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**ERM Symposium
April 2009**

Q2-Advanced Economic Capital

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**Moderator
Hubert Mueller**

Advanced Economic Capital

2009 ERM Symposium
Chicago April 30, 2009

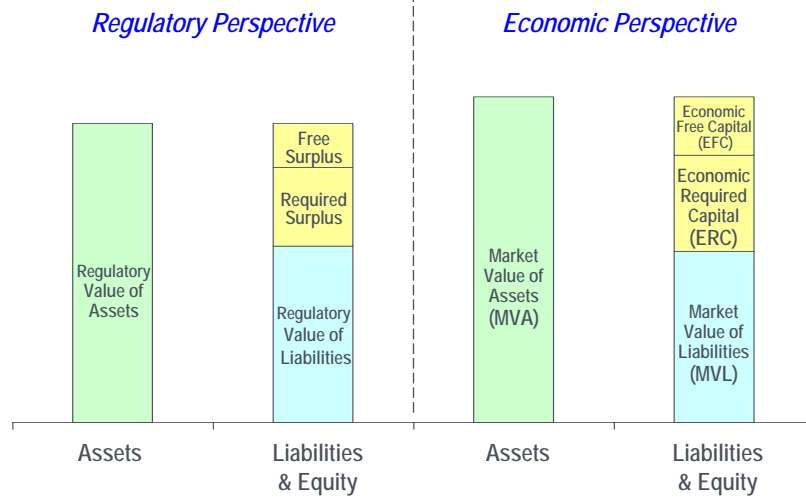
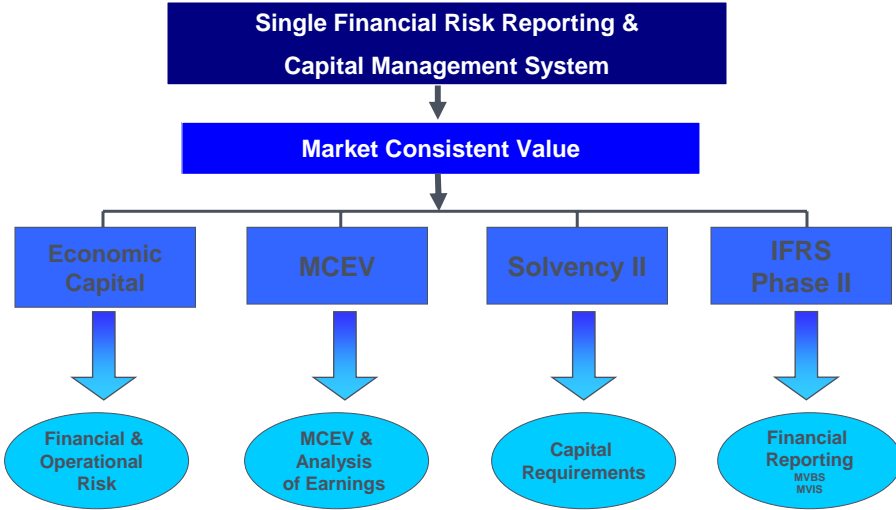
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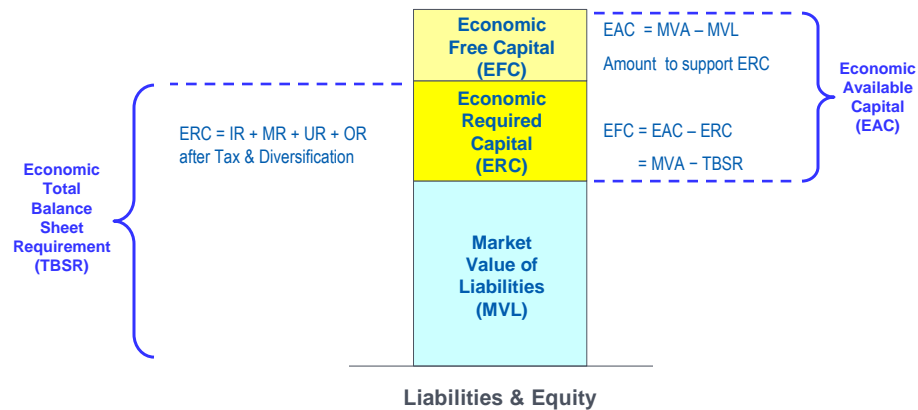
Introduction

- AEGON Context
- Some EC/MCEV Basics
- Advanced Topics
 - Replicating Portfolios
 - **Income Tax : Going Concern vs Exit Value**
 - Fair Value Margins

- Large Multinational Life Insurer
- Based in The Hague NL
- Subject to evolving European regulatory and accounting standards
- AEGONUSA is roughly 75% of the company
- Other markets UK, NL, Canada & others

- Market Value Balance Sheet & Economic Capital since 2006 (internal reporting)
- Market Value Framework applies to all products and all countries
- Current mega-project underway to integrate all financial reporting and build reporting requirements from one core economic model
 - Market Value Balance Sheet (MVBS)
 - Market Value Income Statement (MVIS)
- MCEV
 - “Going Concern” Balance Sheet approach
 - under development





- o MVBS Reporting
- o Economic Capital
 - Extreme Tail Event
- o Risk Governance: Risk Escalation Limits
 - 1-in-10 year event
 - Same process as Economic Capital, but different %-ile
- o Pricing:
 - Premium – Acquisition Expenses > MVL
- o M&A
 - Similar to Pricing
- o MCEV

Coming Soon

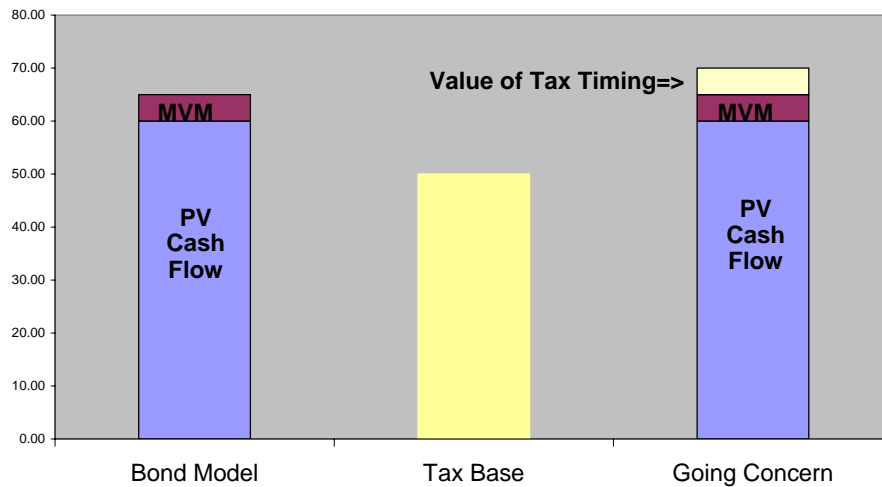
- o Performance metrics

- o Balance sheet approach to MCEV
- o Can demonstrate that MCEV = EAC (with a couple of minor adjustments) under the following conditions:
 - Scenario alignment (risk-neutral)
 - Coverage alignment
 - MVL includes Cost of Residual Non Hedgeable Risk (Market Value Margin) that aligns with MCEV with respect o:
 - Risk shocks
 - Risk charge
 - Diversification treatment
 - MVA & MVL reflect the risk-neutral present value of future tax payments on a “**going concern**” basis
 - MVL reflects the “frictional cost” of holding “Regulatory TBSR” or “Rating Agency TBSR” in excess of “Economic TBSR”
 - Frictional cost = Taxes on investment earnings + investment expenses

- o “Exit Value” or “Bond” Model
 - Transfer Price = RNPV { Cash Flows + Margins + ... }
 - Deferred Tax = Tax Rate x [Tax Base – Transfer Price]
 - Market Value = Transfer Price + Deferred Tax

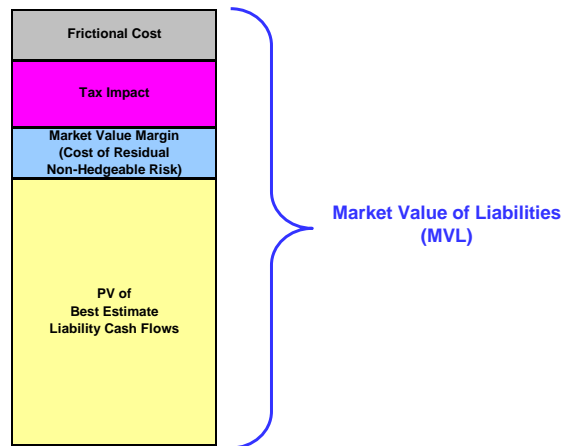
This is the right thing to do if the tax base resets to transfer price on sale.
- o “Going Concern” Model – price at which we are indifferent between manufacturing the liability ourselves or paying someone else
 - Market Value = RNPV { Cash Flow + Margins + Taxes + ... }
 - Solve for Transfer Price in the equation
 - Market Value = Transfer Price + Tax Rate x [Tax Base – Transfer Price]
- o Key difference is the value of tax timing differences

Typical Payout Annuity Situation



- In the US, the tax base of an insurance liability does not change when it is transferred from one insurer to another
- “Bond Model” does not apply
- Need to use “Going Concern” for both IFRS, MCEV and actual transfers
 - Consistent with traditional actuarial appraisal concepts
- In Europe, tax base of an insurance liability resets on sale
- “Bond Model” does apply
- Use “Bond Model” for IFRS and “Going Concern” for MCEV
- In theory, same considerations apply to assets
- “Bond Model” for IFRS assets in all jurisdiction,
- “Going Concern” for MCEV
- Question: Which balance sheet do you manage to?

- Going Concern Transfer Price exceeds Bond Model price when tax base on average less than Transfer Price
 - Example: US Payout Annuity with high tax valuation interest rate
- Going Concern Transfer Price less than Bond Model price when tax base greater than transfer price on average
 - Often the case for US life insurance liabilities
- Inclusion of the Tax Timing Difference component in the liability often makes it longer from an A/L M perspective
 - Even simple liabilities become sensitive to interest rate volatility assumptions
- Need to project future tax environment adds another actuarial assumption to the risk list



- Market Value Income
 - Change in MVA minus change in MVL
 - Adjusted for liability cash flows
 - Adjusted for taxes
 - Adjusted for capital movements
- Movement analysis for MVBS
- Rows aligned with MCEV Analysis of Earnings
- MCEV Analysis of Earnings Columns require a one-period roll-forward of traditional Distributable Earnings
- Custom design of additional columns for internal reporting



Thank you

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 TOWERS PERRIN

Economic Capital

Recent Market Trends and Implementation Issues

April 30 – May 2, 2009
ERM Symposium
Chicago, IL

Hubert Mueller, Towers Perrin

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Overview

- Recent Market Trends
- Implementation Issues
- Additional Considerations for Stress Testing Approach

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RECENT MARKET TRENDS

Towers Perrin's 2008 ERM Survey produced six key findings

1. **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**
2. **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**
3. **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
4. **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%)
5. **Economic capital ("EC") standards are emerging. EC methodology is moving toward a one-year VaR approach, with the majority (56%) using a market-consistent terminal balance sheet**
6. **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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RECENT MARKET TRENDS

Key Finding #5:
Economic capital standards are emerging

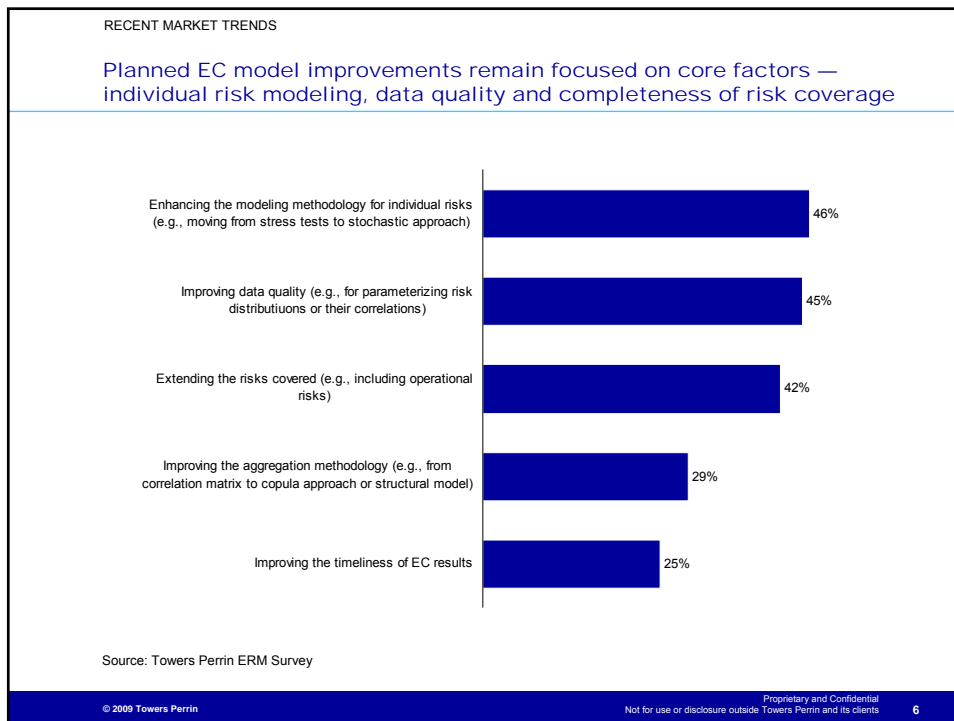
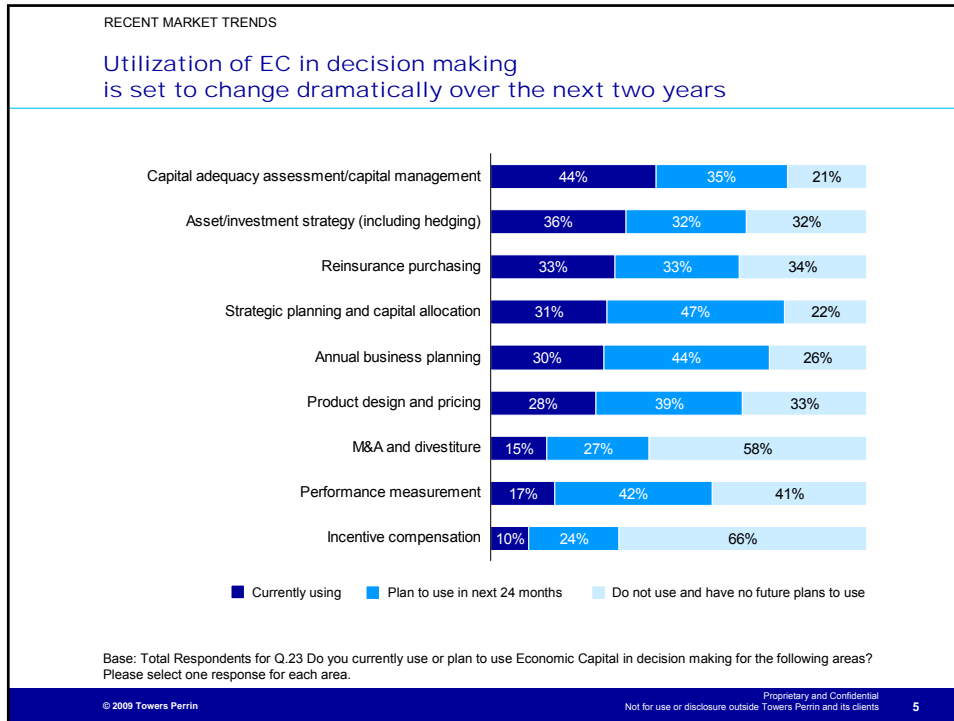
- EC methodology is moving toward a one-year VaR approach, with the majority (56%) using a market-consistent terminal balance sheet
 - There has been a substantial global shift toward calculating EC base risk over a one-year risk assessment period, from 32% of participants in 2004, to 56% in 2006 and 68% in 2008
 - Even in North America, where this approach is less common, the percentage has increased from 43% in 2006 to 57% in 2008
 - While 85% of larger insurers apply a one-year risk assessment period, a significant percentage of medium-size (35%) and smaller (39%) companies continue to use alternative methods, including a two- to five-year time horizon and the runoff of the portfolio
 - The use of VaR or Risk of Ruin as the primary measure of risk tolerance used to calculate EC has increased from 52% in 2004 to 67% in 2008. During the same period, the use of TVaR or CTE has fallen from 31% to 21%
 - The growing popularity of VaR is consistent across the industry with only marginal differences observed among smaller (61%), medium-size (69%) and larger (75%) firms
 - VaR is most often adopted as a risk measure among multilines (81% of respondents), whereas TVaR is most commonly used among reinsurers (33%) and life insurers (28%)
 - Although the use of a market-consistent terminal balance sheet is common among multilines (85%) and life (67%) companies, just 37% of P/C insurers adopt this approach

Source: Towers Perrin ERM Survey

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RECENT MARKET TRENDS

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 as well as the nature of the business and underlying risks tend to differ

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RECENT MARKET TRENDS

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

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RECENT MARKET TRENDS

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

The diagram illustrates the components of Economic Capital and Market-Consistent Value of Liabilities. It features several vertical bars and brackets. On the left, a bar represents 'Nominal Actuarial Central Estimate of Claim Liabilities at t=0'. Next to it is a bar for 'COCM' (Current Outstanding Claim Margin), which is the difference between the nominal liabilities and the 'NPV Actuarial Central Estimate of Claim Liabilities at t=0'. To the right, a bar represents 'Stressed NPV Claim Liabilities Reflecting One-Year Development and Selected Security Standard', which is the sum of the stressed liabilities and the 'Stressed COCM at t=1'. Further right, a bar represents 'Notional Required Risk-Free Market Value Assets'. To its right, a bar represents 'NPV Actuarial Central Estimate of Liabilities'. A bracket on the far right groups the 'Notional Required Risk-Free Market Value Assets' and 'NPV Actuarial Central Estimate of Liabilities' as the 'Market-Consistent Value of Liabilities'. Another bracket groups the 'Economic Capital' (the difference between the notional assets and the stressed liabilities) and the 'COCM' as the 'Solvency Margin'. An upward-pointing arrow indicates the transition from the nominal liabilities to the stressed liabilities.

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RECENT MARKET TRENDS

Market-consistent balance sheet approach is becoming most common method to calculate EC in North America

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 aggregated using a correlation matrix or an EC Aggregator

The diagram compares 'Normal Conditions' and 'Stressed Conditions'. Under 'Normal Conditions', there are two bars: 'MV Assets' and 'MCV Liabs'. The difference between them is 'Net Assets'. Under 'Stressed Conditions', there are two bars: 'MV Assets' and 'MCV Liabs'. The difference between them is 'Net Assets'. A dashed line connects the 'Net Assets' bar in the normal condition to the 'Net Assets' bar in the stressed condition. The difference between these two 'Net Assets' bars is labeled as 'Economic Capital'.

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

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RECENT MARKET TRENDS

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 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
 - Principles-based regulation 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

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RECENT MARKET TRENDS

The economic balance sheet provides the link between EC and market-consistent EV (*MCEV*)

Earnings Approach:

$$\text{MCEV} = \text{MCVIF} + \text{Net Worth}$$

Balance Sheet Approach:

$$\text{MCEV} = \text{MV Assets} - \text{MV Liabilities}$$

* MVM = Market Value Margin

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IMPLEMENTATION ISSUES

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, EU Solvency II.

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

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IMPLEMENTATION ISSUES

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

Step 1	Develop an initial economic balance sheet for the business	Economic assessment of assets and liabilities
Step 2	Identify key risks and specify stress tests	List of calibrated stress events for key risks
Step 3	Determine EC requirement for each risk	Calculate stressed balance sheet for each risk
Step 4	Calculate total EC requirement	Correlations lead to aggregate EC result
Step 5	Review and establish next steps	Analyze EC results and refine longer term EC plan

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IMPLEMENTATION ISSUES

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

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IMPLEMENTATION ISSUES

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

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IMPLEMENTATION ISSUES

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

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IMPLEMENTATION ISSUES

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 increasingly being used
 - Use of copulas are 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
- Some leading-edge companies (mainly in Europe) are implementing "EC Aggregator"
 - Combines the distributions of risks
 - Captures non-linear losses

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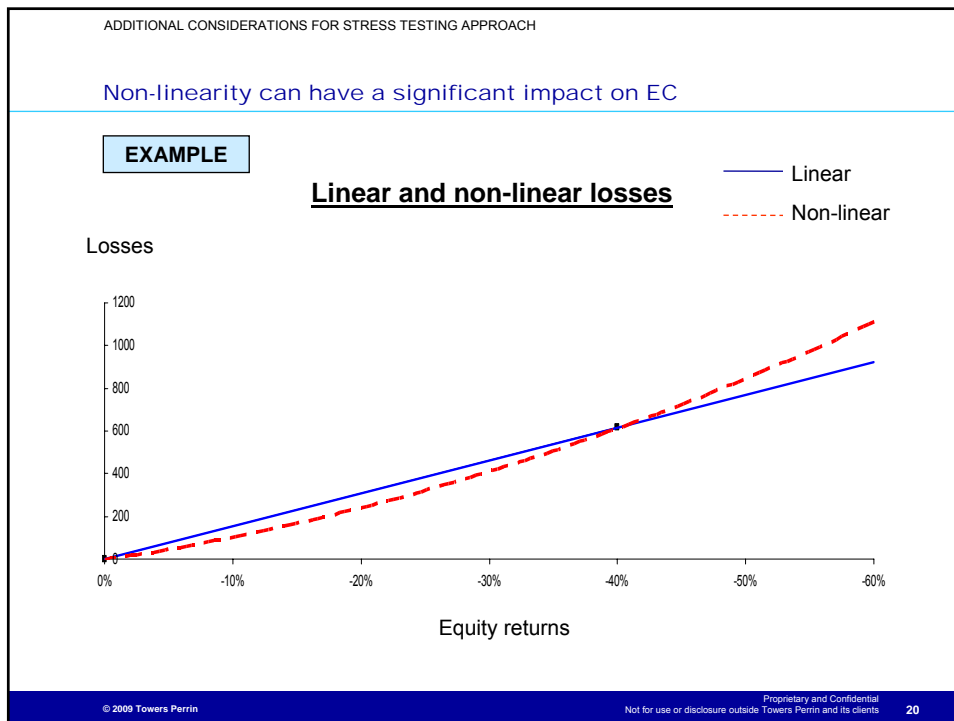
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IMPLEMENTATION ISSUES
Step 5: Review and Establish Next Steps
 Analysis provides valuable insights and identifies areas for improvement

- 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
 - 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

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ADDITIONAL CONSIDERATIONS FOR STRESS TESTING APPROACH

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

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ADDITIONAL CONSIDERATIONS FOR STRESS TESTING APPROACH

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

EXAMPLE

Losses from equity and interest rate movements

Separability assumption

Equity movement

Equity	-40%	-30%	-20%	-10%	0	0
Yield curve (bps)	616				0	-50
						-100
						-150
						-200
	1,069			453		

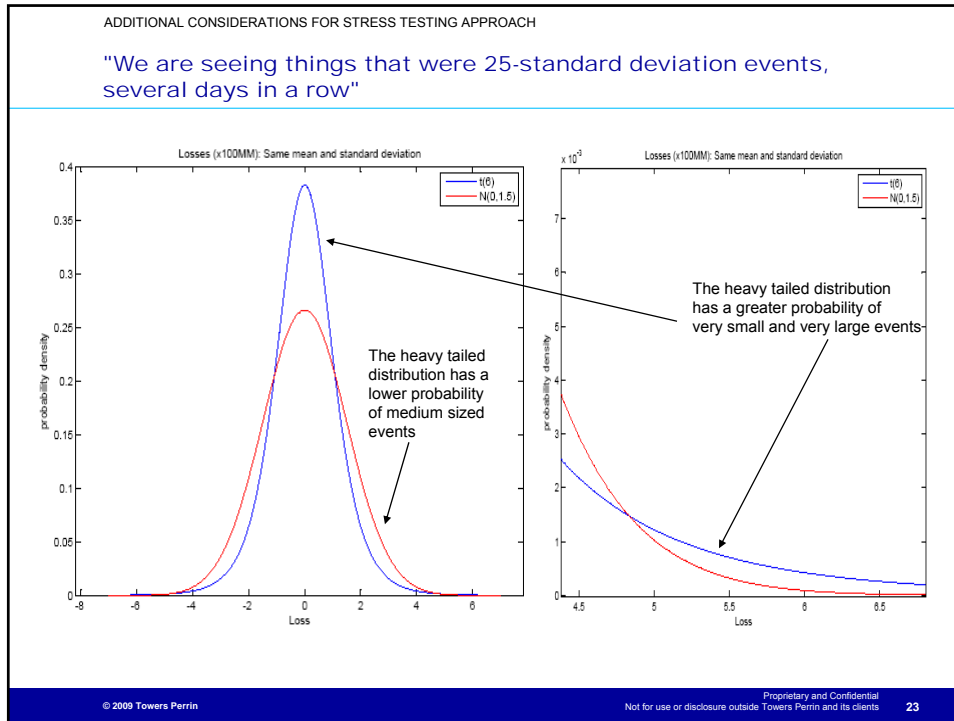
Actual joint stresses

Equity movement

Equity	-40%	-30%	-20%	-10%	0	0
Yield curve (bps)					0	-50
						-100
						-150
						-200
					1,191	

10% underestimation

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- ADDITIONAL CONSIDERATIONS FOR STRESS TESTING APPROACH
- 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
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ADDITIONAL CONSIDERATIONS FOR STRESS TESTING APPROACH

Leading edge insurers are beginning to adopt more sophisticated implementation approaches

- 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)

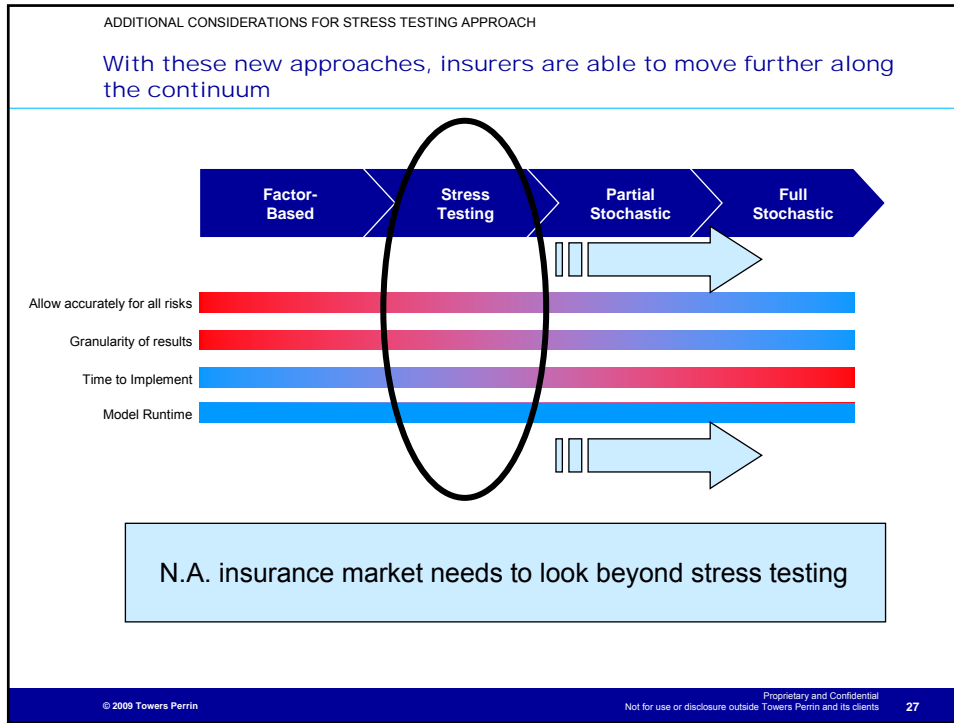
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ADDITIONAL CONSIDERATIONS FOR STRESS TESTING APPROACH

Aggregation of risks via EC Aggregator

The diagram illustrates the process of aggregating risks via an EC aggregator. It begins with 'Replicating portfolios' (Stochastic model output) for Interest rate, Equity, Life BU, and P&C BU. These feed into 'Stress test fitting' (Parametric distributions, Cat model output, Empirical distributions). The outputs are summed: $\Sigma = \text{Loss Life}$, $\Sigma = \text{Equity}$, $\Sigma = \text{Interest Rate}$, $\Sigma = \text{Loss P\&C}$, and $\Sigma = \text{Total}$. This leads to 'Fungibility Tax Reinsurance' and finally 'Required capital'.

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