

Insurance

Gaining comfort: Capital model validation for insurers*

November 2008

*connectedthinking

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The business challenge

From the hurricanes of 2005 to the financial market meltdown in 2008, significant industry events have highlighted that financial models can get it wrong and management can place too much reliance on 'black box' outputs. How can insurers restore Board, management and investor confidence in the models that support their economic capital evaluations?

Economic capital and other risk-based capital models are becoming an increasingly important part of the decision-making and performance management toolkit within the insurance industry.

Economic capital models enable insurers to quantify the risks they face, the capital needed to cover these risks and the risk-adjusted returns that are being made or should be targeted. These models can improve management's ability to judge the balance between risk and reward and hence identify threats, weaknesses and market opportunities. A 2008 global survey of enterprise risk management (ERM) in the insurance industry found that around 90% of respondents had or expected to achieve better allocation of capital and more effective assessment of strategic options as a result of implementing economic capital programmes.¹

However, even the most sophisticated risk models are only as effective as the quality of the underlying data, comprehensiveness of the approach, validity of the model assumptions and the ability of management to correctly interpret the results. The record losses from the 2005 windstorm season highlighted the potential cost of basing risk selection and pricing solely on unrealistic scenario assumptions. A year of escalating financial turmoil has shaken market confidence in risk models across the financial services sector, particularly those that largely relied on third party ratings. As a result, senior executives are now facing ever more probing questions from analysts, investors and audit committees, and are in turn challenging their risk and actuarial teams to provide demonstrable assurance that their risk modelling is 'fit for purpose'.

As doubts mount, there may be a temptation to sideline the measurement of economic capital and return to more tried and tested bases for decision-making. Yet, as insurance and financial products become more complex, markets more volatile and business operations more diffuse, developing a clearer understanding of the company's exposures, their interdependencies and their potential financial implications could prove challenging, if not impossible, without the aid of appropriate models. This is equally true of other areas that use modelling techniques, such as liability assessment and investment decisions based on asset and liability analysis.

Without the aid of economic capital models, insurers could thus find themselves at greater risk from unwelcome surprises in an increasingly uncertain market environment. Moreover, companies that use economic capital models may be better placed to identify the limited opportunities available within today's tough business climate. Further impetus for the development of risk-based capital models and their use within ERM is coming from the planned risk-focused examinations in the US, Minimum Requirements for Risk Management of Insurance Undertakings (MaRisk VA) in Germany and EU-wide Solvency II.

Nonetheless, restoring confidence in complex models will be no easy task. Our ERM survey found that over 60% of respondents believe that the control environment surrounding model data and parameters, model outputs and model updates is no more than moderate or weak.² Nearly three-quarters of participants did not believe that their economic capital output had gained full acceptance from business units, raised risk awareness or influenced day-to-day decision-making. If businesses themselves doubt they have the necessary buy-in, understanding and control to ensure their model is credible, how can they convince their stakeholders?

The search for comfort is made all the more challenging by the fact that there can be no absolute model assurance. Economic capital is an estimate of the capital required by an organisation, and as such cannot be known with absolute certainty. Economic capital models offer a range of possible outcomes with associated confidence levels rather than a determined outcome. Blind reliance on model results is thus imprudent and misguided. Indeed, the starting point for the effective operation and use of economic capital models is to appreciate their inherent limitations and build these into the interpretation of results and strategic assessments.

'To embed the model into the business, it is first necessary to embed the business into the model.'

*'The path to Solvency II: FSA discussion paper',
September 2008*

1, 2 'Does ERM matter? Enterprise risk management in the insurance industry 2008', a global study published by PricewaterhouseCoopers in June 2008 (www.pwc.com/insurance).

While there can be no absolute verification of the actual outputs, it is possible to achieve an acceptable level of comfort by assessing the underlying logic, methodology and architecture of the models. Key considerations include the effectiveness of model governance, testing whether the model reflects the current business environment and emerging risks, and evaluating whether model outputs are reasonable in the context of actual experience. It is also critically important to apply the sense check of informed executive challenge. Moreover, while the specific objectives and circumstances of the business will dictate how the model is used, it can be helpful to compare the framework against evolving industry practice.

Ultimately, the value of the economic capital framework depends on how well it is understood within the business and genuinely integrated into decision-making – if the model could be likened to a car, then management and business teams are the drivers. The person at the wheel may not need to know exactly how the engine works, but like all good drivers they need to know how to get the best out of the car and be able to recognise any problem signs. ‘Good driving’ also requires attention to the culture and mindset of the business rather than just the mathematics of the model.

What does model validation involve?

Validation of an economic capital model should at least include a robust assessment of the:

- adequacy of data inputs;
- appropriateness of model algorithms, assumptions and implementation;
- reasonableness of outputs;
- sensitivity of results to changes in assumptions and inputs;
- adequacy of the model control environment and documentation; and
- appropriateness of the model usage.

At a time when stakeholder expectations are raising the bar for model validation and integration, this paper outlines some of the practical considerations that we believe can significantly help to strengthen the performance and credibility of the model evaluation process.

Executive summary

Standards to validate against: While benchmarking against peers can provide a minimum standard for model validation, it may fail to keep pace with an evolving risk environment and increasing stakeholder expectations. Firms need to set their own bar and keep refining their processes to ensure they meet ever changing demands.

Verifying data and assumptions: Insurers should verify that all relevant risks are being reflected in their economic capital models, gauge the quality of the data and assumptions used to quantify these risks, assess the reasonableness of their risk aggregation methodologies and confirm all model processes work as intended. Vetting all aspects of the data, assumptions and model architecture is clearly an enormous challenge, so firms may need to focus their validation efforts on the most significant components of their economic capital models.

Robust governance and documentation: Model assurance should be underpinned by a robust framework of governance reaching up to the Board, which leverages wider control processes wherever possible. To be effective, executive oversight demands an understanding of the basis for the analysis and, where necessary, a willingness to challenge the outputs.

Effective integration, embedding and usage: Economic capital models can help to provide a risk-adjusted basis for quantifying an organisation's risk appetite, establishing targets and measuring performance. The usefulness of these 'economic' management tools depends on the consistency of firm-wide evaluation techniques and full integration into business planning, which in turn demands buy-in and understanding from across the organisation.

Key considerations for the Board

While absolute assurance is not feasible, it is possible to ensure that the economic capital model is fit for purpose. In our view, the key questions Boards need to be asking are:

- Are we taking decisions that run counter to our risk appetite?
- What scenarios could cause catastrophic failure and is management comfortable with accepting the associated risks?
- Who provides assurance within the firm that our data and our modelling are appropriately controlled and based on sound assumptions?
- What are the most uncertain areas of our modelling and what can we do to improve them?
- Have we subjected our model to sensitivity and back-testing? For example, how well did our model project the impact from the current market turbulence? Is management comfortable with the results?

Standards to validate against

While benchmarking against peers can provide a minimum standard for model validation, it may fail to keep pace with an evolving risk environment and increasing stakeholder expectations. Firms need to set their own bar and keep refining their processes to ensure they meet ever changing demands.

Economic capital models and their underlying assumptions require constant challenge, refinement and alignment with the specific characteristics of the business to ensure the output can provide a credible source of information.

There is no ISO³ or other universal standard for economic capital validation. Although comparison against peers may identify certain baseline deficiencies and areas for improvement, it is unlikely to be enough to provide the necessary assurance. It is perhaps more important to recognise that model risk is a key risk for your business and develop leading rather than just acceptable practices that are built into the wider ERM framework. As stakeholder scrutiny increases in the wake of the financial crisis, the demonstrable effectiveness of such practices is likely to become a key competitive differentiator.

‘Model validation not only increases the reliability of a model, but also promotes improvements and a clearer understanding of a model’s strengths and weaknesses among management and user groups.’

US Comptroller of the Currency Administrator of National Banks ‘OCC 2000-16’, May 2000

A good foundation for the validation framework would be the ‘six tests’ for internal model approval under Solvency II (see Appendix A) and the more detailed guidelines issued by the US Comptroller of the Currency Administrator of National Banks ‘OCC 2000-16’, which are equally applicable to insurers (see Appendix B⁵). Both sets of standards emphasise the importance

of clearly defined responsibilities, formalised governance processes and senior management understanding and accountability, all anchored in regular back-testing against actual experience and comprehensive and frequently updated documentation. The OCC Bulletin also explicitly stresses the need for independent review and audit oversight, as well as validation of vendor models being used within the business.⁴

In addition to reviewing the validity of vendor models, it is important to verify external information and, where appropriate, carry out a full internal evaluation. Experience of the financial crisis underlines this, with many institutions taking false comfort in market indicators that failed, or at least were too slow, to respond to the emerging threats. In particular, many investors relied on external ratings rather than making their own assessment of whether the AAA mono-line credit guarantees would hold. Insurers faced comparable difficulties when relying on the estimates of loss from external catastrophe risk packages, which largely failed to anticipate the full scale of the liabilities arising from Hurricanes Katrina, Rita and Wilma (KRW). In such potentially high risk areas, internal evaluation, monitoring and challenge are therefore essential.

‘[Standard & Poor’s] will seek to understand how insurers are using models to manage their risks and how the insurers that use multiple models manage to reconcile and manage the sometimes contradictory signals different models can produce.’

From ‘ERM development in the insurance sector could gain strength in 2008’, published by Standard & Poor’s on 24.03.08

³ International Organisation for Standardisation.

⁴ US Comptroller of the Currency Administrator of National Banks ‘OCC 2000-16’ Bulletin, 30.05.00.

Verifying data and assumptions

Insurers should verify that all relevant risks are being reflected in their economic capital models, gauge the quality of the data and assumptions used to quantify these risks, assess the reasonableness of their risk aggregation methodologies and confirm all model processes work as intended. Vetting all aspects of the data, assumptions and model architecture is clearly an enormous challenge, so firms may need to focus their validation efforts on the most significant components of their economic capital models.

Are all relevant risks reflected within an organisation's economic capital model? It is important to test whether key risks are considered within the model and whether new and emerging risks are being picked up quickly enough. It is also important to consider how other parts of the risk management framework deal with new and emerging risks to ensure that all such exposures are captured, while avoiding needless duplication.

While certain risks may not be included in regulatory capital adequacy assessments, they may be pertinent to the business and management will need to decide whether they should be explicitly considered within its economic capital model. For example, reputational risk has played a part in many failures in the market, yet it is not a required component of Solvency II Pillar I solvency capital requirement evaluations. To the extent that certain risks are not explicitly considered, management needs to recognise and fully understand the model's limitations.

As with all complex models, the output of economic capital models is only as good as the quality of data that fuels them. Modelling teams need to work with those who supply the source data to ensure it reflects their needs and expectations. Organisation-specific data underlying certain risk models may be sparse, requiring an organisation to place reliance upon external sources of data. In some cases, data supplied from different parts of the organisation can be inconsistent, and will require 'cleansing' prior to use. A thorough understanding of the strengths and weaknesses of the data, as well as its accuracy and completeness, is essential to the model validation process.

The experience of the accuracy of catastrophe models in the wake of the 2005 hurricanes underlines the importance of ensuring the reliability, consistency and comparability of underlying data and the appropriateness of model assumptions. For example, many companies relied on broad property zone assessments of risk that did not adequately reflect the type of construction or even proximity to the coast of their insured properties. In addition, the policy data being fed into the catastrophe models and eventually capital models did not indicate the compounding impact of inter-related risks such as wind and flood damage, along with the resulting business interruption and reconstruction costs.

Economic capital models often reflect aggregations of and correlations between many individual risk models, adding to their complexity. As such, this may give rise to what some perceive as an impenetrable and largely unverifiable 'black box'. While largely grounded in past experience, such models often demand considerable judgements about the future. The nature of this judgement should be recognised and not obscured by inadequate transparency or lost in poor design or processes. In addition, the complexity of some economic capital models means that only a small number of employees fully understand their operation and, as such, these 'black boxes' are subject to limited independent scrutiny.

'...the internal logic of most models is usually very abstract and limiting, so it requires considerable judgement and expertise to apply model results outside of the narrow context under which they are derived.'

*US Comptroller of the Currency Administrator of National Banks
'OCC 2000-16', May 2000*

An effective model control environment and a robust validation framework around the completeness and accuracy of data, the appropriateness of assumptions, and the soundness of model methodologies are essential in opening up the box and winning understanding/trust from within the business. Such a framework can also facilitate a deeper understanding of a model's purpose, uses and limitations, thus providing management with increased confidence to apply the model in support of key strategic decisions.

Market events in 2008 underline the importance of ensuring that modelled scenarios reflect a wide range of potential outcomes, rather than being reliant on the parameters of historic precedent. This includes assessing the financial and economic interdependencies and possible escalation of threats that could endanger the franchise or lead to a market-wide crisis. This evaluation should leverage robust emerging and systemic risk analyses being carried out within the business.

Robust governance and documentation

Model assurance should be underpinned by a robust framework of governance reaching up to the Board, which leverages wider control processes wherever possible. To be effective, executive oversight demands an understanding of the basis for the analysis and, where necessary, a willingness to challenge the outputs.

‘To achieve an effective validation, objective challenge is essential. Proper independence of the validation function will therefore be important, whether internal or external. Individuals performing the validation must possess the necessary skills, knowledge, expertise and experience.’

*‘The path to Solvency II: FSA discussion paper’,
September 2008*

The inherent difficulties of examining all aspects of a model make it equally hard to ensure total control. Indeed, while replication of results is now an increasing element of regulatory and rating agency assessment, this can only go so far – there are too many subjective assumptions, judgements and interpretations to facilitate full replication. Examining and challenging the key areas of the process is therefore likely to be a key element of any model validation.

It is once again important to focus on the areas of greatest risk and build effective governance systems around these. This might involve honing in on the most significant risks faced by the business, such as underwriting, credit or equity exposure. An additional approach is to focus on the key steps in the modelling process such as data, assumption

setting and calculation. The underlying requirement in this regard is a process map that outlines the key controls, responsibilities, areas of potential weakness and procedures for remediation.

Who actually provides the necessary oversight is a key question. In a recent discussion paper looking ahead to Solvency II, the UK Financial Services Authority (FSA) stressed that ‘individuals performing the validation must possess the necessary skills, knowledge, expertise and experience’.⁵ This might suggest that responsibility should rest with the most technically proficient personnel. However, supervision through the FSA’s Individual Capital Adequacy Standards (ICAS) regime and likely provisions of Solvency II indicate that senior management needs to take ultimate responsibility (see Appendix A). This will require them to understand and, where necessary, challenge key assumptions and evaluations. This in turn demands a high level of comprehension among executives in relation to what may be unfamiliar and complex analyses. Compliance and internal audit teams are well-placed to provide a second and third line of defence – verifying the verifiers. However, some form of external assurance is likely to be required, especially against the background of current market scepticism around the nature and scope of models.

What kind of endorsement is required is an equally important question. No model is absolutely verifiable. Boards and management will need to make a reasoned judgement about what level of certainty they require to ensure the outputs are credible and usable.

⁵ The path to Solvency II: FSA discussion paper’, September 2008.

Effective integration, embedding and usage

Economic capital models can help to provide a risk-adjusted basis for quantifying an organisation's risk appetite, establishing targets and measuring performance. The usefulness of these 'economic' management tools depends on the consistency of firm-wide evaluation techniques and full integration into business planning, which in turn demands buy-in and understanding from across the organisation.

Experience of the financial crisis underlines the importance of effective identification, communication and escalation of risks across an organisation. The starting point against which existing and new risks are assessed is a tangible risk appetite that can be articulated and applied within the business.

Economic capital models can help to provide a quantification of risk and associated confidence levels, which can in turn help underpin the process of establishing risk appetite and translating it into business objectives and risk tolerances on the ground. The model outputs can also help to frame qualitative management considerations. For example, if the firm's excess capital comes within 10% of its risk appetite for target surplus, it may benefit from having a series of pre-planned options from which to choose. This would help it to choose a course of action that would enable it to increase surplus assets and hence reduce its risk in the most suitable way for the particular circumstances.

To ensure the validity of the economic capital evaluations, it is essential to integrate all the firm's businesses and their risks into an overall model – nothing can be missed. In practice, however, the diversification of many insurers means that they will continue to run multiple models and consolidate the results. The key question is how much consistency can be applied without losing sight of the particular risk characteristics of different parts of the business.

The objectives of particular models being used within the business will also vary. It is therefore important that model users fully understand the purpose for which results were produced and the associated limitations. For example, capital assessment, reserving and pricing models tend to use different risk distributions. It is therefore important to gauge how far these disparities could distort the basis for decision-making and therefore whether a particular model is useful for making a given decision.

Developing a truly economic framework that links decisions to risk-based capital requirements would require use of comparable risk-adjusted return measures such as Market Consistent Embedded Value (MCEV). Dividing changes in MCEV by economic capital could provide a better indication of the trade off between risk and reward and how this equates to the overall risk appetite than non risk-adjusted performance measures such as local GAAP profits over rating agency capital.

'Risk management is much more than models. The CRO Forum believes that risk models are indispensable for managing the business. However the risk models must be – and in many cases are already – complemented with Internal Controls, such as risk concentration limits on a notional gross and net basis, Probable Maximum Loss (PML) limits, or stress and scenario testing. Finally, there is no substitute for a deep understanding of the risks involved in the business – and for common sense.'

CRO Forum 'Comments on the financial crisis', 24.10.08

Ultimately, capital models cannot function in isolation. To appropriately safeguard and inform the business, the models need to be fully integrated into the overall ERM or risk management framework.

Appendix

Appendix A

Standards for internal model approval under Solvency II

Under Solvency II, insurers can elect to use an internal model for all or part of their solvency capital requirement (SCR) calculations, at a group or entity level. While no precise modelling approach is prescribed, approval depends on the ability of the company to conclusively demonstrate that it meets six key tests, as set out in the draft framework for Solvency II (Articles 118–123):⁶

- Use test: Senior management needs to understand, endorse and use the risk and capital evaluations from the internal model as a key basis for its business planning and strategic decision-making.
- Statistical quality: Evaluations need to be based on timely, reliable, consistent and comprehensive risk data and be underpinned by current, credible and verifiable risk assumptions.
- Validation: Evaluations and underlying assumptions need to be regularly sense-checked against actual experience. Companies also need to gauge the sensitivity of outputs to changes in key assumptions.
- Calibration: Outputs need to be calibrated to a 99.5% value at risk (VAR) or equivalent measure (if using TailVAR for instance) and benchmarked against market practice.
- Attribution: Companies need to regularly check whether the categorisation of risk and attribution of profit/loss in their models accurately reflects the causes and sources of profit/loss within business units.
- Documentation: Companies need to keep written and regularly updated records covering the design, operation, mathematical basis and underlying assumptions of their model.

In addition to these six tests, applicant companies will need to ensure that senior management will be responsible for putting systems in place to ensure that the internal model operates properly.

Appendix B

Summary of supervisory expectations regarding model validation issued by the US Comptroller of the Currency Administrator of National Banks⁷

‘Supervisors believe that the assessment of the costs and benefits of model validation is subjective and context-driven and is the responsibility of senior management. To promote a sound process, the Office of the Comptroller of the Currency (OCC) expects that formal policies ensure the following goals are met:

- Decision-makers understand the meaning and limitations of a model's results. Where the models are too abstract for non-specialists to understand the underlying theory, the bank must have a model reporting system in place that transforms the model's output into useful decision-making information without disguising the model's inevitable limitations.
- Particularly when a model has been in use for a reasonable period of time, its results are tested against actual outcomes.
- The bank should demonstrate a reasonable effort to audit the information inputs to the model. Input errors should be addressed in a timely fashion.
- The seniority of the management overseeing the modelling process should be commensurate with the materiality of the risk from the line of business in process.
- To the extent feasible, model validation must be independent from model construction.
- Responsibilities for the various elements of the model-validation process must be clearly defined.
- Modelling software should be subject to change-control procedures, so that developers and users do not have the ability to change code without review and approval by an independent party.’

⁶ Solvency II amended draft framework directive, published by the EC on 26.2.08.

⁷ US Comptroller of the Currency Administrator of National Banks ‘OCC 2000-16’ Bulletin, 30.05.00.

Contacts

If you would like to discuss any of the issues raised in this paper or find out more about how PricewaterhouseCoopers could help to strengthen your economic capital programme, please contact one of the authors listed below:

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- Insurance digest: Sharing insights on key industry issues, September 2008
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