




Economic Capital: Recent Market Trends and Best Practices for Implementation

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Hubert Mueller



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Overview

- Recent Market Trends
- Implementation Issues
- Economic Capital (EC) Aggregation

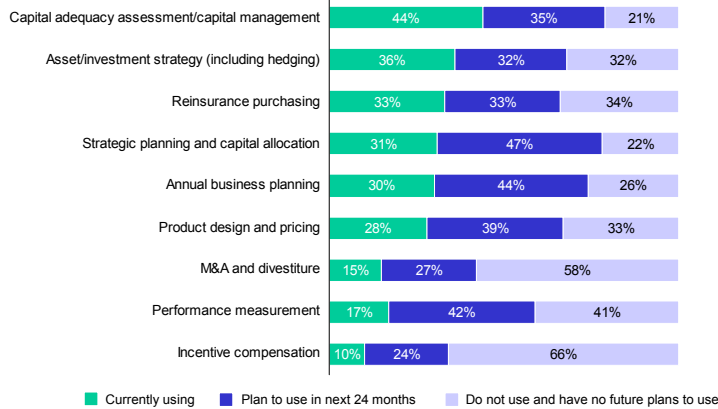
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Towers Perrin's recent ERM Survey produced six key findings

- Embedding ERM is proving to be a significant challenge.** Although companies have made progress in integrating ERM into their business, challenges remain. **55% of insurers believe that significant work is required in utilizing EC in decision making and 60% in utilizing EC in performance management**
- Size matters.** Larger insurers are significantly more advanced in most aspects of ERM implementation and are increasingly looking to realize their competitive advantage. **40% of large companies are already using EC in product design and pricing decisions, with another 42% planning to do so within two years**
- European insurers are better positioned. North American insurers are trailing their European counterparts in key aspects, such as EC implementation and its use in decision making.** Under Solvency II, these capabilities are expected to lead to lower capital requirements and therefore competitive advantage
- ERM is influencing decisions.** In spite of the challenges of embedding ERM, significant numbers of respondents indicate that their ERM program has resulted in key business changes, including such aspects as risk strategy or appetite (36%), asset strategies (35%) and product pricing (31%)
- Economic Capital standards are emerging. EC methodology is moving toward a one-year VaR approach, using a market-consistent terminal balance sheet**
- Operational risk remains a weak spot.** Just 7% of participants believe they have an appropriate capability in place, and 37% indicate that significant work is required. **Operational risk also lags behind other risks in terms of setting risk limits and EC calculation methodology**

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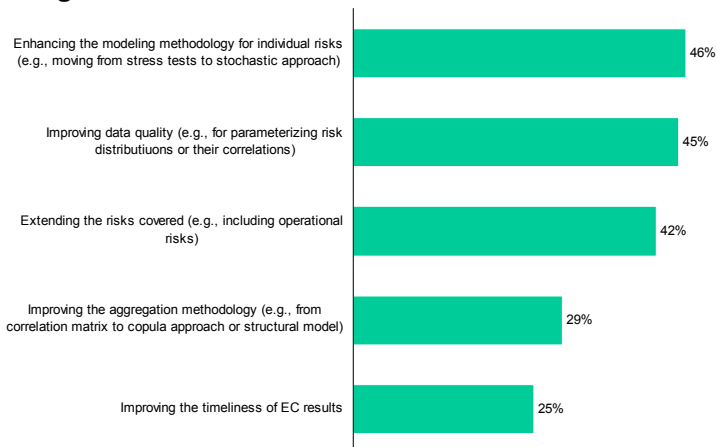
Utilization of EC in decision making is set to change dramatically over the next two years



Source: Towers Perrin ERM Survey

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Planned EC model improvements remain focused on core factors — individual risk modeling, data quality and completeness of risk coverage



Source: Towers Perrin ERM Survey

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Two approaches have emerged as the most common ways to define EC

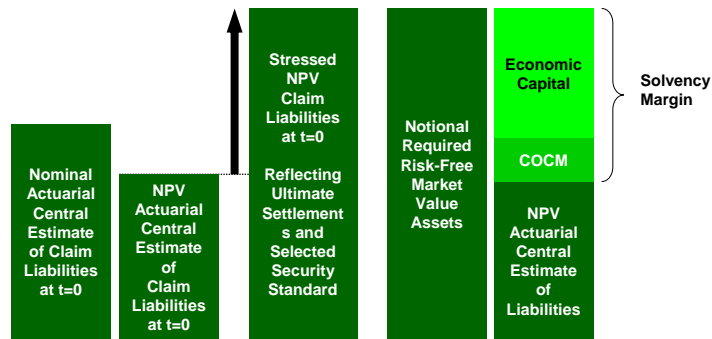
- A liability runoff approach
 - The level of total initial assets, less some measure of reserves for liabilities, required to pay all future policyholder benefits at the chosen confidence level
- A one-year mark-to-market approach
 - The level of assets, in addition to the market value of liabilities, needed to cover a fall in the market value of net assets over a one-year time horizon at the chosen confidence level
- In deciding on which approach to use, insurers need to consider a number of factors:
 - Objectives and intended applications of EC framework
 - Constraints (in implementation and ongoing)
 - Nature of the business and underlying risks

EC objectives are often similar for life and non-life insurers, but constraints, nature of the business and underlying risks tend to differ

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In the run-off view, the claim liabilities are stressed to determine the solvency margin

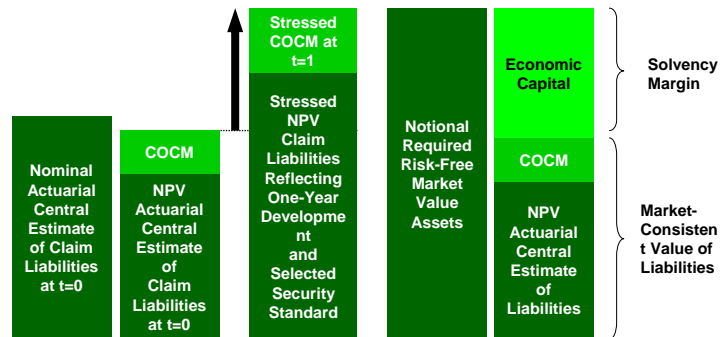
- Since there is a presumption that the liabilities will be held to maturity, all assets in excess of the liabilities are available as a solvency margin



* COCM = Cost of Capital Margin

In the economic (one year) view, the market-consistent values of the liabilities are stressed to determine the solvency margin

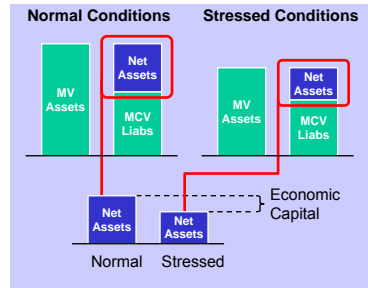
- Since there is a presumption that the liabilities will be transferred, only the assets in excess of the market-consistent value of the liabilities are available as a solvency margin



Market-consistent balance sheet approach is becoming most common method to calculate EC globally

Economic Capital is...

- Measured as the difference in “market-consistent net assets” between normal conditions and stressed conditions
 - A set of stress tests is applied for each risk, calibrated to a probability level over a one-year time horizon, consistent with the company’s financial strength rating
 - For AA-rated companies, 99.95% is often used
- Separate stresses are applied to cover a variety of market, credit and insurance risks that might occur over the projected one-year time horizon
- Using a set of market-consistent scenarios
- Results are typically aggregated using a correlation matrix or an EC Aggregator



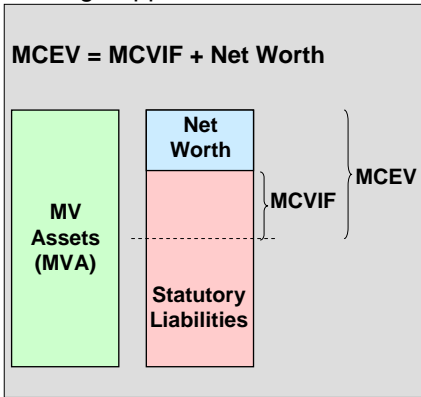
Commonly used in Europe, increasingly used among life insurers in North America

Leading-edge companies are leveraging EC to connect risk and value

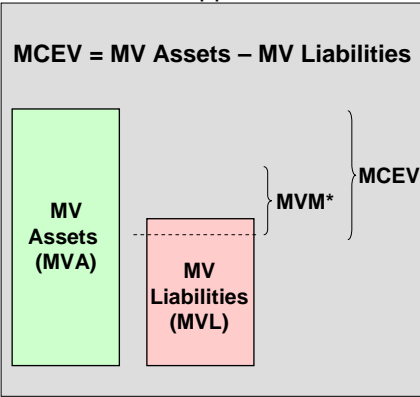
- Increased focus on allocation of capital for performance management purposes
 - EC as required capital for EEV/MCEV calculations
 - EC is the core component for measuring risk in a market-consistent financial management framework
 - Increasingly common as a metric for short-term/long-term incentive plans
- Use of EC for business planning/investment allocations
 - EC budgets are set by business segment
 - Economic balance sheet provides the link between EC and MCEV
- Use of EC in market-consistent pricing
 - Often used for products with significant tail risk
 - May require projection of EC at annual intervals
- EC is seen as a core component of ERM framework
 - EC is a key metric for quantifying risk in an ERM framework
 - Rating agencies are increasingly considering proprietary EC models when assessing capital adequacy

The economic balance sheet provides the link between EC and Market Consistent Embedded Value (“MCEV”)

Earnings Approach:

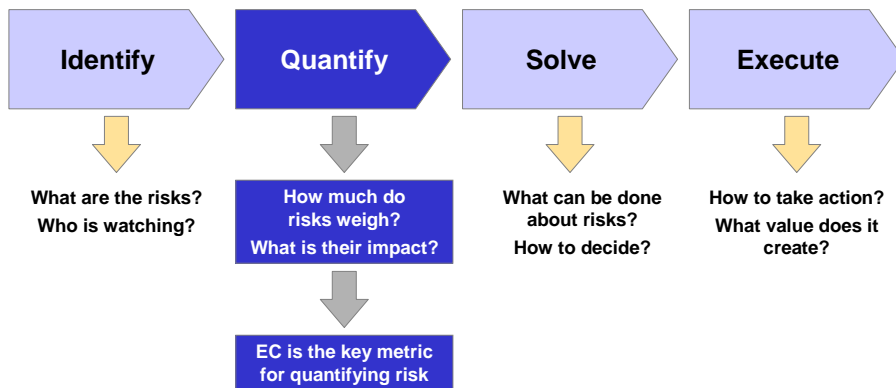


Balance Sheet Approach:



* MVM = Market Value Margin

EC is a key metric for quantifying risk in an ERM framework



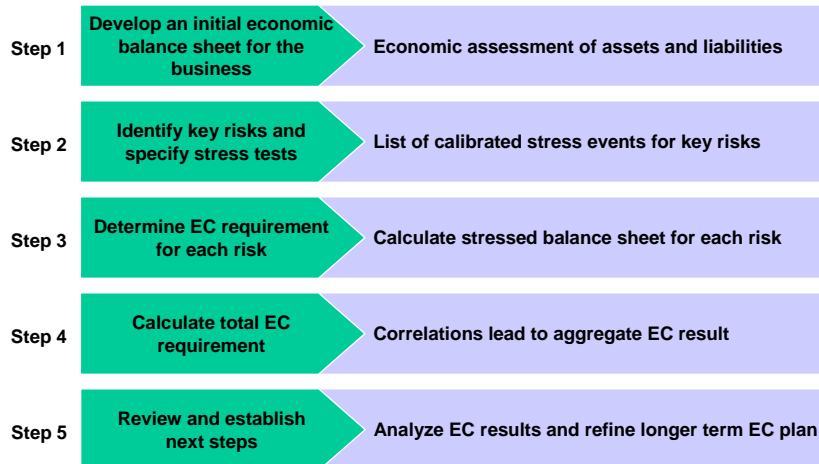
When implementing EC, a series of questions need to be addressed

| Decision 1: Period for Assessment | Decision 2: Definition of Capital | Decision 3: Measure of Risk | Decision 4: Risks to Include | Decision 5: Quantification Methodology | Decision 6: Aggregation |
|--------------------------------------|--------------------------------------|--------------------------------|---------------------------------|---|----------------------------|
| One year | Statutory | VaR | Market | Stochastic Modelling | Aggregator |
| n years | GAAP | TVaR or CTE | Credit | Stress Testing | Variance/Covariance |
| Runoff of portfolio | Economic | Risk of ruin | Insurance | Factor-based | Copulas |
| | | | Operational | | |
| | | | Residual | | |

One-year stress testing approach has been implemented by a majority of multinational insurers and adopted/proposed for: UK ICA regime, Swiss Solvency Test, Solvency II.

It is also becoming the dominant approach used by North American life insurers.

Calculating EC via stress testing: Five stages to implementing the EC approach



Step 1: Develop an Initial Economic Balance Sheet for the Business

Typical implementation issues

- Choice of risk-free rate
 - Swaps vs Treasuries
 - Minimum Cost Replicating Portfolio (“MCRP”)
- Modeling complexity driven by presence of financial options and guarantees
 - Stochastic modeling for products with financial options and guarantees
 - Certainty equivalent calculation for products without optionality
- Risk neutral scenarios
 - Calibration
 - Level of detail (e.g., for assets with credit risk)
 - Volatility calibration (term structure versus surface)
- Other considerations in market-consistent valuations
 - Dynamic policyholder behavior
 - Crediting Strategy
 - Dynamic management actions
 - Allowance for non-financial risk
 - Treatment of reinsurance

Step 2: Identify Key Risks and Specify Stress Tests

Typical implementation issues

- Confidence level to use for calibration of scenarios
 - Link to overall risk appetite
 - Typically set consistent with a target financial strength or credit rating
- Risks to include
 - Focus on largest risks
 - Factor or gross-up approach often used for operational risk in initial calculations
- Number of stresses for each risk
- Level of detail needed to model explicitly for each risk
 - e.g., mortality risk - catastrophe, trend, mis-estimation, volatility
 - e.g., credit risk - default, spread, migration, counterparty risk
- Developing risk distributions / calibration in the tail
 - Limited data availability, especially with respect to tail events
 - By making assumptions about the distribution of risks, tail events can be derived from more central parts of the distribution
- Allowance for non-hedgeable (residual) risk (“NHR”)
 - Should include both financial and non-financial NHR
 - Allowance via increase in required EC, or
 - Development of a Market Value Margin (MVM) in economic B/S

Step 3: Determine EC Requirement for Each Risk

Typical implementation issues

- Model requirements
 - Possible model enhancements needed to allow for stresses
 - Dependent on level of detail of subrisks and corresponding stress parameters
- For practical purposes, most companies perform calculations of stresses at time zero
 - Some companies stretch out equity shocks over a full year (Brownian Motion)
- Level of assets to stress
 - Total balance sheet assets versus assets backing economic liabilities
- Allowance for management actions
 - Consider dynamic policyholder behavior
- Ability to recalculate assets at time zero, especially for assets with optionality
 - Martingale Test
- Smart modeling techniques increasingly being used to reduce runtime
 - Replicating portfolio of assets
 - Representative scenarios

Step 4: Calculate Total EC Requirement

Typical implementation issues

- Choice of correlation factors should be weighted towards the higher correlations that typically arise in more extreme scenarios
 - Solvency II (QIS4) factors commonly used
 - Use of copulas becoming more common
- Level of aggregation
 - Across lines of business
 - Across subrisks and risks
 - Across legal entities
 - Need to consider capital fungibility
- Correlation factors
 - External sources, e.g.
 - Solvency II (QIS3/QIS4)
 - CRO Forum
 - Standard & Poor's
 - ABI (UK)
 - Internal data such as experience studies
- Leading-edge companies (mainly in Europe) are implementing "EC Aggregator" Tool
 - Combines the distributions of risks
 - Allows real-time updates to reflect significant market events

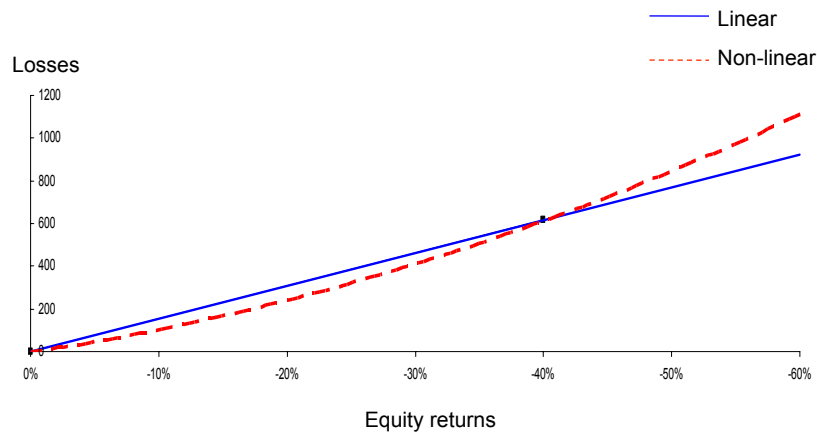
Step 5: Review and Establish Next Steps
Analysis provides valuable insights and identifies areas for improvement

- Review and analyze EC results
 - Important that underlying drivers are understood
 - Communication to management to get buy-in
- Back testing
 - Robustness of EC approach
 - Sensitivity to correlations and major stress parameters
- Some companies calculate EC on both bases (real-world runoff and one year stress test) to check for reasonableness of results
- Typical next steps for EC implementation
 - Refine long term plan
 - Ensure continued buy-in by senior management
 - Continue to take steps to embed and use EC within organization, e.g.
 - Risk monitoring and control
 - Performance measurement and management
 - Risk-based pricing (using risk budgets)
 - Capital allocation/management
 - Incentive compensation

Non-linearity can have a significant impact on EC

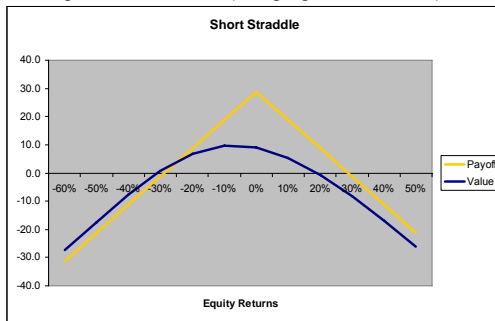
EXAMPLE

Linear and non-linear losses



Calibration of stresses usually assumes monotonic loss functions

- Ultimately, Economic Capital needs to be derived from a distribution of losses (required capital), but stress calibration focuses almost exclusively on the risk distributions
 - Assumes xth percentile of the risk distribution translates into the xth percentile on the loss distribution
- Assumption often reasonable, but not always e.g., where complex risk mitigation strategies are involved (hedging, reinsurance)



Important to distinguish between risk distribution and loss distribution

The impact of two risks occurring at the same time is generally different from the sum of the individual impacts

EXAMPLE

Losses from equity and interest rate movements

Separability assumption

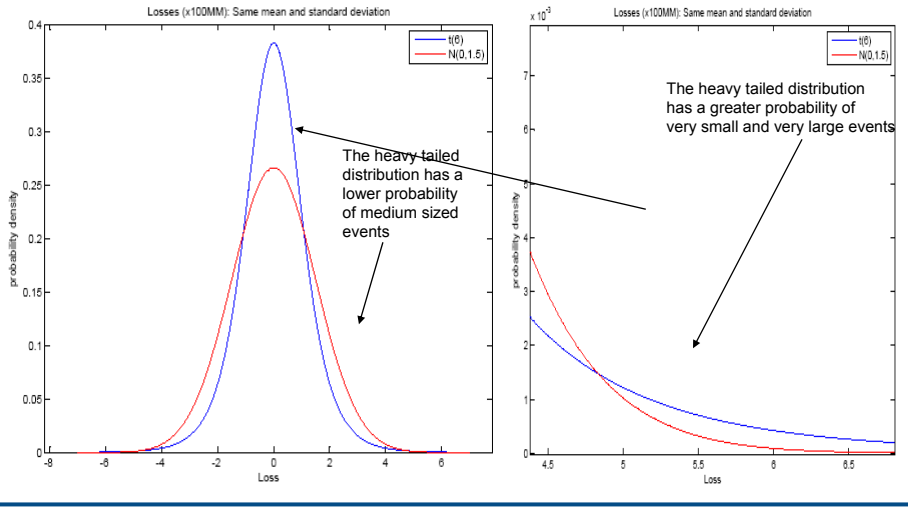
Actual joint stresses

| Equity movement | | Yield curve movement (bps) |
|-----------------|------|----------------------------|
| -40% | -30% | |
| 616 | 0 | 0 |
| | | -50 |
| | | -100 |
| | | -150 |
| 1,069 | 453 | -200 |

| Equity movement | | Yield curve movement (bps) |
|-----------------|------|----------------------------|
| -40% | -30% | |
| | | 0 |
| | | -50 |
| | | -100 |
| | | -150 |
| 1,191 | | -200 |

10% underestimation

"We are seeing things that were 25-standard deviation events, several days in a row"



Significance of these issues will depend on insurer's business and its plans for using Economic Capital

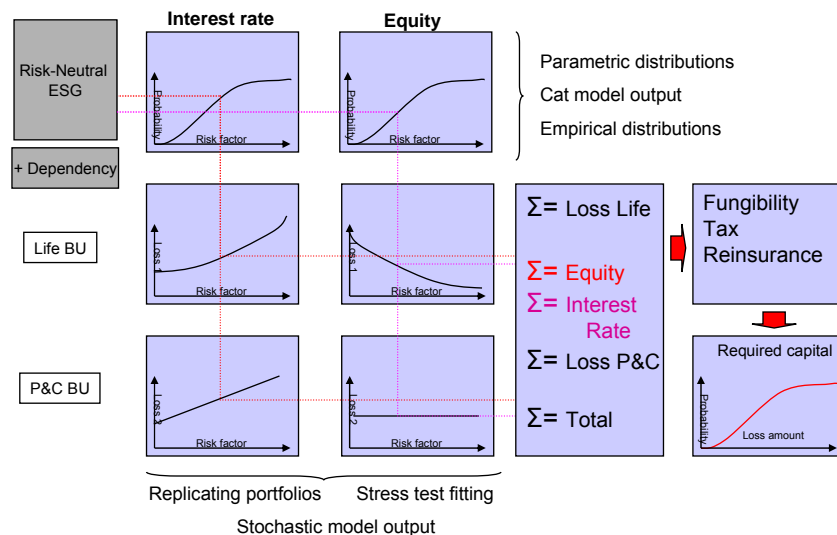
- For relatively simple business, these issues may not be very significant and adjustments may be possible
 - Importance of understanding underlying assumptions and implications for results
- However, in most instances these assumptions are not just theoretical, but pose practical challenges for the insurer
 - Difficult to aggregate results in a reasonable manner
 - Cannot properly allocate capital down to business unit, product and risk level
- Consequently, the usefulness of the results is limited, in particular where a granular allocation of capital is required, e.g.,
 - Product pricing
 - Performance measurement
 - Incentive compensation
 - Risk monitoring and mitigation strategies

Demonstrating use of the EC results is critical for rating agency and regulator recognition of internal models

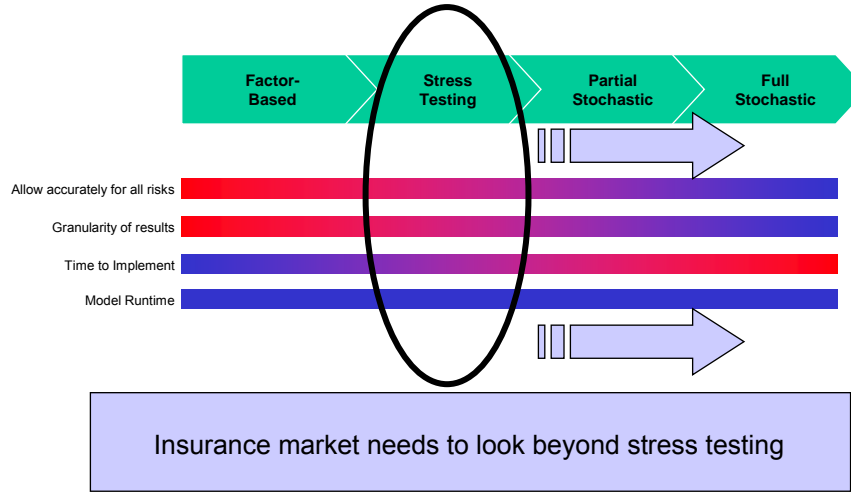
Leading edge insurers are beginning to adopt more sophisticated implementation approaches for EC

- In order to benefit from the full potential of EC as a risk management tool, insurers need to be able to calculate EC
 - Quickly
 - At a sufficiently granular level of detail
 - In a way that allocates diversification benefits in a sensible manner
- Insurers are developing implementation approaches that address the practical limitations of the stress testing approach
 - Clear separation of risk distributions and loss distributions
 - Linked by explicit loss functions – which are not restricted to linear
 - Use of stochastic modeling to develop full loss distributions
 - Risk interrelationships captured by structural model
 - Produces very granular output that can handle group level issues
- Existing stress testing frameworks are forming the foundation for these newer implementation approaches
 - Use existing stress testing infrastructure to develop loss functions
 - Expand calibration of stress events to specification and parameterization of risk distributions
 - Additional use of replicating portfolio modeling approaches (if needed)

Aggregation of risks via EC Aggregator Tool



With these new approaches, insurers are able to move further along the continuum



Contact

Hubert Mueller, FSA MAAA CERA

Principal
Towers Perrin
175 Powder Forest Drive
Weatogue, CT 06089-9658
USA

Telephone: 1-860-843-7079
Fax: 1-860-843-7001

E-Mail: hubert.mueller@towersperrin.com
Internet: www.towersperrin.com