



CRO Forum – Use of internal models in ICS 2.0

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CRO FORUM

Contents

1	Introduction	2
2	Using internal models to strengthen integrated risk management	5
2.1	Internal models in the context of risk diversification and mitigation	6
3	Use of internal models by the industry	8
4	Regulators' approach to internal models	11
4.1	Regulators already allow the use of internal models in a number of different ways	11
4.2	Potential limitations of standard prescribed methods for the calculation of capital requirements	12
4.3	Benefits of using internal models for the calculation of capital requirements	14
4.4	Model governance and model validation	15
4.5	Supervisory reviews of internal models	15
5	Examples of the use of internal models	18
5.1	Internal models capture diversification between risks and regions better	18
5.2	Internal models are able to better capture the true risk profile	18
5.3	Case study – Equitable Life	19
5.4	Currency	20
5.5	Other limitations of using standard models	20
6	Challenges and limitations of internal models	22
6.1	Question 1 – Do internal models create a lack of comparability across companies?	22
6.2	Question 2 – Is there sufficient data to calibrate internal models?	23
6.3	Question 3 – Are internal models too complex?	23
6.4	Question 4 – Can internal models be compromised by competitive pressures?	24
6.5	Question 5 – Are internal models pro-cyclical?	24
6.6	Question 6 – Should internal models be used for internal purposes only?	25
6.7	Question 7 – Are internal models used in practice?	26

1 Introduction

In recognition of the fact that a sound capital and supervisory framework for the insurance sector is an essential precondition for financial stability and policyholder protection, IAIS committed to developing a risk-based global Insurance Capital Standard (ICS). The tight time schedule and the technical challenges involved forced IAIS to focus first on the delivery of ICS Version 1.0 by mid-2017, leaving further issues to a later stage. An important question is whether internal models should be considered in progressing the ICS from Version 1.0 to Version 2.0.¹

Overall, the CRO Forum welcomes the development of a risk-based global insurance standard as it would ultimately lead to a convergence of insurance frameworks around the globe, removing artificial discrepancies, facilitating efficient and effective supervision and – if widely implemented – ensuring a level playing field. Focusing on a standard approach at this stage of the ICS development and using quantitative input from the field testing, IAIS has taken a first step towards the development of a modern, risk-based regime better reflecting the risk situation of an insurer. We therefore support this project.

This paper is primarily aimed at the regulators, supervisors and policymakers who are driving the development of the future global insurance capital standard, and presents the perspective and experience to date with regard to the use of internal models by the insurance industry. The CRO Forum would like to demonstrate why, in addition to the standard approach, the use of internal models should be permitted as an important component and integral part of ICS Version 2.0. The paper outlines the options available to regulators for allowing the use of internal models and takes a detailed look at the advantages that internal models can bring. We argue that the best way to achieve optimum social and regulatory outcomes for policyholders is via a regulatory regime that allows insurers to use full or partial internal models subject to supervisory approval if they consider the standard approach inappropriate for their business and risk profile. Furthermore, we use some examples from practice to demonstrate the limitations of standard methods.

The choice of an appropriate valuation methodology, which is undoubtedly a fundamental issue in this context, is not dealt with here, as it would go beyond the scope of the paper. We are, however, well aware that internal models capture the risk of change in asset and liability values based on a range of considerations using various approaches.

We now highlight the benefits that internal models offer before covering the points in greater detail.

Internal models

1. Provide a more accurate picture of an insurer's risk profile

Specific features of insurance products and risk exposures in different business segments and geographies cannot be reflected appropriately in a standard formula, however sophisticated it may be. A more powerful tool is needed to capture important risk drivers in a granular way.

¹ IAIS: Risk-based Global Insurance Capital Standard Version 1.0 Public Consultation Document 19 July 2016

2. Provide an incentive to manage the business better and improve risk management

Identifying the sources of risk and enabling the nature of the risks to which the company is exposed to be thoroughly understood are equally important for managing the business in a sustainable manner and for implementing robust risk management processes and risk-mitigation techniques.

3. Improve product development and the pricing process

In a competitive environment, internal models can provide important information for the allocation of capital to different business segments that can be used for pricing purposes. Appropriate pricing is fundamental to a company's ability to meet future obligations and consequently to ensure policyholder protection. Furthermore, in-depth knowledge of a variety of insurance and market risks can become a driver of business innovation and stimulate the development of products that facilitate risk sharing in society and support economic growth.

4. Enhance insurance supervision, cooperation and transparency

Dealing with the emergence and approval of internal models, supervisors acquire a deep insight into the risk management processes of a company and an excellent understanding of the risks to which the undertaking is exposed. The intensity and quality of the exchange of information guarantees a high level of supervisory comfort. In this way, models can be considered to be an extension of stress testing. Through the use of standard reporting and templates, supervisors can undertake comparisons between companies, using model output to demonstrate the impact of a defined scenario or sensitivity.

Not only do supervisors benefit directly from the regular exchange of information with the companies involved, but they can also share findings and ideas with their peers in the supervisory colleges. This increases transparency, and ultimately mutual understanding and trust, improving cooperation and supervision in the interest of all parties.

5. Allow regulators to detect poor company performance, intervene in a timely manner and consequently reduce the likelihood and cost of failure

Comprehensive findings of internal models reported to supervisors on a regular basis enable them to gain a clear picture of the risks to which an insurer is, or could be, exposed. This close and detailed monitoring enables them to recognise at an early stage potential threats to the insurer's operations and react appropriately if necessary. We would expect this to reduce both the likelihood and the cost of an insurance failure.

6. Enable risk mitigation techniques to be appropriately recognised

Internal models enable appropriate account to be taken of risk mitigation techniques, such as reinsurance or hedging programmes. By contrast, a standard approach would have to be complex if it were to cope with all existing risk mitigation techniques in the worldwide life and non-life insurance sector, but a standard approach needs to be reasonably simple to apply.

Not allowing the use of internal models

7. May allow risks to remain hidden

Risks, accumulations or concentrations may not be detected by a 'one-size-fits-all' standard approach. Such "missing risks" might have an unexpected and uncontrolled impact at an unknown time in the future, jeopardising a company's solvency. A properly validated model on the other hand must take account of all risk correlations and the calibrations used must be justified, with an explanation of how they match the company's risk profile.

8. Might encourage pro-cyclical behaviour

Complying with an inappropriate standard model in a mechanical manner could lead to a higher risk profile or encourage pro-cyclical behaviour.

Were all insurers to apply the same standard model calibrated on the basis of certain assumptions as to the condition of the financial markets, the effect on all of them would be similar if the markets moved in a particular direction. Similar market behaviour accentuates the impact of financial market stress. We therefore consider that internal models reduce systemic risk.

9. Could prevent new risks being reflected appropriately or detected at all, and there would be no motivation to continuously improve risk assessment

Standard methods cannot be adapted to new risks as flexibly as internal models. Apart from risks being inappropriately reflected, new risks or changing risk profiles might not be detected at all. Furthermore, if standard models are used, there is no incentive to improve risk modelling. Having an overview over different internal model approaches, supervisors can promote best practice in risk modelling.

2 Using internal models to strengthen integrated risk management

A regulatory regime that, subject to supervisory approval, permits insurers to use internal models adapted to the nature, scale and complexity of the risks to which they are exposed provides an incentive for insurers to identify, measure, manage, monitor and report risk in an appropriate and proportionate manner.

Thus, an internal model may be considered as a means of delivering stress-test outputs to guide the company in its business decisions and to support the effective management of risk. The internal model provides a means of automating these 'stress test' outputs and produces results on an ongoing basis rather than, for example, in a single annual exercise. Regulators can also benefit from this output, where appropriate defining stresses and providing standard templates to collect data supporting industry-level aggregations and comparisons.

Large multinational insurers should have the option to adopt a full internal economic capital model to determine regulatory capital, i.e. all risk modules/sub-modules would be calculated using company-specific parameters and methods. For medium-sized companies or specialised monoline insurers on the other hand, a partial internal model solution may be more appropriate, i.e. an internal model would be used to model more material and complex exposures, and a prescribed standard method to model less material risks. Finally, for reasons of proportionality, it may be appropriate for insurers offering non-complex products to adopt a fully prescribed standard method to calculate capital. In some cases, it would be useful to consider a partial internal model to enhance risk management, or for a transitional phase pending development of a full internal model. In any event, proportionality should be the key factor.

As the binding element between various important decision-making processes at an insurance company, an internal model is vital to integrated risk management. As it is subject to a formal and regular improvement process involving all internal stakeholders, it continuously provides an accurate reflection of a group's risk profile.

An internal model covers all material quantifiable risks and compares the portfolio of risks to the economically available financial resources. This provides senior management with in-depth information on economic capital adequacy and enables them to understand the impact of business and risk-management decisions. This is particularly valuable for

- performance analysis and capital allocation,
- product development and capital allocation,
- risk mitigation,
- strategic decisions (including M&A transactions),
- investment decisions.

The economic capital allocation is fully integrated into the capital planning process, which should reflect the long-term nature of the insurance business and the strategic focus of the group. The group strives to maximise the return on the risk-based capital and maintain a pre-defined capital ratio. After the capital is allocated, the group monitors the available and required capital regularly. If the target range is exceeded, either the available capital or the risk level is adjusted with the help of the internal model.

Internationally active insurance groups have to comply with varying definitions of required capital from regulators and rating agencies. The internal model defines the required and available capital according to the group's risk profile. It provides a framework for assessment and comparison of different risks. The group can then allocate risk-taking capacity to business units. Once risk-taking capacity is defined, the risk-based return can be used to measure the performance of the business. Secondly, the close monitoring of the performance of specific products in identified markets influences product development and, last but not least, the pricing of those products. Capital intensity ratios are usually a key element of P&C pricing models. Appropriate pricing is a fundamental prerequisite for a company's ability to meet its (long-term) obligations.

The performance and pricing analysis supports decisions on group strategy for certain business lines and the evaluation of potential M&A transactions by estimating key performance indicators and quantifying risk aggregation and accumulation.

An internal model also enables a company to decide how much capital needs to be allocated for specific market risks. In order to maintain positive diversification effects, an insurance group has to find the right market-risk balance. The internal model is able to compare returns on market risk RBC and insurance risk RBC, and allows senior management to maintain the positive diversification effects.

In contrast to a standard approach, a main feature of an internal model is its ability to properly capture the accumulation and aggregation of risks, also taking into account all non-linear effects and dependencies that would otherwise have been ignored.

Finally, the internal model enables senior management to decide whether to take risk mitigation action such as reinsurance, hedging or alternative risk transfer. It will compare the cost of capital with the cost of the risk-mitigating action, enabling the risks to be managed in the most beneficial way.

2.1 Internal models in the context of risk diversification and mitigation

The fundamental service that insurers provide is giving individuals and businesses a way of reducing their exposure to specific risks. In order to provide such a service at a reasonable cost, insurers manage the type and amount of risk in their portfolio by pursuing diversification strategies. Compared to banks, which tend to distribute more uniform products (e.g. loans) and are prone to financial market movements, insurers deal with a wider variety of products and risks that can substantially differ from company to company depending on the business model and market approach. The advantage is obvious – insurance products can be better diversified between business segments and geographies. The fact that storm exposure is fully independent of earthquake risk (even in the same region) is not a result of any expert judgment, but founded on past experience and scientific research.

Diversification strategies are aimed at reducing risk by exposing the insurer's portfolio to areas that would react differently to the same event, thereby mitigating the aggregate exposure to a single source. These strategies include:

- pooling similar risks that are sufficiently independent of each other,
- pooling dissimilar risks by writing a variety of insurance products across different markets, segments and geographies,
- combining opposing risks and
- limiting risk concentrations.

Since achieving this diversification is a core aspect of insurance business, enabling companies to recognise diversification in the most sensible way possible is in the interest of all parties. This would allow insurers to adequately manage their risks, supervisors to reward strong risk management (discouraging risk concentration and avoiding overly similar approaches on the part of insurers) and policyholders to benefit from insurance cover at a fair price.

In addition, the unique and varied risks faced by each company as a result of the products they offer, the investment decisions they make, and the risk transfer and hedging programmes they implement make it extremely difficult to accurately assess an insurer, particularly a group, using the one-size-fits-all approach implicit in a standard model. In that sense, internal models promote a greater and more precise understanding of the risk profile in general and diversification and concentration effects in particular.

The level of granularity, and sometimes even the model structure, should be driven by the business profile. Fundamentally, risks that are more material for the business should be captured in a more granular manner. Additionally, it may be more important to capture factors such as geographical diversification if a company has significant international operations across multiple markets. Internal models are typically better able to capture geographical diversification.

The usual methods that divide risks into different buckets and aggregate them through common distribution assumptions may lead to the incorrect evaluation of both the risks themselves and the diversification benefits because risks may have interactions that the model may or may not capture depending on the degree of granularity. In addition, classification of risks may also hinder appropriate management of the risks, as the bucketing may lead management to disregard certain important risks or risk interactions.

The level of granularity within risk aggregation is a crucial factor that affects the management and measurement of diversification benefits. For risk measurement, the level of granularity of the aggregation method influences the calculation of diversification benefits. Typically, the more the aggregation approach differentiates between portfolios or activities according to dimensions such as geography, business unit/legal entity, risk type or product type, the more explicitly diversification will be shown.

3 Use of internal models by the industry

Under the current ICS framework, capital requirements are calculated using a standard method. However, we believe that a regulatory regime that does not allow the use of internal models has a number of deficiencies in that it can:

- (i) prevent a common level of policyholder protection being achieved as a result of risk not being appropriately captured;
- (ii) encourage herd behaviour, which could undermine financial stability;
- (iii) create potential for regulatory arbitrage, which could undermine both policyholder protection and financial stability;
- (iv) create barriers to innovation, thereby preventing insurers from playing their role as long-term investors and providers of support for long-term economic growth.

Permitting the use of internal models ensures that risks are properly captured, and insurers motivated to properly identify, measure, manage and report their risks. This in turn:

- (i) ensures that insurers will meet obligations to policyholders as they fall due;
- (ii) motivates insurers to pro-actively manage risk and make risk-based decisions;
- (iii) enables more efficient and effective use to be made of regulatory resources;
- (iv) permits any regulatory intervention to be timely and proportionate;
- (v) supports effective risk-based dialogue between regulators and senior management at companies;
- (vi) supports effective risk-based dialogue between different regulators.

Insurance companies have invested heavily in the development and maintenance of economic capital models that enable them to identify, measure, manage and report the risks to which they are exposed and support their risk management framework, processes and controls. These models tend to be more sophisticated than those traditionally used by external parties such as supervisors and rating agencies to assess an insurer's risk profile and the capital it has available to absorb unexpected losses, which they need to do to determine how well policyholders or bondholders are protected. As a consequence, many regulators now allow internal models to be used in the calculation of prudential capital requirements. This can include allowing:

- (i) internal models to be used in the valuation of assets and liabilities in the base balance sheet and in stress scenarios;
- (ii) internal models to be used in the determination of specific parameters for a standard formula (e.g. factors to be applied to different lines of P&C business based on an insurer's own estimates);
- (iii) internal models to be used in the calculation of capital requirements for particular risk modules or types in a standard formula (e.g. use of external credit or natural-catastrophe models);
- (iv) full internal economic capital models to be used to calculate total required capital.

Insurance companies using internal models have fully embedded them in their management processes to accomplish a number of important tasks:

1. Determining the amount of capital to be held

An internal model enables a business to assess required levels of capital at both group and entity levels in a way that appropriately captures the complexity of the risks incurred by the business. Internal models can also be calibrated across a range of different measures and views reflecting, for example, different timeframes, confidence levels, with and without new business, etc. to provide a consistent basis of assessment.

This then provides information for decisions on dividend levels and the raising of additional capital taken with a view to ensuring that the group's capital positions remain within the defined risk appetite.

2. Monitoring business performance and providing information for pricing

Overall business performance is commonly monitored by reference to two key metrics, which are:

- return on capital allocated (ROCA);
- combined operating ratio (COR).

ROCA is also a key determinant of pricing decisions, as it is used to ensure that the cost of risk is appropriately factored into profitability assessments.

CORs are often compared to breakeven combined ratios, which take into account the time value of money/investment income and the capital allocated to a line of business. This ensures that pricing is consistent with the required capital calculated by the internal model.

Internal models play a crucial role in providing the basis for capital allocations and ensuring that capital is allocated appropriately across regions and product lines.

3. Setting targets for business volumes

Knowledge of the relative profitability of lines of business as measured by ROCA and current COR and comparisons with benchmark returns and corresponding CORs are, of course, extremely useful for strategic decisions on the business lines to be targeted after considering risk appetite.

Internal model output therefore underpins this process to the extent that it is used in the calculation of ROCA and defining risk appetite.

4. Setting risk appetite and monitoring risk exposure

Internal models can capture all material quantifiable risks and hence provide quantification of the overall level of risk run by a business. As such, internal model output plays an important role in determining risk appetite and highlighting key risk exposures.

Internal models can also be used to perform risk analyses, for example breakdowns of capital requirement by risk driver. The data obtained can be used to arrive at the overall desired risk profile.

5. Determining the optimum reinsurance structure

Internal models are routinely used to determine the optimum reinsurance structure, including upper limits of cover and net retentions.

Particular uses include calculating the probability of cover being breached, calculating the impact on capital of different retention strategies and assessing the effect on earnings by calculating expected recoveries (discounted and undiscounted) for comparison with the cost of the cover and percentiles from the recovery distribution.

6. Making asset-allocation and other investment decisions

Many parts of an internal model are also used by insurers to determine their strategic asset allocation. In particular, they provide an effective way of assessing/analysing the

- impact of investment decisions on business risk and capital volatility;
- allocation of capital to investments;
- liability profile for matching purposes;
- impact on capital measures of potential investment strategies.

7. Assessing business opportunities and providing risk-bearing capacity

The precise way in which internal model output is used in assessing a business opportunity will vary according to the particular circumstances of the opportunity.

However, incorporating the impact of significant changes in business written (including the acquisition or disposal of a legal entity or business unit), long-tail liability or run-off strategies into the model, for example, will give an indication of the capital that would need to be allocated to support the resulting business, as well as the impact on the risk profile of the business, including any potential changes to reinsurance strategy.

The modelled capital allocations will often be a significant factor in the economic evaluation of a deal, and when combined with the financial projections for the deal, produce an expected COR and ROCA for the deal which can be compared with target levels.

4 Regulators' approach to internal models

4.1 Regulators already allow the use of internal models in a number of different ways

Internal models used in the valuation of assets and liabilities in the base balance sheet and in stress scenarios

In all but the most rudimentary of prudential regimes, internal models are used in the valuation of assets and liabilities in the base balance sheet to determine available capital. In particular, market-based valuation regimes will require assets for which there is no deep, liquid and transparent market to be valued either by using proxy assets or by using mark-to-model approaches. Such valuation approaches are auditable, as evidenced by similar requirements being adopted for financial reporting purposes. As for liabilities, whilst a wide range of different approaches exists globally for valuing liabilities, requirements usually – either explicitly or implicitly – rely on modelling approaches of some kind. This can range from use of relatively simple static deterministic models to full stochastic dynamic modelling.

Where such models are used to value assets and liabilities to determine the base balance sheet and available capital, they are almost always also used to determine the impact of specific scenarios or factor-based shocks as well for determining required capital where prescribed standard approaches are utilised.

Internal models used in the determination of specific parameters in a standard formula (e.g. factors to be applied to different lines of P&C business based on a company's own estimates)

In addition to the use of internal models in the base balance sheet and in stress scenarios, some regimes also permit their use to determine certain parameters applied in a standard approach. For example, they may allow insurers to use their internal models to determine the size of stresses to be applied to prescribed exposure measures for different lines of P&C business, or alternatively to determine the correlation parameters to be applied between risk modules in a prescribed standard-model design structure.

It is a strength of internal models that an individual assessment of the risk factors in a company's portfolio can be performed and that any risk factor with large exposures can be modelled with more granularity than less important parameters. Furthermore, by using internal models to determine correlation parameters between risk modules, a more appropriate holistic assessment of risks and their dependencies can be achieved.

Internal models for a particular risk module or type in a standard formula

Some regulators also permit the use of internal models in the calculation of capital requirements for particular risks. This differs from the approach directly above as it does not impose a particular structure on the calculation of the risk module or type. Instead, insurers are able to model the sources of the risk in a way that best reflects the nature of their exposure.

Full internal economic capital models

Finally, all European regulators and an increasing number of other regulators permit the full use of internal economic capital models, approving their use for both the valuation of assets and liabilities in the base balance sheet and the calculation of capital requirements. Please refer to Appendix 4 “Internal Model Jurisdictions” for an overview of European jurisdictions that have approved internal economic capital models. Insurers are then able to model individual risks as well as the interaction of those risks in a way that best reflects the nature of their overall exposure. The use of internal models is usually subject to an insurer’s being able to demonstrate compliance with a number of internal-model principles, tests and standards, such as:

- principles for the use of internal models (i.e. ensuring that outputs are aligned with use and management decisions);
- standards for internal-model governance (e.g. appropriate independent review procedures and ongoing compliance with regulatory requirements);
- statistical quality standards (e.g. for the use of data that is appropriate, accurate and complete, and the use of relevant and appropriate actuarial and statistical techniques);
- calibration standards (e.g. prescribing a level of protection such as 1-year VaR at 99.5% confidence level);
- validation standards (e.g. back-testing results against experience, testing the robustness of the internal model, sensitivity testing and ongoing validation through profit-and-loss attribution).

Such principles, tests and standards ensure that risks are appropriately captured and monitored, and that the modelling of risk is aligned with internal decision-making processes so that the appropriate incentives are created for insurers. Moreover, comparison of the different approaches used in internal models fosters best-practice risk assessment and continuous improvement. This in turn ensures that regulators have the necessary confidence in the accuracy and credibility of internal model outputs, and they can use these as a basis for the determination of minimum capital requirements and the different regulatory intervention levels.

4.2 Potential limitations of standard prescribed methods for the calculation of capital requirements

There are a number of potential limitations to standard prescribed methods, which in our view means that such methods may not be appropriate for the calculation of capital requirements, particularly for large multi-national insurers.

No common level of policyholder protection as a result of inappropriately captured risk

When a standard approach to calculating regulatory capital is adopted, it might at first appear that a common level of policyholder protection will be provided, but in practice this is not the case. This is

because a standard approach is based on the assumption that ultimately all insurers' exposures can be broken down into the same life insurance, non-life insurance, market and credit risk exposures. In practice, given the wide range of different asset exposures and insurance market and product differentiation, this is not possible, particularly for insurance groups operating internationally or specialised monoline insurers. Consequently, the use of a standard approach will result in a different level of policyholder protection being applied to each internationally active insurance group.

Neither complexity nor the underlying risks disappear just because a standard method is applied – they merely remain concealed. This increases the risk of company failure, since it gives comfort to insurers that would otherwise be undercapitalised in relation to the true nature of the risks that they have assumed and hence have a failure risk that is higher than the desired 1-in-200 level of regulatory policyholder protection.

Encouraging herd behaviour that could undermine financial stability

As a result of the above, the application of a prescribed standard approach is likely over time to encourage companies to write life and non-life insurance business, invest in assets and pursue asset-liability mismatch strategies that are, relatively speaking, treated more favourably than others under the standard approach. This could result in herd behaviour and create systemic risk, as all insurers would then be exposed to similar risks and similar shocks. It could also lead to cyclical behaviour.

Potential for regulatory arbitrage that could undermine both policyholder protection and financial stability

In the worst case, this could result in inappropriate risk-taking as insurers could be motivated to write life and non-life insurance business, invest in assets and pursue asset-liability mismatch strategies that are treated unduly favourably under the standard approach, thus undermining both policyholder protection and financial stability. In addition, the use of a standard approach could create an incentive for risk treated unfavourably to be transferred to or reinsured in other jurisdictions where it benefits from more appropriate or more favourable treatment. This risks fostering the emergence of an unregulated "shadow" insurance industry, which would not be in the interest of policyholders and would undermine financial stability.

Creating barriers to innovation, thereby undermining insurers' ability to support economic growth

The role of insurance is crucial in providing optimum risk-sharing in a society. However, in a constantly evolving world there is an ongoing need for insurance companies to be able to provide individuals and businesses with new risk-sharing opportunities. Internal models can help encourage innovation in insurance products by providing the flexibility for capital requirements to reflect the true nature of newly developed products, which is not possible with a standard method. Imposing a standard method, therefore, would hinder the development of new products if the capital requirements were unduly onerous, depriving consumers of innovative risk-sharing products. Conversely, in cases where a standard method underestimated the true nature of risks in new products, this would encourage the overprovision of such new products, putting policyholder protection at risk, as happened, for example, in the case of Equitable Life in the UK.

4.3 Benefits of using internal models for the calculation of capital requirements

Internal models bring a number of benefits to the calculation of capital requirements, which in our view means that they provide the most appropriate solution for the calculation of capital requirements for many internationally active insurance groups.

Ensuring that insurers are able to meet policyholder obligations as they fall due

Allowing the use of internal models ensures that insurers are motivated to properly identify, measure, manage and report their risks. As a result, insurers will be able, and strongly motivated, to manage their asset-liability mismatch risk closely. Permitting the use of internal models will also ensure that insurers identify potential shocks that could particularly adversely affect their balance sheet, and have sufficient capital to withstand such shocks or alternatively implement risk-reducing strategies to reduce the potential impact.

Motivating insurers to pro-actively manage risk and make risk-based decisions

Allowing the use of internal models for regulatory purposes provides a strong incentive for insurers to identify and measure risks appropriately in a consistent and comparable manner across their business. This in turn ensures that relevant information is available in a timely manner to support decision-making. In particular, allowing the use of internal models motivates insurers to develop effective risk-identification, risk-appetite and capital-allocation processes, and supports risk-based decisions in areas such as M&A, reinsurance, new product development, hedging and asset allocation.

More efficient and effective use of regulatory resources

Insurance companies have invested heavily in the development and maintenance of economic capital models to properly identify and measure risk. Using these models for regulatory purposes rather than a standard approach will enable regulators to focus their resources better as they provide a deeper insight into a company's risk processes and a more accurate indication of companies' financial strength, permitting any action taken to be more targeted.

However, the complexity of internal models and their approval and supervision can pose challenges for regulators. Availability of qualified experts with longstanding experience and company-specific knowledge of internal models is a prerequisite for fulfilling the regulatory control function. While it is true that it might be challenging to ensure continuity of human resources for this task, if internal models did not exist the level of regulatory resource that would be required to ensure the same level of understanding of the risks incurred by regulated entities would be significantly higher.

Timely and proportionate regulatory intervention

In addition, because internal models provide a more accurate and timely indication of financial strength, their use enables regulators to intervene in a more timely and proportionate manner. This is particularly important, as early intervention can significantly reduce the likelihood of policyholder loss, market disruption and contagion in the event of the financial condition of an insurer deteriorating.

Effective risk-based dialogue between regulators and senior management

Allowing the use of internal models ensures that regulators are able to engage constructively with the senior management of an insurance company by creating common language for discussion of the sources, nature and scale of the risks faced by the company. This facilitates a more open, transparent and meaningful dialogue between regulators and senior management, promoting mutual understanding of the nature and scale of the risks. For example it is significantly easier for supervisors to understand and analyse appropriately the impact on risk profile of large new business deals or business-mix adjustments within an internal model infrastructure than with standard approaches. The latter only show different figures, whereas with an internal model it is very likely that there will be an associated model change, which usually has to be reported separately to the supervisor.

Effective risk-based dialogue between regulators and supervisors

Allowing the use of internal models similarly permits constructive dialogue between regulators on the true nature of the risks incurred by a regulated entity. This also enables supervisors to compare results across different jurisdictions the entity operates in, helping them to achieve sound regulatory outcomes and focus on material risks and issues. It also results in enhanced supervisory cooperation, engagement and coordination for the model approval process, compensating for limited supervisory resources.

4.4 Model governance and model validation

Model governance also requires that members of the board and senior management have a good working knowledge of the internal model. This fosters an in-depth understanding of risks and establishes and reinforces a company's risk culture.

To ensure that capital requirements are commensurate with risk, internal models – in contrast to standard approaches – require a regular validation process in which calibration choices are independently challenged and requirements for high-quality, granular data are set. The latter promotes good data management and data-quality processes.

A regular cycle of model validation – as a prerequisite for the use of an internal model in the context of the ICS – should include performance measurement, reviews of parameter choices and actual-to-expected comparisons. This ensures that supervisors are involved in an ongoing structured dialogue with companies, which enables them to promote consistency of methods and comparability of outcomes.

Making sure changes to models are subject to appropriate governance and testing is also important in this regard as it enables model validation to focus on changes made to the model and to assess whether changes in the risk profile of the insurance company or in the external environment could affect the model's continued appropriateness.

4.5 Supervisory reviews of internal models

We have discussed the benefits of internal models from a supervisory perspective. However, as there is no single global supervisory regime in place, supervisory review processes may differ between jurisdictions, although this is equally challenging for standard approaches that are applied to different risk profiles. It is therefore essential that the same internal model principles be applied across all jurisdictions to produce comparable outcomes.

As regards the appropriate application of similar internal model principles within and across jurisdictions, we acknowledge that the supervisor fulfils a key control function for internal model users. The supervisor may need to develop appropriate tools and processes in order to carry out this function as efficiently and effectively as possible. Tools and processes that may form part of this framework include

- internal supervisory governance on model approval;
- supervisory guidelines on modelling best practices and methodologies;
- supervisory peer reviews;
- benchmarking of internal model inputs and outputs;
- cross-border supervisory cooperation and coordination

Supervisors are likely to need internal governance processes in place for internal model approval in order to ensure that models have been thoroughly and consistently reviewed having due regard to a company's risk profile, and that there is an appropriate level of supervisory challenge and governance of the internal model approval decision. To help guarantee an appropriate and consistent approach to reviews, supervisors may develop guidelines on modelling best practices and methodologies to support the approval process. Supervisory experience and any emerging practices can be fed into the guidelines. The consistent application of the supervisory approval process can be further strengthened by a system of peer review within the supervisory authority. The level of development and application of these tools for a particular supervisor is likely to depend on the size of the insurance market concerned, the resources of a particular insurance supervisor, and the number of internal model users in that market. Where there are few internal model users within a given market, supervisory coordination and cooperation is more important, as discussed below.

Benchmarking may also be an important component of the supervisory review toolkit. However, particular care is required when implementing an internal-model benchmarking framework. Internal model benchmarking can take a number of forms. It may involve comparing internal model inputs or outputs across a sample group of companies at a given point in time, or internal model outputs expressed in terms of a "standardised" metric over time. The key difficulty with both of these approaches is the very same as that faced with standard formulae, i.e. they are effective only when risk profiles are similar across companies or stable for a given company over time. Therefore, the use of standardised metrics to compare the outputs of internal models, while helpful, should be practised with caution and should not be the only available tool for supervisors. Indeed, the reason for having internal models is that there is no single standardised measure that can reliably capture the risk profile across companies or over time – if there were, internal models would be unnecessary in the first place.

Model inputs or outputs can be compared or benchmarked at differing levels of risk granularity, which may under certain circumstances be a meaningful comparison. This is likely to be the case where the characteristics of the risks being compared are similar, for example approaches to equity risk capital where firms in a given market tend to follow a similar investment strategy, such as tracking a particular index. Nevertheless, how the treatment of this risk contributes to the appropriateness of the overall model result will depend on the nature, calibration level and proportion of this and other risks in the portfolio and their interdependency. This is an important consideration when comparing risks across companies in either internal model or standard method approaches.

We conclude that benchmarking internal model inputs may be of benefit for discussions between a company and its supervisor on internal model design and calibration, having regard to the particular risk profile of the company.

Finally, cross-border coordination and cooperation among supervisors in the internal model supervisory approval process is essential for cross-border groups. Effective supervisory coordination and cooperation creates a common supervisory understanding that enhances the supervision of the group and makes the review process more efficient for supervisors and companies. Furthermore it helps to ensure that similar internal model principles are applied across jurisdictions and provides a framework for the sharing of supervisory experience and knowledge, which, as noted above, is particularly important for smaller supervisory authorities that may have limited resources.

Ultimately, the dialogue between supervisors and companies enhances risk culture, internal controls and the documentation landscape of the companies involved. This supports the view that internal models provide more meaningful and richer results, better reflecting the actual risks incurred by an insurance company.

The in-depth knowledge of the methodology of internal models gained through the certification process should make their use more acceptable for regulators and improve transparency in the insurance sector.

5 Examples of the use of internal models

In the sections below, we provide five examples of the use of internal models in practice. The examples are not applicable in every case, but will depend on the type of business concerned.

5.1 Internal models capture diversification between risks and regions better

The Solvency II standard method puts all CAT risks in one bucket, calibrated for a European CAT event. If a company writes non-European CAT risks, the standard method will not depict them appropriately.

In the non-life module, ICS 1.0 (standard formula tested in 2016) recognises diversification between different lines of business and between regions. However, take for instance a regionally specialised P&C insurer with large exposures to Storm Europe and Earthquake Italy. These events are uncorrelated, but the current ICS version would not allow for any diversification effect for the premium risk of such a specialised insurance company.

The above examples show that a standard formula approach would fail to recognise the true diversification profile of insurance companies (this is not an ICS-specific issue, but rather a problem of every standard solvency regime). Even worse, it might create undesirable incentives and encourage herding behaviour, making the insurance industry overall more vulnerable to specific scenarios.

On the other hand, we do recognise that a standard approach could be, for instance, calibrated appropriately for some monoliners that write business only in one currency and one business segment in a specific region.

5.2 Internal models are able to better capture the true risk profile

While standard methods reflect the impact of relevant risk drivers on capital requirements, they are not able to capture the variety of risk profiles accurately enough to produce fully comparable results due to their relatively simple structure. Typically, standard methods are predicated on a factor-based or scenario-based approach. These methods are calibrated by applying a deterministic shock to the risk drivers that – for a standard average portfolio (exposure) – results in the same capital requirement as a full analysis of the actual risk profile under the chosen risk measure (e.g. VaR 99.5%).

By extension, if the individual company's portfolio of exposures deviates from the one chosen for calibration, the resulting risk capital requirements are systematically distorted and may provide adverse incentives for portfolio management.

By way of example, consider a portfolio of n term life insurance policies that is exposed to the uncertainty of the number of deaths within the next year. For simplicity it is assumed that the mortality expectation is describable by one parameter q , and the actual number of deaths within one year follows a binomial distribution. From the properties of the binomial distribution, the expected number of deaths is $n \cdot q$ and the variance is $n \cdot q \cdot (1 - q)$. We assume that the risk measure for the required capital calculation is chosen as one standard deviation (σ), but the same argument applies to the VaR risk measure. For the calibration of a scenario-based standard method, q would be increased by an

“equivalent” deterministic shock so that the number of deaths resulting from the portfolio increases by σ . The result for the equivalent “shocked” mortality rate q' is:

$$q' = q + \sqrt{\frac{q(1-q)}{n}}$$

The larger the portfolio (n), the smaller the shock that represents a deterioration of one standard deviation.

Assuming that the standard shock $q \rightarrow q'$ is calibrated on the basis of a portfolio of n risks, the same shock would disadvantage larger portfolios as for those it results in more than one standard deviation (cf. above formula).

This demonstrates that applying standard shocks across different companies will not result in comparable outcomes. The actual protection level provided by standard-model-based capital requirements will vary from company to company.

While the above is a very simplified example, it shows that a more complete description of the portfolio characteristics – than provided by standard approaches – is necessary to ensure comparable outcomes regarding implied protection levels. Internal models have the flexibility to model the true risk profile and lead to more comparable outcomes. An implicit bias of results and unwanted incentives can be avoided, for example an unintended incentive to limit portfolio size in the above example, as larger portfolios receive inadequate diversification benefit. In general, standard approaches tend to have unintended consequences and to create a non-level playing field.

5.3 Case study – Equitable Life

Equitable Life is a life insurance company in the UK and, founded in 1762, is the world’s oldest mutual insurer.² Equitable Life had once been a successful provider of mutual insurance products but has been closed for new business since December 2000 following financial collapse, following which many policyholders lost a significant part of their savings.

Between 1956 and 1988, Equitable Life sold with-profits savings policies with an option to choose at retirement date a Guaranteed Annuity Rate (GAR) or the Current Annuity Rate (CAR). The GAR offered a guaranteed annuity income, whereas the CAR represented the ‘open market option’, where policyholders could buy an annuity in exchange for a lump sum. The income provided by the CAR depended on market conditions at the time of purchase – in particular the level of interest rates – and actuarial mortality assumptions.³

In 1993, the CAR fell below the GAR, causing policyholders to opt for the latter. Policies sold after 1975 were estimated to be worth 25% more than CARs, resulting in a cost to the company of £1–1.5bn. This led to the company closing for new business in December 2000, and applying restrictive surrender terms in the form of high market-value adjustments. As a result, it was estimated that 50,000 policyholders suffered a 20% reduction in their annuity income.⁴

The problems of Equitable Life were caused by its failure to recognise the true value of its guarantees, and the risk embedded in them was not recognised in its balance sheet. It was acknowledged at the time that this was due to the lack of economic valuation and appropriate modelling of economic risk. In response to these failings, the UK government introduced the Individual Capital Adequacy Standard

² Source: Equitable Life website (www.equitable.co.uk)

³ Source: Joint opinion of Ian Glick QC and Richard Snowden for the Financial Services Authority

⁴ Source: BBC report, 20 October 2010, “Equitable Life: Timeline of key events (www.bbc.co.uk/news/business-10725923)

(ICAS) regime, which required companies to perform an individual capital assessment to assess their own capital requirements via the use of an internal model from 31 December 2004.

The ICAS regime has been a success for the UK insurance industry as it has led to a much deeper understanding of the nature of the risks to which insurers are exposed. For example, it has led to the recognition of risks that were not adequately captured in the then solvency capital requirements, such as implied volatility and liquidity risk, and has fostered a detailed understanding of operational risk (e.g. IT failure, mispricing risk, fraud). The true test of the regime came in the financial crisis of 2008/2009, which the UK insurance industry was able to withstand adequately. Arguably, without the introduction of the ICAS regime, many risks may have remained concealed from insurers and their regulators, with potentially more failures similar to Equitable Life during this period.

5.4 Currency

With reference to the ICS 1.0 development (standard formula tested in 2016), we note that the three interest-rate shocks are not segmented into different currency exposures. For a globally active (re-)insurer, however, there might be provable diversification effects between different currencies.

Currency risk itself is calculated via stresses that consider a depreciation of all long positions and an appreciation of all short positions against the local currency. This obviously misestimates combined long-short allocations in coupled currencies, such as, for instance, the US dollar and the Hong Kong dollar.

Internal models could also address the risk of sudden decoupling of currencies; Switzerland experienced such decoupling on 15 January 2015 when the Swiss National Bank discontinued the minimum exchange rate of CHF 1.20 per euro. Current standard formulae do not distinguish between coupled and uncoupled currencies.

5.5 Other limitations of using standard models

Standard models by nature adopt a uniform approach to measuring risk. It is due to this simplification that Solvency II and other global regimes have recognised that even a complex standard formula cannot cater for all business models and risk profiles. For instance, the characteristics of motor insurance differ significantly between Germany and the UK, where the historical volatility of loss ratios is much higher than in Germany. No single parameter could fit the different risk profiles companies are exposed to in motor insurance in the two countries.

Consider now the difficulty of estimating mortality improvement trends (i.e. lower mortality rates for persons of the same age from year to year). As can be seen from the graph below, the US population showed a turnaround in mortality rates from infectious diseases in the 1980s as a result of the HIV pandemic. Since the exposure of a company to such trends is heavily dependent on the actual portfolio mixture, it is evident that a "one-model-fits-all" approach is not reasonable. Even though these effects (e.g. the HIV pandemic) could be eliminated, it is still normal for there to be a difference between the short-term and long-term views of mortality improvement (long-term rates are higher than short-term rates). This is difficult to depict in a standard approach, but can be of major significance for a company's risk profile.

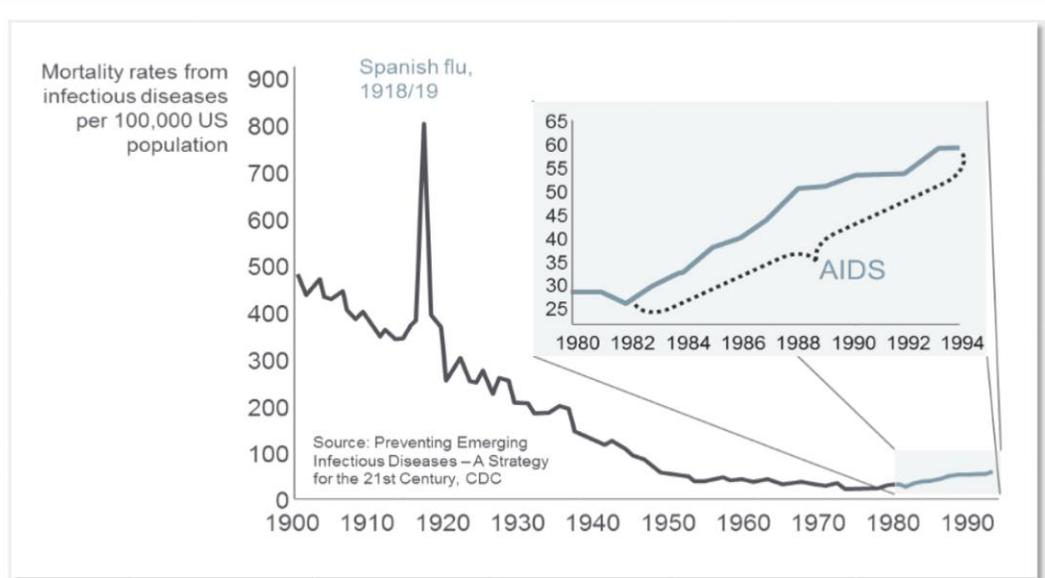


Figure 1: Mortality rates from infectious diseases per 100,000 US population over the period 1900 until 1990.

6 Challenges and limitations of internal models

“He who knows only his own side of a case, knows little of that”⁵

As described in preceding sections, internal models bring many benefits. However, we are not asserting that using internal models to determine economic capital is not without its challenges or that internal models do not have limitations. There are challenges and limitations in their use and these challenges need to be met and limitations recognised if the full benefit of using internal models is to be realised. Whether the challenges and limitations of using a full or partial internal model outweigh its benefits for prudential regulatory purposes will depend on the nature, scale and complexity of an insurance company’s business and risk profile.

In this section, we discuss some of the perceived problems often raised by supervisors and other stakeholders regarding the use of internal models. We also discuss the misconception that standard methods, which are themselves models, address these perceived problems and do not come with their own set of additional problems.

6.1 Question 1 – Do internal models create a lack of comparability across companies?

Are the internal model results of different companies comparable because different insurers will apply different approaches, resulting in different methodologies and calibrations? Where internal models are used for prudential regulatory purposes, can this result in companies being subject to different regulatory capital requirements for the same risks?

In principle, there are two sources of difference between companies. First, similar risks may be captured in different ways. Second, different risks will be captured in different ways as companies’ internal models reflect their own risk profiles. The first source may not be desirable from a regulatory perspective, but the second is a fundamental benefit of internal models. No two (re)insurance companies are the same, and internal models can capture the real differences in risk profile. The first difference can be minimised by defining common principles and calibration standards that internal models must meet and requiring adherence to these standards to be subject to supervisory review and approval. Furthermore it enables internal models to capture individual company risk profiles in a common way and therefore ensures that despite different insurers having different risk profiles a common level of policyholder protection is delivered.

In this context, it is important to address the misconception that standard methods increase comparability. Since standard methods do not capture differences in risk profile, they will only create true comparability for two companies that have exactly the same risk profile. The degree to which standard methods achieve comparability will decrease as risk profiles diverge. At one end of the scale, for two companies with similar risk profiles (i.e. size and type of risks in a given region), a standard formula could in theory achieve reasonable comparability. At the other end of the scale, where two companies underwrite different proportions of different risks in different markets, standard methods will not permit comparability. The extent to which a standard method produces appropriate capital requirements for companies with differing risk profiles will depend on the relative proportions of risks in those companies that are either not captured or inappropriately captured by the standard method.

A related criticism of internal models is that they reduce market discipline, as adequate disclosure is difficult to achieve with company-specific internal models. However, again this risk can be minimised by defining common principles and calibration standards that internal models must meet and requiring

⁵ John Stuart Mill

adherence to these standards to be subject to supervisory review and approval as well as by developing disclosure requirements that facilitate comparability. In addition to common principles and calibration standards, requiring robust model governance and validation standards can also help to promote comparability between insurers

Furthermore, the existence of different approaches used in internal models fosters best-practice risk modelling approaches and continuous improvement.

6.2 Question 2 – Is there sufficient data to calibrate internal models?

Are some aspects of internal models difficult, if not impossible, to calibrate, particularly dependencies between risks at the extreme tails of the distribution? Additionally, can data limitations result in overfitting? Even for risks with long data histories, can fundamental changes in product attributes or market conditions render the data stale or misleading?

For certain risks and dependencies, the data required to calibrate internal models may not have a sufficiently long history or may not be fully relevant. However, the process of developing and validating an internal model (and indeed the supervisory approval process) leads to greater internal and external awareness of the risks and vulnerabilities of a company and encourages the collection of data and improvement of data quality. In this context, we refer to the section on “Internal models from a prudential perspective” and in particular the sub-section on how models motivate insurers to proactively manage risk and make risk-based decisions. The use of internal data should always be subject to review by internal product and market experts, with a view to assessing continued relevance and meaningfulness in the light of changing conditions and circumstances.

Internal models provide the framework for asking the right questions about the nature of risks underwritten, though it is not always possible to get the perfect answer. There are likely to be similar challenges in calibration for standard methods, but standard methods will not provide a framework for insurers to consider in greater depth the nature of the risks they are facing. If anything, standard methods make the problem worse because they are significantly less adaptable to new or emerging data and changing risks. Internal models allow the potential for adaptation of calibrations to specific business characteristics and the loss experience of the company. With an internal model, the best modelling approach that fits the available data can be chosen.

6.3 Question 3 – Are internal models too complex?

Are models overly complex and difficult to understand? Does this opacity undermine their usefulness as a supervisory tool, undermine market discipline and create the potential for minor errors in assumptions to develop undetected into a more pronounced underestimation of capital requirements?

The internal model framework can be designed to address the issue of complexity. The section on “Internal models from a prudential perspective” describes principles, tests and standards that may form part of an internal model regulatory framework. In particular, meeting appropriate standards for governance and documentation should ensure that models are well understood at the appropriate levels both internally and externally. Internally, regulations may require boards and senior management to understand key elements of the model, while externally the process of supervisory approval of the internal model should ensure that the approved model is well understood and communicated.

A validation framework that encompasses sensitivity-testing of assumptions will minimise the risk of minor errors spreading undetected. Furthermore, scenario analyses provide a means of validating the

overall model result. In addition, benchmarking can be used to check that both inputs and outputs fall within a reasonable range.

The right balance needs to be achieved between complexity and simplicity, and the appropriateness of a model for a given business or risk needs to address this issue. The lack of flexibility and adaptability in standard methods creates the need for solutions that can be tailored to specific risk profiles. In this regard, the option to use a full or partial internal model in addition to a standard method allows a proportionate approach to be adopted and helps ensure that the standard method itself does not need to try to cover all possible circumstances, which would result in it becoming over-complex. Models are based on economic principles and tend to be more transparent and adaptable to contexts than standard methods (e.g. for sovereign risks).

6.4 Question 4 – Can internal models be compromised by competitive pressures?

Do models understate risk? For example, it has been observed that the use of internal models to determine minimum regulatory capital requirements, as in the case of Basel II, has resulted in a reduction in aggregate capital in the financial services sector. Is there a risk that a prudential regime that allows insurers to calculate their own capital is compromised over time as companies use models to reduce capital as illustrated by the banking experience?

The approval of internal models under Solvency II, for example, has proved to be a useful process that has added value for companies and their supervisors. Far from leading to light-touch supervision, it has increased supervisory scrutiny. Moreover, we are not aware of any evidence suggesting that the introduction of Solvency II has resulted in reductions in aggregate capital requirements in the insurance sector.

The adaptability of models could be perceived as being an advantage or a disadvantage. It could be a disadvantage if companies use this adaptability to make changes to internal models in order to reduce their capital requirements. However, this can be addressed by implementing an appropriate framework for internal model changes. Such a framework should ensure that changes to internal models are subject to appropriate internal governance and validation and that model changes are being driven by the need for the model to be updated and improved to ensure it remains fit for purpose for managing the business and the risks. It could also require that model changes be subject to supervision and review by the regulator where a model is used to determine prudential capital requirements. Internal models that are used to determine prudential capital requirements should be subject to strong governance requirements. Boards and senior management should be expected to demonstrate an understanding of the model, including the risks that are and are not covered by the model and the general methodology and limitations of the model. This will ensure that models remain appropriate and that there is no incentive for firms to use models as a means of systematically reducing capital over time.

Adaptability is a strength of internal models as it allows the design of the model to respond to changes in risk profile. This is a significant advantage of internal models over standard methods, which will not be responsive to changes in risk profile.

6.5 Question 5 – Are internal models pro-cyclical?

From a macro-prudential perspective, could an over-reliance on internal models make the financial system more prone to shocks? Do internal models create the potential for pro-cyclicality, in that capital requirements that are sensitive to changes in financial conditions can be ramped up during a crisis, leading companies individually to retrench at a cost to overall financial stability? Likewise, as

conditions improve again, could the incorporation of more positive variables drive capital lower, setting the stage for excessive risk-taking and leverage that augur ill for the future?

In setting internal model assumptions, insurers will generally endeavour to strike a balance between using a short-term dataset that captures most recent experience but which may represent a particular cycle or paradigm, and a longer dataset that provides for more stable assumption-setting but is likely to be more out of date. Insurers are likely to be mindful of the pro-cyclical implications of choosing a dataset that is too narrow or represents a particular market cycle. The regulatory framework for internal models setting out the principles, tests and standards that need to be satisfied as described in section 4.1 should ensure that the assumption-setting process takes due account of these points. The risk of pro-cyclical assumption-setting is not specific to internal models but can apply to any framework that requires the setting of assumptions, including stress and scenario testing or standard methods.

Generally, internal models are likely to facilitate a prudential framework that is less systemic. In a prudential framework that allows for internal models, there will be greater diversity in assumptions, which will make the framework more resilient to a uniform shock. It will also encourage insurers to analyse more carefully the risks that could arise, be they systemic or otherwise. Insurance prudential frameworks such as the UK ICAS regime, which effectively allowed internal models, proved resilient during the financial crisis.

For insurance groups, internal models are more adept at reflecting the demonstrable benefits of diversification between non-financial insurance risks and financial risk factors. Explicitly capturing these diversification effects in internal models depicts the lower sensitivity of insurance companies, as compared with banks, to systemic financial risk factors. Recognition of diversification effects also enables insurers to avoid both “fire sales” during a crisis and excessive risk-taking during an expansionary period (and, in practice, supports the market-stabilising role of insurers as prudent buyers of creditworthy and fundamentally valuable assets facing episodic, liquidity-driven valuation pressures).

6.6 Question 6 – Should internal models be used for internal purposes only?

Should internal models be an additional lens, and not the basis for regulatory required capital? In particular, using internal models in a prudential framework requires significant supervisory expertise in a range of specialist areas and requires extensive engagement with companies. Is the overhead practical for smaller supervisors?

Internal model implementation is likely to be a learning curve in understanding insurance risks in general for companies and supervisors. This is beneficial for both the insurer’s and the supervisor’s understanding of the risks faced, which in turn increases policyholder protection. Supervisors will want to engage extensively with larger companies in any case and will learn more about those companies through their involvement in the internal model approval process. Though internal models do present a significant challenge for smaller supervisors, there are mechanisms for supervisors to pool their expertise, for example supervisory colleges or through cross-border working groups on internal models. Indeed, there is evidence to suggest that internal model approval processes foster cooperation between supervisors, thereby encouraging more sharing of information and more harmonised and effective supervision of insurance groups. At the European level for example, EIOPA provides training and support on internal models and a platform for European supervisors, large and small, to share practices and emerging experience with regard to internal models. In this sense, not permitting the use of internal models could present a cost to society through less effective and coordinated prudential supervision.

Using internal models for prudential purposes fosters alignment between the board and supervisory perspectives of risk. This provides a consistent basis for company-supervisor dialogue in areas such as ORSA outcomes and strategy. On the other hand, a company is likely to have to manage conflicting incentives or signals where regulatory capital requirements deviate from its own assessment.

Companies incur significant costs in developing and maintaining internal models. Wouldn't they only invest in internal models to this extent if there were a clear capital benefit in doing so?

Using internal models to calculate regulatory capital brings many significant benefits, as described in the section on "Internal models from a prudential perspective". In particular, models facilitate alignment of the product offering and risk management with the risk and capital calculation, whereas standard methods can be an obstacle to doing business. Standard methods involve the risk of over-calibrating some risks, thus creating incentives for regulatory arbitrage (between products and sectors, and/or through the development of the "shadow sector").

6.7 Question 7 – Are internal models used in practice?

Do firms use internal models in practice other than as a means of determining regulatory capital requirements?

In our experience there is a strong culture of internal model use, from board and senior management levels downwards, at companies that have internal models approved by the regulator. The primary driver of this is not regulatory requirements or expectations, although that is an important consideration. Rather, as described in section 2, internal models are integral to insurance company risk and capital frameworks and embedded in decision making processes. Ongoing use of the model in this way demonstrates companies' commitment to the internal model and acts as a means of continuous validation.

Appendix 1

The notion of internal models

Different stakeholders may not have the same understanding of and views on the purpose and application of internal models in insurance. To avoid any ambiguity, we will first refer to the following definition:

“An internal model is a mathematical model of an insurer’s operations to analyse its overall risk position, to quantify risks and to determine the capital needed to meet those risks.”⁶

The focus here is on the quantification and management of risks and the calculation of an appropriate level of corporate capital. The model’s output is shared with the senior management responsible for managing the business.

On the basis of the available data and assumptions regarding future experience for a number of risks, the mathematical model (usually) projects cash flows to produce pro-forma financial statements and estimate the overall impact on the insurer’s financial position. This exercise can be complemented by a sensitivity analysis (stress testing or scenario testing) to better investigate the effects of extreme events and to determine a level of capital that reflects the risks assumed.

Internal models for risk and capital management can have many uses at an insurance company, depending on the degree to which they are embedded in its internal procedures, including:⁷

- valuation of insurance liabilities;
- financial condition analysis;
- stress and scenario testing;
- analysis of asset-liability mismatches and the refinement of investment policy;
- analysis of market risk in certain investment products with guaranteed values (such as segregated funds, participating products with maturity guarantees and variable annuities);
- pricing of insurance products;
- evaluation of reinsurance programmes and
- evaluation of various management and bonus strategies.

Applying either deterministic or stochastic methods of modelling risk drivers, internal models permit comprehensive risk assessments that can provide senior management with valuable guidance for strategic planning purposes. Moreover, they ensure that there is a common understanding of insurance and financial risks (and a consistent metric to measure them) throughout the operation. Regulatory capital considerations are not within the primary scope of this powerful risk and capital management tool. This is also recognised by the International Association of Insurance Supervisors (IAIS) in the Insurance Core Principles (ICP 17 Capital Adequacy), Section 17.12.2:

⁶ International Actuarial Association (IAA)

⁷ Note on the Use of Internal Models for Risk and Capital Purposes by Insurers; IAA, November 2010

“...One of the main purposes of an internal model is to better integrate the processes of risk and capital management within the insurer. Among other uses, internal models can be used to determine the economic capital needed by the insurer and, if an insurer has supervisory approval, to determine the amount of the insurer’s regulatory capital requirement.”

IAIS⁸ defines internal models as follows:

“Internal models can be considered in the dual contexts of:

- *a method by which an insurer determines its own economic capital⁹ needs; and*
- *a means to determine an insurer’s regulatory capital resources and requirements, where appropriate.”*

There is obviously no need for initial or ongoing supervisory approval for the use of internal models to determine an insurer’s own economic capital needs or for corporate management. If, however, the insurer has supervisory approval, internal models can be used to calculate the insurer’s regulatory capital requirements. In that case, ICP 17 stipulates:

“As a basic principle, an internal model that is to be used for regulatory capital purposes should already be in established use for determining economic capital. The methodologies and assumptions used for the two purposes should be consistent, any differences being explainable in terms of the difference in purposes.”

The requirement for consistency of methodologies and assumptions is understandable and is aimed at avoiding conflicts of interest. In many cases, it is to the benefit of an insurer to use a single modelling approach both for internal purposes and to meet regulatory capital and reporting requirements, as this guarantees a consistent view of the risk situation for internal management and external communication, and has a positive side effect in terms of containing administrative expenses.

It is worth noting that IAIS recognises the benefits of using internal models for regulatory capital purposes and encourages supervisors to approach insurers in this respect (Section 17.12.6, 17.12.7):

“Where the supervisor is aware that an insurer has an existing internal model but has not sought approval to use it to calculate the regulatory capital requirement, the supervisor should discuss this decision with the insurer.

Effective use of internal models by an insurer for regulatory capital purposes should lead to a better alignment of risk and capital management by providing incentives for insurers to adopt better risk management procedures which can:

- *produce regulatory capital requirements that are more risk sensitive and better reflect the supervisor’s target criteria; and*
- *assist the integration of the internal model fully into the insurer’s strategic, operational and governance processes, systems and controls.”*

⁸ ICP 17 Capital Adequacy

⁹ Economic capital refers to the capital that results from an economic assessment of the insurer’s risks given the insurer’s risk tolerance and business plans.

A prominent example of a capital regime allowing the use of (partial or full) internal models is Solvency II in the European Economic Area (EEA).

Even if the Solvency II Directive¹⁰ does not explicitly define the notion of internal models, a definition can be found in the CEA – Groupe Consulatif Glossary:¹¹

“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.

Within the Solvency II framework an internal model is intended to fully or partially replace the standard formula for the calculation of the Solvency Capital Requirement. Both quantitative and qualitative requirements will be set by the regulator and explicit approval has to be granted by the supervisor.”

According to the above definition, the risk management framework is the core element of an internal model and not only the actuarial component used for capital calculations. This is of prime importance if the concept of an internal model is to be established in all areas of a company that influence the mind set of decision-makers. This aspect is especially significant for the approval of internal models for Solvency II purposes:¹²

1) *Use Test*

Insurance and reinsurance undertakings shall demonstrate that the internal model is widely used in and plays an important role in their system of governance, referred to in Articles 41 to 50, in particular:

- a) their risk-management system as laid down in Article 44 and their decision-making processes;*
- b) their economic and solvency capital assessment and allocation processes, including the assessment referred to in Article 45.*

By demonstrating that the internal model is of high quality, is used throughout the company, and influences day-to-day business decisions, companies give supervisors and stakeholders a higher degree of comfort with the model. In other words, the internal model should be established as an integral part of the insurer’s overall risk management framework and embedded in its processes. This is very important, but by no means sufficient to fully guarantee the robustness of the model in all circumstances. Based on experience during the financial crisis, the validity of the use test has been questioned in some jurisdictions, while in others it reinforced the view of the industry that models worked quite well and that the empirical proof provided by the use test is a critical element in the design of the model.

Furthermore, it should meet the following requirements:

- 2) *Statistical quality standards*
- 3) *Calibration standards*
- 4) *Profit and loss attribution*
- 5) *Validation standards*
- 6) *Documentation standards*

¹⁰ Directive 2009/138/EC of the European Parliament and of the Council of 25 November 2009

¹¹ CEA – Groupe Consulatif Glossary; Brussels, March 2007, p.35

¹² Directive 2009/138/EC of the European Parliament and of the Council of 25 November 2009 (see Articles 100, 120-125)

Finally, the Solvency II Directive allows for the use of full or partial internal models:

Full internal models

All risk modules/sub-modules of the Solvency Capital Requirement are calculated using parameters and (not necessarily stochastic) methods as described in the company's internal model.

Partial internal models¹³

Partial modelling may be applied to one or more of the following:

(a) One or more risk modules, or sub-modules, of the Basic Solvency Capital Requirement

(b) The capital requirement for operational risk

(c) The adjustment for the loss-absorbing capacity of technical provisions and deferred taxes

In addition, partial modelling may be applied to the entire business of an insurance or reinsurance undertaking, or only to one or more major business units.

¹³ Directive 2009/138/EC of the European Parliament and of the Council of 25 November 2009 (see Article 112)

Appendix 2

Different approaches to model correlation

Although diversification is a concept fairly easy to grasp, modelling diversification is far less obvious. In order to assess diversification, two main components fundamentally need to be analysed:

- The marginal risk distribution for each risk
- The dependency structure that links these risk distributions

The realistic measurement and modelling of dependencies is one of the most difficult aspects of economic capital modelling and also one with the highest bottom-line impact.

The detailed modelling of dependencies also depends very much on the structure of a model and the level of granularity modelled.

Most standard models adopt a fairly straight-forward and easy-to-understand approach. The impact of certain stresses, e.g. equity drop, interest-rate change or large insurance claim, on the portfolio is modelled and those impacts are aggregated via a variance-covariance matrix. However, the difficulty with these approaches lies in determining this matrix. Additionally, these correlation matrices vary over time and with the actual portfolio. This makes using statistics even more difficult.

Other models start with the underlying risk drivers and model the dependencies between them, and only evaluate the impact of the joint scenarios on the portfolios in a second step. Risk drivers here are, for instance, certain equity indices, interest rates, FX rates, earthquakes, etc. The difference from the above approach is that the actual portfolio of an insurer is unrelated to the modelling of dependencies between risk factors. In this approach, the dependency model is more stable and can thus be better calibrated. Additionally, unlike the impact of stresses, the risk factors are often publicly known and by no means secret. This makes it easier to involve consultants or academics in the determination of dependencies.

Whether the dependency between the impact of stresses or the underlying risk factors directly are modelled, there are essentially only two techniques.

The first one attempts to infer the dependencies on statistical grounds. This involves the model designers first choosing a dependency structure. Currently most commonly used is the copula approach, where marginal probability distributions are combined into a joint probability distribution. The copula has a number of parameters, which need to be estimated by applying statistical methods. The difficulty with the approach is that there is often no good a priori reason for choosing the copula. Moreover, the more well-known copulas, like the Gaussian with its linear correlations, which is actually used in the variance-covariance approach, are known to understate the tail dependencies. Thus, inferring dependencies, especially tail dependencies, from relevant data sets that are limited in size is subject to uncertainties.

So, while the general copula approach allows for rich interactions between risks, it requires assumptions or knowledge of the underlying marginal distributions and estimation of all copula parameters. However, these calibration issues will arise with any approach to model dependencies, and the variance-covariance approach makes implicit assumptions regarding the underlying marginal distributions as well as the resulting joint distribution.

The second method of modelling dependencies builds on causal relationships. Unfortunately, it only applies to risk factors and not to impacts. It requires an understanding of why and how the risk factors relate. Since special attention can be given to the dependencies in very adverse situations, this method has some predictive power for tail dependencies, but still requires input assumptions based on expert judgement.

The modelling framework for the linear dependence between risks in a standard formula approach such as that proposed by ICS has significant limitations that internal models seek to remedy, the main ones being:

- issues around non-linear dependency of extreme events;
- issues around the interpretation of values in correlation matrices.

In the real world, a company should be allowed to measure the observed risk correlations and then determine the parameters of the model structure that is being used to best reflect such observations.

Appendix 3 Jurisdictions with approved internal models

With the introduction of Solvency II, many European insurers have further developed their internal models and had them approved by their local regulator. The table below lists the European countries in which the local regulator has approved (partial) internal models for regulatory capital calculations. So far, more than a hundred (partial) internal models have been approved by local European regulators.¹⁴

Number of internal model approvals - Europe

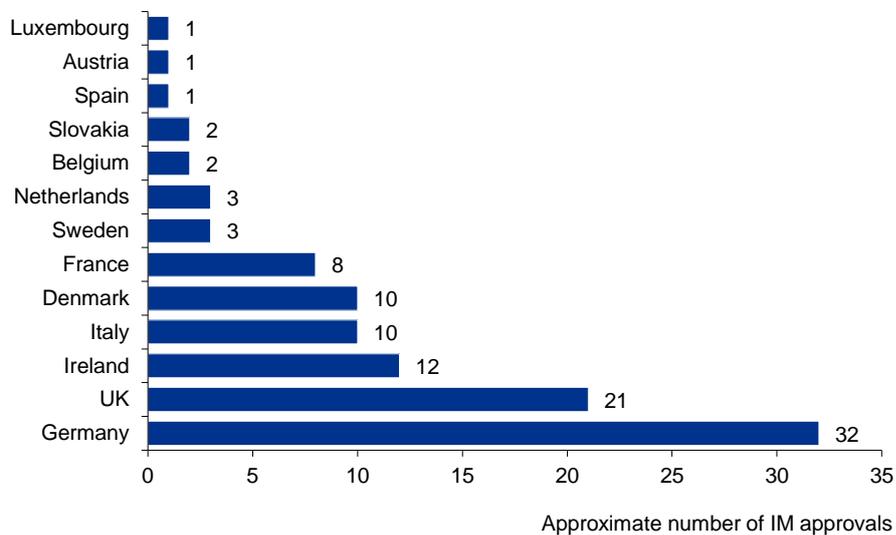


Figure 2: Approximate number of internal models approved in different European jurisdictions. Other jurisdictions not included in this overview may still be in the internal model approval phase, or have no internal models approved yet.¹⁴

Internal model approvals outside Europe are vary somewhat, as not all jurisdictions outside Europe have adopted a risk-based capital framework for insurers. For the risk-based capital jurisdictions outside Europe, we currently observe progress in the development of internal models, with some of these jurisdictions expressing interest in Solvency II equivalence or being granted (provisional) equivalent status (this includes Australia, Bermuda, Brazil, Canada, Mexico and Japan).

¹⁴ Source: <https://www.insuranceerm.com/guides/europe-solvency-ii-status/>

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