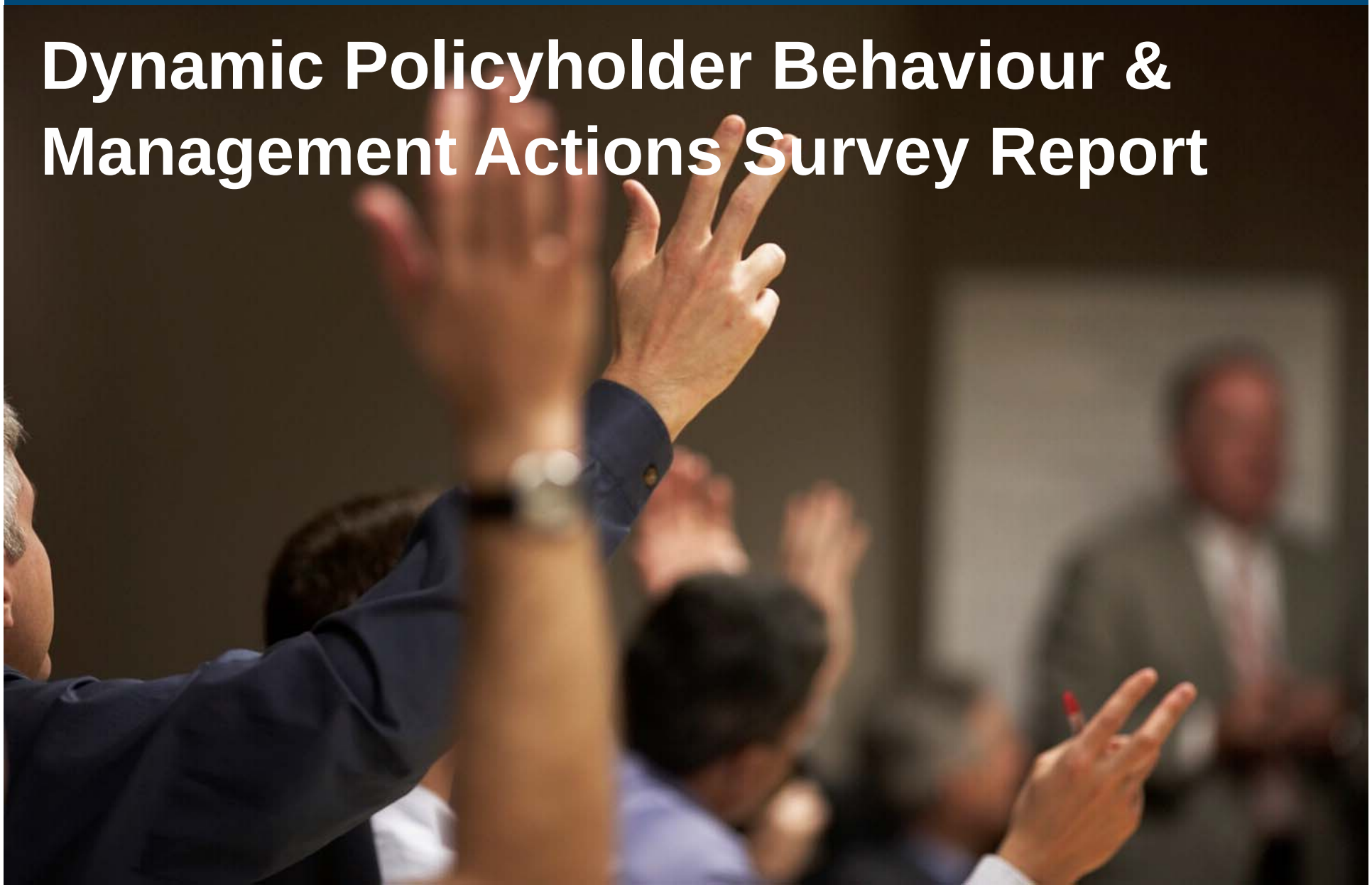
Dynamic Policyholder Behaviour & Management Actions Survey Report



Milliman

Table of Contents

Milliman

In 2009 Milliman carried out a survey into what life insurance companies were doing in respect of modelling dynamic policyholder behaviour (DPB). The published survey results covered 34 companies in six European countries.

This survey takes a fresh look at current DPB practice around the world, and also covers a related subject, the modelling of management actions (MA).

These subjects are becoming increasingly important as more and more focus is placed on stochastic modelling calculations and the tails of distributions. In particular, Solvency II in Europe specifies requirements for both DPB and MA, so we expect there to be a good deal of focus by companies in these areas, and this should form a key component of a company's risk management.

Recent market turmoil in various countries also highlights the importance of understanding how management may react to various scenarios and of reflecting this in the modelling of MA.

There is, however, little material available in this area to guide companies and little clarity and consensus on approaches. In particular, the Solvency II requirements do not set out how DPB and MA should be modelled in practice and tend to give only high-level principles.

We have, therefore, carried out this survey in order to collect information about current practice concerning the modelling of DPB and MA for life business by insurance companies in a range of the **main European markets, together with the US and Japan.**

We note that the opinions mentioned in this presentation are those of the authors and not necessarily those of Milliman. We have not audited or verified the data and information received by us as part of this survey. The views expressed in this presentation are based on the limited sample data received, supplemented by general market experience where we have considered this appropriate. No part of this presentation should be taken to constitute advice of any type.

Milliman

Definitions

- By **dynamic policyholder behaviour (DPB)** we mean:

  The modelling of assumptions about how policyholders will behave in the future, which are assumed to vary according to one or more factors which are not known at the outset of an actuarial projection.

  Such factors may include, for instance:

  - Changes to markets (e.g., interest rates, equities)
  - Bonus rates declared by the company, etc.

- By **management actions (MA)** (sometimes also called management rules) we mean:

  The modelling of how management will behave in the future in response to conditions that may prevail.

  Such management actions could include:

  - Investment strategies
  - Setting bonus/profit-sharing rates, etc.

Generic product types:

For the purpose of this survey, we have defined certain generic product groups/types for **Europe**, as follows:

Traditional business

- **Participating business** – Contracts which contain an element of guaranteed benefits (which could include a guaranteed minimum return), and where additional policyholder benefits (profit sharing) can be added based on the performance of the insurer and/or a specified pool of assets. The amounts of profit sharing may or may not involve an element of discretion on the part of the insurer.
- **Unit-linked without guarantees** – Contracts where the policy value at any time is directly linked to the value of underlying assets at that time, and which do not provide investment guarantees.

VA-type business

- **Unit-linked with guarantees/variable annuities (VAs)** – Contracts where the policy value at any time is directly linked to the value of underlying assets at that time, but which also provide investment guarantees.

A slightly different set of product types has been set for **Japan/US**, to better fit practice in these markets:

Traditional business

- **Participating business** – As above
- **Products with flexible crediting rate** (e.g., universal life when insurance company has discretion)
- **Other general account products (i.e., based on general assets of the company) with significant cash value**

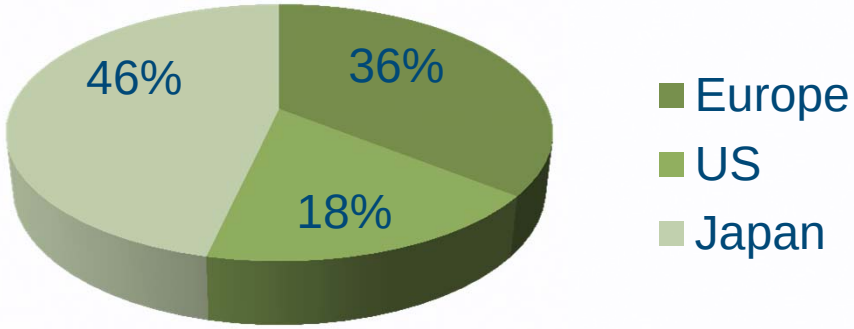
VA-type business

- **Unit-linked with guarantees/variable annuities (VAs)** – as above

For all countries, any **other products** (i.e., which don't fit into any of the above categories) have been classed as **traditional business** for the purpose of this survey.

Milliman

Division of responses by geographic region



Survey responses came from the following countries:

- Germany
- Switzerland
- Italy
- France
- UK
- Ireland
- US
- Japan

56 companies across eight countries took part in the survey, including subsidiaries of multinationals and domestic companies.

This summary presentation of the DPB and MA survey results is available for non-survey participants.

Note: In most cases, the bar charts of this presentation indicate number of respondents (rather than percentages) and pie charts are used to show percentages. In those cases where bar charts are used to indicate percentages, the figures are shown followed by a percentage sign (%).

Milliman

Dynamic policyholder behaviour

Types of DPB modelled

Milliman

Survey results

85% of respondents writing traditional products model at least one type of DPB for this business.

50% of respondents writing VA-type products model at least one type of DPB for this business. While this is lower than for traditional business, there may be products that present reduced or no risks of dynamic behaviour (e.g., lapses for some European guaranteed unit-linked products with dynamic asset allocation).

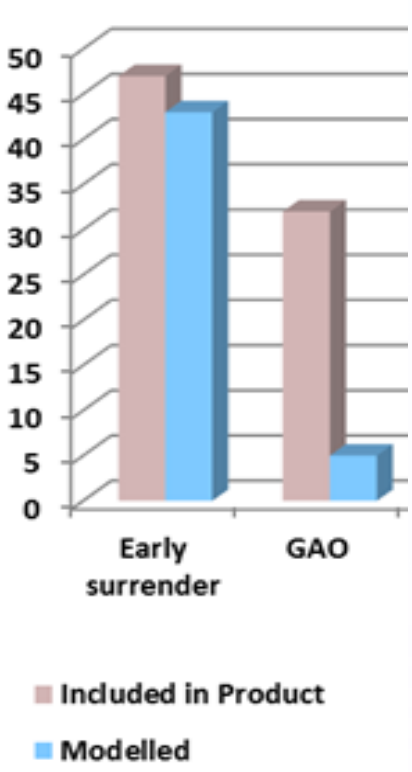
Our analysis

We believe it is important to make at least some allowance for DPB, even when it is difficult to assess the level of client rationality. In our view, not assuming any dynamic behaviour is not a neutral assumption, but instead a strong (and potentially imprudent) assumption that clients are not at all rational.

A more neutral/prudent assumption would be to assume some level of DPB. Just because there is no statistically reliable evidence of rationality in past experience, this does not necessarily mean that policyholders will never act rationally in the future. For example, this could happen under more extreme economic scenarios than have been observed in the past data, or as the level of public awareness of the value of embedded options increases over time.

We believe that, at the very least, companies should be testing the sensitivity of their solvency position to DPB to understand their exposure to these risks (even if their central assumption is that there is no DPB).

Traditional business: DPB modelling is prevalent for early surrenders, but much less so for GAOs and other product features



Survey results

For traditional business:

91% of respondents offering early guaranteed lapses/surrenders model DPB for this guarantee.

Only around **16%** of those respondents that offer guaranteed annuity options (GAO) then model DPB in relation to this option (i.e., dynamic take-up rate).

Other features commonly offered, but rarely/never modelled as DPB on these products include suspension of premiums, fund switching, payment of ad-hoc (one-off) premiums on guaranteed terms, extension of original policy term on guaranteed terms, renewal of risk products or benefits, and utilisation of policy loans.

Milliman

Our analysis

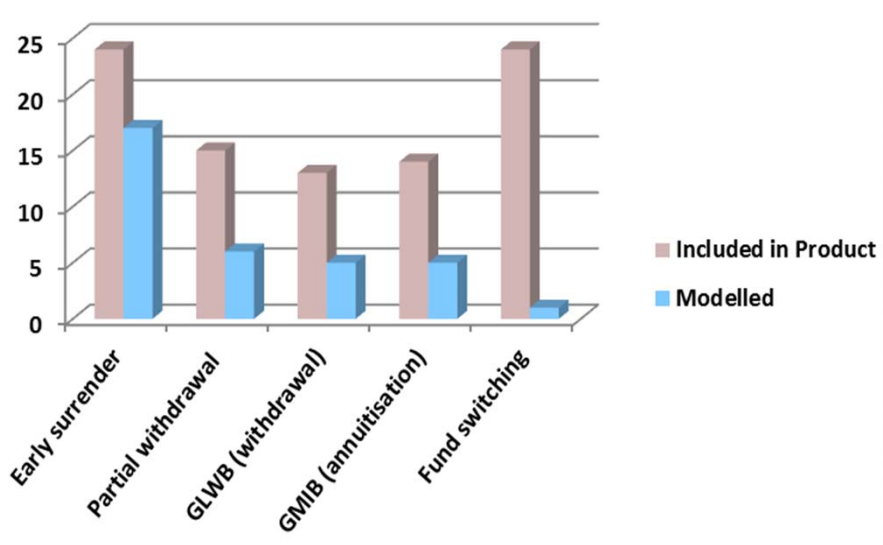
Early lapse/surrender is clearly a key option in this type of product and this is reflected in the high level of companies modelling DPB in relation to it.

Our view is that more companies should consider modelling DPB for GAOs. Current low take-up rates do not necessarily imply that this will continue in the future, especially in extreme market conditions (particularly given the transparent nature of the value of this option). Future improvements in longevity could also make taking up GAOs more attractive (and companies should remember that when an option becomes very attractive, this may outweigh tax and/or other disadvantages).

The ability to pay additional ad-hoc premiums on guaranteed terms is potentially an “open-ended” guarantee. In our view, some consideration should be given to DPB around this option, particularly when considering extreme scenarios for economic capital purposes (even if past experience shows no correlation between exercise of this option and financial conditions).

Even if not modelled for liability valuation purposes, some of the other product features should be assessed for risk management purposes (e.g., within the Own Risk and Solvency Assessment (ORSA)).

VA-type business: DPB modelling is common for early surrenders, but less so for other types of option/guarantee



Survey results

For VA-type business:

The options/guarantees for which DPB is most commonly modelled are:

- Early lapse or surrender (**71%**)
- Partial withdrawal (for non-GLWB* and non-GMWB**), or utilisation rate of GMWB (**40%**)
- GLWB, timing or amount of withdrawal (**38%**)
- GMIB***, annuitisation (**36%**)
- Option to switch funds (only **4%**)

The figures above represent the percentage of companies offering each type of option/guarantee, which also model DPB in relation to these.

Our analysis

Modelling of DPB in relation to early lapse/surrender options/guarantees is less prevalent for VA-type business than for traditional business (71% vs. 91%).

At the same time, DPB modelling around annuitisation options/guarantees is more common for VA-type business (36% vs. 16%).

Both forms of option/guarantee can have a significant influence on performance. The apparent difference in relative importance given to the two compared with traditional business may reflect higher observed take-up rates of GMIB compared to GAOs and/or VA-type models being more amenable to allowing for dynamic take-up of GMIBs.

* GLWB – Guaranteed lifetime withdrawal benefit
** GMWB – Guaranteed minimum withdrawal benefit
*** GMIB – Guaranteed minimum income benefit

Milliman

Dynamic policyholder behaviour

DPB models & assumptions

Milliman

Survey results

Traditional business:

A question was asked around drivers in DPB models for early surrender. This was most commonly answered in respect of participating traditional business (business paying an element of profit sharing to policyholders). The driver most commonly used by respondents is the difference between an “external” rate and the credited/interest rate (profit sharing rate) paid to policyholders. According to survey respondents, external rates are generally expressed in terms of market interest rates, with the most common being government bond yields, in some cases reduced by a margin. Some companies use a “competitor rate” (e.g., based on an assumed new money investment mix).

In addition to this key driver, various other factors are also taken into account by some respondents. These include: sales channel, type of client (e.g., high net worth, retail, institutional), policy term/remaining duration/elapsed duration, product and contract size.

Milliman

Our analysis

Whilst the difference between credited interest rate and an external rate may not fully reflect the value of an option to a policyholder for participating products, it is a measure which is reasonably transparent and understandable to a policyholder.

A number of the other factors listed on the previous slide could be significant in determining policyholder behaviour. For instance, corporate policyholders might be expected to be more active in terms of DPB than retail.

The MCEV Basis for Conclusions[1] requires that alternative investment vehicles for policyholders should not be restricted to other insurers, which means that considering only competitor returns on other life policies may be insufficient. Use of a bond yield as a benchmark might be considered a proxy for returns on alternative investments.

We note that, since our 2009 survey, spreads on some countries' government bonds have widened so much that a DPB rule based on risk-free rates and another based on government bond yields could now give rise to quite different results. For example, where government bonds incorporate a significant risk of default, government bond rates could be well above the actual returns projected in the model (after haircuts), and hence a DPB rule referenced to government bond rates could cause a triggering of dynamic lapses which wouldn't be observed in reality.

[1] See MCEV Principles (the European Insurance CFO Forum Market Consistent Embedded Value Principles) Copyright© Stichting CFO Forum Foundation 2008

Survey results

VA-type business

All but one of the respondents modelling DPB for VA-type business cited “in-the-moneyness” (i.e., intrinsic option value) as the main driver of early lapse/surrender, with one also including market interest rates.

One company (in respect of unit-linked with guarantees) described the driver as market interest rate, credited rate or guaranteed interest rate attaching to the income rider.

In some cases, dynamic lapses are also assumed to depend on:

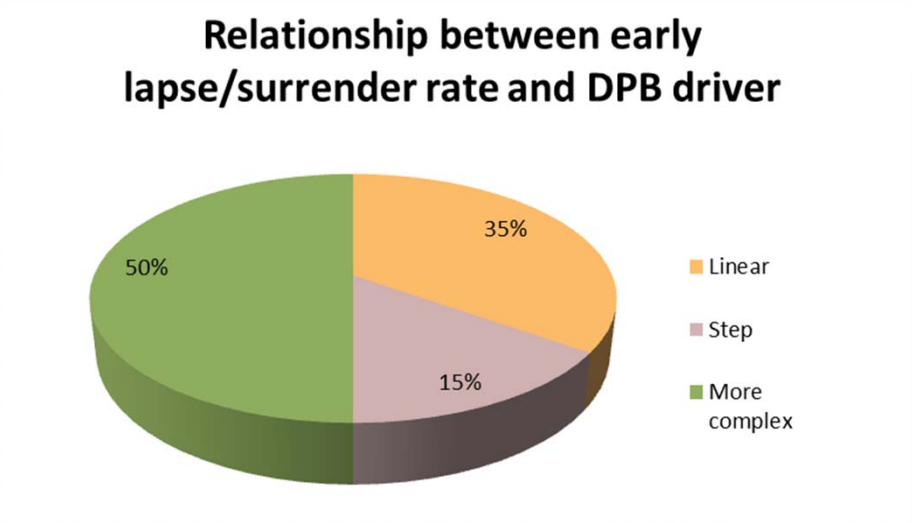
- Type of VA guaranteed benefit
- Policy duration
- Gender
- Maturity duration on guaranteed minimum accumulation benefit (GMAB)
- Policy size/benefit levels
- Whether in or out of the surrender penalty period
- Age

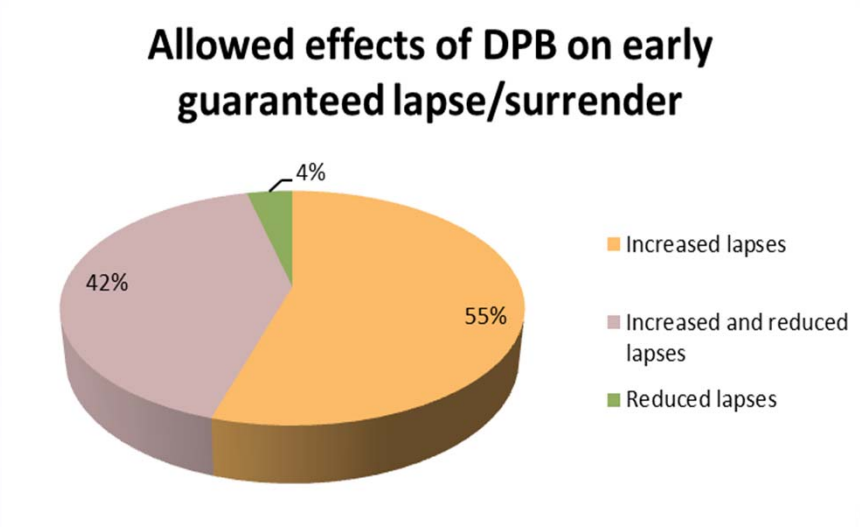
Our analysis

The current value to the policyholder of the option/guarantee of surrender is an obvious key driver of exit behaviour and is usually fairly simple to model. The almost unanimous choice of this driver for DPB modelling is therefore unsurprising.

Other factors influencing exit behaviour can act to greatly magnify or reduce the likely DPB effect of a deeply in-the-money option value, however. It will be important to identify and capture these effects to avoid potentially material distortions.

Milliman





Survey results

A question was asked about the relationship between dynamic lapse rates and the key "driver". Of those responding:

- **35%** of models are based on a linear function (at least within certain ranges).
- **50%** use more complex mathematical functions. These include logarithmic and polynomial functions (e.g., quadratic).
- **15%** of models use "stepped" functions.

European respondents tend mostly to be using linear functions, with more of a mix in the US and Japan.

A question was asked about whether models allowed for increased and/or reduced lapse rates under DPB. Of those responding:

- **55%** of the DPB models allow only for an increase in lapse rates.
- **42%** allow for both increased and reduced lapse rates.
- **4%** allow for reduced lapses only.

Milliman

Our analysis

Clearly, the fitting of a function is a very subjective process. However, whilst a linear function may be reasonable in more moderate scenarios, its appropriateness for extreme scenarios needs to be considered. In extreme circumstances, disproportionately larger volumes of lapses might be expected, and in such scenarios other forms of function could better reflect this non-linearity.

The most appropriate function will depend on what underlying behavioural drivers are assumed to influence policyholder actions, based on an understanding of the policyholders, distributors and the nature of the options which they may exercise.

Our view is that a DPB model should ideally allow for both increased and reduced lapse rates.

In particular, over the full range of stochastic scenarios that are being considered the average lapse rates should be consistent with the deterministic (best estimate) lapse rates. This is not possible if only an increase in lapse rates is assumed under DPB.

One alternative approach is to assume both a low rate of attritional lapses and also possible additional dynamic lapses, with both then present to some degree at any point in time.

Most DPB models for lapses impose a cap and floor on dynamic lapse rates, and include a band within which no DPB is assumed to occur

Survey results

A question was asked about floors/caps on lapse/surrender DPB. Of those responding:

- **89%** of the DPB models for early surrender impose a cap on lapse/surrender rates
- **79%** of the DPB models for early surrender impose a floor on lapse/surrender rates

A question was asked about whether companies include a band within which no DPB for early surrender is assumed to occur. Of those responding, **67%** model such a band.

This means, for instance, that no DPB is assumed to occur when (market rate – credited rate) lies between -1% and +1%.

Respondents were asked to estimate the extent to which their lapse/surrender DPB models assume policyholders would act in an economically rational way, on a scale from 0 to 10 (with 10 being fully rational). Values from 1 to 10 were given, with the most common reported level being 5. US respondents generally tended to report higher values than some European/Japanese respondents.

Milliman

Our analysis

Care should be taken in imposing caps and floors. As noted previously, extreme scenarios could drive large volumes of lapses, which the DPB function should reflect. This is particularly the case for more sophisticated policyholders, such as corporate clients. In addition, retail policyholders may grow ever more aware of their exit potential over time, which could drive more extreme behaviour than is currently envisaged. Unless "run-on-the-bank" style situations are for some reason inconceivable, then it seems valid to have models which can project extreme DPB under extreme scenarios, and a cap may be inconsistent with this.

In our view it is reasonable to model a band within which no DPB is assumed to happen. For example, policyholders may be unlikely to react to very small market movements, and/or there may be a range of tolerance within which financial advisers might not act to encourage their clients to change policy.

Whilst "rationality" is a very subjective measure, it gives some interesting results. In particular, it does appear to suggest that ignoring DPB altogether is not a prudent approach. It should be borne in mind that policyholders could perhaps be expected to become more rational over time, and that more extreme scenarios could drive higher levels of policyholder rationality.

In practice, rationality may also be driven by distributor recommendations rather than solely by policyholders' own innate level of rationality. Sensitivity of results to different levels of rationality should also be considered.

Survey results

Only five respondents (out of 32 who offer this product feature on traditional business) model DPB for GAOs (Guaranteed Annuity Options).

Different drivers are described, including the absolute difference between market interest rate and bonus/interest rate and the value of the guarantee.

Two respondents allow for increasing or decreasing take-up rates, one increase-only and one decrease-only. Only one allows for the possibility of a 100% take-up rate. None allow for a 0% take-up rate.

The assumed level of policyholder rationality varies from 2 to 7 (out of 10, 10 being the highest).

Milliman

Our analysis

In our view, more attention should be given to the modelling of GAOs on traditional business. Even if current take-up rates are low, this does not necessarily mean this will always be the case in the future, especially in extreme scenarios. In particular, GAOs can be more transparent than other types of options, if it is easily possible to compare GAO annuity rates with those available in the market.

When considering DPB, the total cost of the GAO should be considered, which may require consideration of any underlying guaranteed mortality rates compared with current best estimate mortality projections, as well as the guaranteed interest rate. Where GAOs allow profit sharing to be paid, this should also be factored into the cost of the GAO.

Generally, we would expect the major risk to come from increased take-up of this option. However, both increased and reduced take-up should be considered to ensure that the average take-up rate of the full range of stochastic scenarios is consistent with the deterministic take-up rate assumption.

Unless there are particular constraints on the take-up of GAOs (such as regulatory constraints which are certain to continue in the future), it is our view that in some scenarios a take-up rate of 100% on GAOs should be considered (i.e., no cap). This is particularly the case if an annuity must be taken at maturity (such as on certain pensions contracts) and the only other option is to buy an annuity in the market. As noted above, it may be the case that the value of this option can be highly transparent to policyholders, and assuming less than full rationality could be a dangerous assumption.

In certain scenarios, a take-up rate of 0% could also be reasonable (i.e., no floor) if the GAO is far out-of-the-money.

In some situations and markets, a take-up rate of 100% when the GAO is in-the-money and 0% when it is out-of-the-money could be appropriate.

Survey results

Of the survey respondents, only a relatively limited number of companies have the following types of option/guarantee on VA-type business and also model DPB for them:

Utilisation of GLWB (timing or amount of withdrawal)

Five respondents indicated modelling DPB in respect of this feature, but only two described their modelling. One noted that the DPB function is driven by the account value in the special account and is applied using a quadratic formula. The other described the level of in-the-moneyness of the guarantee as the driver. In both cases duration was also given as a factor.

Both of these respondents allow for both increases and decreases in utilisation, and both assume the level of policyholder rationality to be 5 out of 10.

Utilisation of GMIB (annuitisation rate)

Five respondents indicated modelling DPB in respect of a GMIB option. In each case, the driver was described as the level of in-the-moneyness (i.e., the relationship between account value and base benefit). Other drivers given were:

- Number of years until annuitisation
- Age
- Tax status

Three companies allow for both increased and reduced utilisation; one allows for increased only

The level of policyholder rationality assumed varies between 4 and 8 (out of 10).

Partial withdrawals (income switch on/off)

One respondent indicated modelling of this feature. The formula for DPB is driven by the fund value relative to the guarantee and term to the next ratchet date. Policyholder rationality is assumed to be 2 out of 10.

Dynamic policyholder behaviour

Derivation of DPB models

Milliman

Survey results

Methods used for derivation of DPB assumptions include the following methods, or combinations of methods:

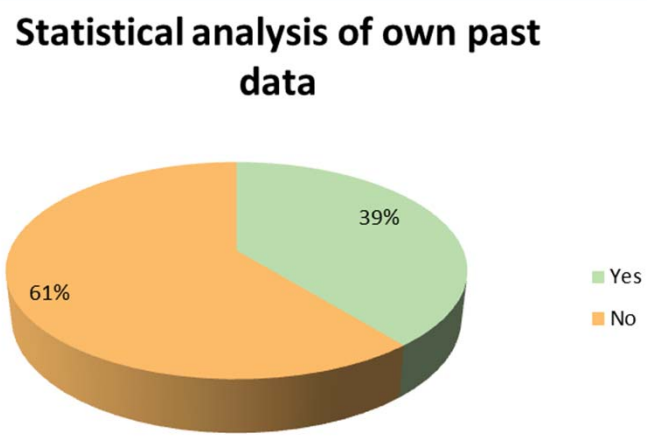
- Discussions with the regulator.
- Expert/actuarial judgment (e.g., consideration of what might constitute rational DPB in the light of product features), support from actuarial consultants.
- Market study, industry study/survey, industry trends, analysis of past life company failures.
- Qualitative or statistical analysis of historical experience.
- Reference to products or experience from parent company or other countries/companies.
- Reference to similar products for products with little experience.
- Analysis of early repayment data on housing loans in respect of early lapse/surrender.
- Cross-functional discussions.

Our analysis

Deploying a combination of methods and approaches is particularly recommended for the case of DPB assumptions, allowing candidate values derived from distinct perspectives to be compared and contrasted.

The setting of DPB assumptions can suffer from scarce data at the best of times, so derivation purely at the level of local operations may not take advantage of wider experience available elsewhere that can help to ensure assumptions are able to reflect possible trends and more extreme scenarios.

Less than half of respondents carry out a statistical analysis of their own past data to help define their DPB models



Survey results

Only **39%** of companies modelling DPB carry out a statistical analysis of their own past data to help derive their DPB models. The extent to which companies base their DPB models on these analyses, where carried out, varies greatly.

Our analysis

For various reasons, analyses of historic data can be difficult to use for the setting of DPB models. These reasons include lack of credible data, interactions/correlations between different risk factors, and one-off factors distorting the data (such as a change of distributor relationship).

However, it is our view that, whilst not providing the whole picture, such analyses can be improved to help identify risk factors and, over time, will become increasingly more useful as historic data builds up. We feel, therefore, that some attempt should be made to analyse past experience.

It does not seem advisable to base assumptions entirely on past experience, as this ignores the possibility that policyholder awareness of the value of options may increase over time. This could be driven by external factors such as regulatory requirements to keep policyholders more informed, information provided by journalists or the development of a secondary market.

Perhaps the main problem with the use of past data is that it is likely that only some of the possible economic scenarios have been observed in the fairly recent past. It would be dangerous, for example, to assume that because policyholder reaction to a modest increase in interest rates has not been significant, this can then be extrapolated to imply that it will not be significant for a large increase in interest rates.

Milliman

Survey results

Only six respondents specifically mentioned considering an economic driver in their statistical analysis of past data.

The most common subdivision of data reported was product type, but calendar year, expired policy duration and distribution channel were also not uncommon. Other forms of subdivision reported included age, tax status, in-the-moneyness of guarantees, premium mode and fund type.

Methods of analysing historical data reported by respondents included:

- Analysis of lapse rates by calendar year, compared with the value of the DPB driver. For VAs, analysis of lapse rates against the in-the-moneyness of guarantees.
- Analysis of actual to expected ratios.
- Statistical methods, such as generalised linear modelling (GLM); graphical analysis.
- Use of extrapolation and qualitative judgement where the data was not credible.

Our analysis

The initial analysis of the data should be split by all potential risk factors (such as case size) to test their significance; data can be re-combined later if appropriate.

It seems sensible to split the data by calendar year, and to consider how experience varies with the economic driver used for DPB.

Graphical methods or GLM can be useful in identifying significant risk factors and studying potential correlations/interactions between factors.

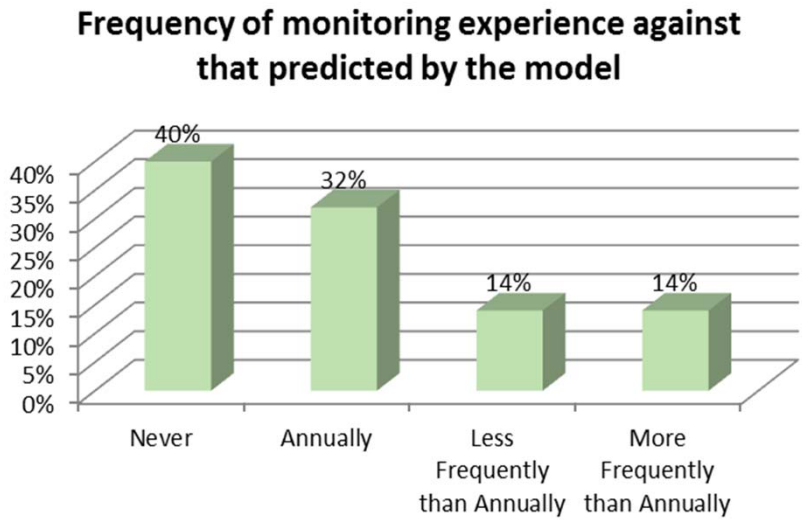
Knowledge of external and internal factors (e.g., tax changes, new product launches, changes in distributor relationships) which will have influenced past behaviour should be used in order to interpret the observed past experience.

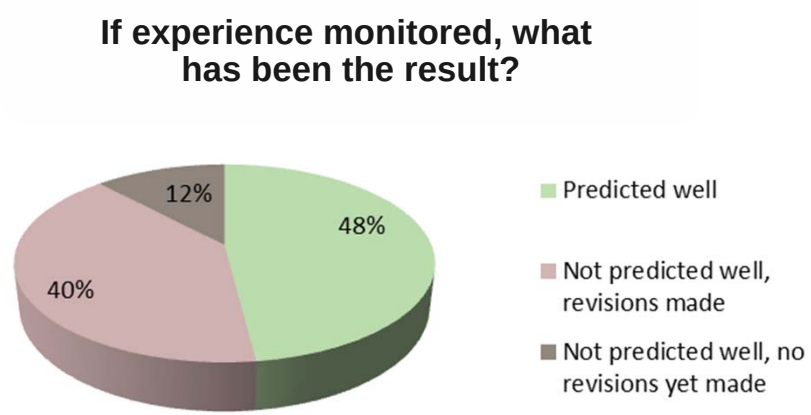
Paucity of data and the complexity of what may be influencing results will often make it a challenge to allow for multiple factors in analyses. Expert judgement and input from managers from different areas (e.g., from claims and sales) may prove to be the best way to understand likely future behaviour.

Dynamic policyholder behaviour

Management of DPB

Milliman





Survey results

Companies were asked how frequently they have monitored DPB experience against that predicted by their models. Of those answering this question, **40%** responded never, **32%** annually, **14%** less frequently than annually and **14%** more frequently than annually.

Of those carrying out monitoring of experience, **48%** reported that their model predicted experience well. Of the **52%** who reported that their model did not predict experience well, **40%** have revised their model and **12%** have not.

Milliman

Our analysis

We feel that regular monitoring of the model against experience is an important exercise and should be part of the actuarial control cycle, especially for any company where DPB can have an important impact on the company's financial position.

In particular, where DPB has the potential to significantly influence a company's asset-liability management, then regular monitoring will be especially important.

The recent financial crisis has given an ideal opportunity to see how well models can perform in relatively extreme market conditions.

Given some scepticism around the extent of the predictive ability of DPB models, it is interesting to see that 48% of respondents do state that their models have predicted experience well. It is important to continue regular monitoring, however, to ensure that this situation continues. Past experience should be used to refine assumptions for the future.

We note also that when models don't predict well, this may be because other factors are at play in influencing client behaviour, e.g., lack of confidence in banks may discourage people from surrendering life policies.

Milliman

Survey results

Of those respondents that have taken steps to mitigate the impact of or reduce the risk from DPB, **43%** mentioned new product design and **36%** mentioned ALM/hedging.

Other actions mentioned include: liquidity management, monitoring experience against DPB models, revision of marketing plan, revision of sales compensation structures, reserving, and analysis of stress scenarios.

Our analysis

DPB is a key risk with a lot of uncertainty, and companies should consider ways of mitigating it.

In particular, it is important that new products are designed to be robust to different DPB assumptions. This should be a key part of sensitivity testing. Discussion of DPB should involve other departments involved in new product development rather than being seen as a purely actuarial issue.

Also, the inherent uncertainty around what actual DPB will be experienced makes it sensible to test the robustness of asset-liability management strategies to different DPB outcomes.

.

Survey results

Of the six respondents who do not appear to model DPB at present, only one noted specifically planning to model DPB in the future.

Of those who do model DPB and responded to a question about future DPB development, **22%** of companies said they did not have defined plans to make further developments to DPB models.

Our analysis

All companies should be considering DPB modelling. Failure to do so can result in underestimation of the risks inherent in the business, and hence, ultimately, in financial loss. As noted previously both the MCEV Principles and the latest Solvency II proposals require consideration of DPB.

The impact of variations in DPB experience should always be borne in mind for product design and ALM.

Many companies have now moved beyond the early stages of DPB modelling and we would expect them to be refining and expanding the scope of their DPB modelling in the coming years, as well as integrating it further into their management decisions.

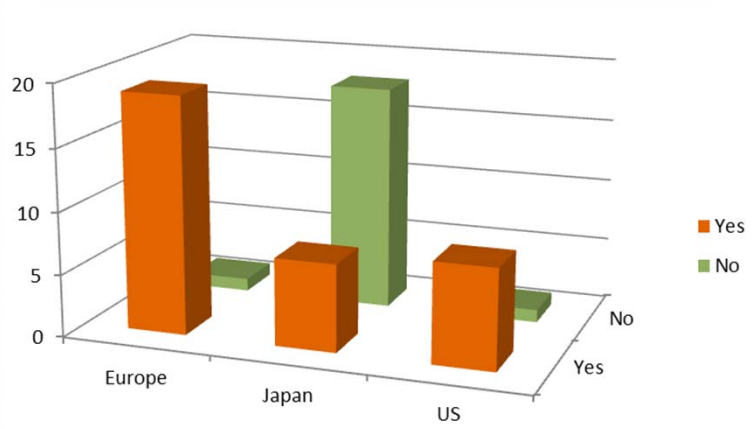
Milliman

Management actions

Investment strategies

Milliman

Companies modelling interactions between assets and liabilities



Survey results

Companies were asked whether they project both assets and liabilities and the interactions between them in their models (the alternative is projecting assets and liabilities separately, or not modelling assets at all).

For Europe and the US, the majority of those answering this question (**95%** and **89%** respectively) are modelling interactions. For Japan, this percentage is only **28%.**

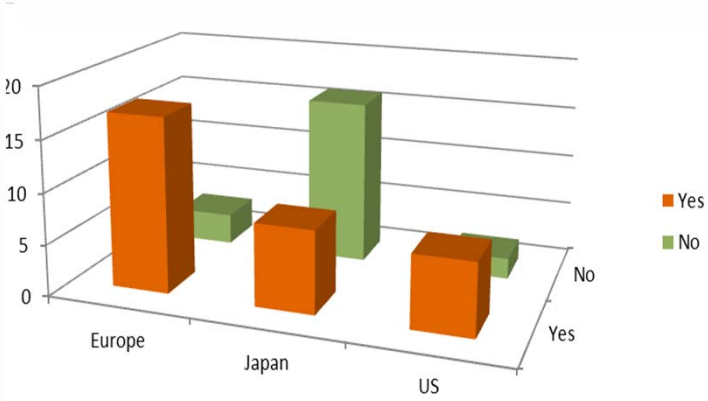
Our analysis

It is important to model the interactions between assets and liabilities where these are material. This is likely to be the case particularly for participating products where policyholder benefits depend in some way on returns on assets, but where the return on assets is, in turn, dependent on cash flows related to the liabilities, such as premiums into, and claims paid out of, a pooled fund, which can influence the timing of buying and selling assets, the timing of realisation of gains and losses, etc.

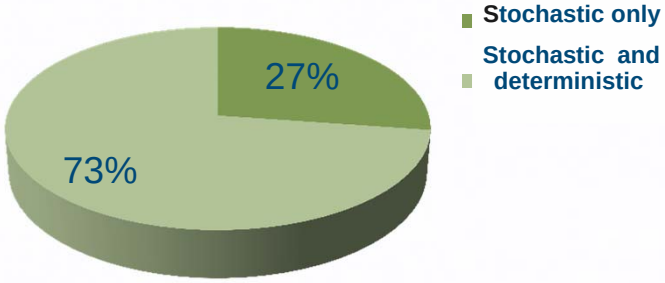
For Japan, whilst the percentage of companies who said that they model asset-liability interactions may currently be lower, this is more driven by a different set of requirements historically, given the types of portfolios that are being modelled, particularly for more traditional companies. It is likely that the modelling of asset-liability interactions will become more developed as ERM frameworks are implemented more widely.

Milliman

Companies modelling future investment strategies



Modelling of investment strategies within stochastic models only or within both stochastic and deterministic models



Survey results

Companies were asked whether they model future investment strategies, by which we mean the incorporation of assumptions about the future buying and selling of assets, changes in asset mix from that at the start of a projection, and/or the timing of realisation of gains and losses. For this purpose, we would include very simple strategies such as “buy five-year bonds when there is cash available to invest,” but would exclude hedging, which is dealt with in a later section.

For Europe and the US the majority of those answering this question (**85%** and **78%** respectively) are modelling future investment strategies. For Japan, however, this percentage is only **33%.**

The most common product for which investment strategies (excluding hedging) are modelled is participating business, followed by products with flexible crediting rate (US/Japan only), unit-linked with guarantees/VAs, and other general account products with significant cash value (US/Japan only). Only one company is modelling investment strategies for unit-linked without guarantees (Europe only).

Companies which model investment strategies were also asked whether this was within their stochastic models only, or within both their stochastic and deterministic models. **73%** of companies modelling investment strategies are doing so within both their stochastic and deterministic models.

Milliman

Our analysis

It is important to model future investment strategies where there are asset-liability interactions. In particular, where there is the requirement to buy or sell assets, some type of assumption is required in the model as to which assets should actually be bought or sold. For some types of participating products where book value accounting is adopted, as is common in Europe for example, the timing of realisation of gains and losses will impact returns credited to policyholders, and therefore some type of assumption would be required to be included in the model in respect of this.

Even quite simple investment strategies may be feasible to model and could represent a reasonable view of expected management actions, although whatever is modelled should align with what would be expected in reality. In particular, it would not be prudent to model a strategy (e.g., selling equities when guarantees get closer to being in-the-money) which reduces the value of liabilities and/or capital requirements if the management would not be expected to act this way in reality.

For Japan, while the percentage of companies who said that they model future investment strategies may currently be lower, this is more driven by a different set of requirements historically. It is likely that the modelling of future investment strategies will become more developed in the future.

Modelling of investment strategies becomes more important when considering stochastic scenarios, where the projected path cannot be determined from starting conditions. However, and in particular where there are interactions between assets and liabilities, investment strategies should also be considered in a deterministic projection, since decisions on assets to be purchased and sold, for example, will still depend on projections of assets and liabilities produced by the model.

Survey results

For participating business, the following lists the most common types of investment strategy modelled (excluding hedging), with some specific examples given by respondents:

- Types/mix of assets to purchase, e.g., duration varying by calendar year, but fixed by scenario.
- Types/mix of assets to sell, e.g., sell assets with the shortest duration first, sell proportionally within asset categories, sell assets with book value nearest to market value first.
- Overall target asset mix, e.g., target mix varying by calendar year but fixed by scenario, dynamic target ratio for equities.

Following these “achieving a competitive target fund yield/bonus rate on a pooled fund”, “timing of realisation of unrealised gains/losses” and “overall target duration of assets” were also common strategies modelled.

The proportions of companies modelling each strategy dynamically are generally in the range **30%-60%**. By dynamic, we mean management actions which can vary with different future scenarios, typically depending on external conditions (such as markets) and/or results produced by the model itself, i.e., such that the exact actions to be taken are not known at the outset. A modelled future management action which is invariant, no matter what the future scenario, would thus be regarded as static.

The most commonly implemented “driver” of investment strategies modelled for participating business is market interest rates. Fund yields/bonus rates, level of unrealised gains/losses, level of “free assets”/own funds or level of solvency cover, calendar year and level/value of policyholder options/guarantees are also common.

Milliman

Our analysis

A range of investment strategies are being modelled for participating business. It is important that the strategies modelled are sufficiently realistic, but not more sophisticated than the scope of the model or the purposes to which the model is put.

Consideration should be given to whether modelled strategies should de dynamic or static, i.e., whether they should be sensitive to future scenarios or essentially be fixed. This is particularly the case for extreme scenarios – for instance, is it appropriate that the mix of assets to be sold should be the same regardless of whether there are unrealised gains or losses in a pooled fund?

We note also that the impact of extreme scenarios, and whether it would be appropriate to consider modelling (dynamic) strategies that vary across such scenarios, could be exacerbated by DPB.

It would seem likely that, for participating business, various drivers should be considered, in particular the level of unrealised gains/losses in the fund in the case where book value accounting is used.

A few companies gave information of investment strategies modelled for business other than participating business. Examples of responses included:

- The same investment strategies as for participating
- Investment strategies in order to match cash flows/durations under each scenario
- Meeting liquidity requirements
- Future cash flows invested in government bonds of fixed duration
- Mix of investments to target specific duration, maximising yield subject to investment policy constraints
- Sell shortest assets first
- Based on current investment strategy
- Include equities for liabilities with longer duration

Management actions

Hedging

Milliman

Survey results

As might be expected, VA-type products are those for which hedging is most commonly deployed. Hedging is modelled for around **71%** of these.

Hedging is also commonly deployed for participating business and products with flexible crediting rate (US/Japan). Hedging is modelled for **50%** of these.

Hedging is less common for other types of products.

Of those modelling hedges, many noted that this modelling was only on a static basis, although some said that dynamic hedging was modelled.

Many companies said that their hedge modelling tracked real-life hedging closely, and some noted plans to improve hedge modelling in the future. Two companies plan to develop nested stochastic projections.

Our analysis

The percentage of companies hedging who then also model this hedging perhaps seems quite high. This might suggest that a motivation for modelling hedging is to obtain credit for it in actual economic capital calculations. This suggests that such calculations are effective in providing a motivation for risk mitigation.

This is an area where companies should consider developing their modelling to better track what happens in reality, including dynamic hedging where this is carried out in practice. At the same time, even the most developed models may not yet be sophisticated enough to follow reality.

Management actions

Bonus/profit-sharing rates

Milliman

Survey results

Regular bonuses and cash bonuses are the most common forms of profit sharing which are modelled, followed by terminal bonuses, and, to a lesser extent, market value adjustments.*

Where modelled, the various types of bonus are modelled on a dynamic (as opposed to "fixed") basis in most cases (ranging from **65%** for cash bonus to **95%** for regular bonus). Bonuses are considered "fixed" in this sense if they are assumed not to vary by scenario (even if they vary by calendar year).

Our analysis

It would seem appropriate that, where bonuses depend on or are related to returns on assets and where stochastic modelling is being carried out, bonuses should be modelled on a dynamic basis in order to be consistent with the projected economic conditions.

Modelling a fixed rate of bonus no matter what the future economic scenario can give rise to results that could differ materially from reality, including the triggering of unrealistic dynamic lapses. Furthermore, if the bonus rate has been fixed at an assumed "central" rate, i.e., assumed to lead to an averaging of results across all scenarios, then DPB could introduce asymmetry/distortion and this assumption would thus be invalidated.

* This is a type of adjustment whereby, on a contract with guaranteed benefits, policyholder benefits can be adjusted if the market value of underlying assets is lower than the guaranteed benefits; this would typically be applied on early surrender

Survey results

The most common “drivers” considered when modelling bonus/profit-sharing rates for participating business are market interest rates and book value returns on the underlying fund. Also common are levels of unrealised gains/losses, non-investment sources of profit (e.g., mortality surpluses) and bonuses/profit-sharing rates projected for previous calendar years. The cost of options and guarantees is rarely considered.

Our analysis

As usual, there needs to be a balance between realism and complexity. It would seem reasonable that factors such as the cost of options and guarantees and the level of unrealised gains/losses in a fund should impact the level of profit sharing paid. The cost of options and guarantees might be seen as circular or overly complex, but heuristic or approximate measures are still possible.

However, in some cases, modelled investment strategies can form an indirect driver of modelled profit-sharing rates—for example, modelling the timing of realisation of gains and losses in order to achieve a target return will by definition drive profit sharing where this depends on book value returns.

Survey results

The other most common type of management actions modelled are future capital injections/shareholder dividends.

The level/type of future new business modelled was noted by three companies.

Our analysis

We believe more consideration should be given to the modelling of future new business, in particular where the returns on new business depend on the existing business. This could apply for a whole company or at the level of a particular pool of assets.

In this case, future new business can have a significant impact on, for instance, the ALM position of the assets compared with a closed company or fund and the level of profit sharing paid to existing policyholders. This in turn could impact levels of new business which may be sold, where profit sharing paid is an important competitive element.

In practice, there can be important management decisions—for instance, in the case of pooled funds, whether to continue to write new business in an existing pooled fund or to open a new fund.

Lastly, we note also that the modelling of future new business will in any case become important in the context of jurisdictions requiring an ORSA.

Survey results

A question was asked about whether particular management actions were modelled in respect of extreme scenarios (in particular “bad” scenarios). Just over half the companies responding said they modelled no particular actions.

Examples of management actions modelled under extreme scenarios for the other respondents include: capital injections, reducing profit-sharing rates to zero, use of actions requiring regulatory approval in practice and the introduction of hedging.

Most companies noted no variation in modelled management actions for different purposes (e.g., economic capital, statutory reserving, embedded value reporting, etc.).

Only a few companies noted specific planned developments around the modelling of management actions, including: actions around extreme “bad” scenarios, improved modelling of hedges, more detailed analysis of past management actions, development of modelling of DPB resulting from management actions and more sophisticated investment management strategies (e.g., dynamic asset selling rules).

Our analysis

Attention should be given to what companies would do under extreme scenarios, and an attempt made to model them, in particular for measures, such as economic capital, where the focus is on such extreme scenarios. In this way, results from the model could be used to inform the process of planning for extreme scenarios by considering the impact of different actions.

As far as possible, consistency between modelling for different purposes should be achieved; however, it is recognised that for certain statutory purposes it may be necessary to introduce conservatism as required by regulations.

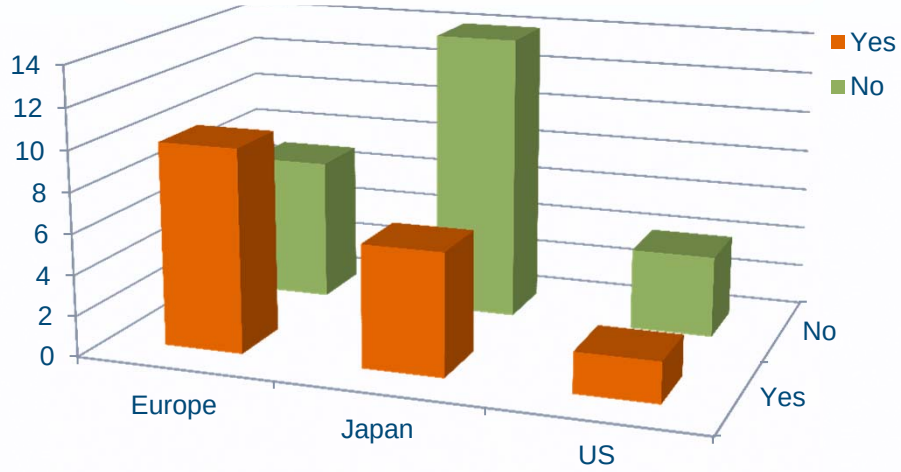
Development of models is an ongoing process and we appreciate that, for many companies, modelling of management actions is a fairly recent concept. However, modelling of management actions should be developed to form part of risk management, and inform decisions that management will actually take.

Management actions

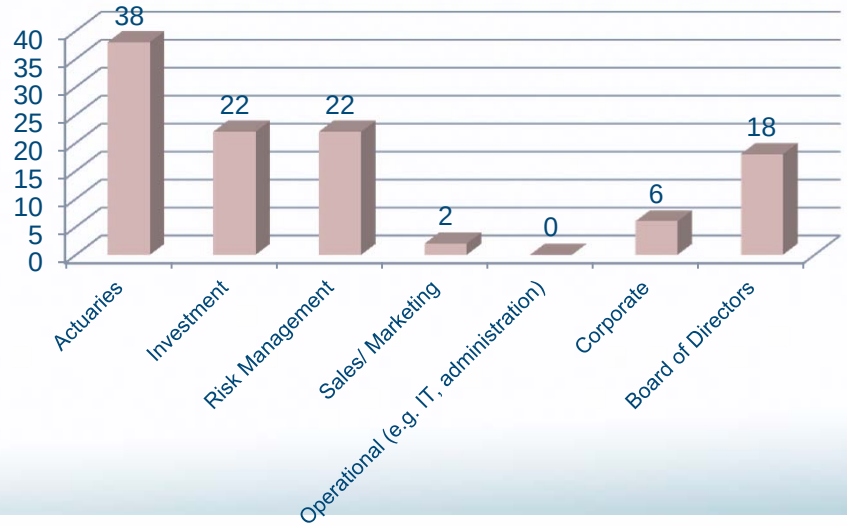
Setting MA rules

Milliman

Companies performing an analysis of past management actions



Which types of professionals were involved in setting the MA rules



Survey results

In Europe, more than **60%** of respondents said they performed an analysis of past management actions to assist in determining their modelled actions. In the US and Japan, this was only around **30%.**

Companies who did perform such an analysis were then asked to what extent the analysis informed the modelling rules (on a scale of 0-10, with 10 being totally, and 0 not at all). Most companies were in the range 5-8, with none being higher than 8.

Companies were asked which types of professionals were involved in setting the modelled management action rules. Actuaries were the most common group, with investment and risk management professionals and the board of directors also appearing prominently. Sales/marketing were rarely mentioned, and operational (e.g., IT, administration) never.

Milliman

Our analysis

Models should be as realistic as possible, and an analysis of actual past actions taken in particular circumstances can assist in informing MA modelling, although care should be taken, as future modelled conditions may not have occurred in the past and there can also be valid reasons for changing strategy.

Overall, however, rather more importance should be placed on obtaining and modelling management's clearly stated intentions (within an appropriate governance framework) on what they are committed to do in given circumstances in the future, irrespective of what management may have done in the past.

We feel that, in order for modelled management actions to be as realistic as possible and to form part of the overall risk management process, a wide range of professionals should be involved in setting them.

Whilst actuarial staff are likely to be those carrying out the modelling, actual management actions carried out in practice will be informed by a range of factors outside of purely actuarial ones. For instance, a decision on bonus rates will be driven by commercial factors as well as directly financial ones.

However, the role that actuaries can play by communicating effectively the whole management actions modelling exercise, and its significance, should be stressed. Actuaries are also the best placed to know what can reasonably be coded into a model.

Survey results

Most companies indicated that they do not currently hold a formal documented plan for how management actually intends to act in particular circumstances (although three out of five responding in the US do hold such a plan).

All ten companies with such a plan responded that their modelled management actions were driven by this plan. On a scale of 0 to 10 (10 being the highest), the extent to which the models reflected the plan (both in scope and sophistication) were generally given as between 5 and 8.

Our analysis

In order for the modelling of management actions to become embedded in the risk management process, it is important that actual management action plans be documented, agreed by appropriate management and reflected in models.

Indeed, such a documented plan is required by the proposed European Solvency II rules. Interestingly though, the proportion of European respondents with plans in place is currently lower than in the US.

Not all companies yet have formally documented action plans, but those that do seem to reflect these action plans in their models. The extent will vary and depends on differences in model sophistication, and/or the detail/scope of the plans themselves, but in all cases both model and plan development can and should benefit from mutual reference as far as is possible.

Models should reflect the formally documented action plan that has been signed off by management as representing their likely decision-taking in specific circumstances. Not all such circumstances are amenable to modelling, but those that are should be appropriately reflected in the model.

Where models only reflect the plan to a small extent, there is the risk of wide divergence in actual and expected results, and a control cycle analysis is rendered less meaningful.

Improving the extent to which models reflect action plans does not just mean a focus on extending the models, however—the nature and format of the action plan can also influence just how far the plan can be translated into the world of the model.

Survey results

Companies were asked whether the optimisation of a particular measure (such as minimising economic capital requirements) was used as a criterion in setting planned/modelled management actions.

79% of respondents indicated “no.”

For those that responded “yes,” details of the measures/criteria used included: minimising economic capital requirements, minimising the value of options and guarantees, optimising PVFP and setting optimal strategies based on balancing various financial metrics measuring risk/return.

Our analysis

Whilst optimisation of particular measures can be a goal of management actions, there will in practice usually be various competing factors driving decisions, and this should be reflected in modelled actions. For instance, a modelled action which seeks to minimise economic capital requirements by minimising bonuses under certain economic stresses may not represent what management would do in practice, due to the requirement to pay competitive bonuses.

We note, therefore that optimisation of more complex “composite goals” could make sense as an objective (e.g., “maximising X as long as Y remains above a minimum of A”).

Management actions

Monitoring MA and risk management

Milliman

Survey results

Companies were asked if they monitored actual management actions against those predicted by their modelled rules. Around **73%** of respondents indicated that they do not do this.

Of the 11 respondents who do monitor the actual management actions, nine said that the model predicted actual actions well. Of the remaining two, one of these has subsequently revised the model. Of these 11 respondents, five monitor the impact of deviations between actual and modelled actions.

A few companies noted that they planned to develop such monitoring in the future as experience unfolds.

The extent to which modelling of management actions helps to determine actual risk management decisions varies from 0 to 9 out of 10 (10 being fully), with 0 being the most common response.

Milliman

Our analysis

Monitoring of actual management actions against those predicted by the model should become part of the actuarial control cycle, with models being refined over time. Indeed, the proposed European Solvency II rules require the maintenance of such a control cycle, including explanations of any relevant deviations between planned and modelled actions.

There is a potential danger of management then overly "managing to the model," however, and there will be occasions when a departure from planned MA can be justified and appropriate. This danger can be mitigated if (justified) deviations from modelled behaviour are not viewed negatively, depending in turn on how the process of monitoring deviations is framed.

It does not seem right that models should have no influence on real management actions—for instance, this is clearly out of line with the concept of the European Solvency II "use test." Also, it appears to imply that a valuable way of testing what is the best management action is discarded. Whilst models can never give the full picture of real life, they can be used as a powerful tool to help inform actual management decisions, for instance by being used to test the expected effect of different actions in the face of a particular set of circumstances.

However, the limitations of the model do need to be well understood, and care is needed to avoid simply "letting the model decide," or using models as a justification for making erroneous decisions.

Appendices

Milliman

We would like to thank all those from the participating companies who took the time to complete the survey upon which this presentation is based.

We would also like to thank the following Milliman offices for their contributions in encouraging participation and collating survey submissions:

- Dublin
- Dusseldorf
- London
- Milan
- Paris
- Seattle
- Tokyo
- Zurich

Milliman

Dominic Clark

Tel: + 39 02 76 260 51

Mobile: + 34 609 026 561

dominic.clark@milliman.com

Jeremy Kent

Tel: + 39 02 76 260 51

Mobile: + 44 795 074 8647

jeremy.kent@milliman.com

Ed Morgan

Tel: + 39 02 76 260 51

Mobile: + 44 7939 016 401

ed.morgan@milliman.com

Milliman

“Dynamic Management Actions” by Dominic Clark, Jeremy Kent and Ed Morgan
Presented to the Staple Inn Actuarial Society, London, 6 March 2012

“Life: Another Dimension” by Jeremy Kent and Ed Morgan
“The Actuary” Magazine, published in the UK, November 2009

“Dynamic Policyholder Behaviour” by Jeremy Kent and Ed Morgan
Presented to the Staple Inn Actuarial Society, London, 18 November 2008

"An Empirical Analysis of Dynamic Policyholder Behaviour" by Christian Knoller, Gunther Kraut and Pascal Schoenmaekers
Munich Risk and Insurance Center, Working Paper 7, 25 July 2013

"1-year VaR Assessment and Dynamic Management Actions" by Craig Turnbull
Barrie+Hibbert, Insights, July 2010

“Dynamic Policyholder Behavior Assumptions" by Simon Walpole
International Financial Reporting for Insurers, Hong Kong, August 29-31, 2011