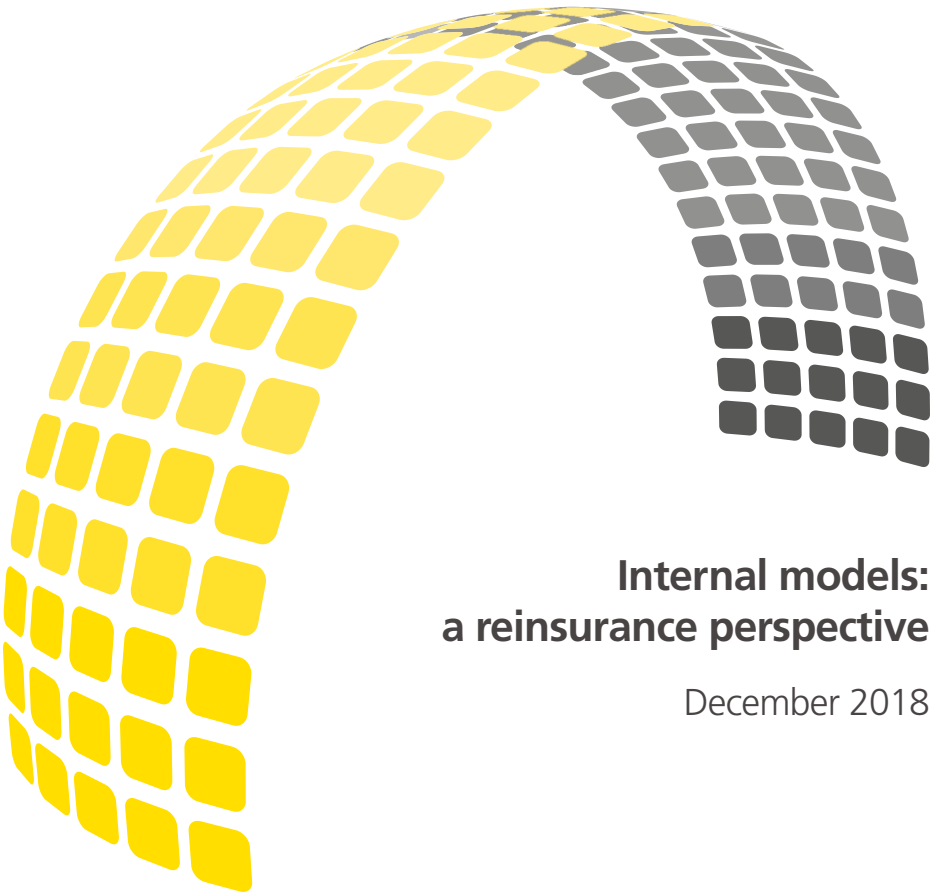
reinsurance
advisory board



Internal models: a reinsurance perspective

December 2018

About Insurance Europe's Reinsurance Advisory Board

Insurance Europe's Reinsurance Advisory Board (RAB) is a specialist representative body for the European reinsurance industry. It is represented at chief executive officer (CEO) level by the seven largest European reinsurance firms: Gen Re, Hannover Re, Lloyd's, Munich Re, PartnerRe, SCOR and Swiss Re, with Insurance Europe providing the secretariat.

Through its member bodies, the RAB represents around 60% of total worldwide reinsurance premium income. The RAB promotes a stable, innovative and competitive market environment. It further promotes a regulatory and trading framework that facilitates global risk transfer through reinsurance and other insurance-linked capital solutions.

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Introduction

The seven members of the Insurance Europe Reinsurance Advisory Board (RAB) have a century-long experience in managing society's extreme and complex risks. Risks have changed considerably since the 19th century, when many RAB firms were established, and those risks continue to evolve today: climate change is increasing the frequency of extreme weather events; governments are under pressure to respond to the risks posed by ageing populations; and technological advances have exposed people and businesses to cyber risk.

Adapting to a rapidly changing risk landscape and identifying emerging risks lie at the heart of reinsurers' business models. Reinsurers play a crucial role in the real economy. They expand insurers' capacity to assume risks from businesses and individuals, supporting sustainable growth. By pooling a large number of diverse risks (both in terms of type and geography), reinsurers benefit from diversification, since not all risks will materialise at the same time.

The large variety, complex interdependencies and joint impact of risks require correspondingly sophisticated models. For this reason, most RAB firms already use their own internal models. Models for natural catastrophe risk started to be developed in the 1980s. Reinsurers have invested extensively ever since, particularly over the last 20 years, in developing models that are aimed at the holistic measurement of risk and the effects of diversification.

Internal models have proved crucial for sound risk management and business steering. This is because they create the right risk incentives and promote a better internal and external dialogue about risk exposures, thereby improving risk resilience. From the 19th century onwards, the sector has been able to weather a number of catastrophes and financial downturns, from the San Francisco earthquake of 1906 to the attack on the World Trade Center in 2001 and from the Great Depression in the 1920s to recent financial crises.

Modern insurance regulatory regimes, such as the European Union's Solvency II, the Swiss Solvency Test, and the South African Solvency Assessment and Management (SAM) framework, have sought to recognise the importance of risk management and business steering within the insurance sector. Consistent with the principle of proportionality, different approaches to risk measurement are needed, depending on the size, nature and complexity of a (re)insurer's risks. A "one size fits all" approach is unworkable, as it results in an approach whose complexity is inappropriate for companies with smaller and simpler risks and leads to results that are misleading or

wrong for undertakings with larger and more complex ones. In general, prescriptive approaches and formulas are not able to reflect the complexities and nuances of larger and more complex organisations, whereas customised, well thought-out and documented approaches can and do pass the "fit for purpose" or use test. In recognition of this, Solvency II, the Swiss Solvency Test and the SAM allow internal models to be used to calculate regulatory solvency capital requirements, subject to supervisory approval.

In the wake of the financial crisis and the efforts to make banks more resilient, there has been significant debate about internal models, particularly the methods for assessing credit risk, including the merits of internal models versus more standardised approaches.

Internal models have a number of benefits, making the risk profile of companies more transparent and enriching the dialogue between the supervisor and the undertaking. Internal models analyse risk in more detail so that the output of the model more closely reflects an undertaking's risk profile.

Mandating the use of standard formulas or imposing supervisory overlays would threaten the progress that has been made in risk management in the insurance sector and the increased harmonisation in the way supervisors and companies look at risk.

RAB members are involved in a dialogue with supervisors to demonstrate the rigorous design, appropriate calibrations and robust governance underpinning their models. This publication is intended to support those discussions. It addresses the supervisory criticisms that have been levelled against internal models and explains why, for reinsurers, internal models remain the most accurate measure of risk, the best driver of good risk management and the most appropriate basis for comparing risks between companies as shown in the "Impact of internal model use on capital adequacy and comparability" section on p13. This publication may also be useful for companies considering whether to develop a full or partial internal model.

A. History and experience of internal model use by reinsurers

1. Specific characteristics of the reinsurance business model

Reinsurers provide a risk transfer function that allows primary insurers to smooth the impact of both major losses and peak risks; this makes insurers more attractive for investment and helps them to benefit from a reduced cost of capital. They provide a risk finance function; acting as an alternative financing source and thereby expanding insurers' capacity to assume risks from businesses and individuals. Finally, reinsurers provide an information function, helping society to price and manage risk.

The risk profile of reinsurers is generally significantly different to that of banks and direct insurers. The fundamental difference is that reinsurers are business-to-business enterprises. This makes the operational and expense structures and risks of reinsurers fundamentally different to those of direct insurers. For example, direct insurers have potentially millions of customers, whereas reinsurers have only a few thousand institutional clients. This means that reinsurers have different operational risk, underwriting risk and counterparty default risk profiles to direct insurers.

The reinsurance business model is based on diversifying risks as widely as possible across lines of business and geographies. Consequently, a single event in one region will have a more limited impact on the solvency position of reinsurers than on more locally focused insurers and banks. It is very difficult to capture diversification effects in a standardised approach, particularly those flowing from geographical diversification.

Banking internal models cannot be easily equated with (re)insurers' models, as some commentators have suggested. Banks are primarily exposed to credit, liquidity and market risks through their roles as deposit collectors and loan providers. Credit risk arises through banks' role as loan providers, liquidity risk through the duration mismatch of long-term assets (loans) versus short-term liabilities (bank deposits) and market risk through the trading book. As clearly demonstrated during the recent global financial crisis, there is a strong correlation between these risks and the deep level of complex interconnectedness between banks, which explains the systemic nature of banking activities.

2. Developments in internal models

Global reinsurers have been at the forefront of the developments in internal models over recent decades.

Over many years, reinsurers have invested considerable effort and resources (both IT and human) in developing internal models. During this time, modelling techniques have evolved to what is now regarded as "state of the art" integrated risk management that drives risk identification, assessment, control and steering processes. Appropriately designed and calibrated internal models now represent the most advanced way in which proper economic capital assessments can be determined for global reinsurance groups.

The design of internal models has influenced the comprehensive and holistic modelling of (re)insurers' economic balance sheets and risk profiles, going beyond the separate modelling of individual risks (market, credit, underwriting and catastrophe).

An essential feature of any capital assessment methodology is the determination of post-stress capital adequacy. This requires the attachment of a probability to the emergence of a particular stress event. Full distributions of risk factors can be calibrated within internal models, taking account of all the information available. For example, a life risk calibration — be it for mortality or health risks — takes into account, as appropriate, the specifics of the local market in terms of underwriting standards, medical advances in screening and detection, as well as the level and quality of historic data on the underlying risks.

The application of an internal model depends on the availability of high quality data that is used in the calibration process. Reinsurers have built up data over long periods. These proprietary datasets, coupled with publicly available data, can be used to calibrate full distributions of underlying risks. The datasets have also augmented reinsurers' understanding of risks and their risk management capabilities.

To illustrate this point, techniques to mine data on mortality trends using internal biometric experience data, together with the World Health Organization's Human Mortality Database, have led to a much better understanding of the regional differences in mortality trends. This data has enabled reinsurers to model how longevity risk and mortality risk deviate from expected mortality improvements. For example, the deviation from expected mortality improvements is assumed to be low in the short-term and much higher in the long-term, which is difficult to embed in a standardised approach. The data also allows internal models to capture the diversification that exists for companies with global and not just local exposures.

Another important development has been the increase in the popularity of stochastic modelling techniques rather than the deterministic approaches that were used before. Stochastic scenarios represent the impact of a large number of combinations of risk factors on an undertaking's exposures. The benefit of this approach is that it identifies the individual risks and combinations of risks that are most detrimental to the undertaking. It cannot be replicated by more simplistic approaches. Examples include non-linear exposures to catastrophe events, analysis of non-symmetric impacts such as tax or profit-sharing arrangements or the impact of combinations of risks. Internal models can quantify such impacts and assess long-term risk exposures within a dynamic framework.

In practice, developments in modelling techniques have led to a more integrated and centralised risk management approach and a move away from decentralised risk management. This has been crucial in establishing a holistic view of the overall risk landscape of (re)insurers. While it was possible under a decentralised approach not to recognise that market risk stemming from investments in shares was more material than underwriting risks, the integrated approach results in a clear and transparent overview of the risk landscape of the entire balance sheet. Responsibility for this oversight function is allocated to a central department that at the same time governs the internal model. This, in turn, also allows the formulation of holistic risk strategies.

The integrated approach demands an explicit modelling of dependency structures between the different risk modules. This allows reinsurers to analyse risk concentrations and supports a sound measurement of diversification. Modelling also supports a forward-looking approach, allowing reinsurers to understand, analyse and steer their portfolio in order to create the most diversified and stable book of business.

3. Uses of internal models

Reinsurers have been using their internal models to inform business decisions for many years — well before the formal application of Solvency II in January 2016. By embedding their internal models into the business-steering approach, reinsurers ensure that decisions are well-founded and underpinned by a clear understanding of the associated risks.

The importance of a broad and consistent model application is clear when one

considers the 2008 financial crisis. The crisis highlighted fundamental weaknesses in financial models throughout the banking system. It also highlighted that — within the banking industry — financial models were considered as tools to calculate regulatory capital requirements. The models were not embedded within organisations and, in particular, the results of the models were not used appropriately in decision-making. It is therefore imperative that the use test is recognised as important by management and is not just seen as a regulatory exercise.

For (re)insurers seeking internal model approval, the requirements of the use test place a significant onus on the board and senior management to understand and explain the output of the capital model in much greater detail than ever before. Supervisors not only require from senior management in-depth knowledge of the use of the model, but also awareness of other areas, such as key modelling assumptions, limitations, simplifications and diversification methodologies applied in the model. Fully embedding the model in the business ensures that the model output is understood and can be effectively used in decision-making, as well as ensuring that the model remains appropriate to the business being undertaken.

The core uses of an internal model are:

- **Business and capital planning** The internal model should be used in business planning for assessing the riskiness of possible future strategies and the variation in outcomes. For example, it should be used in product development to assess the capital requirements and risks of new products, or in mergers and acquisitions where it can be used to assess the effect of a decision on the overall risk and capital profile. Capital metrics and risk appetites can be used to help understand the risk-adjusted trade-off between different opportunities over the business-planning horizon. Output from the internal model can be used to produce these metrics, which also support the ongoing monitoring of progress against the business plan.
- **Stress and scenario testing** Stress and scenario tests are important risk management tools that can be used to assess the resilience of the business plan and to ensure that risk mitigation strategies exist for potential adverse events. Stress testing models extreme uncertainties, while scenario testing allows businesses to mimic theoretical future events to see what impact they would have on the business plan. Both are important tools and involve the use of the internal model.

- **Setting economic capital levels** Companies may want to manage their business to a higher level of capital than that assumed by the regulatory solvency capital requirement approach (for example, for reasons related to ratings). There is no prescribed method for calculating economic capital. It could be based on the regulatory capital requirement (for example, by increasing the confidence level from 1 in 200 to 1 in 1000) or it could use separate assumptions (for example, assessing the risk over the time it would take to run off liabilities to policyholders).
- **Monitoring risk appetite** A firm's risk appetite is an articulation of the level of risk that is acceptable and desirable for the business. Limits and thresholds are set to monitor the level of risk against the risk appetite. The internal model can be used to monitor these metrics.
- **Understanding risk aggregations** Catastrophe modelling is already an established practice and can be strengthened when integrated with a capital model. It is possible to use internal models to understand the impact of catastrophe aggregations on the overall capital requirements and solvency position. Risk aggregations can also occur across risk categories (for example, an increase in credit risk for reinsurers following a major market event).
- **Business pricing** When pricing business, internal models can be used in the allocation of expenses and (re)insurance costs to classes of business. Each class of business can use this information in the pricing of policies, potentially finding efficiencies in their profit margins. This ability of internal models will become increasingly important to ensure an underwriting profit is still achieved in ever-more competitive marketplaces.
- **Capital cost allocation** An internal model allows capital to be allocated to business units, or classes of business, based on their weight or cost of capital. This allocation provides a useful tool for performance management and an assessment of return on capital employed, allowing for improvements in capital efficiency.
- **Optimising risk mitigation** The model can be used to optimise risk mitigation techniques by, for example, supporting the determination of the optimal reinsurance or retrocession structure for the entire business or group. This can allow cover to be expanded for growing classes of business. The internal model can also be used to control the accumulation or aggregation of risks.

- **Investment decisions** The output of the internal model can be used to provide information on the impact that possible investment decisions have on capital requirements (regulatory and economic). Firms with long-duration liabilities may use the model for their asset/liability management.
- **Remuneration** The use of internal models for risk-based remuneration helps to ensure the appropriate alignment of management incentives.
- **Regulation** Solvency II allows firms to calculate their Solvency Capital Requirement (SCR) using an internal model (full or partial). The internal model should be used to calculate the expected capital requirements over the business planning horizon (usually 3–5 years) for the purposes of the Own Risk and Solvency Assessment (ORSA). This should include a forward-looking assessment of risks to the business and it is a useful tool for understanding the risk profile and its evolution.

This list is not exhaustive, nor is it the case that all of the uses are relevant for all (re)insurers.

4. Impact of internal model use on capital adequacy and comparability

Internal models have contributed to making capital assessments for (re)insurers more risk sensitive and reliable, in turn making the allocation of capital more effective and efficient. Risk factors with large exposures are modelled with more granularity to obtain better results, while risks with little exposure can be modelled in less detail. Internal models also allow for a better understanding and mitigation of key sensitivities to different parameters, risks and economic scenarios.

Internal models address limitations that exist in standard approaches, such as an inadequate recognition of diversification, missing risk factors and deviations from market-standard characteristics.

In this way, internal models increase the comparability of capital levels between (re)insurers and help to improve transparency in the insurance sector. In contrast, standardised approaches hinder comparability, as they typically cannot capture differences in business profiles.

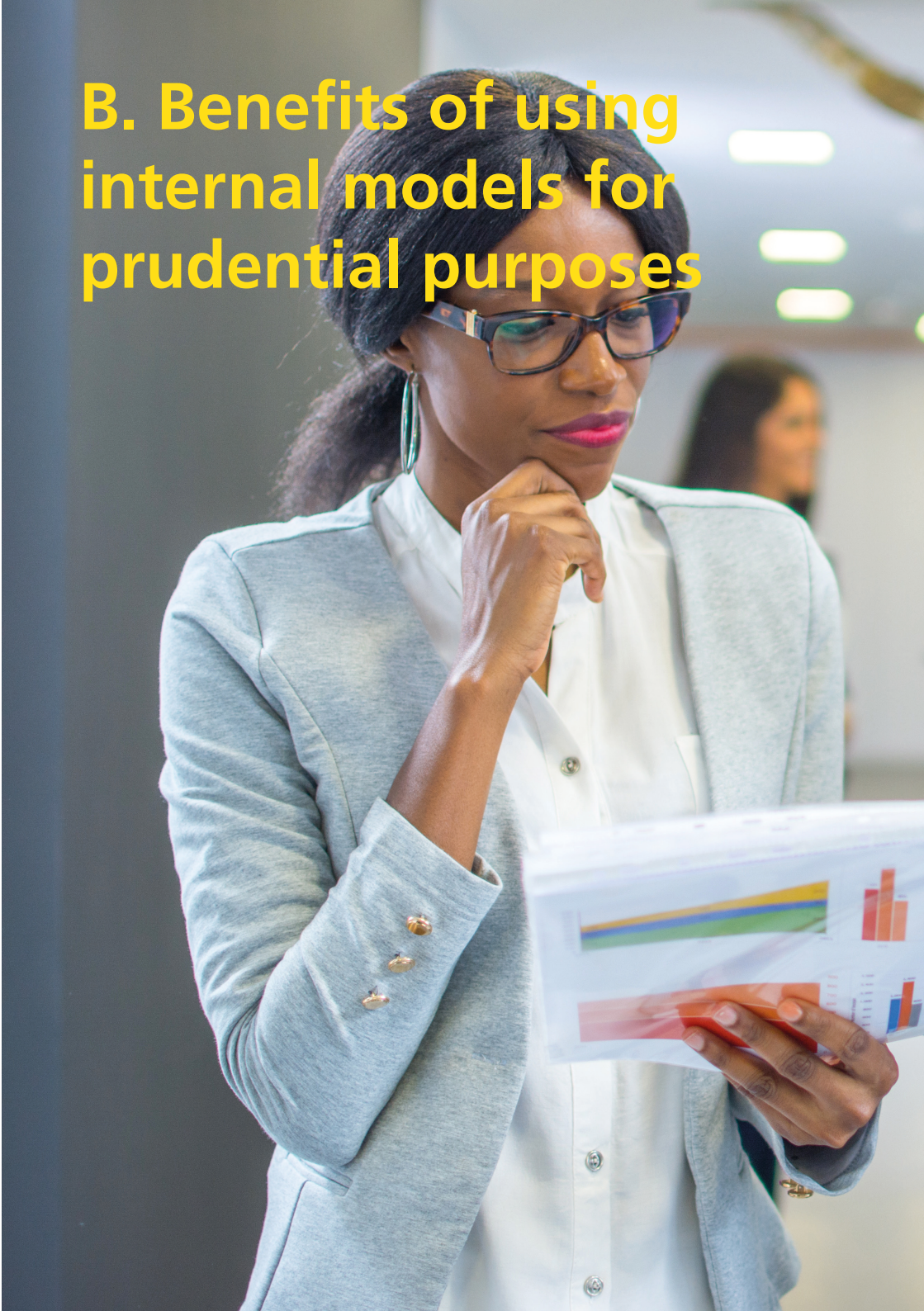
Take this simple example:

Example 1: Motor market differences

The characteristics of motor insurance differ significantly between the UK and Germany. Historically, the volatility of loss ratios has been much higher in the UK than in Germany, yet the Solvency II standard approach captures the volatility of motor business using a common parameter for all markets. As the effective volatility of the loss ratio will vary significantly between a UK motor insurer, a German motor insurer or a motor insurer operating partly in the UK and partly in Germany, the parameter of the standard formula cannot fit all markets, whereas an internal model makes it possible to adopt a parameter adapted to a (re)insurer's actual business.

Concerns that internal models will result in a "race to the bottom", with the sector's overall levels of capital adequacy being depleted over time are unfounded. Internal models are subject to a rigorous internal and external approval process at the outset and then for any major subsequent changes. They are also subject to robust governance in terms of modelling methods, data use, processing and reporting. Once internal models are well-established, evidence indicates that minor changes to them can lead to increases as well as decreases in solvency requirements.

B. Benefits of using internal models for prudential purposes



1. Holistic understanding of risks

The principle of pooling risk is fundamental to the concept of insurance and is particularly important for reinsurers. The balance sheets of large multinational reinsurers are typically exposed to a variety of risks (see Figure 1). Internal models represent the most practical way in which the diversification effects and risk concentrations within a globally diverse portfolio can be appropriately captured.

In order to steer towards profitable and sustainable business in a complex risk landscape, reinsurers need a holistic understanding of all the risks to which they are exposed. A holistic approach is important to identify any interactions and interdependencies between risks.

Reinsurance risks depend on the nature of the underlying risk and insurance market, as well as the specifics of the reinsurance treaty. Internal models can reflect the risk profile of reinsurance portfolios at the appropriate level of granularity and ensure that the aggregation structure accurately represents the dependence between individual risk factors at that level.

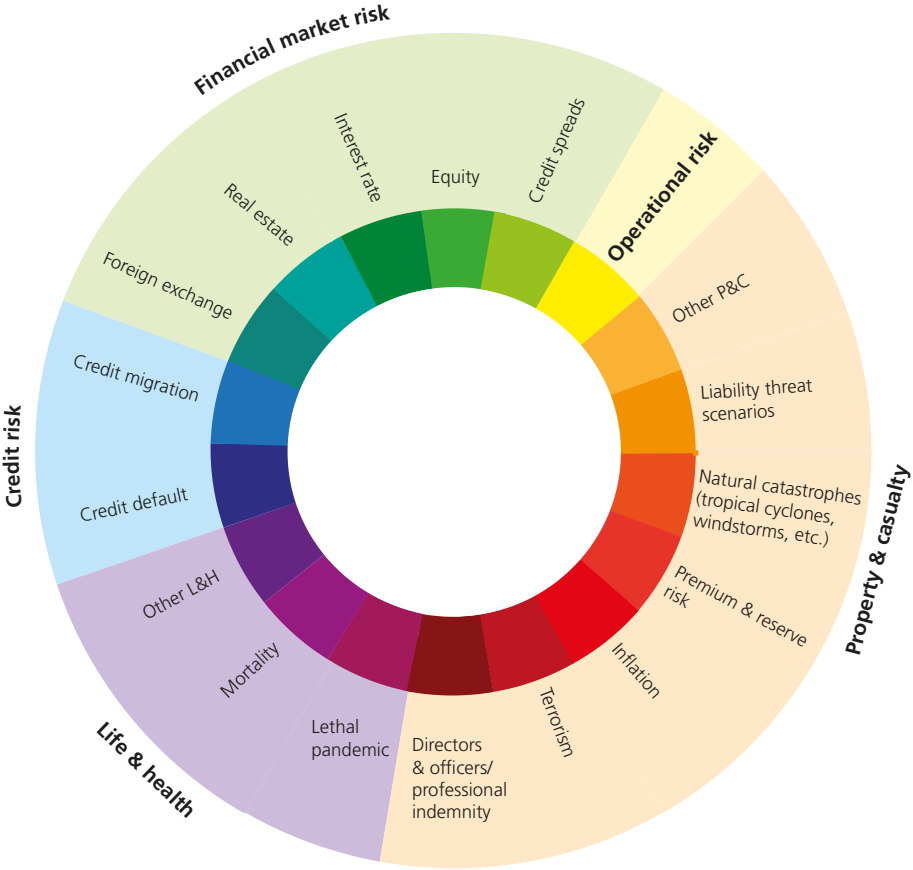
The necessity of standard formula-type methods to identify a limited number of risk classes by risk type or region will result in an arbitrary allocation of risks to certain classes with consequences for the calibration and aggregation of those risks. Grouping heterogeneous risks into similar risk classes will lead to inaccurate calibration and aggregation of the underlying risks. Most reinsurers take a more holistic approach by quantifying the joint impact of all risks on their balance sheet.

When assessing the joint impact of several risks, one has to model the interrelationship (or dependency structure) between them. What matters most in a solvency context is the tail dependence, ie the possible occurrence of events when large losses arise at the same time from multiple sources and accumulate to form an even larger loss. The interrelationships between risks may serve to reduce their impact (diversification) or may increase their effect (concentration).

There are many ways to model dependencies and the degree of sophistication an undertaking applies has to be commensurate with the potential impact. More granular modelling approaches are generally used for the material risks that have the largest exposures.

The simplest approach — which underlies most standard formulas — is to calculate the risk of single portfolios (typically defined through lines of business

Figure 1: Variety of risks to which reinsurers are exposed



or organisational units) and to aggregate them using a correlation matrix. Dependencies in standard formulas are typically defined between risk types, eg market risk, credit risk, insurance risk. This simple approach has, however, at least two major shortcomings:

- Dependencies between portfolios arise because several portfolios might be exposed to the same risk factor and the risk factors themselves could be dependent too. Thus, the correlation between portfolios is dependent on the underlying exposure, which makes the calibration of a correlation matrix very challenging. Therefore, it is impossible to come up with a standardised correlation matrix that is appropriate for all companies.

- Tail dependency cannot be captured appropriately through correlations[1]. When the distributions of the underlying risk factors are heavy-tailed, the correlation approach frequently leads to an incorrect aggregation, often understating the risk.

Internal models do not need to rely on one standard approach to model dependencies. In particular, unlike standard formulas that tend to only capture the co-movement of losses through correlation, internal models can deal with causal relationships between risks in an appropriate manner.

While combining individual risks in particular may require expert judgement to calibrate the joint distributions, such techniques can ensure that the specifics of the individual risks are captured when combined with other risks. This essential role was notably underlined by the chair of the European Insurance and Occupational Pensions Authority (EIOPA), Gabriel Bernardino, on the route to implementing Solvency II: "Internal models will be more risk-sensitive, will better capture individual risk profiles and will provide a better alignment between the truly underlying economic risks and the capital requirements placed on insurance companies by Solvency II"[2].

Here are two examples to illustrate this:

Example 2: Mortality risk and longevity

Data on mortality trends, including the World Health Organization's Human Mortality Database, shows that the relationship between mortality and longevity, namely the diversification between term assurance or whole of life and annuities, is mainly driven by the difference between the ages of the underlying policyholders and cannot simply be expressed by a pre-defined correlation between risk modules.

1 Embrechts, P., McNeil, A. and Straumann, D., "Correlation and dependence in risk management: Properties and pitfalls", 1999

2 Speech at J.P. Morgan European Insurance Conference, London, 2 June 2015

Example 3: Financial market risk and mortality risk

There is a consensus between experts that pandemic influenza — like the 1918 Spanish flu — could have an adverse impact on global financial markets. For (re)insurance companies that are exposed to both mortality risk and financial market risk, the correct aggregation of these two risk classes is a key task, as the resulting capital requirements will depend on how this specific dependence can be modelled.

Considering available information and using expert judgement, an internal model could deal with this problem in a straightforward way. In a first step, the excess mortality rates caused by the pandemic and the financial market risk factors are generated independently of each other. In a second step, the financial market risk factors could be adjusted to be a function of the excess mortality (the more severe the pandemic, the larger the effect on asset prices).

The latter step obviously involves a large degree of expert judgment, but the advantage of the described approach is that the assumptions would be transparent (eg "an excess mortality of x causes equity prices to fall by y") and provides a good platform for challenge. In a standard approach, one can only debate the diversification benefit between a life and a financial market portfolio; there is absolutely no basis on which to decide why one number would be more accurate than another.

This example deals with a situation in which the dependency could be described through a functional relationship. The pandemic is expected to cause most asset prices to fall but the opposite is obviously not true; a fall in asset prices would not cause a pandemic. In simple terms, correlation-based approaches can only capture the co-movement of the losses from different sources, but there is no way to take into account the causality.

2. Incentivising good risk management

(Re)insurers thoroughly and carefully select the methods and parameters to calibrate their model to ensure that the risks can be steered accurately from an internal perspective. The internal model calibration process forces the (re)insurer to individually assess all risks and to establish proper procedures that guarantee that the calibration processes are transparent and well-documented. As a result, the (re)insurer establishes a unified framework to measure and monitor risks.

Hence, the calibration process improves the (re)insurer's understanding of risks and underlying exposures. The (re)insurer furthermore derives additional information to validate the calibration process, eg scenario analysis and stress tests. These instruments can later be — and are in fact — used within the regular risk management processes and to extend the existing risk-management toolkit.

In addition, the calibration process requires the knowledge of a substantial number of employees and is strongly anchored in the risk culture of the (re)insurer. Technical experts provide analysis to support the calibration, senior management participates in the related discussions, and decisions in the committees are taken on a well-documented and transparent basis. On top of this, the validation process ensures that all calibration choices are independently challenged.

Internal model calibration and validation create a significant requirement for high quality, granular data, which encourages good practices in terms of data management and data quality assessment. Where external data is collected to complement internal data, this also needs to be assessed and hence leads to a reinforcement of internal control processes. This is likely to improve risk management beyond internal model applications.

In the process of model calibration, (re)insurers allocate their resources using a risk-based approach. In this way, the model calibration positively shapes the whole risk management approach and culture. (Re)insurers invest significant resources in their internal model. They are therefore incentivised to make use of the model in as many areas as reasonably possible, again embedding the risk management culture in the entire enterprise. It is unlikely that the same level of risk management awareness is created when an external standard formula is used, given that in the case of standard formulas responsibility for risk quantification rests with the regulator.

An internal model leads to a common understanding and language regarding

an undertakings' risks. It fosters a harmonisation of all risk-related processes, such as performance measurement, asset allocation, risk monitoring and capital management.

Internal models encourage (re)insurers to consider risk and capital upfront, before decisions are made, creating high expectations about the model's quality and leading to ongoing model improvements. In contrast, the standard formula is a calculation for compliance purposes only, which does not properly reflect the risk profile of the company. It is therefore not fit for use in an active way for decision-making.

In contrast to internal models, the standard formula can often deter good risk management. For example, the treatment of currency risk in the standard formula incentivises companies to hold capital in their reporting currency rather than the currency in which the risk resides.

3. Supporting financial stability

The use of internal models by reinsurers has had a positive impact on financial stability in a number of respects:

- Models have contributed to society's knowledge and understanding of risks. For example, reinsurers have invested heavily in natural catastrophe modelling — updating and refining techniques and collaborating with universities and scientific institutions in order to better understand extreme weather and climate risks.
- Internal models are a more sophisticated means by which to understand and quantify risk aggregations (for example, the accumulation of casualty risks across portfolios and markets).
- Unlike crude measures of risk, which foster a herding mentality and can lead to all companies undertaking similar action at the same time, internal models treat risk in a more bespoke way, can incorporate new developments more easily and flexibly, and allow for contra-cyclical behaviours. The obvious market-wide political compromises embedded in the standard approach mean that standard formulas will tend to evolve more slowly than economic and financial evolutions.
- By ensuring that capital requirements reflect risks, internal models enable reinsurers to continue to play an important stabilising role for the financial industry and the economy.

4. Enhancing supervisory scrutiny and risk dialogue

It is already evident to undertakings that have developed an internal model and submitted it to their supervisor that the whole process of interaction and discussion with supervisors has brought substantial benefits to internal risk assessment, management and governance procedures and has, in some cases, led to improvements in the internal models.

The process of applying for an internal model to be used for supervisory purposes entails substantial work over a period of years, passing through multiple iterations. Some (re)insurers started work on their internal models several years prior to their submission to supervisors. During this period, there were frequent discussions between (re)insurers and their supervisors on the differing elements of the proposed internal model.

The range of legally prescribed issues to be addressed by an internal model has required (re)insurers and their supervisors to engage in much broader exchanges of information and views than was previously the case, with many different departments, including risk management, actuarial and corporate governance. It has also facilitated a more structured discussion between (re)insurers and their supervisors about risks.

These interactions have been of value to both companies and supervisors. (Re)insurers have had to provide detailed information on a regular basis about their work in the various areas addressed by the model. They have also had to respond to often robust supervisory challenges. This, in turn, has further fostered a culture of enhanced internal controls, better governance oversight and improved documentation. It might be speculated that these positive trends would not have occurred to the same extent or at the same speed without the discipline of external pressure and accountability.

The requirements surrounding model validation are set out in Article 124 of Solvency II. They place an obligation on undertakings to have a regular cycle of model validation, which includes monitoring the performance of the internal model, reviewing the ongoing appropriateness of its specification and testing its results against experience. The knowledge of members of the board and senior committees is also tested by supervisors as part of the use test. These obligations guarantee that the dialogue between undertaking and supervisor is not occasional and unstructured but is regular, planned and organised, even after the process of

submission and approval of an internal model is complete. Discussion also occurs when the (re)insurer envisages a major change to the assumptions or practices outlined in the internal model, since this requires supervisory approval.

Such regular interaction arising from discussion of the internal model not only benefits the undertaking, it deepens the supervisor's knowledge of the risk management, governance and business operations and the specific characteristics of the undertaking. Supervisors are likely to establish processes for the approval of internal models to ensure that they are thoroughly and consistently reviewed in relation to the company's risk profile, and that there is an appropriate level of supervisory challenge in the internal model approval process. As the supervisor's knowledge of the internal model increases, so does its capacity to challenge and interact more effectively with the undertaking.

To help guarantee an appropriate and consistent approach, supervisors may decide to develop guidelines on modelling best practices and methodologies to support their assessments during the approval process. The supervisory experience gained and new best practices can be fed into the guidelines or comparable convergence tools. The level of development and application of these tools is likely to depend on the size of the national insurance market, the resources of the supervisor, and the number of internal model users in the market. In markets in which there are only few internal model users, supervisory coordination and cooperation can be more important. The consistent application of the supervisory approval process across Europe can be further strengthened by conducting peer reviews and discussions in supervisory colleges.

For the above reasons, the preparation and use of an internal model have served to enhance the quality of supervisory scrutiny and risk dialogue between undertakings and their supervisors. Those benefits are expected to continue in the future.

5. Costs associated with internal models

While there are a number of benefits from using internal models to calculate solvency capital requirements, the implementation and ongoing review of an internal model require significant human and IT resources. For some companies whose risks do not deviate materially from the standard formula, the costs of developing a full or partial internal model may outweigh the benefits.

C. The future for internal model use

1. Regulatory developments in the EU

I. EIOPA's internal model benchmarking studies

In 2018, the EIOPA Board of Supervisors announced that internal model firms with significant exposures should take part in an annual market and credit risk benchmarking survey, with a view to fostering consistent supervisory assessments as part of the supervisory review process. Additionally, a non-life internal model benchmarking exercise was launched.

EIOPA is understood to be concerned about the risk of variability in internal model outputs and the need to guard against model drift to ensure that capital requirements are not eroded over time.

While the RAB fully supports ensuring that internal models remain credible so that they can continue to be used for regulatory purposes, it has significant conceptual concerns with benchmarking exercises. Such exercises create the risk that undue harmonisation disconnects an undertaking's regulatory capital measure from its actual risk profile, raising the concern that it would no longer be an internal view of risks.

Benchmarking starts from the false assumption that risk profiles in the insurance sector are sufficiently homogenous for it to be possible to easily compare them directly (through the use of benchmark portfolios). Yet there are significant differences between the business models of reinsurers and wholesale insurers in terms of business mix and approaches to modelling. So it is important that the analysis takes into account those differences and does not result in inappropriate comparisons between reinsurers and direct insurers or predominantly retail players. This is especially relevant for components of the risk profile other than market and credit risks. In fact, as outlined above, this variation in risk assessments across the market is beneficial for overall financial stability. It mitigates the potential risk that the use of overly similar models leads to similar conclusions for all model users.

Furthermore, looking at certain risks in isolation from others makes it difficult to have a holistic understanding of the materiality of different risks, their ranking and interdependence. The insurance business model is liability driven and attempts to assess, for example, market risks in isolation without understanding an undertaking's liability profile or vice versa are not meaningful. The internal model and its

components adapt to the intensity of the exposure of the company to particular risk drivers — which is precisely the strength of internal models. Hence, using benchmark portfolios will only provide limited insights into the appropriateness of an internal model for a company's specific risk profile.

Finally, there is a lack of transparency about the methodology and tools used by EIOPA to conduct benchmarking studies. The RAB would welcome greater transparency to allow companies to understand and, if necessary, challenge how comparisons are made.

II. EIOPA's internal model ongoing appropriateness indicators

EIOPA's 2019 work programme refers to its current work on internal model ongoing appropriateness indicators (IMOGAPIs)[3]. Their purpose is to understand how internal models perform over time, enable comparisons between internal models used by different companies and identify outliers. It is understood that that an assessment of how IMOGAPIs could be integrated with reporting requirements is underway.

Solvency II has strict requirements about minor and major model changes, which are intended to guard against model drift. Internal model users are required to develop a policy for changing the full and partial models, which specifies what minor and major changes are. Major changes to the model and any changes to the policy are subject to the supervisor's approval. All changes are to be documented, and a quantitative assessment is required should there be a material impact on the output. It is not clear why EIOPA views these requirements as insufficient to ensure ongoing model appropriateness. Moreover, RAB companies have governance processes in place requiring regular internal monitoring of their models to ensure they remain fit for purpose and appropriately calibrated. As part of the governance framework, the internal model is subject to independent reviews conducted either by an independent model validation function or external parties.

EIOPA's work on IMOGAPIs raises the same concerns as its benchmarking studies. There are significant differences between the business models of insurers (insurers compared with reinsurers, wholesale compared with retail, for example), which affect the business mix and approaches to modelling.

3 "Single Programming Document 2019–2021 with Annual Work Programme 2019", pp.53 and 94, EIOPA, September 2018 https://eiopa.europa.eu/Publications/EIOPA%20Single%20Programming%20Document%202019-2021.pdf

In terms of reporting, the current flexibility for internal models rightly reflects the differences between companies. It would be difficult for more standardised reporting to cater for different modelling approaches.

EIOPA's initial indicators are understood to be based on comparisons with the standard formula. As already outlined, the standard formula is often not a good measure of risk, particularly for reinsurers. The RAB opposes direct comparisons with the standard formula, as outlined in detail above, as internal models are a superior tool in terms of reflecting the real risks that companies face.

III. Review of the mandates of the European supervisory authorities

The European Commission is proposing to amend the mandate of EIOPA to strengthen its role in internal model approval and supervision. The Commission has stated in its proposals that major inconsistencies exist between the requirements of national authorities when they approve internal models, and that colleges of supervisors have difficulty reaching agreements on group internal models, leading to an "uneven level playing field".

Under the EIOPA proposals, national supervisory authorities (NSAs) would be required to inform EIOPA of the receipt of an internal model application and EIOPA could issue an Opinion, on its own initiative, on the application to use or change the internal model. The NSA would be required to either comply with the Opinion or explain in writing to EIOPA why it has not. NSAs would be required to cooperate with EIOPA when deciding whether to grant group model approval and any associated terms and conditions.

The RAB's view is that it is difficult to separate the approval of an internal model and its ongoing supervision from the-day-to-day supervision of a company, as the regulation requires that models are not purely a regulatory tool and are fully used for capital management and business steering purposes. In the EU, NSAs are primarily responsible for the direct supervision of (re)insurers and possess the best understanding of the risk profile and business mix of the entities they supervise. Therefore, NSAs should remain responsible for internal model approval and oversight. Giving more powers to EIOPA on internal models would significantly complicate internal model approval and oversight, as well as blurring the lines of responsibility.

2. International regulatory developments

As part of the implementation of its global Insurance Capital Standard (ICS), the International Association of Insurance Supervisors (IAIS) has agreed — at the discretion of the group-wide supervisor — to allow additional reporting for the capital requirement based on internal model calculations during the five-year monitoring phase that precedes adoption of the standard. Furthermore, the IAIS recognises the use of internal models as a viable option that will be considered for inclusion in the ICS by the end of the monitoring period[4].

In 2016, 176 companies and 35 groups in the European Economic Area (EEA)[5] were using a supervisor-approved (partial or full) internal model. It is likely that many of the groups will meet the definition of an internationally active insurance group (IAIG). All these companies have demonstrated to their supervisor that the Solvency II standard formula would not reflect their risk profile appropriately. It is, therefore, a very welcome move from the IAIS to consider including supervisor-approved internal models by the end of the monitoring period. The RAB believes that internal models should be accepted as an alternative to the standard method, and not only as additional reporting.

One of the overarching objectives of the ICS is comparability. However, as stated above, standardised approaches alone are not capable of achieving this goal, as they need to be simple enough to be applicable to all companies. It is therefore not possible for a standardised approach to be sufficiently granular to correctly reflect the specific risks faced by each undertaking and to capture all the diversification effects between different risk types and geographies on the balance sheets of IAIGs. The risks of some companies would be understated, while the risks of others would be overstated, meaning that while the calculation steps would be comparable, the solvency positions would not.

"One-size-fits-all" assumptions — that do not take into account the specific characteristics of reinsurers — give a misleading view of capital requirements. This is further exacerbated by divergent implementation of the standard model in different jurisdictions.

In fact, internal models help to make companies' risk profiles more transparent and

4 "Implementation of ICS Version 2.0", IAIS, Kuala Lumpur, 2 November 2017

5 "Report on long-term guarantees measures and measures on equity risk", EIOPA, December 2017 https://eiopa.europa.eu/Publications/Reports/2017-12-20%20LTG%20Report%202017.pdf

comparable. By requiring companies to assess their own risk to a certain confidence level, meaningful comparisons can be drawn between the different outcomes. Solvency ratios can then be used to understand the underlying risk profile of reinsurers, from the characteristics of certain treaties to the aggregation structure of risks and diversification across regions and risks. They can also be used to accurately estimate and reflect the risks underwritten in different forms (for example through insurance-linked securities) and to allow for appropriate coverage of the risks, independent of their form.

3. Regulatory developments in banking

In 2017, the Single Supervisory Mechanism (SSM) in the EEA launched a "Targeted Review of Internal Models" (TRIM), which entails a series of studies of banks' internal models. On-site investigations are underway and are expected to continue in 2019. TRIM is one of the SSM's top priority projects to harmonise banking supervision in the eurozone (applicable to all 118 major banking institutions regulated by the European Central Bank) and was motivated by criticism of the banking sector's internal models since the financial crisis, namely that:

- The complexity of internal models made it increasingly difficult for supervisors to assess whether risks are being mapped correctly and consistently.
- The same risks were not modelled in the same way by different institutions, revealing inconsistencies and high variability in capital requirements.

TRIM therefore seeks to reduce unwarranted variability in the calculation of risk-weighted assets and to confirm the adequacy and appropriateness of internal models. The changes expected following TRIM may be as far-reaching as:

- Restrictions to internal model parameter estimations or direct specification of model parameters by regulators (input floors).
- Blending of internal model capital requirements with standard approaches in order to limit capital savings (output floors).

With the objective of removing incentives to minimise risk weights, the Basel III reforms in 2017 introduced new limitations to the use of internal models for regulatory capital purposes. After particularly contentious negotiations over the Basel III reform package, the Basel Committee agreed on an output floor of 72.5%, meaning the capital benefit that a bank can gain from using an internal risk measurement model can be no more than 27.5% of the capital requirement calculated solely on the basis of the standardised approaches.

While currently not on the table, it is important to point out why an internal model floor as proposed for the banking industry would be inappropriate for insurance.

In banking, the concept of risk-weighted assets (RWA) gives a balanced perspective of the main inherent risks, namely market and credit. However, unlike banks, (re)insurers are exposed to a much broader range of risks, on both the asset and the liability side of the balance sheet. Internal models for (re)insurers capture the complex interdependencies between risks and reflect companies' risk profiles as accurately as possible. The introduction of a floor would contradict the main purpose of the models, as it would link capital requirements to a less appropriate measure of risk.

Furthermore, the concept of a floor creates the false impression that internal model results will always be lower than the standard formula, which may not be the case. In fact, internal models often reflect a broader set of risks than the standard formula. EIOPA's comparative study of market and credit risk modelling[6], for example, notes that — unlike the standard formula — most Solvency II internal models reflect negative interest rate risk and sovereign risk. The RAB would therefore caution against the introduction of floors in the insurance sector.

So, what is the future of internal model use? The answer is simple. Firstly, advanced regulatory frameworks must recognise that standardised approaches may result in reasonable proxies for risk for small and medium-sized companies without complex risks, but that they have significant limitations for internationally active companies and especially reinsurers. Secondly, the discussions between supervisors and internal model users should be used to inform, but not limit, the future development of internal models and their supervision.

6 "First Comparative Study on Market and Credit Risk Modelling", EIOPA, May 2018 https://eiopa.europa.eu/Publications/Reports/EIOPA_comparative_study_on_market_and_credit_risk_modelling.pdf

4. Insurance market trends

The rapidly changing global risk landscape will only increase demand for insurance, particularly in developing countries, with a corresponding increase in demand for reinsurance as a result. Regulators and companies have a common interest in embracing these developments to close the protection gap. However, for this to be done in a prudentially sound way, regulatory frameworks must be sufficiently flexible that they can be easily tailored to the specific situations of local markets and capture the changing risk profiles of global reinsurers. Internal models are sufficiently adaptable to be able to reflect the evolving risk landscape and local markets.

A prime example is climate risk, where advancements in technology have improved reinsurers' understanding of the frequency and impact of natural catastrophes, as well as of the prevalence of climate-sensitive diseases with high geographical sensitivity. Internal models can easily adapt to these advancements without the need to constantly amend legislation.

A rigorous supervisory approval process, coupled with appropriate governance requirements and the obligation to show that the internal model is embedded throughout the business, should address supervisory concerns over internal models without undermining their benefits.

As stated above, within Europe, both companies and supervisors have already invested significant resources and time in adapting to solvency frameworks that allow greater use of internal models. The process for reviewing and approving an internal model is lengthy but worthwhile for both supervisors and companies, giving supervisors a much greater insight into an undertaking's risks than would be the case with a standardised approach and embedding good risk management at all levels throughout companies.

An internal model regime that is subject to robust governance and checks and balances does not require supervisory benchmarks, indicators and guardrails, which only serve to make the understanding of risk less transparent and more complex. Supervisors should continue to focus on discussing internal models, promoting a beneficial risk dialogue and ensuring that (re)insurers can continue to identify, price and manage risk in a prudentially sound way. Furthermore, the experience gained by supervisors in internal model approval and supervisory processes across Europe could be used to develop best practices. Such insights could continue to improve the existing robust governance structures, thereby ultimately contributing to increased supervisory convergence in the EU.

Conclusions

Modern solvency regimes such as the EU's Solvency II, the Swiss Solvency Test and the South African SAM framework have the potential to use the risk assessment capabilities of (re)insurers by allowing their internal models to be used to determine regulatory capital requirements. While the resource demands of internal models are considerable, these costs are for many companies significantly outweighed by their substantial benefits in terms of companies' and supervisors' understanding of risks. Furthermore, the diversity of internal model approaches compared to a framework in which all reinsurers are obliged to use a standard model approach increases financial stability.

Like all risk measures, models need to be adapted over time to reflect the emerging risk landscape. However, internal models are a much more flexible tool for this purpose than standard approaches, which frequently reflect market-wide political compromises and may therefore be more difficult to update.

There are no shortcuts in the process of reviewing and approving an internal model. Supervisory overlays, including benchmarks and indicators, will not give supervisors the information they need to understand a company's risks, nor will they improve the transparency or accountability of the insurance sector. The RAB discourages the development of such measures and instead encourages EIOPA and national supervisors to maintain a dialogue on national markets' experiences of internal model approval in order to document and encourage best practices. This will prove invaluable in improving the supervisory dialogue between companies and their supervisors, and also between supervisors within a college, ensuring that discussions focus on the real issues.

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