses whilst policyholders want to pay a reasonable financial guarantee premium this year and in subsequent years, and receive a satisfactory credited rate on their policies.

Given these facts two observations can be made:

- Management actions with regard to managing the level of buffer funds materially affect future outcomes
- Expected returns influence buffer fund management

For this case study, we will assume that company management has set the following objectives:

1. Maintain sufficient capital today and in the future to retain a moderate financial guarantee premium
2. Keep a reasonable and commercially viable relationship between URG and ASR
3. Strive to avoid a complete elimination of ASR
4. Expose shareholder equity to a limited likelihood of losses due to financial risk

*Fuzzy logic is the established and widely recognised term

Current financial models approach these objectives by addressing each aspect of the decision in turn. They are typically supported by step functions and action limits to reflect management decisions. A more advanced approach would be to look at all the decision making parameters together, using a cause and effect structure. The smooth decision making framework reflecting the company's principles will be developed in two steps.

The 'cause' component of this framework will be based on three inputs and a system of membership functions for classifying these inputs qualitatively:

- Available capital to cover losses (CAP), as a proportion of policyholder reserves, is derived from the sum of URG and the portion of ASR available to cover losses

- The overall level of ASR as a proportion of policyholder reserves

- Expected investment performance (EIP) as a percentage of URG – can be based on factors such as expected investment income, interest rates, asset portfolio composition, risk margins and others.

The 'effect' component will be based on a single action, ie the realisation of URG, which can be 'Low', 'Medium' or 'High'.

With these tools in place the company's qualitative objectives can be converted into rules such as:

- If CAP is 'Medium above target' and ASR is 'Medium below target' and EIP is 'Positive high' then realise 'High' amount of URG

- If CAP is 'A lot below target' and ASR is 'A little below target' and EIP is 'Negative low' then realise 'Low' amount of URG

A sample of cases where such rules were applied to derive the level of URG that should be realised is shown in the table below.

The results in the table suggest that the cause and effect framework replicates the four key management requirements:

1. As EIP decreases, less URG are realised to reflect the concern that although there may be sufficient CAP today, this may not be the case in the future. As CAP decreases, less URG are realised reflecting the need to preserve the available buffers for future periods.

2. When CAP is high compared to ASR, URG are realised to build up the ASR. This is why the results for CAP (11%) and ASR (2%) are not as sensitive to decreasing EIP as the results for CAP (11%) and ASR (6%).

3. Even in those cases where CAP is low and EIP is not expected to be good, some release is made in an effort to build ASR.

4. Looking at the results for CAP (11%) and ASR (6%), it takes a very strong EIP to free up a lot of unrealised gains. Similarly, positive but low or medium EIP does not materially alter the final decision to realise URG.

STEP1: INPUT			STEP2: CLASSIFY THE INPUT			STEP3: DETERMINE ACTIONS	STEP4: DERIVE EXACT ACTION
CAP	ASR	EIP	CAP	ASR	EIP	URG realisation levels	Proportion of URG realised
11%	6%	-20%	Medium above	Little above & Little below	Negative medium	Low	4%
11%	6%	-10%	Medium above	Little above & Little below	Negative low	Low & Medium	12%
11%	6%	0%	Medium above	Little above & Little below	Negative low & Positive low	Low & Medium	12%
11%	6%	10%	Medium above	Little above & Little below	Positive low	Medium	20%
11%	6%	20%	Medium above	Little above & Little below	Positive low & Positive medium	Medium	20%
11%	6%	40%	Medium above	Little above & Little below	Positive high	High	41%
11%	2%	-20%	Medium above	A lot below & Medium below	Negative medium	Medium	20%
11%	2%	-10%	Medium above	A lot below & Medium below	Negative low	Medium	20%
11%	2%	0%	Medium above	A lot below & Medium below	Negative low & Positive low	Medium	20%
11%	2%	10%	Medium above	A lot below & Medium below	Positive low	Medium	20%
11%	2%	20%	Medium above	A lot below & Medium below	Positive low & Positive medium	Medium & High	35%
11%	2%	40%	Medium above	A lot below & Medium below	Positive high	High	40%
5%	2%	-20%	Medium below	A lot below & Medium below	Negative medium	Low	4%
5%	2%	-10%	Medium below	A lot below & Medium below	Negative low	Low	4%
5%	2%	0%	Medium below	A lot below & Medium below	Negative low & Positive low	Low & Medium	12%
5%	2%	10%	Medium below	A lot below & Medium below	Positive low	Low & Medium	12%
5%	2%	20%	Medium below	A lot below & Medium below	Positive low & Positive medium	Low & Medium	16%
5%	2%	40%	Medium below	A lot below & Medium below	Positive high	Medium	20%

CONCLUSION

The ability of financial models to adequately capture management actions may be restricted by rigidity in the decision making algorithm that is used. The approach presented strives to overcome these problems by enabling a combination of action classes to be considered and then weighted to derive a final action. In those scenarios where financial projections are near the boundaries of current models, actions do not drastically differ, merely as a result of which side of a limit the simulation reached. Smooth decision making eliminates absolute boundaries, making it less important to determine 'correct' limits to classify the decision inputs and corresponding actions. As a result, the modelled decisions become sensitive to the principles that govern them rather than their technical implementation.

Strong management teams are consistent in their ability to implement sound strategies that deliver commercial success. They typically seek to test and justify their actions with robust financial analyses. For this purpose enhanced financial modelling and strategic planning tools that better reflect management decisions can be developed through simple modifications to existing platforms. The quality of strategic decisions in this area can be enhanced by offering management an alternative to the quantitative assessment of different strategies which would otherwise have to be tested in practice.

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