



Groupe Consultatif

Valuation of Best Estimate under Solvency II for Non-life Insurance

Interim Report

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Contents

- 1 Introduction 1
 - 1.1 Purpose of this paper 1
 - 1.2 Contact details 2
- 2 Executive summary 3
 - 2.1 Key messages 3
- 3 Definitions and interpretations 7
 - 3.1 Definition within the Directive 7
 - 3.2 Our interpretation and opinion 9
 - 3.3 Linkage to other components of Solvency II 16
- 4 A best estimate reserving process 18
 - 4.1 The four steps in the reserving process 18
 - 4.2 Application of expert judgement 22
- 5 Current state of claims reserving practices 23
 - 5.1 Observations on current reserving practices 23
 - 5.2 Claims reserving methodologies and classification 24
 - 5.3 What will be needed for transition 30
- 6 Current state of unallocated loss adjustment expenses practices 31
 - 6.1 Observations on current reserving practices 31
- 7 Current state of premium reserving practices 32
 - 7.1 Observations on current reserving practices 32
 - 7.2 Premium reserving methodologies and classification 32
- 8 Recommendations for implementing measures 34
 - 8.1 Implementing measures 34
 - 8.2 Supervisor actions 40
- A1 Glossary and abbreviations 41
- A2 Background to the definition of best estimate 43
- A3 Publications 47
- A4 Members of Groupe Consultatif’s Pillar I Non-life group 49

1 Introduction

1.1 Purpose of this paper

This paper sets out Groupe Consultatif's comments and observations on the best estimate valuation for the non-life technical provisions (claims, premium and unallocated loss adjustment expenses) as currently defined within the proposed Directive¹.

This paper is divided into eight sections:

- **Section 1** provides an introduction to the paper.
- **Section 2** contains the executive summary.
- **Section 3** introduces the definition of best estimate as per the proposed Directive and sets out Groupe Consultatif's interpretation and comments on what this will require from firms in practice.
- **Section 4** makes the case that the best estimate valuation of technical provision is not just about a number, it is a professional process requiring expert judgement. This section sets out the requirements and expectations for such a process and comments on the breadth of expertise required throughout an organisation.
- **Section 5** aims to give some insights on current practices and methods used to evaluate claims reserves and a few points which may need to be taken into account in the transition phase. The aim of this section is to provide some background understanding; but not to provide an exhaustive list.
- **Section 6** provides a brief description of the current practice for unallocated loss adjustment expenses.
- **Section 7** comments on the valuation of future liabilities focusing on current practice, and acknowledges this is an area that requires further work and guidance as confirmed by feedback from QIS4.
- **Section 8** should be seen as initial ideas for implementing measures in relation to technical provisions, and hopefully some thoughts that could prove useful as a starting point for ongoing discussions between CEIOPS, Groupe Consultatif and other stakeholders as appropriate.

This is an **interim report**, and, as such, does not seek to give a comprehensive view on all possible ways of dealing with the valuation of best estimate under Solvency II for non-life insurance. It is intended to be a step towards addressing the need for further guidance on best estimate valuation, and the report may be updated following our discussions with CEIOPS during November and December 2008².

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¹ As published by the European Commission on 26.2.2008 (2007/0143 COD). We do not cover risk margins or treatment of annuity and health business within this paper

² For further readings on the topics covered we refer to Appendix A3

We have used the terminology ‘reserving’ throughout the paper. We recognise that the accounting/ supervisory terminology may refer to ‘reserving’ as ‘provisioning’ and to ‘reserves’ as ‘provisions’.

There is a vast and steadily growing literature on the professional actuarial reserving process and methods. We have identified some of the more accessible sources at Appendix A3.

1.2 Contact details

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2 Executive summary

Achieving consistent technical provisions across countries and over time is one of the core challenges for the quantitative measures within Solvency II (even if there is wide support in principle for market consistent valuation with the technical provisions being split into two components the best estimate and the risk margin). Consistency of best estimate valuation is the focus of this paper.

We understand from CEIOPS that it was evident in QIS4 that it was difficult within the study to assess the consistency of methodology applied. This difficulty in our view is due to a number of factors:

- Accounting practices (local GAAPs) vary across Europe and do not always produce technical provisions that are fit for comparison. The local GAAP figures are currently not aligned to the Solvency II valuation principles, and not everyone has had the time fully to assess the implication of reserving on the new basis;
- There is no standardised definition of a reserving ‘best estimate’ across Europe;
- Historic differences in coverages and in definitions of business classes;
- Lack of appropriate data and systems for some organisations and countries; and
- The fact that best estimate valuation is not an exact science but should incorporate professional judgements.

With the introduction of Solvency II companies will have to prepare for a move towards more advanced reserving techniques, greater transparency and communication of uncertainties to the Administrative or Management Body and external stakeholders including supervisors.

2.1 Key messages

2.1.1 Best estimate reserving process

Reserving is inherently uncertain because it reflects the uncertainty in the business. The future is uncertain and the past is not always a reliable guide to the future. Even for classes with a lot of historical data and stable claims experience reserves are still subject to uncertainty and external influences will affect how usable data is.

When opining on the best estimate, the actuarial function needs to exercise **judgement** in how much credibility to assign to historical data and how much to rely on prospective modelling given their **knowledge** and **experience**; careful analysis of the underlying liabilities; qualitative information and communication with relevant areas of the organisation (e.g., underwriting and claims departments, pricing and planning functions, reinsurance or accounting and IT).

The actuarial function should also consider the parameter estimation error; the risk that the model being used might not give the correct output due to a misspecification or a misuse of the model (model risk); and the potential implication of systemic risks.

For the Administrative or Management Body to get comfort on the level of reserves, appropriate **governance and control** frameworks need to be in place around the **reserving process**. Furthermore key drivers, uncertainties and issues relating to the technical provisions should be presented by the actuarial function to the Administrative or Management Body.

The above should be documented with an internal reserving report/memorandum setting out the best estimate reserves as proposed by the actuarial function together with a description of how the Administrative or Management Body considered the uncertainty and how it selected the final best estimate reserving on a Solvency II basis as at the valuation date.

Overall sufficient **documentation** should be in place that would allow new personnel with access to existing software and programs to reproduce the reserving data and the best estimate reserves. This documentation may be made available on request to the company's supervisor, but is foremost an internal document and would not be forwarded to supervisors in normal circumstances.

2.1.2 Valuation of best estimate technical provisions

According to Article 76 in the proposed Directive “The best estimate shall be equal to the probability-weighted average of future cash-flows, taking account of the time value of money (expected present value of future cash-flows), using the relevant risk-free interest rate term structure.”

We interpret this as:

- the best estimate equals the **mean on a discounted basis**;
- the estimation should be **unbiased**;
- a combination of **entity-specific and external parameters**³ should be used;
- the cash-flows should reflect the company's **current and expected future state**;
- cash-flows should be discounted using the **risk-free** yield curve⁴

The approach to reserving introduced under Solvency II is for a many companies a fundamental shift moving the best estimates to a discounted basis where low probability high cost events have to be considered with removal of any margins.

Reading the wording in the proposed Directive it may at first appear that there is no alternative other than to calculate reserves than with stochastic modelling. However there are well known issues with stochastic modelling and stochastic approaches will not provide solutions to problems on best estimate valuation where deterministic methods fail. In deciding what method to be used, one must keep in mind that it is not necessarily true that a stochastic method will produce a more reliable best estimate than a deterministic approach.

³ External – from the insurance industry or other sources

⁴ Should another discount rate be used it will have implications for the risk margin as discussed in the appendix.

An expert in general insurance reserving would not rely solely on models but would rely on a variety of techniques at his or hers disposal including the **application of judgement based on sound reasoning and business logic**.

To determine the mean, a model has to be used. We use “model” in a general sense as an abstract and simplified representation of some aspect of the real world. The model does **not necessarily** have to be a **simulation based**. As a consequence we do not believe that Article 76 precludes using deterministic models.

With the best estimate being the probability weighted average of future cash-flows, some **weight has to be given to losses with low probability but high cost** within the best estimate valuation. We call these ‘binary events’. This will be a change as the majority of companies currently consider these types of risk as part of their capital assessment rather than best estimate reserves. Examples of binary events include the occurrence of a new type of latent claims or a change in legislation impacting claims payment retrospectively; or a high inflation environment.

The use of **stress & scenario testing** is an important tool to explore and describe the key drivers and uncertainties associated with the best estimate. Furthermore it is an integral step in opining on the range of best estimates.

2.1.3 Use of simplifications and proxy methods

The need of simplification and proxy methods arises from at least two sources. On one hand, the need might arise because the company IT systems are not capable of providing company data in the necessary format. On the other hand, the company might not have the necessary data, because, for example, it has not been in the business long enough.

With respect to gaps in the IT systems, it is important in our view that companies identify sooner rather than later the steps required to enhance IT systems and data to enable appropriate analysis of the claims data for reserving purposes by 2012. By then it should only be in **exceptional cases** that companies apply **proxies** and when it is done it should only be on a **temporary basis**.

With respect to gaps in the available data there is a continuum of methods for determining the best estimate reserve available to the actuarial function differing in degree of complexity.

The method applied by any organisation should be **proportionate to the underlying risks**, and its application must be **compatible with the principles and general requirements for the valuation of technical provisions** set out in the proposed Directive.

Many commonly used reserving methods are listed as ‘acceptable proxies’ within the QIS4 Technical Specifications. We would characterise these methods as acceptable actuarial methods once the following two conditions are met 1) available company specific data is at least partially used rather than a pure application of market data; and 2) the actuarial function is involved to bring knowledge, expertise and ability to make judgements on the appropriateness of the reserving method. Dependent on the nature, scale and complexity of the business the actuarial function may decide and justify the use of simplified methods.

We note that CEIOPS are considering defining materiality levels as to the proportion of the books where proxies/ simplifications would be allowed. We believe care should be taken in setting out such hard measures as it may be inappropriate, particularly in discouraging the formation of new companies or discouraging companies from entering new lines of business.

2.1.4 Linkage to other components of Solvency II

The valuation of the best estimate technical provision is a process that includes

- Data;
- Analysis performed;
- Process, governance and control framework within which the estimation is performed; and
- An accompanying reporting framework.

In addition, the best estimate valuation process should be linked, through inputs, outputs and shared processes, to other components of the Solvency II quantitative requirements including:

- risk margin, the MCR, the SCR standard formula, any internal model and the SFC reporting.

Moreover, the CEA/ Groupe Consultatif glossary defines an internal model as⁵:

Risk management system of an insurer for the analysis of the overall risk situation of the insurance undertaking, to quantify risks and/or to determine the capital requirement on the basis of the company specific risk profile.

We would consider the best estimate valuation process as one part of the overall internal model framework within any given organisation. Hence, as part of the implementing measures it might be worth considering for supervisors whether some of the tests and requirements within the proposed Directive for Internal Models including the statistical quality, calibration, validation and documentation standards (Article 119, 120, 122, 123) and the use test (Article 118) should be applied in an appropriate manner to best estimate reserves as well as internal models.

⁵ This definition has also been adopted by the IAIS

3 Definitions and interpretations

3.1 Definition within the Directive

3.1.1 Best estimate

The best estimate technical provisions have been defined within the Directive as the probability-weighted average of future cash-flows relating to the settlement of the current insurance/ reinsurance obligations taking into account the time value of money⁶.

According to Article 76 “The calculation of the best estimate shall be based upon current and credible information and realistic assumptions and be performed using adequate actuarial methods and statistical techniques. The cash-flow projection used in the calculation of the best estimate shall take account of all the cash in- and out-flows required to settle the insurance and reinsurance obligations over the lifetime thereof. The best estimate shall be calculated gross, without deduction of the amounts recoverable from reinsurance contracts and special purpose vehicles. Those amounts shall be calculated separately, in accordance with Article 80”.

“Insurance and reinsurance undertakings shall segment their insurance and reinsurance obligations into homogeneous risk groups, and as a minimum by lines of business, when calculating their technical provisions.” (Article 79).

“When calculating amounts recoverable from reinsurance contracts and special purpose vehicles, insurance and reinsurance undertakings shall take account of the time difference between recoveries and direct payments. The result from that calculation shall be adjusted to take account of expected losses due to default of the counterparty. That adjustment shall be based on an assessment of the probability of default of the counterparty and the average loss resulting there from (loss-given default)” (Article 80).

Processes and procedures have to be in place to ensure that the best estimate, and the assumptions underlying the calculation of best estimates are regularly compared against experience (Article 82).

The report on solvency and financial condition is required to include *“a description, separately for assets, technical provisions, and other liabilities, of the bases and methods used for their valuation, together with an explanation of any major differences in the bases and methods used for their valuation in financial statements” (Article 50 d).*

3.1.2 Simplifications and proxies

Simplifications: The term simplifications is used within the proposed Directive with reference to the SCR standard formula. These may also apply to the best estimate technical provisions as a key input to standard formula. According to Article 108 *“Simplifications in the standard formula Insurance and reinsurance undertakings may use a simplified calculation for a specific submodule or risk module where the nature, scale and complexity of the risks they face justifies it and where it would be*

⁶ Article 76 of the proposed Directive

disproportionate to require all insurance and reinsurance undertakings to apply the standardised calculation”.

The QIS 4 technical specification had a section TS.II.A.32 – TS.II.A.40. We have quoted a few of parts of the specification below describing the term ‘simplifications’:

TS.II.A.32. “According to the proportionality principle, undertakings may use simplified methods and techniques to calculate insurance liabilities, using actuarial methods and statistical techniques that are proportionate to the nature, scale and complexity of the risks they face.”

TS.II.A.37. “Participants may use simplified actuarial methods and statistical techniques if the criteria outlined in TS.II.A.38 are satisfied or are likely to be met. Of course, as indicated in TS.II.A.36, it is not necessary to re-calculate the best estimate using a more appropriate approach in order to demonstrate that the absolute / relative quantitative criteria set out below are met. It is sufficient to meet those quantitative criteria when using the simplified method. All criteria should be applied on a best effort basis.”

TS.II.A.38. “Simplified actuarial methods and statistical techniques may be used if:

- the types of contracts written for each line of business or homogenous group of risk is not complex; and*
- the line of business or homogenous group of risks written is simple by nature of the risk ...; and*
- any additional nature and complexity standards set out for each liability are met; and*
- the liability that is valued is not material in absolute terms, or relative to the overall amount of the total best estimate.... [The paragraph goes on to specify some proposed quantitative thresholds]”*

Proxies: There are no references to proxies within the proposed Directive, however within the QIS 4 specification proxies section TS.II.A.41 – TS.II.A.44 proxies are described as follows:

“Proxies for the valuation of technical provisions come into play where there is insufficient company-specific data of appropriate quality to apply a reliable statistical actuarial method for the determination of the best estimate. Proxies can be regarded as special types of simplified methods which are positioned at the “lower end” of continuum of methods that could be applied

Under the future Solvency II regime, proxy methods will be needed whenever a lack of sufficiently credible own data cannot be avoided. This is the case, for example:

- for entirely new types of insurance in the market that won’t have any historic data to act as a guide (e.g. cyber risks);*
- for classes of business that are being written for the first time by an insurer;*

- *where due to legislative or significant underwriting changes the characteristics of the terms of the insurance contracts are changed in such a manner that historic data is rendered useless⁷; or*
- *when the insurer (or the class of business in question) is too small to allow the build-up of credible historic claims data.*

Under the Solvency II framework, proxies can be used to determine technical provisions if:

- *the proxy is compatible with the general principles underlying the valuation of technical provisions under Solvency II; and*
- *the use of the proxy is proportionate to the underlying risks.*

An appropriate valuation of technical provisions under the Solvency II principles (including the use of proxies) will require sufficient actuarial expertise. Consistent with this, the Framework Directive Proposal requires insurers to provide an actuarial function to ensure the appropriateness of the methodologies and underlying models used as well as the assumptions made in the calculation of technical provisions. However, it should be acknowledged that currently a significant number of insurers have not yet built up their actuarial expertise to the level which will be required under Solvency II, especially in non-life insurance where in some markets the use of actuarial techniques has traditionally been less widespread than in life insurance.”

3.1.3 Case-by-case estimates

According to Article 81 in the proposed Directive “*If insurance and reinsurance undertakings have insufficient data of appropriate quality to apply a reliable actuarial method to a subset of their insurance and reinsurance obligations, or amounts recoverable from reinsurance contracts and special purpose vehicles, a case-by-case approach may be taken with respect to the calculation of the best estimate”.*

3.2 Our interpretation and opinion

3.2.1 Best estimate

Article 76.2. “*The best estimate shall be equal to the probability-weighted average of future cashflows, taking account of the time value of money (expected present value of future cash-flows), using the relevant risk-free interest rate term structure.”*

This implies firstly that the **best estimate equals the mean** (and not the median or mode) and secondly, that the underlying cash flows are actually random or stochastic.

The **cash flows to be valued have to be specified** by the firm. We understand the relevant cash flows for Solvency II purposes to be those that are associated with the insurance liabilities under the assumptions on the firm’s state (going-concern, run-off or

⁷ In our view this should refer to requiring adjustments to past data rather than considering past data to be useless.

insolvent which may impact assumptions on expenses, underwriting, claim handling or for discretionary policy holder benefits, profit participations etc).

We **distinguish between parameters that are the same for all firms and those that are entity-specific**. The former would include financial market parameters, e.g. yield curves, share price volatilities, etc. The latter would include claims experience, expenses, etc. Entity-specific assumptions should be based on the company's own experience and best projections subject to credibility.

All **estimations should be unbiased**, without conservatism and based on the most recent and relevant information.

The cash flows should be **discounted using the risk-free yield curve**, without additional spread due to illiquidity etc. Please refer to the Appendix A2, where the appropriate discount rate is derived from the basic principles of market consistent valuation and the use of market information to calculate the relevant rate also is discussed.

3.2.1.1 Best estimate – determining the mean – use of a model

To determine the mean, a model has to be used. We use “model” in a general sense as an abstract and simplified representation of some aspect of the real world.

The model does not necessarily have to be a simulation based, or even an algorithm. It could also be generated without estimating a series of cash-flows and their probability. As a consequence we do not believe that Article 76 precludes using deterministic models.

In this context, the purpose of the model is to gain information on the mean of the future undiscounted claim payments. Any model will be based on judgements on the method used and assumptions including future trends. In most cases the relevant reality that is to be captured is too complex to be amenable to exact modelling. It is therefore not possible to prove that the best estimate is correct (see Appendix A2 for comments on provability). It is important however that the best estimate can be demonstrated to be useful, appropriate and reasonable.

The best estimate valuation of technical provisions is not just about a number, it is a process requiring expert judgement. To determine an appropriate best estimate it should be ascertained that:

- The model is fit for purpose;
- The limitations of the valuation and the valuation process must be understood by Administrative or Management Body;
- The model is well understood by the user, e.g. the actuarial function;
- The data feeding the model must be verifiable and of sufficient granularity;
- Its underlying assumptions and parameters must be clear and explicit;
- It takes account and feasible clarify the main factors that affect or will affect the cash flows of the liabilities; and

- Uncertainties and sensitivities in the results must be communicated to the Administrative or Management Body.

Section 4 sets out the requirements and expectations for a best estimate valuation process in more detail.

There might be situations where the insurer would be unable to calculate the best estimate, due to the uncertainty of the liabilities and the lack of ability to develop an appropriate model. If the total risk due to these liabilities can not be estimated, the (re)insurer might require special risk management strategies.

3.2.1.2 Best estimate – definition of cash-flows

The future cash-flow relating to the unexpired risks consists of:

- Premium income
- Commission and administrative expenses
- Payments for losses and loss adjustment expenses allocated to a certain claim
- The expenses for the overall claim settlement (unallocated loss adjustment expenses, mainly cost allocation for the claims departments);
- Receivables for salvage and subrogation
- Amounts received from and/or payable to any types of reinsurance/ coinsurance

All of these cash flows have different characteristics in amount, timing, variability and some are interdependent. The definition of any company's best estimate needs to make clear what cash-flows are accounted for.

3.2.1.3 Best estimate – treatment of reinsurance

The sum of expected future undiscounted payments for losses and loss adjustment expenses less expected salvage and subrogation equals the mean of a distribution of unpaid undiscounted losses gross of reinsurance. The expected cash flow might be generated directly from a model or by applying an expected cash flow pattern to the mean of the distribution of unpaid losses, i.e. by combining two components individually estimated.

The cash flow net of reinsurance or the cash flow ceded under reinsurance needs to be estimated in a consistent way but potentially using different models to reflect the properties of the reinsurance programme, changes in the programme over time and any difference in the timing of direct payments and reinsurance as well as the take into account the potential default of the reinsurer.

Different practices are used across the industry. The most common for proportional reinsurance is to model gross payments and apply proportional factors to scale to the net level. For non-proportional reinsurance the industry tends to apply the reinsurance contract features to the gross incurred claims. However due to data limitations the proportional factor is also used as a proxy for non-proportional reinsurance, with some companies being more conservative by only recognise actual ceded reserves. As with any

proxy, we do not recommend any systematic unconsidered use of any of those approaches.

The discounted best estimate net of reinsurance is then determined by discounting the result of the gross and ceded cash-flows, or the net undiscounted cash-flow using the relevant discount rate. The net cash flows should take into account the credit risk of the reinsurer according to the proposed Directive. It is evident from QIS4 that more guidance on how to make the allowance for the credit risk (reinsurance bad debt) should be developed.

3.2.1.4 Best estimate – homogeneous risk groups

According to the directive the technical provisions shall be calculated by risk groups. The risk groups (class-by-class) have to be selected by the actuarial function according to the underlying business and internal processes (taking into account potential alignment to reinsurance and pricing). We believe that disclosed pragmatism should be allowed, as classification prescribed by the regulator could potentially lead to loss of transparency.

Groupe Consultatif will comment on the identification of homogenous risk groups and the segmentation of insurance liabilities separately to CEIOPS in a response to the questions raised in the letter to us dated 18.09.2008.

3.2.1.5 Best estimate – treatment of ‘binary’ events

With the best estimate being the probability weighted average of future cash-flows, some weight have to be given to losses with low probability but high cost within the best estimate valuation. We call these ‘binary events’. Examples of binary events include the occurrence of a new type of latent claims; a change in legislation impacting claims payment retrospectively; high inflation environment.

If the insurer has only a small number of such exposures, diversification is small and the insurer owns a liability with an essentially binary payout pattern. The best estimate is then – as before – defined as the sum of the product of the probability of the event occurring and the expected payment, discounted at the risk-free rate.

The most common practice today is not to make these types of allowance within the best estimate, but rather to consider the events as part of the downside risk considered within the assessment of the firm’s own economic capital requirements. We comment further on possible treatments in the section 3.3.2 on linkage between best estimate reserves and SCR below.

3.2.1.6 Best estimate – use of stress & scenario testing

The use of stress & scenario testing is an important tool to explore and describe the key drivers and uncertainties associated with the best estimate. Furthermore it is an integral step in opining on the range of best estimates. We comment on the communication of these results in Section 4 on the best estimate valuation process.

For definitions of stress tests and scenarios, please refer to the Appendix A1. Stress tests are most useful to determine the key influencing factors of the best-estimate calculation. For this, the different assumptions and risk factors are stressed to arrive at an understanding on the main driver of the estimate.

Scenario analysis is useful to arrive at an understanding on how potentially the best estimate can change given hypothetical situations. Scenarios describe possible, albeit unlikely events that could have a negative impact on the firm's balance sheet. Formulating appropriate scenarios is an art since ideally it incorporates all material dependencies that are affected by a given event or that are relevant to the best-estimate.

Scenarios should enter the best estimate calculation weighted with their probability of occurring. In some cases, the methodology used to arrive at the best estimate might not capture events described by the scenario. Then, the impact of the scenario on the best estimate needs to be appropriately integrated into the best-estimate.

Scenarios used for the calculation of the SCR should also be appropriately considered for the determination of the best estimate, if relevant. For example, a pandemic or natural catastrophe scenario might be not only a material influencing factor for the SCR but also for the best estimate.

3.2.2 Simplifications and proxies

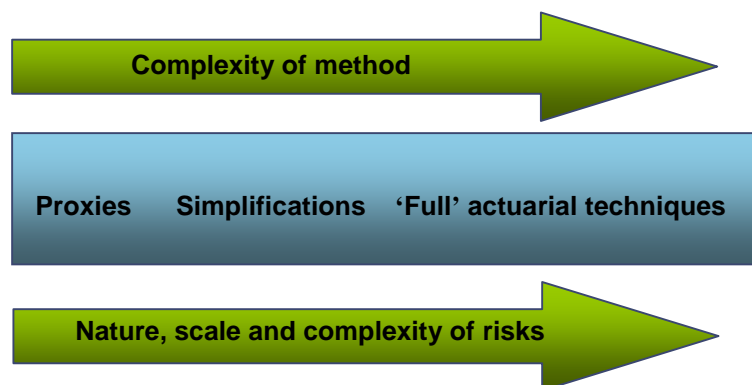
The concept of simplifications and proxies has been introduced from a regulatory perspective, with proxies being temporary in nature.

The need of simplification and proxy methods arises from at least two sources. On one hand, the need might arise because the company IT systems are not capable of providing company data in the necessary format. On the other hand, the company might not have the necessary data, because, for example, it has not been in the business long enough. It could also be due to the lack of appropriate staffing in the actuarial function.

With respect to gaps in the IT systems, it is important in our view that companies identify sooner rather than later the steps required to enhance IT systems and data to enable appropriate analysis of the claims data for reserving purposes by 2012. By then it should only be in exceptional cases that companies apply proxies and when it is done it should only be on a temporary basis.

It is possible to use models and methods without applying actuarial judgement, for example where insufficient resources exist, but we doubt this is consistent with the intent of the Directive. We believe that an appropriately staffed actuarial function is required in order to ensure the appropriateness of the methodologies and underlying models used. In the run up to 2012 companies should be preparing to introduce an actuarial function if they do not currently have one, or consider workable alternatives.

With respect to gaps in the available data there is a continuum of methods for determining the best estimate reserve available to the actuarial function differing in degree of complexity⁸.



The method applied by any organisation should be proportionate to the underlying risks, and its application must be compatible with the principles and general requirements for the valuation of technical provisions set out in the proposed Directive.

Many of the most commonly used reserving methods are listed as 'acceptable proxies' within the QIS4 Technical Specifications. In situations where there might be inadequate company-specific data, the company would according to QIS 4 be in a 'proxy situation'.

We believe the methods listed in the QIS4 Technical Specifications are acceptable actuarial methods once the following two conditions are met:

- 1) available company specific data is at least partially used rather than a pure application of market data; and
- 2) the actuarial function is involved to bring knowledge, expertise and ability to make judgements on the appropriateness of the reserving method.

Dependent on the nature, scale and complexity of the business the actuarial function may decide on using simplified methods justify the choice and explaining the potential impact on the best estimate valuation of the technical provision.

We note that CEIOPS are considering defining materiality levels as to the proportion of the books where proxies/ simplifications would be allowed. We believe care should be taken in setting out such hard measures as it may be inappropriate, particularly in discouraging the formation of new companies or discouraging companies from entering new lines of business.

3.2.3 Case-by-case estimates

Loss reserves for reported claims are established on a case-by-case basis. Generally this is done either by claim adjusters according to facts on coverage, damage and liability on an

⁸ Source: [Report on Proxies by CEIOPS – Groupe Consultatif Coordination Group, July 2008](#)

individual claim at a certain point in time; or by (semi)-automatically generated reserves for large quantities of similar types under the supervision and control of claims management.

Large damages and difficult claims may rely on expertise of doctors and other professionals to quantify the claim amount. In any case these are estimates based on an individual claim by claim basis rather than actuarial methods.

For these individual case-by-case estimates different standards may apply in European countries and even insurance companies operating in the same market might follow different philosophies how to quantify such a claim. E.g., the intensity of using claims experts, documenting claim history for reference and creating tables or databases to generate standards, frequency of updating estimates by reviewing individual claims, level of automation can vary significantly. Further, the conservatism of allowing adverse development depends on local regulation, customer/claimant protection, tax treatment considerations and the general risk strategy in a company.

As a result case-by-case estimates are not consistent enough to compare them across different markets, business lines, ages of claims or insurance companies. For generating a best estimate they are very useful information though at least as long as there is consistency within one analysis segment over time to avoid distortions in an actuarial or statistical model. It is important to note, that the inconsistency across time is not a problem but a change of the procedure normally is.

A best estimate valuation of the non-life technical provisions is generally produced by applying actuarial methods. When exceptional events have been observed in the historical data used by such a method the results might be unreasonable as a projection of this exceptional event misstates the real situation. In these situations actuaries might rely on the case reserve as the best estimate for such extreme event⁹. The event is by definition exceptional and cannot be observed using enough statistical observations and the extraordinary character of the claim involves intense review by claims experts and adjusters which cannot be replaced or improved by a modelling technique. In these situations the best estimate for the exceptional event equals its case estimate and removing the case estimate from the historical data provides a clean data base for the actuarial projection to generate the best estimate for all other events or claims in that portfolio.

It is worth noting that because of the inconsistency in case-by-case estimates across Europe, one can not assume that it is a prudent estimate for the best estimate reserve as implied by Article 81. In many countries this would be insufficient to cover incurred but not reported claims (or even the incurred but not enough reported claims). Therefore in general insurance companies hold an IBNR/ IBNER reserve over and above the case-by-case reserve.

⁹ In this situation the Actuarial Function may still consider different settlement scenarios (i.e. different types of binary events)

3.3 Linkage to other components of Solvency II

3.3.1 Risk margin

The risk margin is defined as the expected cost of future capital required for non-hedgeable risks necessary to support the insurance liabilities. Therefore, the risk margin is the probability weighted average of future cash flows stemming from the cost of future capital, taking into account the time value of money.

Hence, the risk margin can be seen as a best estimate of a particular, uncertain cash flow stream, namely the cash flows of future capital requirements due to non-hedgeable risks.

At a high level, the requirements for the determination of the risk margin are identical as for the best estimate reserves with respect to expert judgment, the use of models and simplifications, governance and processes and reporting. In fact the risk margin calculation requires even more judgment and modelling as some of the required future information by definition is not available and uncertain.

Both the best estimate of liabilities and the risk margin are impacted by risk emerging over the whole time horizon of the liabilities. Ideally, risks that are considered over the time-horizon of the liabilities that are used for calculating the risk margin are also used for determining the best estimate and vice versa.

The aim for the overall level of technical provisions is for them to be valued in a way that is consistent with the market. There are yet a number of areas to be further developed or considered by CEIOPS including the concept of transfer to a reference entity, the treatment of diversification between risks and lines of business and the best way to deal with the fact that cost of capital is a secular variable.

3.3.2 SCR

In case of a binary event type cash-flow the best estimate is such that it is never sufficient to pay the claim, if the claims occur. Such a liability will likely have a bigger impact on the SCR.

However, there are situation where a binary event will not impact the SCR at all. For example, if the probability of the event occurring is smaller than 0.5% and the insurer is mainly exposed to this risk (i.e. has no further diversification). This occurs because Solvency II has chosen Value at Risk as a risk measure with a risk tolerance of 99.5%, hence in this example the SCR will not capture the risk of the binary event.

As a simple but relevant example, consider a monoline credit insurer that insures the rating of bonds and assume that the major exposure is to currently A rated bonds with a 0.1% default probability. In addition, assume that the bonds are highly correlated. Let the total exposure be EUR 1bn. In this situation, the best estimate is EUR 1mn and the SCR is 0.

The choice of risk measure therefore can lead to situations where a major risk to the insurer is not captured. However, such a situation requires special risk management treatment. The insurer will most likely write a profit in any given year but in case the event occurs, the insurer will not be able to pay ever.

In such a situation it is essential that management determines their own risk appetite and tolerance (rather than be driven by the regulatory VaR 99.5%). As a result the team may decide to hold up to the full exposure less the best estimates i.e. EUR 999mn as capital.

If such a situation invalidates the business model of an insurer, the only possibilities is diversification, e.g. by writing different lines of business, or obtain appropriate reinsurance.

We would like to stress that it would be the responsibility of the Administrative or Management Body to hold capital in excess of the SCR, even though this might not be required explicitly by Solvency II. However, it is implied by the Comments on the Articles in the Draft Directives, which clearly states that *“The main objective of (re)insurance regulation and supervision is adequate policyholder protection.*

3.3.3 Internal models

The comments made in the section above are equally applicable when companies determine the SCR using internal models.

The methods used to calculate the probability distribution within any internal model should be consistent with the methods used to calculate the technical provisions.

3.3.4 ORSA

For the Administrative or Management Body to get comfort over the best estimate valuation, the reserving process needs to be implemented, reviewed and be appropriately documented as part of the ORSA. For further details on the best estimate valuation process see section 4.

3.3.5 SFC

The SFC is required to contain a description of the bases and methods used for the valuation of liabilities, together with an explanation of any major differences in the bases and methods used for their valuation in financial statements.

The communication should be consistent with the key drivers, uncertainties and issues relating to the technical provisions that might internally be presented by the actuarial function to the Administrative or Management Body. For internal purposes we would recommend that an internal reserving report/memorandum act as a record and evidence of the end to end reserving process: data, calculation, review and responsibilities.

The handling of such a memorandum would vary between companies according to the proportionality principle, so implementing measures should permit flexibility but could usefully outline the sections a memorandum should include. For more information see section 8.1.5.

4 A best estimate reserving process

The best estimate valuation of technical provisions is not just about a number, it is a process requiring expert judgement. For the Administrative & Management Body, supervisors and other stakeholders to get comfort with the results, there must be proper governance systems, controls and reporting in place.

This section sets out the requirements and expectations for such a process that would be considered best practice under Solvency II including how the best estimate valuation links to other financial statements. A critical component of a best estimate valuation process is the application of judgement from the actuarial function throughout.

To meet the requirements under Solvency II the best estimate valuation of the technical provisions need to be reported on a quarterly basis, as it is required for the calculation of MCR. In general, companies will at least have an annual reserving cycle, although several companies execute their reserving process on a quarterly basis.

The process should be transparent including explanation when the Board/ Senior management decides to book reserves different to the recommendation of the actuarial function.

4.1 The four steps in the reserving process

The main steps involved in the reserving process are:



The best estimate reserving process should be proportionate to the nature, scale and complexity of the (re)insurer – and this applies to all stages of the process. In our view a strong reserving framework requires the following to be in place:

- Well defined individual responsibilities and roles for everyone involved within the valuation process;

- Data, systems and processes ensuring that the information required to calculate the reserves are available in a complete and well documented way;
- The best estimate reserves (and overall technical provisions) are consistent¹⁰ with the assumptions used within the business plan and those used for other purposes including pricing and capital management;
- The analysis carried out is used consistently between different areas of the business. For example, the reserve uncertainty information that may emerge from the reserving process should be suitable for use within an internal model (or if it is not the case the reasons should be clearly stated);
- Results are sense checked by use of validation, calibration and scenario testing techniques as well as by discussion with other relevant experts. A process of peer review should be in place internally or externally; and
- Have an internal reserving report/memorandum setting out the best estimate reserves together with the key drivers, uncertainties and issues together with a description of how the Administrative or Management Body considered the uncertainty and how it selected the final best estimate reserving on a Solvency II basis as at the valuation date.

Below we expand briefly what each of the four steps in the reserving process typically involves.

4.1.1 Data

This step includes the production, collection and processing of the data required to perform reserving analyses. The following should subject to proportionality be in place:

- Ideally a system that maximises the ability to report transparently across departments and subsidiaries;
- A comprehensive list of the data required by the reserving process should be maintained. This would include specification of segmentation by homogenous risk groups and any additional split of the data required;
- Data used in the reserving process should be captured automatically and with sufficient granularity to support all methods that might be applied, ideally at transaction level (this could include underlying currency detail);
- Identified data omissions should be documented;
- Standard diagnostics (that vary by line of business) would be produced in an automated manner to monitor changes in business mix, eg. Lapse rates/renewal rates, exposure by rating factor, geographical location makers, average deductible etc.;

¹⁰ We note that 'consistent' does not necessarily mean 'the same', as work may, for instance, be carried out at different points in time. Particular economic assumptions tend to change over time

- Reconciliation of the data to the balance sheet and accounting systems (ideally using the same system); and
- Where reserving is carried out in advance of an accounting date (e.g. using end of November data for the main analysis feeding the year-end accounts) a defined and documented process should be in place specifying how such data is adjusted to a year-end position.

4.1.2 Analysis

The analytical part of the best estimate valuation process should be clearly specified and documented. Good practice tends to include the following steps and features:

- Standard software and template are used for as much of the analysis as possible. These could have been developed either by external providers or in-house. The advantage of standardising the process is to reduce the amount of ad-hoc calculations required and thereby the chance of making errors;
- Underlying assumptions are consistent with those used across the business (eg approaches to treating inflation, underwriting versus accident year basis);
- Different reserving and estimation methods are considered and selection justified including the use of proxies and simplifications;
- Where techniques are used that have known shortfalls, allowance should be made and suitably documented for addressing these shortfalls;
- Reserving techniques/ methodologies (see section 5) and assumptions should be specified and applied, with sufficient documentation of assumptions used and judgements made (see section 4.1.4);
- Market conditions should be considered and allowed for within the analysis (i.e. impact of insurance cycle or ‘binary events’ such as changes in regulations);
- Business diagnostics should be used in a quantifiable way to improve the accuracy of the reserving process; e.g. number of claims settled for nil, average time to settlement, settlement amount as a proportion of case estimate, trends in frequency and severity at a granular level etc.;
- The impact of changes in assumptions from one period to another should be quantified, tracked, explained and reported.
- Standard reserving results templates may be used;
- Sensitivity testing should be performed;
- It is good practice to assess the reserve uncertainty splitting it into elements to necessary granularity
- Goodness of fit tests are applied where relevant (eg statistical test done on quality of fit following, say, a curve fitting exercise); and

- Actual versus expected analysis (comparing expected against actual claims development over the last period) and back-testing (assessing the impact of applying prior period valuation methods and parameters to this times data) are applied where relevant.

4.1.3 Process, controls and governance

The reserving should be carried out by persons having a good understanding of the underlying business and be subject to:

- Well defined individual responsibilities and roles for everyone involved within the valuation process;
- A standardised process of peer review (by other suitably qualified people) should exist, together with appropriate documentation. This process might be performed internally and/ or externally, as appropriate;
- Documentation surrounding the process should exist, as detailed in section 8.1.5;
- Reserving output should be shared with other areas of the business (eg with underwriting, pricing and claims through a Reserving Committee). Their views should be captured and included where necessary, ie a feedback loop;
- Where valuation process output is used in models elsewhere in the business the methodology and assumptions used should be consistent;
- Reports on reserve reviews should be owned by and signed-off by an appropriately qualified person within the actuarial function and be delivered to and endorsed by management (use test).

4.1.4 Reporting

An efficient reporting process should include the following features:

- Periodic internal reserving report/memorandum setting out the best estimate reserves should exist which will include the final position of the Administrative or Management Body (each company would be expected to have some minimum standard layout over time);
- The reporting should be done at a sufficient level of granularity for the Administrative or Management Body to form an opinion on the valuation and to understand the key drivers of the figures, including changes since the previous evaluation;
- Details of key judgements would be included in the final report, and highlighted as such. Less material judgements might be documented in the underlying templates and analysis files;
- The report should give sufficient information to allow another suitably experienced expert to form an opinion on the appropriateness of the actuarial

function's key judgements and, together with the files, be sufficient to allow another suitably experienced expert to reproduce the results without access to the actuarial function;

- Consistent templates and reports should be used over time and across business divisions/ subsidiaries; and
- Transparency should exist between the best estimate proposed by the actuarial function and the final number booked within the Solvency II balance sheet (including reconciliation with the published technical provisions)¹¹.

For more thoughts on possible content for the internal reserving report/ memorandum see section 8.1.5.

4.2 Application of expert judgement

In line with the Directive Proposal, and given the natural inherent limitations of all of these models (as discussed in section 5), we believe that an actuarial function is required in order to ensure the appropriateness of the methodologies and underlying models used.

It is important that the application of such judgement is itself clearly documented, together with the underlying reasoning. As discussed in section 4.1.4, the level of reporting should enable another suitably experienced expert to form an opinion on the appropriateness of the key judgements¹².

¹¹ The Administrative or Management Body are overall responsible for Solvency II and hence for the level of technical provisions under the Solvency II balance-sheet. It is unclear from Article 47 whether the Administrative or Management Body has to adopt the actuarial function's advice on the best estimate valuation of technical provisions. If a decision is made to book another set of figures the Administrative or Management Body have to justify the reason for the difference.

¹² For further information on the application of expert judgement we also refer to the Groupe Consultatif's note on this topic (www.gcactuaries.org)

5 Current state of claims reserving practices

This section aim to give some insights on current practices and methods used to valuate claims reserves and a few points which may need to be taken into account in the transition phase.

There are a growing number of reserving methods¹³ in use by actuaries today. The aim of this section is to provide some background understanding about these types of methods; but not to provide either an exhaustive list or a full description of commonly used methods.

The methods categorisation we have selected is rather arbitrary, but fits in our opinion the purpose of being aligned with commonly used methods. There are many other way to categorise or describe the different methods with further details, for which we would like to refer to available literature (see section A3).

5.1 Observations on current reserving practices

Several observations can be made about the current approaches to reserving that are used across Europe.

- Accounting practices (local GAAPs) vary across Europe and do not always produce technical provisions that are fit for comparison. The local GAAP figures are currently not aligned to the Solvency II valuation principles;
- There is no standardised definition of a reserving ‘best estimate’ across Europe;
- In countries with established actuarial practices, it is common practice to consider different reserving methods and for actuarial judgement to be a critical element;
- Within a line of business it is common practice for different reserving methods to be applied to different cohorts and different maturities (referring to accident or underwriting year);
- Reserving methods and assumptions tend to evolve over time, with new methods and assumptions being developed to address new challenges as they arise;
- There is no accepted definitive list of ‘acceptable’ reserving methods;
- Types of business exist for which judgementally selected reserves would be considered to be the most relevant or accurate estimates available, there being no currently known statistically based method that produces reasonable results for that type of business;

¹³ Within this section we use the term methodology, methods and models interchangeably. We note that the methods used are likely to grow over time as actuarial science advance.

- For certain unique situations new reserving approaches may have to be developed to cope with the situation. Examples include asbestos (now a well-developed technique but once an innovative way of dealing with a unique situation), the World Trade Centre, laddering claims;
- Most common reserving methods that are in use initially produce an estimate of a gross undiscounted reserve. To produce an estimate of a discounted reserve would require subsequent calculations to be performed; and
- Many commonly used reserving methods are listed as ‘acceptable proxies’ within the QIS4 Technical Specifications as they are supposed to replace missing company own data by market ones. We are emphasising in this paper that:
 - We are considering the involvement of the actuarial function judgement and the full process described in section 4 to be the main criteria of appropriateness of an applied method or not.
 - Solutions using external data instead of company own data are usually provisional. However they can be used as additional methods to benchmark company portfolio against other companies.

5.2 Claims reserving methodologies and classification

It is not possible to prescribe any method to be either always appropriate or always inappropriate for a particular book of business (e.g. Long-tail, short-tail, line of business, geographical, currency). Hence it is not possible to define any default methods.

Within a line of business it is common practice for different reserving methods to be applied to different cohorts and different maturities (referring to accident or underwriting year), and in some cases weighted averages of more than one method outputs may be applied (e.g: average of results from a chain ladder method based on paid claims and incurred claims).

The elements to consider when selecting a method for the best estimate valuation should include but not be limited to:

- Valuation requirements (e.g. point estimate, range of reserves)
- The nature, complexity of the business and the characteristics of the claims behaviour
- Availability of relevant data (entity specific and external data)
- Specific segment development over time (mix, processes)
- The materiality of the segment
- The maturity of considered accident / underwriting year and available historical data
- The exposure in the economic, legal environment and other risks

- The firms overall strategy e.g. risk appetite
- Internal processes and policies including underwriting, claims management, reinsurance strategy
- Expert judgement and adequate discussion across departments

The level and the degree of the complexity of the method is never a good measure for its appropriateness.

As with any sort of modelling it is as much an art as a science, and one needs to appreciate that all models are “wrong” to some extent. Models are not “reality”, they are a simplified representation of reality, enabling the user to make practical future projections of expected future claims. As a consequence, there is no one “right” model, and different models may be equally applicable. The uncertainties surrounding the selection of model are sometimes captured by the consideration of model risk.

When determining the best estimate, the actuary needs to exercise judgement in how much credibility to assign to historical data and how much to rely on prospective modelling. Judgement does not imply that the actuary’s choices are arbitrary or based on believe or faith. The judgement has to be based on a careful analysis of the underlying liabilities, the actuary’s experience, qualitative information and communication with relevant areas of the organization (e.g., underwriting and claims departments, pricing and planning functions, reinsurance or accounting and IT) to ensure industry best practice. For further details on expert judgement please see 4.2.

Details of commonly used methods can easily be found in actuarial manuals and literature. A list of references is included in Appendix A3.

5.2.1 Traditional or deterministic methods

Deterministic reserving models are, broadly, those which only make assumptions about the expected value of future payments and thus an assessment of best estimate position. These methods are generally called deterministic because they do not provide any information on the distribution of possible results around the single point estimate. While some of these methods might give some insight in the possible variation, there is no probability assigned on those variations.

5.2.1.1 Development Pattern Techniques

Common methods: Basic chain ladder, Link ratios; ..

Description of method & its underlying assumption: The past is a predictor for the future. Historical behaviour is observed from loss triangles (origin year across development period) to then be projected into the future. Claims are assumed independent with no correlation across underwriting/ accident years.

Data requirements: These methods require claims data to be prepared in the form of triangles. The data can be paid claims, incurred claims, claim number data.

Actuarial judgements include: Segmentation of risk groups; Use of paid claims or incurred claims; Use of external data; Adjustment for inflation and other calendar year effects; Exclusion and treatment of exceptional claims (e.g. may be reserved on a case by case basis); Selection of development factors and treatment of tail development; Testing the appropriateness of the method.

Observation on the method: These methods are commonly used. The methods work well when there is a stable pattern that the Actuarial Function can reasonably expect to continue into the future. QIS 4 technical specifications refer to those methods while using external data instead of company own ones as “Market development-pattern proxy” (p.68 - TS.IV.B)

These methods are not appropriate or at least very uncertain when losses of an accident/underwriting year are nil (e.g. reinsurance classes with high excess layers) or close to zero, or there are strong calendar effects.

5.2.1.2 Loss Ratio Methods

Common methods: Ultimate loss ratio method

Description of method & its underlying assumption: Ultimate Losses estimates are the product of Ultimate Loss Ratio and Related Premium (earned or written). The actuarial function will have to assess ultimate loss ratios for each of the years that have not fully developed.

Data requirements: Ultimate loss ratio and related premium (earned or written) on which to apply the loss ratio

Actuarial judgements include: Segmentation of risk groups; Use of external data; Treatment of exceptional claims (e.g. normalised loss ratio and/or inclusion/exclusion of large losses); Testing the appropriateness of the method;

However to apply this method, it is critical to understand the company’s portfolio and the market environment, as it will involve a great amount of judgement. The actuarial function will have to consider factors such as premium rating actions, trends in claim frequency and claim inflation. Information derived from the people that price and underwrite the products will be particularly valuable.

Observation on the method: Those methods are used for recent accident/underwriting years when the development is not sufficient; they require a good ultimate premium assessment process. Methods and assumptions are usually easy to discuss / challenge with other departments, as loss ratio is generally a commonly used indicator in companies. QIS 4 technical specifications refer to those methods while using external data instead of company own ones as “Expected loss based proxy” (p.79 - TS.IV.F).

5.2.1.3 Frequency & severity method

Common methods: N/A

Description of method & its underlying assumption: The ultimate cost of claims can be expressed as the product of claims frequency and claims severity. These methods perform a separate estimation of claim frequency and claim severity by using various techniques (for example development pattern methods).

A key assumption underlying this method is the independence of claims frequency and severity.

Data requirements: Claim counts and data for any other chosen exposure measure; Claims amounts; Assumptions for claims frequency and inflation on claims payments.

Actuarial judgements include: Segmentation of risk groups; Use number of claims (e.g. reported/closed/zero claims); How to estimate number of claims; Use of external data; Adjustment for inflation and other calendar year effects; Exclusion and treatment of exceptional claims; Method to estimate claims amounts; Testing the appropriateness of the method.

Observation on the method: Usually need more detailed information than the development pattern ones; Assumptions usually easier to discuss with other stakeholders (underwriters, claims department); Those methods allow a direct split between IBNER and IBNR reserves; QIS 4 technical specifications refer to those methods while using external data instead of company own ones as “Frequency severity proxy” (p.72 - TS.IV.C).

5.2.1.4 Hybrid methods

Common methods: Bornhuetter-Ferguson method, Cape Cod,...

Description of method & its underlying assumption: Hybrid methods blend the results of two or more of the techniques described above to determine an estimate of the ultimate cost of claims.

The most common form is the Bornhuetter-Ferguson method, which uses a weighted average of the results from a development pattern and a loss ratio (using credibility theory). The older the accident year the more credible are the results from the development pattern and hence more weight is applied to these methods for older accident years. More recent accident years will place more reliance on the loss ratio.

Data requirements: Dependent on choice of hybrid method, see under previous headings

Actuarial judgements include: Dependent on choice of hybrid method, see under previous headings; How to weight the different methods

Observation on the method: Tends to reduce the weaknesses of specific parts of any method. QIS 4 technical specifications refer to some of those techniques while using external data instead of company own ones as “Bornhuetter-Ferguson based proxy” (p.74 - TS.IV.D).

5.2.2 Stochastic methods

Deterministic methods like those described in section 5.2.1 provide the actuarial function with a single point estimate of claim reserves. These methods give no information on the uncertainty around this single point estimate. We define stochastic methods as all methods that give insight to this uncertainty.

Stochastic approach is more and more a necessary tool for the non-life actuarial function. Even without the introduction of Solvency II and its explicit requirement for stochastic reserving when companies use internal models (to determine the Reserve Risk component) the actuarial function should be aware of the uncertainty in the results of its valuation. These methods take into account the randomness of the underlying business. (e.g.: All the deterministic methods from the previous section can also be applied on a stochastic basis when further assumptions on the underlying business are made).

Reading the wording in the draft proposed Directive it may at first appear that there is no alternative other than to calculate reserves than with stochastic modelling. However there are well known issues with stochastic modelling and they will not provide solutions to problems on best estimate valuation where deterministic methods fail. In deciding what method to be used, one must keep in mind that it is not necessarily true that a stochastic method will produce a more reliable best estimate than a deterministic approach.

Therefore, it is vital that the actuarial function using these methods understands the limitations of the methods and their underlying assumptions. The current stochastic reserving models (of which we give some examples) measure volatility in different ways. One should be aware that measuring volatilities in different ways will deliver by definition different results. This will remain a point of attention when applying and also when interpreting the results of a stochastic model.

An expert in general insurance reserving would not rely solely on stochastic models but would rely on a variety of techniques at his or hers disposal including the application of judgement based on sound reasoning and business logic.

Any stochastic reserving method as currently applied in practise deals with immensely complex series of events and models these with only a few parameters. Hence, as with any model, it is open to the criticism that its assumptions might be far too simple and hence unrealistic: the actuarial function will have to further develop their communication skills to discussing and communicate the outcome of their calculations.

As discussed in section 3.2.1 there will be situations were the uncertainties and variations of results may be better understood by applying stress & scenario testing than by performing a stochastic analysis.

5.2.2.1 Methods provide a standard deviation of the forecast (analytically)

Common methods: Thomas Mack Model; Over-dispersed Poisson; PTF method; Christofides method; ...

Description of method & its underlying assumption: These methods estimate one additional moment to derive the standard deviation of the outstanding claims or ultimate losses. Further assumptions can then be made to provide a full distribution. Possible distribution functions are for example, Gamma or Lognormal.

Data requirements: These methods can be based on the results of a deterministic chain ladder method and will thus require the same data used to derive the deterministic calculations.

Actuarial judgements include: Similar as underlying deterministic model, Volatility to measure, inclusion/exclusion outliers, how to deal with tail factors selection of distribution function.

Observation on the method: These methods only give an additional moment. Additional assumptions on the underlying distribution function have to be made to provide information on full distribution.

Some methods only work with development triangles that are always increasing and can not deal with a tail factor.

5.2.2.2 Methods that provide a full distribution

Common methods: Bootstrap approach (applied to Thomas Mack Model or the over-dispersed Poisson); Bayesian models (Markov Chain Monte Carlo models); or direct simulation (PTH method Christofides method)

Description of method & its underlying assumption: There are a large range of different methods with different names and categorisations in literature. A commonly used method is the bootstrapping approach which after assuming an underlying model (e.g. Thomas Mack) derives many sets of data by sampling in order to obtain “simulated” distribution function.

Data requirements: Data is in general in line with information required for the deterministic methods.

Actuarial judgements include: It is important to understand how well a method deals with specific issues such as the tail of distributions. For example, many methods will rely upon past data to determine the distribution. If the past data does not include extreme events, the distribution will not then the stochastic model will not consider it and there is a risk that the probability of severe events is underestimated.

Observation on the method: There is no single one method that fits every circumstance. Some methods may be better at modelling variation around the mean at lower percentiles, while other methods may provide a better measure of the more extreme scenarios.

Some of these models cannot be easily implemented in Excel Spreadsheet.

5.2.3 Model parameterisation

We distinguish two approaches to determine the parameterisation of a model:

- Retrospective approach;
- Prospective approaches.

We define a retrospective approach as an approach based on only on past data and experience. Such an approach assumes, implicitly or explicitly, that the risks in the future are similar to the risks in the past and that, therefore, past experience is a good predictor for the future experience. As such these models can be adequate for business that has large amounts of experience data and that is in a static environment.

Purely retrospective approaches are not adequate in cases where extreme events could give rise to material losses since such rare events will likely not be sufficiently included in the historical data. Equally, cash flows that are affected by a changing future environment (e.g. due to potential changes in the legal environment, to the economy etc.) can not be adequately modelled using only historical data.

Prospective approaches use additional forward-looking assumptions to determine future cash flows. The assumptions might be partly but are not purely based on past experience and incorporate allowances for how the future might develop.

Prospective approaches should be used for all situations where pure statistical approaches are not applicable, which is in most cases.

Most actual models use mixtures of statistical and prospective approaches. It is then important that the actuary is clear on the underlying assumptions in order to be able to integrate the different approaches in a consistent way.

5.3 What will be needed for transition

The concept of a best estimate requires a well established actuarial function in place which is fundamentally connected to the business areas it is reviewing (mainly underwriting and claims organization).

If such a function does not exist it needs to be organized but even when already available the interpretations of the directive discussed above call for some significant changes to many current practices.

In particular, the models, their use and the judgement applied need to be integrated in a regular process of analysis, back-testing and adjustment including an independent control function to challenge and test it.

As the best estimate is one component of the internal model, it is important that the actuarial function owns the full chain of reserves assessment, from best estimate to risk margin component. This means that they must understand the full ranges of reserving techniques but also they must have a strong knowledge of the underlying business to allow for appropriate use of judgment:

- The relevant skills need to be trained, sometimes based on new software tools and new models tested for their applicability in practice.
- Discussions across departments and functions are crucial and creation of regular meetings / committees including all the stakeholders is recommended.

In addition it may be important to be able to demonstrate the compliance of the best estimate valuation process with the test set out in the proposed Directive for documentation, validation, calibration, statistical quality and use test.

6 Current state of unallocated loss adjustment expenses practices

Unallocated Loss Adjustment Expenses (“ULAE”) are expenses that an insurer bears to be able to process and settle claims that can not be allocated to an individual claim, for example, salaries of the claims department.

In the QIS 4 technical specification for the best estimate it was stated that this type of expenses should be considered. According to the QIS4 technical specification TS.II.B.15 *“Expense assumptions should include an allowance for future cost increases. These should take into account the types of cost involved. The allowance for inflation should be consistent with the economic assumptions made.”*

6.1 Observations on current reserving practices

Normally, the ULAE are only available by business year and therefore it is not possible to include them in the cash flows underlying the best estimate calculation of the claims provision.

Companies with less sophisticated expense allocation system will allocate claims expenses by line of business using policy or premium measures while more sophisticated companies will use appropriate systems based on interviews with their claims department in order to allocate these expenses by type of claim and task within each line of business.

For the purpose of QIS4 the majority of companies used the “New York” claims-handling-costs proxy, where the observed ratio of paid expenses to paid claims is applied to the outstanding claims. In our opinion, this method has certain limitations and it is not always appropriate to all lines of business as it assumes that the ULAE expenses are proportional to the underlying incurred claims. For example it implies in the case of run-off that it is implicitly assumed that the overhead does not have to be allocated to a decreasing number of pending claims.

We believe that companies should be encourage to develop a proper expense allocation systems in order to apply a more thorough and reliable methods.

7 Current state of premium reserving practices

Valuation of future premium liabilities is an important element of the best estimate valuation under Solvency II. As part of QIS4 insurers were asked to value premium liabilities on a best estimate basis¹⁴. QIS4 submissions show that companies had difficulties in the treatment of future premiums.

We acknowledge that additional research is required to further develop methodologies regarding the best estimate valuation of premium reserves. We note that the elements to be considered as part of premium reserve will be dependent on whether the analysis is based on an accident or underwriting year basis.

The actuarial profession will be well positioned to further develop best practises towards the introduction of Solvency II for this area.

7.1 Observations on current reserving practices

Premium reserves currently considered within Europe are mainly based on accounting principles. The main classes of non-life premium reserving components are:

- Unearned Premium Reserve (UPR)
- Unexpired Risk Reserve (URR)

The UPR is calculated for premiums that have been written but not yet earned as it covers risk over a future timeframe. This component of premium reserve is defined by a “pro rata temporis” method which, in most cases, is made contract by contract¹⁵.

The URR is an additional requirement considered in most member states. In cases where the future premiums are expected to be insufficient an additional reserve should be held to account for this deficiency considering the whole remaining contract period, this additional reserve is commonly called the URR. In general only the downside of the future premium is considered under the URR (i.e. surpluses in specific lines are not accounted for). The URR should be considered over the whole remaining period of the contract (i.e. until the next renewal).

7.2 Premium reserving methodologies and classification

There are no well known and European wide standards and/or methodologies to set premium reserve on a best estimate basis¹⁶. For accounting purposes there are standards to value the Unearned Premium Reserve (UPR). However, these are not on a best estimate bases. Methods used to determine the Unexpired Risk Reserve (URR) could potentially also be used as a basis for the best estimate valuation of premium risk.

¹⁴ QIS4 technical specification TS.II.E.14 – TS.II.E.17

¹⁵ For a further discussion see the draft report from the IAA adhoc Risk Margin Working Group Paper, Appendix D3.

¹⁶ It would be desirable if the Solvency II requirements could be framed to be consistent with IFRS.

For the best estimate valuation of premium reserves the following key information is required:

- Information on period to be considered; this should be the whole future contract period until the next renewals.
- Expected premiums over the considered contract period. The components of the premium available to pay claims and claim costs should be considered, as well as the future cash flows (if any) related to commissions and maintenance expenses until the next renewals (as they might differ from the loadings foreseen in the premium).
- Expected claims (including claim costs) that need to be allocated to the considered contract period.

To determine the best estimate of future losses and costs results of the analysis on the claims reserves and the unallocated loss adjustment expenses (see previous chapters) can be used. For the premium reserves one needs to determine to what extent these analyses on historical years are also applicable for the future.

The premium reserve can then be derived by considering the cash-flows derived from applying the earnings pattern for premium and converting these to claims payment and expected expense cash-flows.

Further analysis need to be performed to ensure a consistent best estimate premium valuation across Europe.

8 Recommendations for implementing measures

8.1 Implementing measures

Under Article 85 there should be separate implementing measures for life, non-life and health insurance.

We suggest the implementing measures for non-life could be created under the following subheadings:

- Reserving data
- Calculation and analysis
- Review and approval
- People, competencies and responsibilities
- Reporting
- Other issues relating to reserving

This section should be seen as our initial thoughts that hopefully will be a starting point for future discussions between CEIOPS, Groupe Consultatif and other stakeholders as appropriate. We note that the European Commission envisage these being Level 3, and Groupe Consultatif will be happy to work with all parties to get to an optimal balance between Level 2 and Level 3.

8.1.1 Implementing measures – reserving data

Implementing measures shall require insurer to have an established process to

- Compile sufficient quality data from internal operational sources
- Reconcile to other data sources especially financial statements
- Make appropriate and proportional checks for example comparison against previous quarter's/ year's data
- Make adjustments where such adjustments is required for the stability of the reserving analysis (such adjustments would have to be reported – see below)
- Extract relevant external benchmarks
- Convert data to the format required for the reserving analysis
- Ensure oversight by the actuarial function especially in relation to Article 47 c)

The above process should be documented at a level of detail that would allow new personnel with access to existing software and programs to reproduce the reserving data

set. This documentation will be available on request to supervisor, but is foremost an internal document and would not be forwarded to supervisors in normal circumstances.

The internal reserving report/ memorandum (see 8.1.5) would record exceptions, difficulties and changes to the above data process.

Areas that in our view should not be covered in Level 2 (these might be in Level 3 or insurer competencies may deliver these without any regulatory prescription):

- Guidance on appropriate granularities of in house operational data by line of business
- Guidance on use of external benchmarks
- Methods and types of checks
- Suitability of data adjustments
- Suitability of performing monthly, quarterly or annual analysis
- Accident versus underwriting year data

8.1.2 Implementing measures – calculation and analysis

Implementing measures shall require insurer to

- Calculate reserves (this may include point estimates and/or ranges of reserves and/or assignment of distributions)
- Have competent skilled professionals within the actuarial functions as prescribed in Article 47 to perform these calculations
- Ensure that assumptions are only made by skilled professionals
- Ensure that skilled professionals have considered multiple methods from time to time and continues to select the most appropriate approach
- Compare experience with prior year reserve calculations (point estimates and ranges) in accordance with Article 47 d)
- Justify simplifications have been used as short cuts or because of data constraints bearing in mind overall materiality for the business

The above process should be documented at a level of detail that would allow new personnel with access to existing software and programs to reproduce the reserving calculation. This documentation will be available on request to supervisors, but is foremost an internal document and would not be forwarded to supervisors in normal circumstances.

The internal reserving report/ memorandum (see 8.1.5) would refer to which commonly-used and accepted calculations methods have been used or would give full details where

non-standard¹⁷ approaches have been applied. By exception there should be descriptions where non-life insurance risks have been treated as hedgable.

Areas that in our view should not be covered in Level 2 (these might be in Level 3 or insurer competencies may deliver these without any regulatory prescription):

- Choice of methods¹⁸ (these should in our view not be in Level 3 either as they inevitably must depend on professional competences and existing actuarial literature)
- Details of discount rates to be applied
- No prescription of line of business benchmarks for settlement patterns, loss ratios should be set at Level 2 or Level 3
- Materiality limits for simplifications / proxies should not be defined in Level 2

8.1.3 Implementing measures – review and approval

The following ideas are preliminary and will be developed further in the context of the forthcoming CEIOPS governance paper.

Implementing measures may require insurer to

- Have a process by which the actuarial function presents the results of the reserving calculations to the Administrative or Management Body of the insurer including key drivers, uncertainties and issues in accordance with Article 47 e)
- Before the presentation of the results the insurer should consider the challenge process (internally and/or externally through peer review, audit and interactions with other areas of the business such as claims department, underwriters, pricing). The extent to which choices and judgements have affected the reserve calculation should influence the company's decision on how much internal/ external challenge is proportionate to the circumstances. Internal or external challenge to the reserve calculations (and to the personnel performing these calculations and making relevant judgements) may not coincide with the date of the Solvency II balance sheet and the 'challenges' may be partial or less frequent than the actual production calculations.
- Have a process for the Administrative or Management Body to set the best estimate reserve to be used for the purpose of the Solvency II balance sheet
- In the reserving report/ memorandum, the difference between the actuarial reserving calculation and the set reserves would be recorded

¹⁷ By non-standard we refer to methods that are not documented in actuarial literature. The most commonly used methods have been listed within section 5.

¹⁸ For the calculation of technical provisions including case estimates; IBNR, IBNER, RBNS, premium reserves, ULAE etc.

- Where there is a difference between the technical provisions for the purpose of the Solvency II balance sheet and within financial statements, document in the internal reserving report/ memorandum the amount and reasons for the difference in accordance with Article 50. The reserving report/ memorandum should include reference to auditors' findings relating to the reserves within the financial statements. If the auditor's remit extends to the Solvency II balance sheet, in addition to the financial statements, then this might give rise to further findings.
- Ensure the reserves used for the purpose of the Solvency II balance sheet have been reviewed and independently challenged (internally and/or externally) as part of the overall risk management framework as set out under Article 41 and 43
- Appropriate documentation for the review and approval process as above should exist

Areas that in our view should not be covered in Level 2 (these might be in Level 3 or insurer competencies may deliver these without any regulatory prescription):

- No pro-forma for internal reserving report / memorandum. This would be likely to be most effectively covered by actuarial or other professional guidance.
- Procedures to be followed by, or reporting formats to be used by, auditors (already well established by national and international audit guidance etc.)
- Internal management governance should not be prescribed at Level 2 (the roles of the Administrative or Management Body, compliance, internal audit, risk management and the actuarial function will vary by the size and culture of each (re)insurer).

8.1.4 Implementing measures – people, competencies and responsibilities

Specific implementing measures may be required to cater for the existing situations where a certifying actuary exists to either sign-off reserves in the financial statements or to certify some component of the regulatory balance sheet. However in our following proposals for implementing measures we assume there is no certifying actuary.

Implementing measures should state

- Competent data and IT professional shall administrate the data process under the coordination and oversight of the reserving personnel within the actuarial function
- The reserving calculations shall be performed by suitable skilled actuarial expertise. In situations of skill shortages (maybe temporarily in nature or in small insurers who can not maintain a permanent in house function) the insurer will need to consider outsourcing or be able to state reasons why it has not done so
- The representative from the Administrative or Management Body should be appropriately skilled to understand and challenge the technical nature of the proposals arising from the reserve calculation

- For the setting of the reserves under the Solvency II balance sheet the individuals' responsibilities and roles should be clearly defined in accordance with Article 41 and 42
- The people and responsibilities should be clearly documented

8.1.5 Implementing measures –reporting

The principle purpose of the internal reserving report/memorandum is to act as a record and evidence of the end to end reserving process: data, calculation, review and responsibilities.

A typical process might involve a draft memorandum prepared by the Actuarial function (as per Article 47) which would be central to the review and approval process. For example it might routinely be presented at a quarterly or monthly Reserving Committee.

It is unclear from Article 47 whether the Administrative or Management Body, who are overall responsible for the Solvency II balance-sheet, has to adopt the actuarial function's advice on the best estimate valuation of technical provisions. If a decision is made to book another set of figures the Administrative or Management Body have to justify the reason for the difference.

Hence subsequent to approval, additional pages should be added to the memorandum effectively recording the amendments and final approval by the Administrative or Management Body.

The handling of such a memorandum would vary between companies according to the proportionality principle, so implementing measures should permit flexibility. For groups the reporting might usefully be made consistent across business entities and units, but the implementing measures do not need to require this.

The internal reserving report/ memorandum will be available on request to supervisor, but is first and foremost an internal document and would not be forwarded to supervisors in normal circumstances.

Implementing measures shall require insurer to

- Have an internal reserving report/memorandum setting out the best estimate reserves. This should be produced on a regular basis and will comprise a main body text supplemented by appendixes (which may not change between consecutive reports). The main body text should cover:
 - The best estimates reserves on a Solvency II basis as at valuation date
 - Key drivers, uncertainties and issues as presented by the Actuarial function to the Administrative or Management Body
 - Description of how the Administrative or Management Body considered the uncertainty and how it selected the final best estimate reserving on a Solvency II basis as at valuation date

- Difference between the technical provisions for the purpose of the Solvency II balance sheet and within financial statements as at valuation date (amount and reasons for the difference in accordance with Article 50)
- On an annual basis reference may be made to the auditors findings relating to the reserves within the financial statements.
- The report should record where there has been an independent review (internal or external) and the findings

The appendixes should cover (these would on the main be static):

- Brief description of the overall reserving process
- Brief description of data extraction, reconciliation, cleansing/adjustments
- Specific details of data shortcomings, difficulties and changes to the data process
- Documentation of reserving methodologies used (only to be documented in details where non-standards methods are applied)
- Justification for the choice of reserving methodology including use of proxies (in cases of material changes to methodology this should be in the main text rather than in the appendix)
- Analysis of actual versus expected on prior year reserves including any adjustments made
- Description of assumptions with particular details for parameters involving greater judgements (linking to the uncertainties presented in the main body of the report as appropriate)
- Listing of responsibilities
- Listing of timing of key meetings, presentations and approvals

Areas that in our view should not be covered in Level 2 (these might be in Level 3 or insurer competencies may deliver these without any regulatory prescription):

- No pro-forma for internal reserving report / memorandum (but its coverage should be as described above). This is likely to be most effectively covered by actuarial or other professional guidance.

There should be a stock take of current existing actuarial and other professional guidance for reserving. This would identify whether there are gaps which need to be filled by Level 3 guidance.

8.1.6 Implementing measures – other issues relating to reserving

The implementing measures should avoid unnecessary duplication between the internal reserving report/memorandum and the Solvency & Financial Condition Report (SFC).

Implementing measures shall require that

- Where SCR standard formula is being considered the reserving figures and methods therein shall be consistent with the reserving and methods adopted for the purpose of the Solvency II balance-sheet
- Where internal models are used for the purpose of SCR the modelling of the balance-sheet and the reserving risk must be consistent with the reserving and methods adopted for the purpose of the Solvency II balance-sheet

8.2 Supervisor actions

Implementing measures should outline how supervisors would be given powers to scrutinise the best estimate reserving process.

These powers would not always be exercised and in many companies and territories supervisors will feel able to rely on the companies own assessment, internal/ external independent reviews and work of external auditors. We observe that situations will occur where financial statements have been externally audited whereas this may not be the case for the Solvency II balance-sheet.

Situations where a supervisor had concerns that best estimate reserves were mis-stated would be considered as part of the supervisory review of the broader company ORSA, of which the reserving process constitutes one part. Typically a supervisor would require improvements to an unsatisfactory reserving process but if these were not implemented then supervisors might feel it necessary, temporarily, to make capital add-ons in this respect¹⁹. In this eventuality implementing measures should make clear whether there would be some kind of consultation between insurer and supervisors – or would be possibility of appeal where mutual agreement is not achievable.

In cases where best estimates were being over-stated systematically it would not be appropriate for supervisors to make capital add-ons.

¹⁹ The reserving process should not be judged in isolation. It is important that the supervisor considers the treatment of reserving risk as part of the SCR before forming a view on the overall adequacy and the need for a temporary capital add-on.

A1 Glossary and abbreviations

Groupe Consultatif and CEA glossary

We refer to the Solvency II glossary produced by Groupe Consultatif and CEA published March 2008. Within this paper we have used the following additional terms:

Actuarial function: See Article 47 in the proposed Directive

Administrative or Management Body: The proposed Directive states clearly that the administrative or management body of the (re)insurance undertaking has the ultimate responsibility for the undertaking's compliance with the Directive (Article 40)

Model risk: Recognises the risk that the model being used might not give the correct output due to a misspecification or a misuse of the model

Origin year: For claims triangles, typically either on an underwriting or accident year basis

Parameter risk: The uncertainty arising from parameter estimation,

Process risk: The uncertainty arising from future process variation

Stress and scenario testing: are core elements of risk management and in particular for setting SCR and best estimate. We distinguish between stress tests and scenario analysis. In the context of best-estimate, a stress test is concerned with the impact of a large change of a single or a small number of related risk factors on the best estimate. A scenario in contrast tries to describe a consistent hypothetical state of the world taking into account as good as possible the inter-dependencies between all risk factors. As a simple example, a stress test might be concerned with the impact of an increase in mortality by 100%, a scenario would describe the impact of a global pandemic, taking into account not only increases in mortality, but also the effect on the financial market, sickness rates, business disruption etc.

Systemic risk: Any risk inherent to the entire market or entire market segment which cannot be mitigated through diversification.

List of abbreviations and acronyms used in this paper

IBNER: Incurred But Not Enough Reported (used for to describe claims)

IBNR: Incurred But Not Reported (used for to describe claims)

GLM: Generalised Linear Model

MCR: Minimum Capital Requirement

ORSA: Own Risk & Solvency Assessment

PTF: Probabilistic Trend Family

QIS: Quantitative Impact Studies (QIS4 is the fourth such exercise)

RBNS: Reported But Not Settled (used for to describe claims)

SCR: Solvency Capital Requirement

SFC: Solvency & Financial Condition Report

A2 Background to the definition of best estimate

Market consistent valuation, replicating portfolio and discounting

In order to decide on the appropriate discounting it is useful to go back to the fundamental idea of market consistent valuation as used by Solvency II. The basic idea consists of taking a cash flow and separating it into two components: A component that can be replicated using deeply and liquidly traded financial instruments and a component that can not be replicated. These two components give rise to the two elements of the market consistent value: the market value of the replicating portfolio and the risk margin. In Solvency II, the risk margin is defined as the cost of capital needed to support the component of the cash flow that can not be replicated.

If the special case is considered where the expected cash flow of the insurance liabilities are replicated using government bonds, then the market value of the replicating portfolio exactly corresponds to the best estimate as defined by Solvency II, where the cash flows are discounted with the risk-free yield curve.

If the universe of deeply and liquidly traded financial instruments is extended and other instruments than government bonds can be used to replicate the cash flows, the discount rate will change. To see this, consider the use of commercial bonds to replicate the cash flows. Then, the implied discounting of the cash flows is in reference to the commercial bonds, i.e. would include a spread over the risk-free yield curve. However, in this case, the risk margin due to non-hedgeable risk will also change. In this case, the credit risk of the commercial bonds will be part of the risk margin, in contrast to the situation where replication is done with government bonds only.

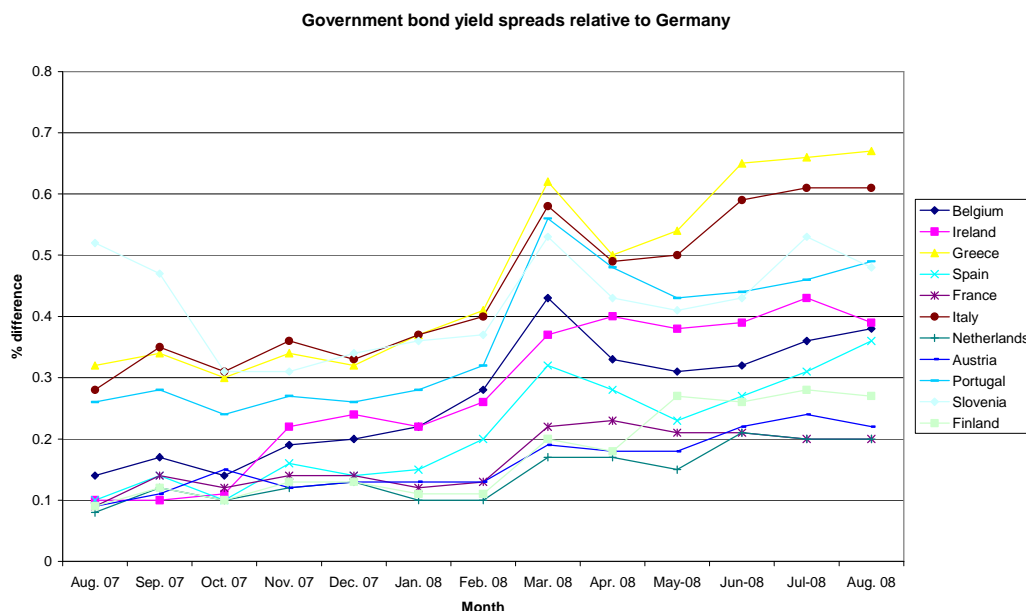
To conclude:

- The discount rate follows naturally from the replication approach of market consistent valuation and is not a choice
- If only credit risk-free government bonds are assumed to be deeply and liquidly traded, then the discount rate is given by the risk-free yield and the risk margin does not include a margin for credit risk of the replicating portfolio
- If additional instruments other than risk-free government bonds are assumed to be deeply and liquidly traded, then the discount rate is given by the replicating portfolio and will be higher than risk-free. The risk margin will include a margin for the credit risk of the replicating portfolio

The Solvency 2 framework is predicated on being able to specify in both ‘normal’ and ‘extreme’ scenarios discount rates derived from market information sources which are as far as practicable exclusive of any element of compensation for the risk of credit default or deterioration (the ‘risk-free’ rate). Historically, government bonds have been the main reference for discount rates.

Remolona and Wooldridge (2001) discussed issues associated with the formation of risk-free yield curves in the context of changing market conditions in the early days of

development of euro-denominated debt markets. A difficulty in the context of a Europe-wide framework such as Solvency 2 is the heterogeneity in government bond yields illustrated in the following chart:



This increasing divergence is attributed by BIS (2008) mainly to changes in the liquidity preferences of investors. While it is of course feasible to deal with heterogeneity by use of a weighted average yield curve, this would have the effect of over- and under-valuing liabilities by reference to a true market-consistent level.

The use of swap-based yields as a starting point for definition of appropriate discount rates is endorsed by Hull et al (2004) and by the CRO Forum. This in part reflects the rapid growth – at least up to and including 2007 – of the interest rate swap markets, particularly within the Eurozone.

These analyses also all however recognise that the major part of the interest rate swaps market referenced to 3-month or 6-month LIBOR/EURIBOR is necessarily influenced by the characteristics of the reference rate used for the floating leg of the swap. To the extent that term LIBOR/EURIBOR rates include a premium for credit risk on unsecured interbank lending, the rate on the fixed leg also will include a credit risk premium (even though the swap itself is collateralised). Although in calmer times this premium is quite small (for example Hull et al suggested 10bps in 2004) it has increased considerably during the recent market turmoil since about July/August 2007.

This analysis suggests that – where available – swap-based yields referenced to overnight indexed interbank lending rates are a much closer proxy for an appropriate ‘risk-free’ discount rate for Solvency 2. This is consistent with recent growth in markets for interest rate swaps linked to EONIA and SONIA at the expense of swaps referenced to term LIBOR/EURIBOR (see for example de Teran and Schultes (2008)). An appropriate adjustment needs to be made for the small risk of unforeseeable overnight default and for uncertainty associated with that risk.

It is entirely possible that macroeconomic and capital market developments should prompt reconsideration of this thinking from time to time. For this reason we suggest that the relevant measures in the context of Solvency 2 should be mainly in the form of Level 3 guidance.

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Remolona, Eli M. and Wooldridge, Philip D., (2001) *The Changing Shape of Fixed Income Markets* (September 2001). BIS Working Paper No. 104 Available at SSRN: <http://ssrn.com/abstract=847544>

Provability of the best estimate

There are limits to what can be required from a model and in particular from the calculation of the best estimate. There can not be ‘proof’ that the model or the best estimate is correct. Models are simplifications of reality. In most cases the relevant reality that is to be captured by the model is too complex to be amenable to exact modelling. In many cases, it is even impossible per se to ever be able to arrive at a true best estimate. For this, it is helpful to consider the differences of the following questions:

- Will the coin land on head?
- Will the actuary receive new information in 5 years, leading to the need to a revaluation of the best estimate?

In the first case, the probability (given that the coin and the toss are fair), can be calculated to be 50% and there is no uncertainty around the estimate of the probability. In the second case, the probability could conceivably be estimated or guessed but there is a very large uncertainty around this estimate.

In many cases in insurance, uncertainty is present around the estimates of the cash flows that can not conceivably be further reduced and it is actually this uncertainty that is the basis of insurance.

Further, different models – and consequently potentially different results – are common and cannot be proven right or wrong. In some cases it is even not possible to determine which model is more appropriate when the uncertain situation (e.g. a claim) is settled as it takes too long or since a combination of different trends cannot be separated. If a portfolio of claims is settled at a different amount than estimated at an earlier point in time that might have happened due to an inappropriate model or just as a result of random fluctuation, because of claims inflation, change in legislation or other external factors not known before or not captured by any model. In other words one will never know whether

the final outcome was close to the true mean of the distribution or an extreme sample from its distribution. While it is desirable to fully control the best estimate by a model, this is technically not possible.

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