

Solvency 2 – ERM in practice

Enterprise Risk Management for Actuaries
GCAE/Hellenic Actuarial Society Summer
School
Samos – July 2010

Introduction to Solvency II

Background



- Closely follows on the heels of Basel II capital regulations for the banking industry
- Based on principles and not rules
- Risk management function is a necessity (increased risks which have to be analysed and taken into consideration in correlation with insurance risks)
- Principal objectives
 - Deepen the Single Market (harmonisation and consistency in calculations, supervision and disclosures)
 - Enhance policyholder protection
 - Improve (international) competitiveness of EU insurers
 - Further better regulation (full separation and analysis of risks, more accurate and fair calculation of technical reserves)

Introduction to Solvency II

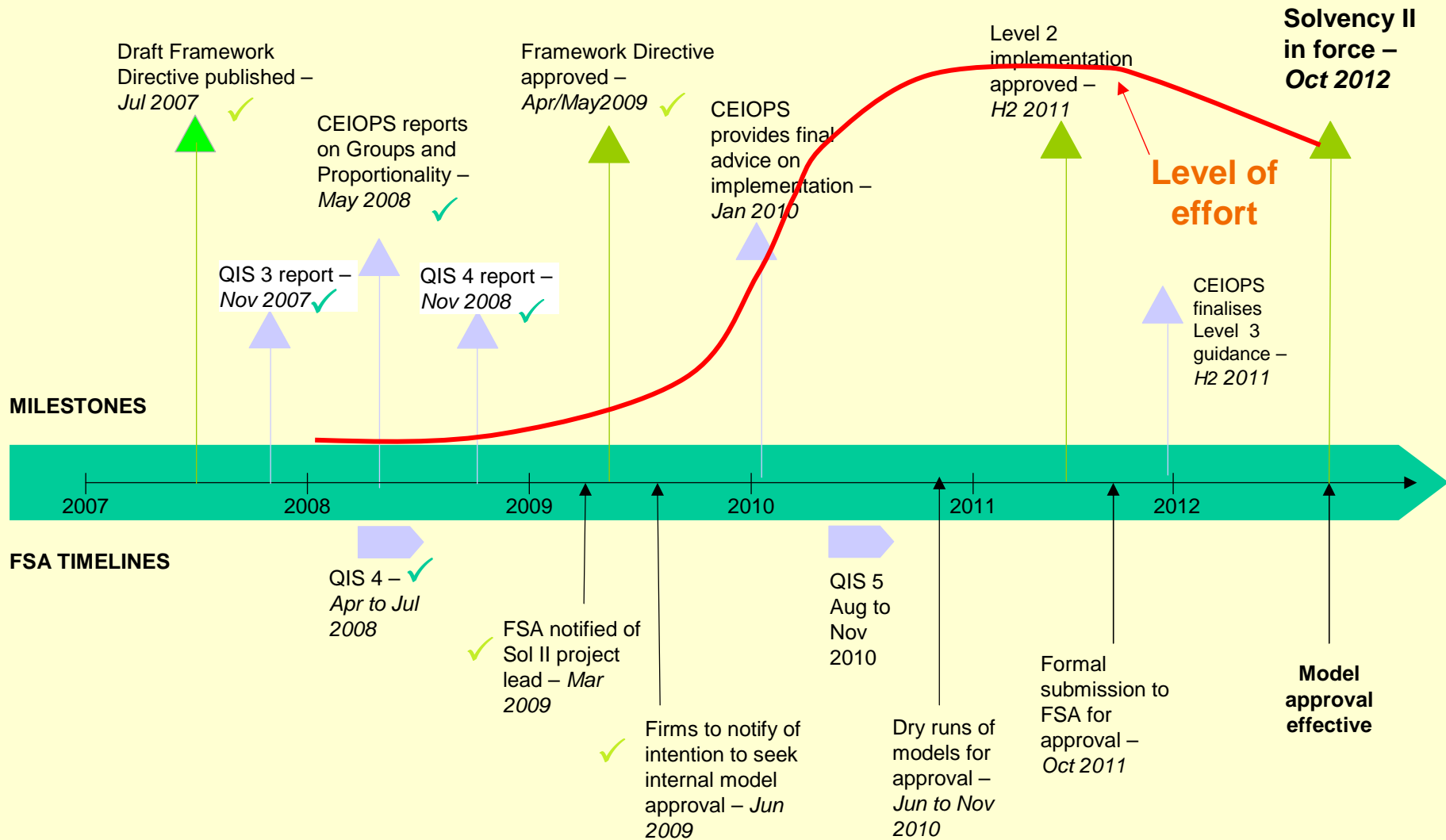
Background



- Key features of Solvency II are :
 - Risk-based approach
 - Integrated approach for insurance provisions and capital requirements
 - Comprehensive framework for risk management
 - Capital requirements defined by a standard approach or internal model
 - Recognition of diversification and risk mitigation
 - Unified legislative basis for prudential regulation of insurers and reinsurers
 - Non-zero failure regime
 - Link to International Accounting Standards Board's work on insurance contracts
- To be implemented under the Lamfalussy structure

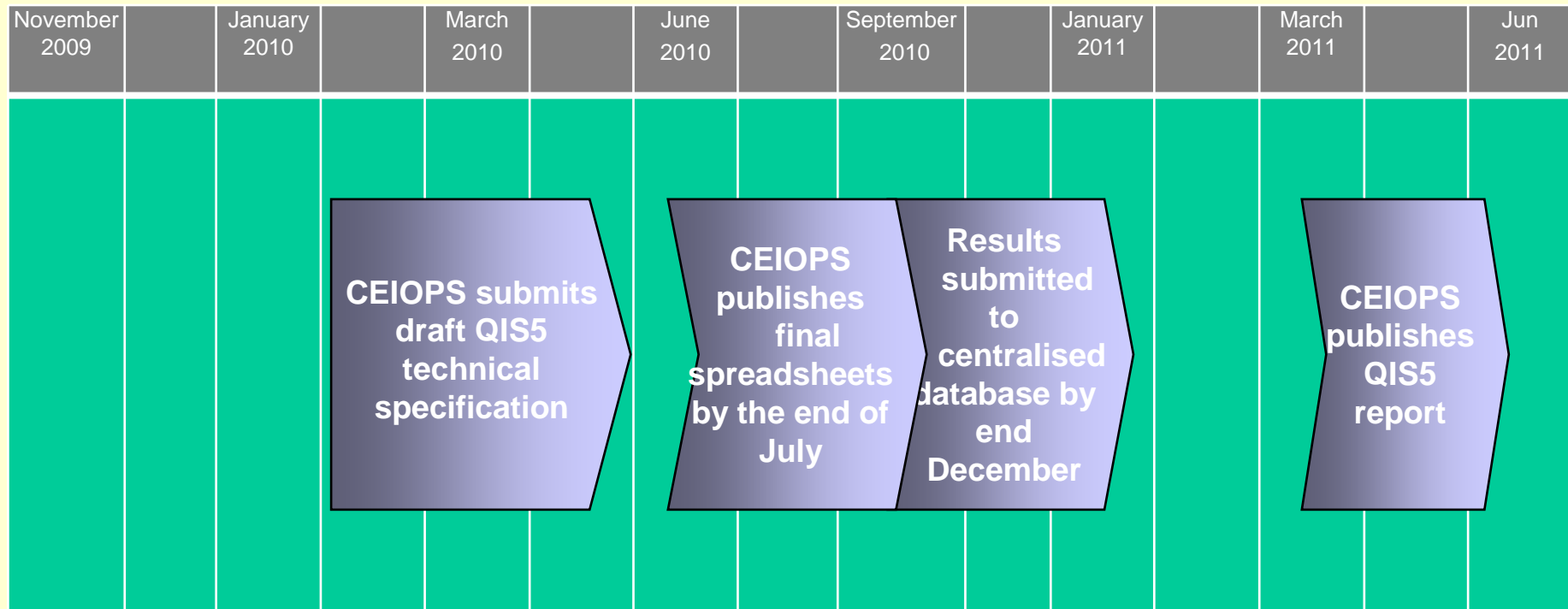
Introduction to Solvency II

The timeline



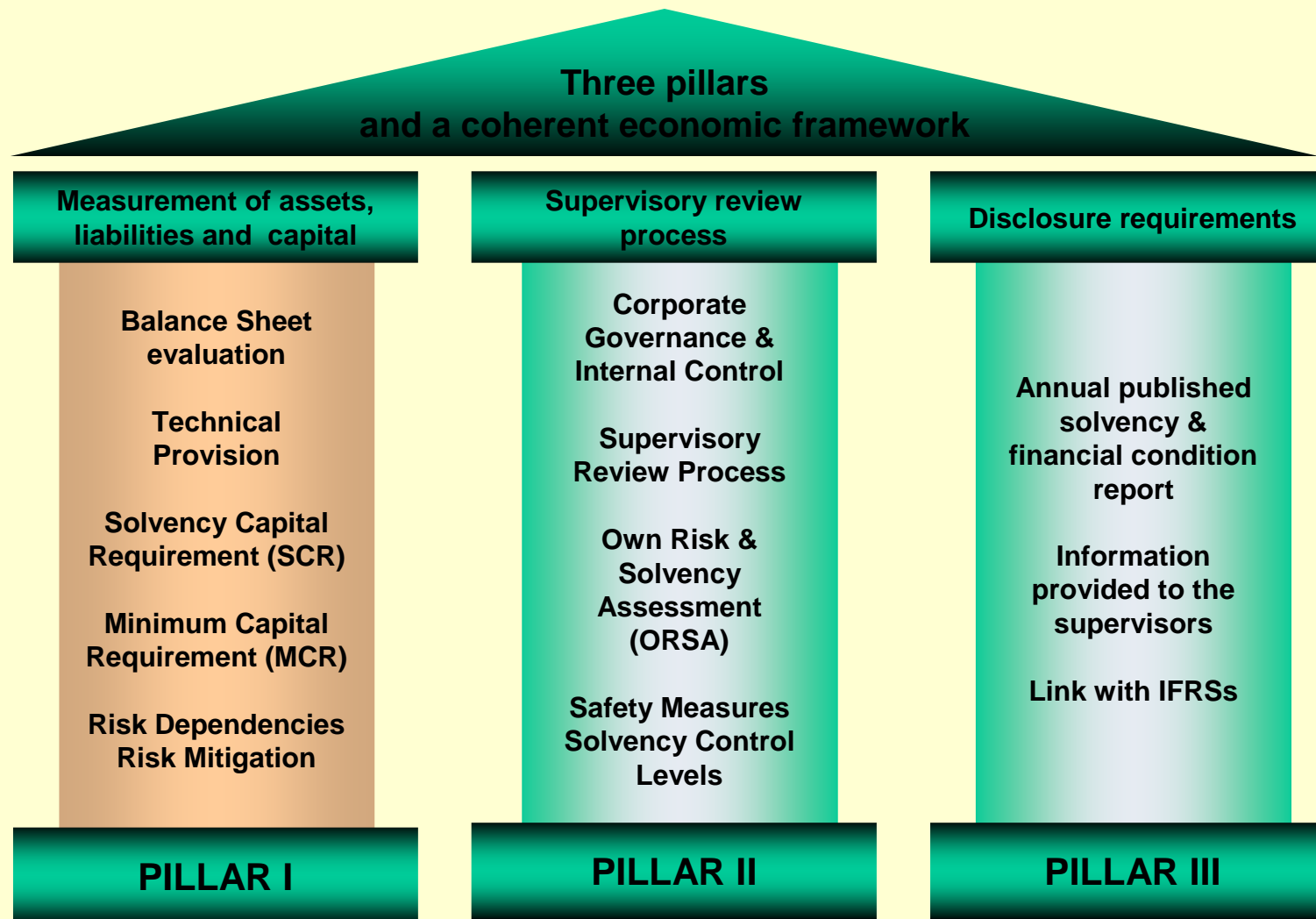
Introduction to Solvency II

QIS 5 timeline



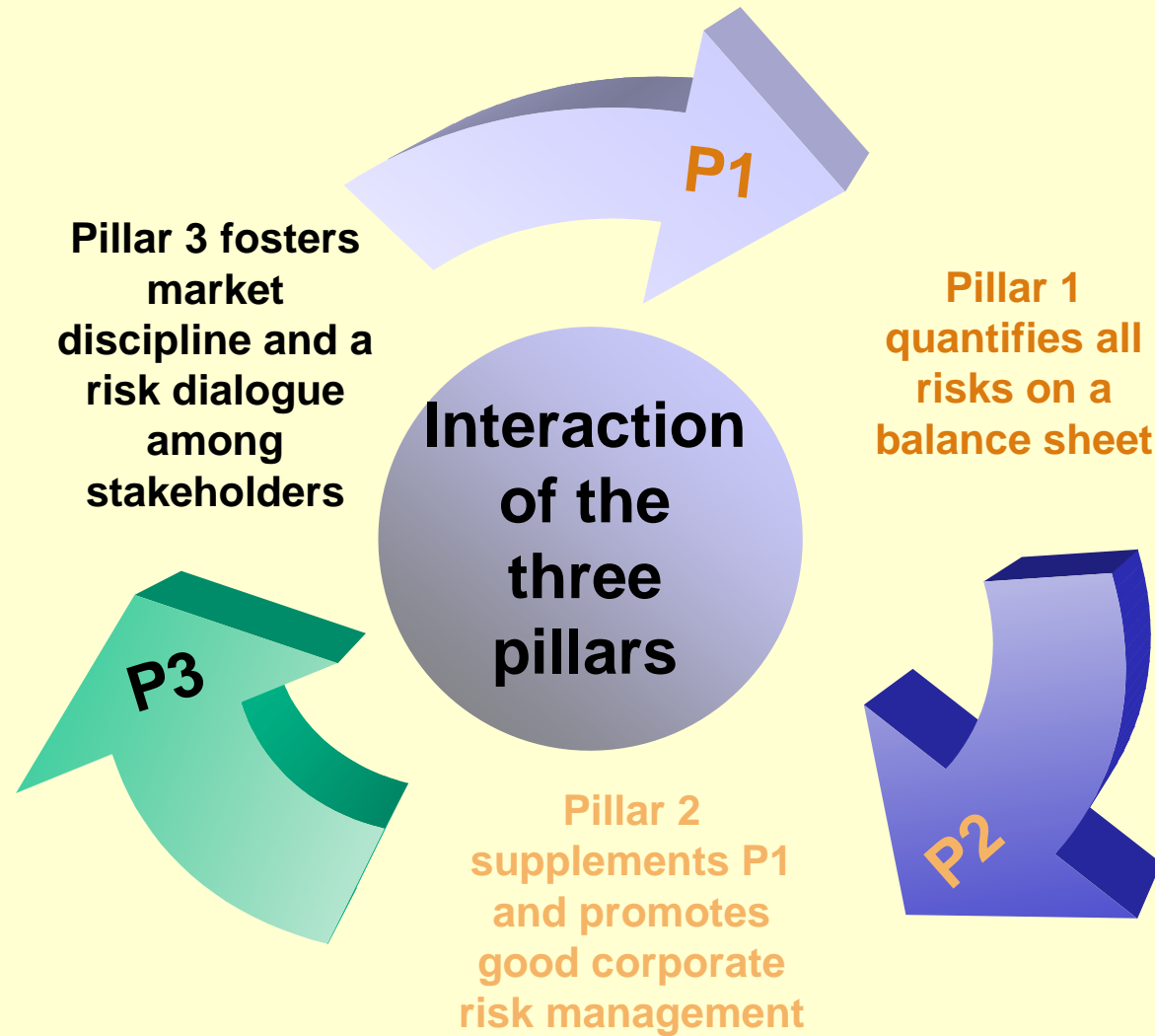
Introduction to Solvency II

The three pillar concept



Introduction to Solvency II

3 pillar concept



Introduction to Solvency II

Pillar 1



- Two capital requirements:
 - Minimum Capital Requirement (MCR)
Reflects an absolute minimum level of required capital below which supervisory action will automatically be triggered
 - Solvency Capital Requirement (SCR)
Represents additional capital to firms to absorb significant unforeseen losses

Introduction to Solvency II

Pillar 2 – ORSA



- An internal assessment process
- A supervisory tool
- Aim is to identify whether the particular risk profile of an undertaking deviates from the assumptions underlying the regulatory capital calculation
- The ORSA does not create a third solvency capital requirement
- Very specific to the undertaking's risk profile

Introduction to Solvency II

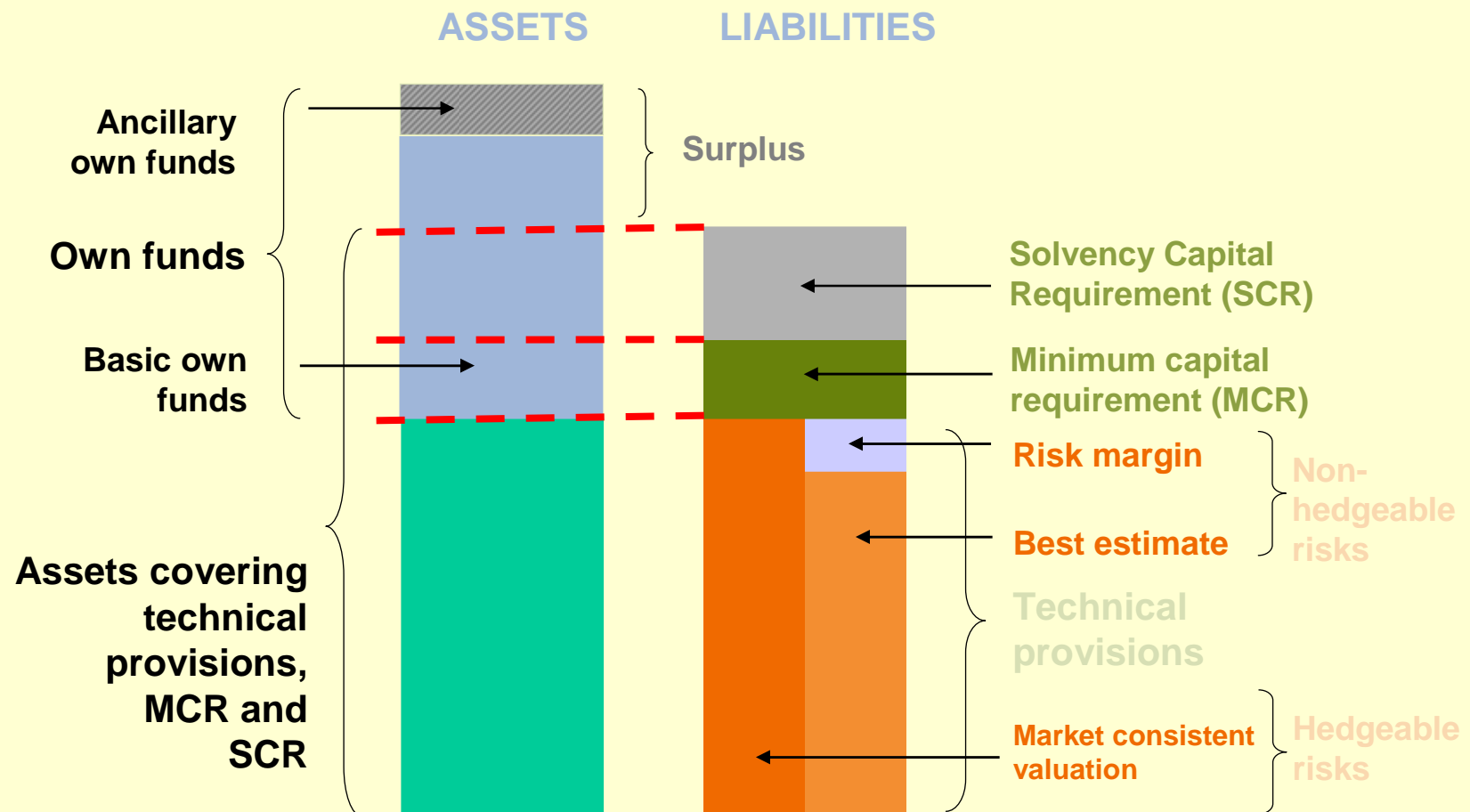
Pillar 3



- Pillar 3 is about disclosure and demonstrating to the regulator that the analysis supporting the other two pillars is dependable
- It requires insurers to provide key, verifiable information relevant to their capital adequacy. In broad terms, these would cover:
 - measures of financial condition and performance
 - measures of risk profiles and the data and other assumptions upon which they are based
 - measures of uncertainty, including the accuracy or otherwise of previous estimates and the sensitivity of the calculations to market volatility

Pillar 1: The building blocks

Overview



Pillar 1: The building blocks

Technical provisions



- Best estimate – realistic assumptions
- Market consistent
- Hedgeable vs non-hedgeable
- Risk-free rate?
- 16 part segmentation
 - 4 product categories
 - 4 risk drivers

Pillar 1: The building blocks

The SCR & MCR



- **Quantitative Capital Requirements: Quantifies the capital the company is required to hold in order to be considered solvent and allow the company to withstand adverse circumstances, even severe ones**
- Based on two thresholds:
 - Solvency Capital Requirement (SCR)
 - Minimum Capital Requirement (MCR)
- SCR will allow a company to withstand adverse circumstances, even severe ones

Pillar 1: The building blocks

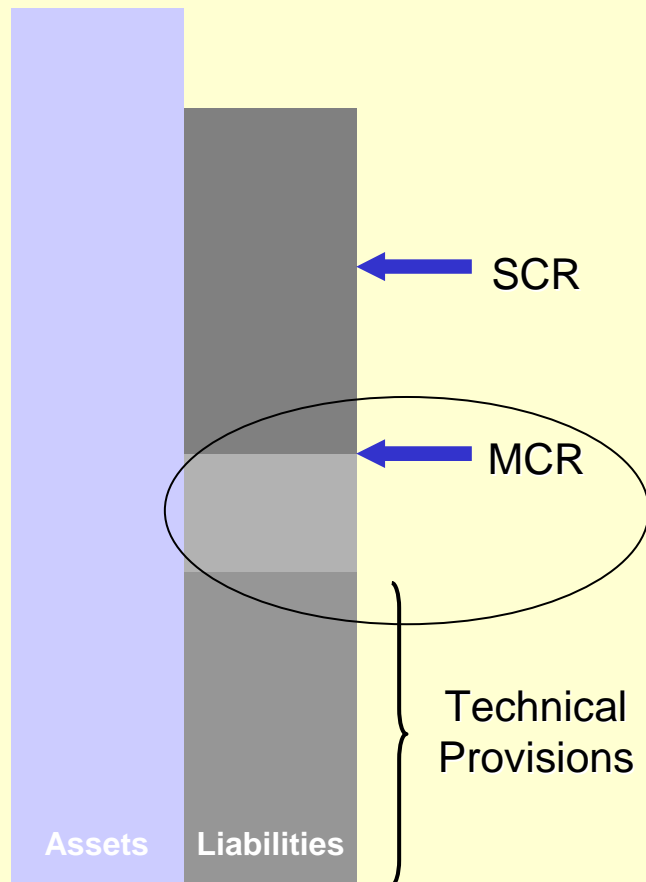
SCR – Solvency Capital Required



- The SCR is calculated for different sub-risk components
- SCR for sub-risk are calculated either on a factor approach (closed formula) or on a scenario approach (shock)
- For those sub-risks for which the SCR is calculated with a scenario approach the SCR is equal to the difference:
$$\text{SCR} = \text{Own Funds (basis)} - \text{Own Funds (shock)}$$
- Aggregation of all sub-risks is done with a prescribed correlation approach

Pillar 1: The building blocks

MCR – Minimum Capital Requirement



- Minimum Capital Requirement
 - An absolute floor and level representing an unacceptable risk to policyholder triggering ultimate supervisor intervention
 - Simple and robust calculation but not risk sensitive enough
 - Ratio of MCR to SCR intended to be in range 25-45%
 - **Proposed approach:**
 - **Linear approach – Percentage of basic volume measures e.g. technical provision with limits**

Pillar 1: The building blocks

The Risk Margin



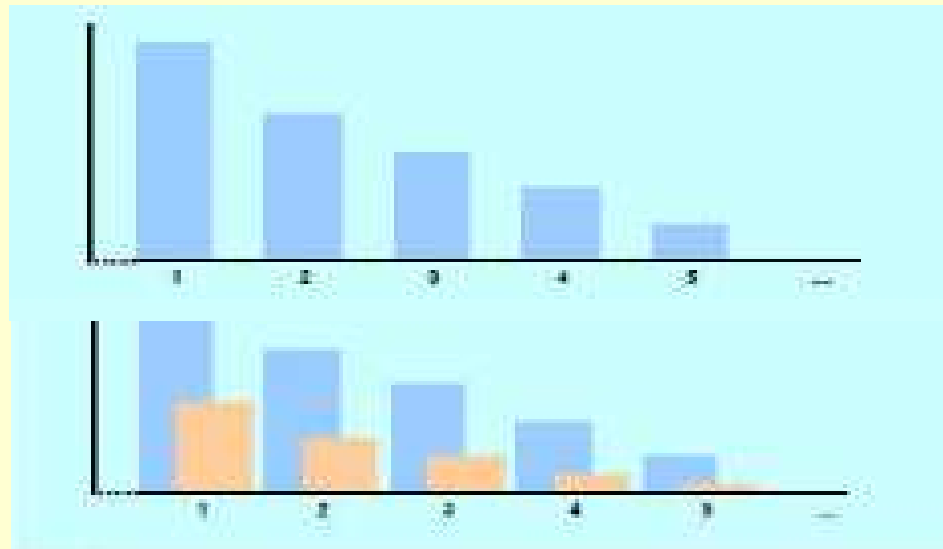
Estimate capital required in respect of non-hedgeable risks over lifetime of contract. The risk margin is the cost of holding this capital, charged at 6% pa, and discounted to balance sheet date

(1) Project the SCR for each of the non-hedgeable risks

(2) Risk margin

$$= \sum (\text{CoC factor}) \times \text{SCR}_t \times v^t$$

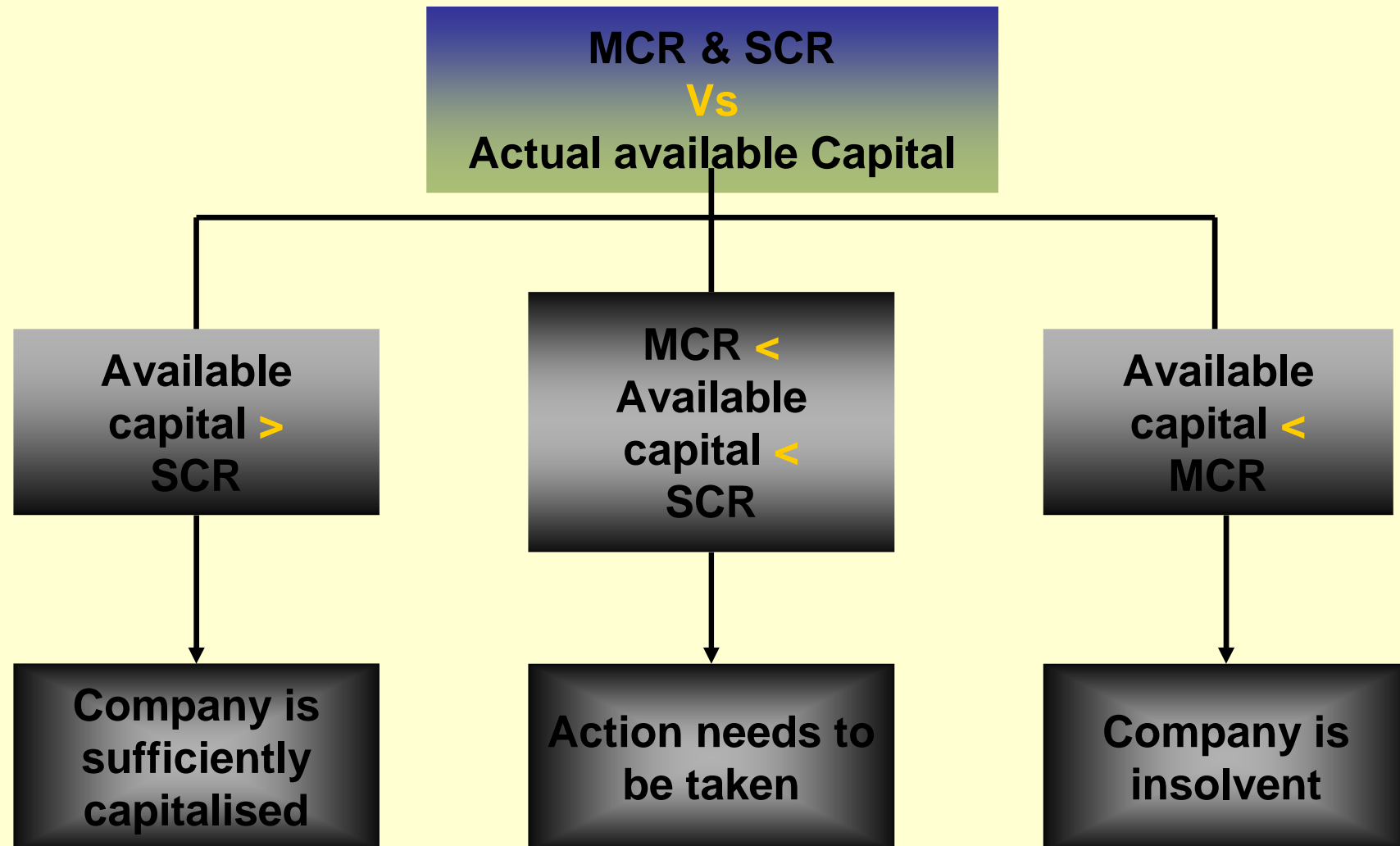
CoC factor = 6% charge



Consistent with Swiss Solvency Test

Pillar 1: The building blocks

The SCR & MCR



SCR/MCR

Own Funds: CP46



- Generally more restrictive than Level 1 requirements
- Limited examples of capital instruments
 - Supervisory approval and re-approval processes
- Re-categorisation of some elements of ‘excess of assets over liabilities’

No clarity re grandfathering of existing capital instruments

Pillar 1: The building blocks

What is an internal model?



- Article 109 of the Framework Directive allows companies to calculate their SCR using an internal model “as approved by the supervisory authorities”
- This can be a full or partial model
- However the FSA has indicated it does not believe any existing ICAs are good enough to be used as internal models

Pillar 1: The building blocks

Why use internal model?



- The standardised approach will most likely be calibrated conservatively. This suggests that internal models will produce lower capital requirements
- The improved risk modelling and additional insights provided by internal models should give those firms which use them a competitive advantage
- An internal model should be an important part of a company's Enterprise Risk Management (ERM) framework. For many firms the views of rating agencies are almost as important as the regulator and rating agencies are increasingly focussed on risk management. A survey performed by S&P a few years ago classified only 3% of insurers' ERM as "excellent"

Pillar 1: The building blocks

Defining the Scope of the Model



- The regulator will approve the Internal Model based on the scope (and the definition of minor and major changes)
- If it is not defined clearly then you might need to keep going back to the regulator for re-approval
- For example are these covered by the scope?
 - Updating of parameters / assumptions
 - Use of 'fleet of foot' models, e.g. monthly solvency assessment
 - Launch of new products
 - Planned enhancements

Solvency II – Three Pillar Approach



Governance

Pillar 1:

Quantitative capital requirements

- Market-consistent valuation
- Own funds
- Economic risk based capital requirements
 - minimum (MCR)
 - solvency (SCR)
- Groups

Pillar 2:

Qualitative supervisory review

- Internal controls and risk management
- Required functions
- Own risk and solvency assessment (ORSA)
- Supervisory review
- Capital add-ons

Pillar 3:

Market discipline

- Transparency
- Disclosure
- Solvency and financial condition report (SFCR)
 - solo
 - group

Compliance and Audit

Some risks are better addressed by governance requirements and not just by setting quantitative requirements

- Board has ultimate responsibility for compliance (Art 40)
- Requirements of a system of governance (Art 41)
 - Adequate and transparent organisational structure
 - Clearly articulated segregation of responsibilities
 - Effective system for reporting of information
 - Should be proportionate to nature, scale and complexity of operations
 - Written policies regarding all aspects of governance
 - Board approved and reviewed at least annually
 - Comply with Articles 42 to 48

System of governance



Article 42

Fit and proper requirements

Article 43

Risk management function

Article 44

Own Risk and Solvency Assessment (ORSA)

Article 45

Internal control (**Compliance function**)

Article 46

Internal audit function

Article 47

Actuarial function

Article 48

Outsourcing

Fit and proper requirements



Article 42

Fit and proper requirements

Definition of 'fit':

Persons professional qualifications, knowledge and experience are adequate to enable sound and prudent management

Definition of 'proper':

Persons are of good repute and integrity

Who needs to be fit and proper?

- All persons who effectively run the undertaking or have key functions

Responsibility of the management body of the undertaking

- Identify and notify supervisor who are required to be fit and proper
- Have appropriate procedures to ensure that all members of the Board and key function heads continuously are fit and proper

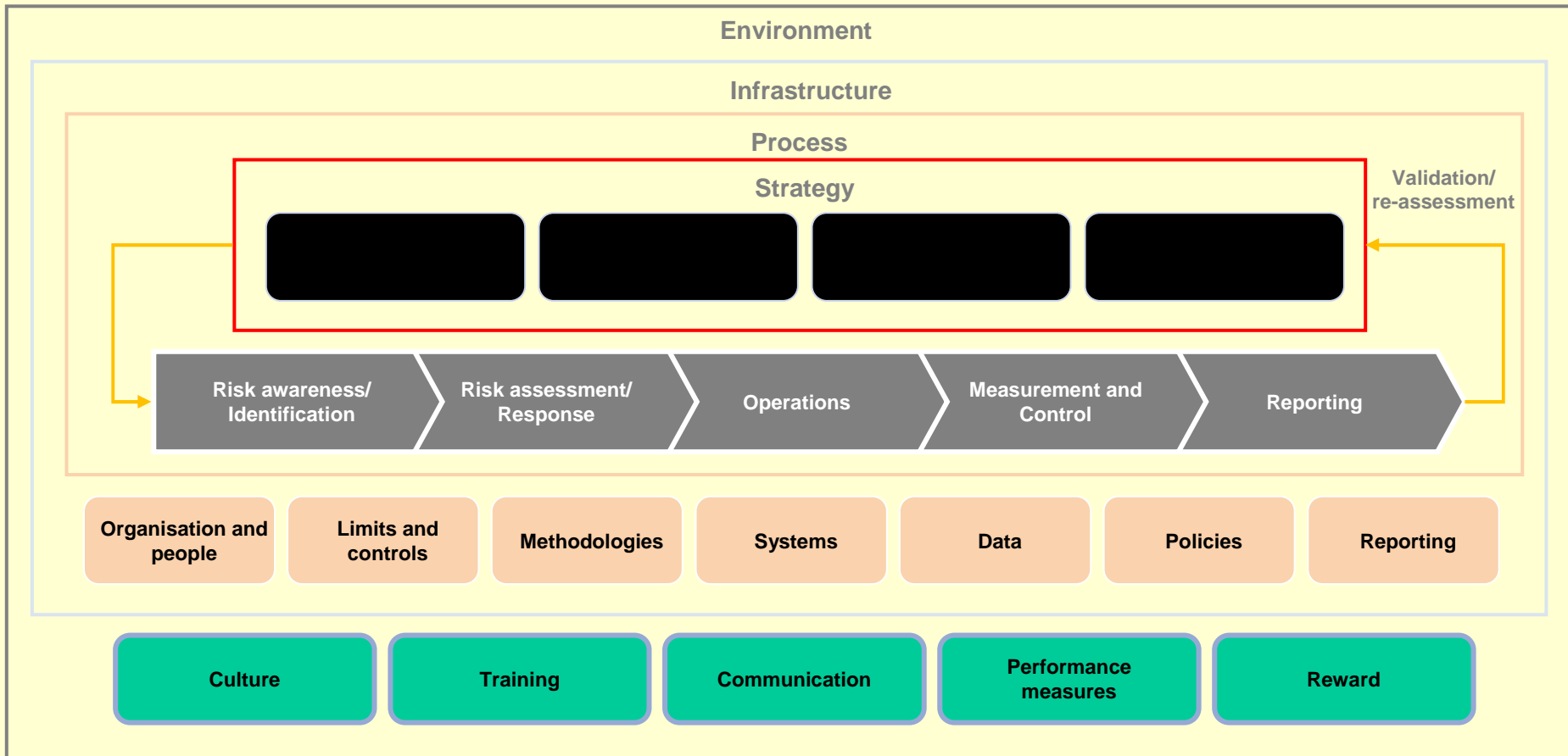
Article 43

Risk management function

A risk management function should:

- Comprise of **strategies**, **policies** and **processes** to identify, measure, monitor, manage and report risks, including interdependencies between risks
- Facilitate the implementation of the risk management systems, for
 - underwriting and reserving
 - asset – liability management
 - investments (credit & market risks);
 - liquidity and concentration risks
 - operational risk
 - reinsurance and other risk mitigation techniques

Risk Management needs to cover all aspects



Solvency II risk management and ERM



- ERM = Enterprise Risk Management (ERM)
- What is ERM?

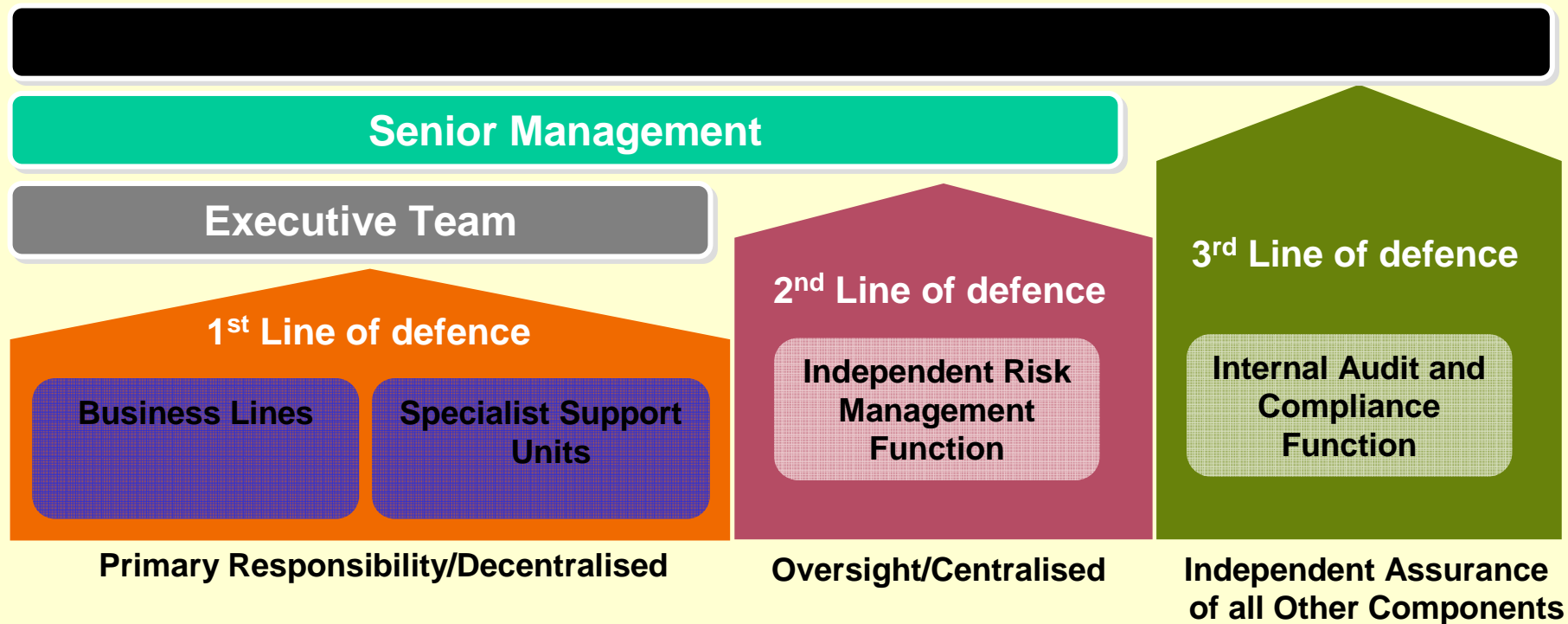
The International Association of Insurance Supervisors defines ERM as:

“a process, effected by an entity’s board of directors, management and other personnel, applied in strategy setting and across the enterprise, designed to identify potential events that may affect the entity, and manage risk to be within its risk appetite, to provide reasonable assurance regarding the achievement of entity objectives”.

Risk Management requirements in SII – overlap with ERM concepts

ERM Risk Governance Structure

Three Lines of Defence



Risk management and internal models



The risk management function 'own' the internal model

- **Where firms use an internal model (partial or full), the risk management function will be responsible for**
 - designing and implementing the internal model
 - testing and validating the internal model
 - documenting the internal model and any changes
 - informing the Board about the performance of the internal model, suggesting improvements for identified weaknesses
 - analysing and reporting as to the appropriateness and performance of the internal model

But, internal models are complex so actuarial function can assist in these tasks

Article 45

Internal control (**Compliance function**)

What is an internal control system?

- It is a coherent, comprehensive and continuous set of mechanisms designed to secure:
 - The effectiveness and reliability of the operations
 - Availability and reliability of information / data
 - Compliance with laws and regulations
- Aspects to an internal control system
 - Control environment
 - Control activities
 - Communication
 - Monitoring
 - Compliance function

Compliance function



- The Compliance function will:
 - **advise the Board** on compliance with the (current and emerging) laws, regulations and administrative provisions
 - assess the possible **impacts of changes in the legal environment** impacting the re/insurer
 - identify and assess of **compliance risk** (notify the risk management function)
- The firm should ensure there is an appropriate compliance framework to ensure it carries out these duties
- The compliance function must be independent of internal audit
- The compliance function may be:
 - independent of all other functions
 - part of the risk management function

Article 46

Internal audit function

All firms must have an internal audit function

- Must be objective
- **Independent** from the operational functions that it provides assurance over
 - includes all first line of defence operations
 - includes all second line of defence operations, including the finance, risk, actuarial and compliance functions
- Internal audit findings and recommendations must:
 - Be reported to the Board or Audit Committee
 - Determine what actions may be taken
 - Make recommendations to ensure proposed actions are executed

Article 47

Actuarial function

- Greater responsibility for the ‘technical provisions’
 - Coordinate the calculations of the technical provisions
 - Ensure appropriate methodologies, models and assumptions are used
 - Complete experience analysis
 - Review the data used for technical provisions

“Use Test” Principles: the Internal Model and the calculation of technical provisions should be consistent

Actuarial function



- The actuarial function's duties do not have to be performed by qualified actuaries, however shall be knowledge of actuarial and financial mathematics, commensurate with the nature, scale and complexity of the re/insurer
- CEIOPS suggests that European technical standards are to be developed
 - Aimed at greater harmonisation across Europe
 - Where does BAS fit in?

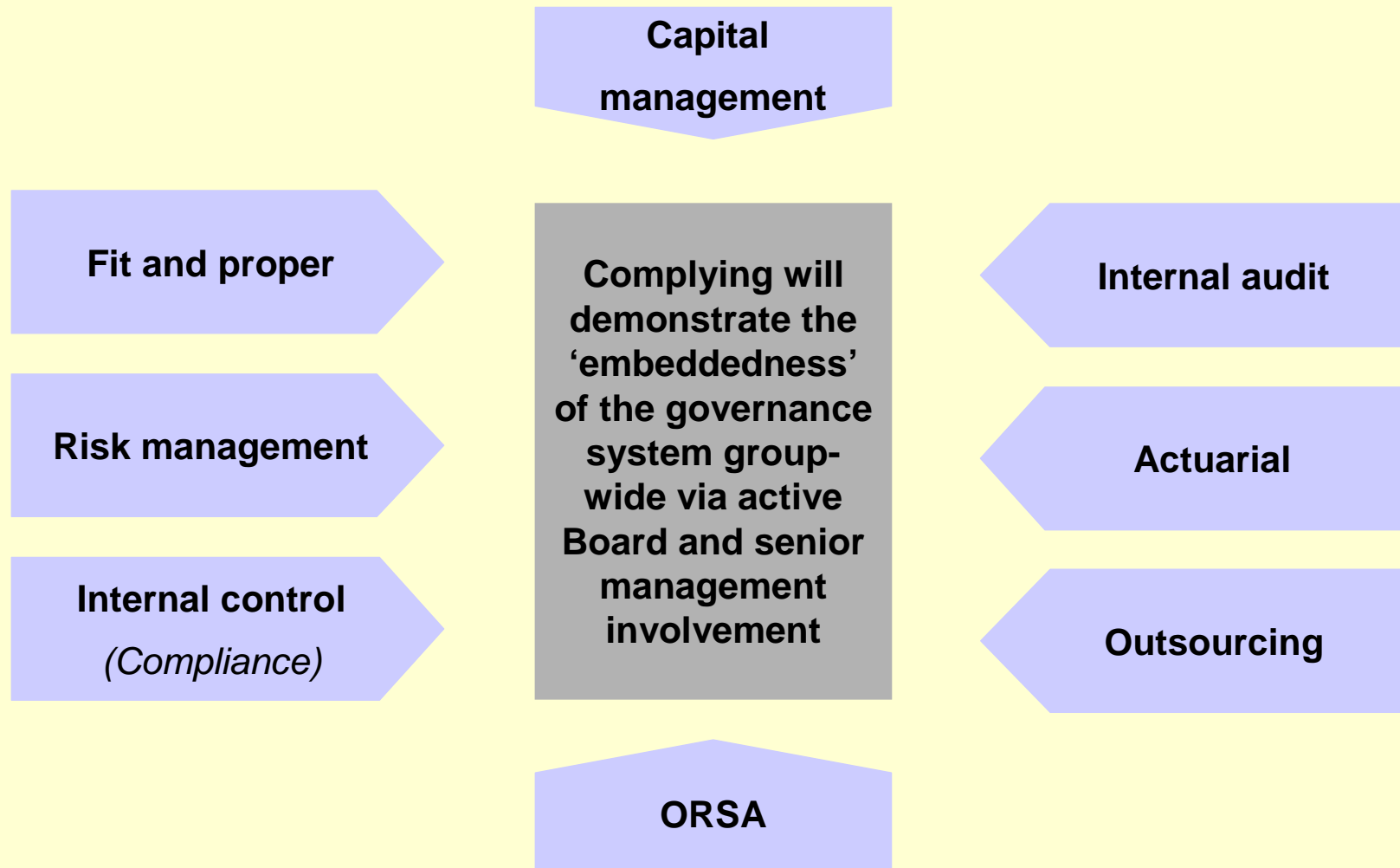
Article 48

Outsourcing

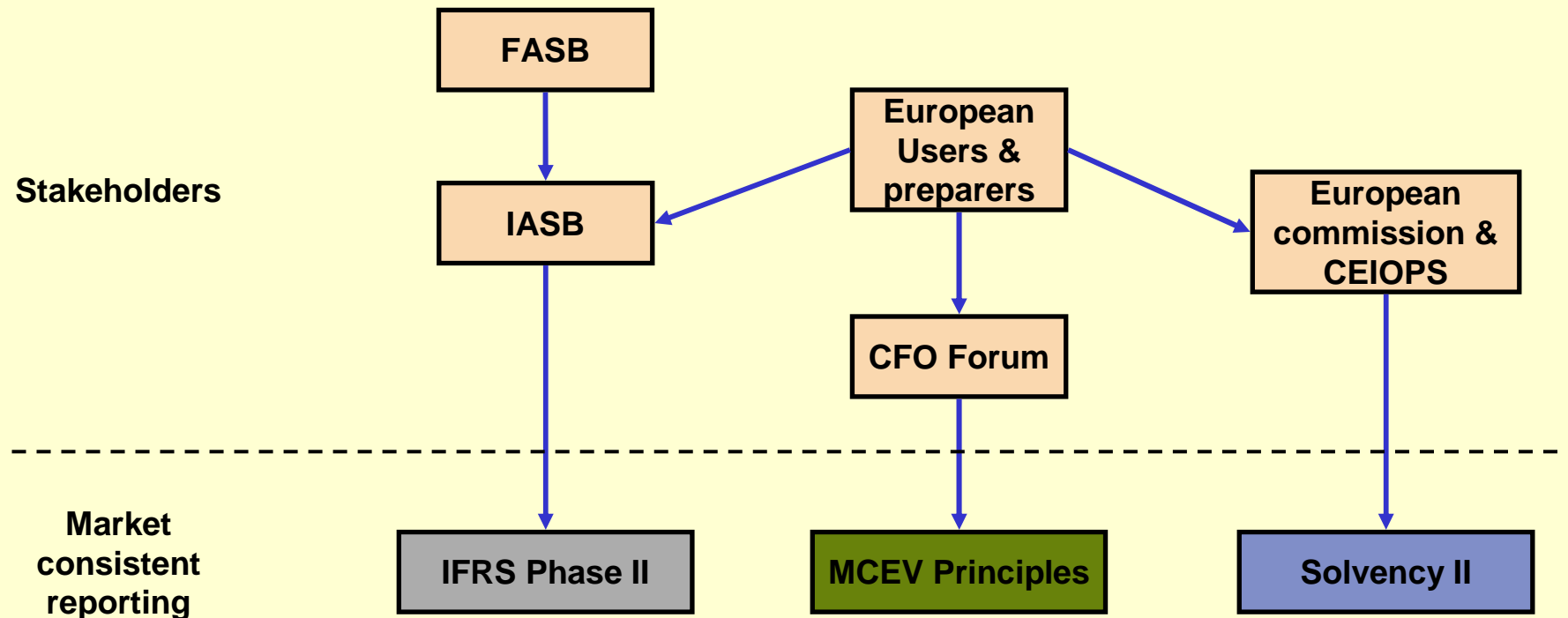
Undertakings may outsource functions

- Undertaking remain fully responsible for all of their obligations
- Additional requirements if critical or important operational functions or activities are to be outsourced (effectively a risk assessment)
- Firms must ensure regulators have access to the OSP's business premises to enable them to review the outsourced activity
- Firms must notify the regulator of any proposed outsourcing of critical or important functions or activities, developments there of and changes to

System of governance - summary



How it fits together



Key similarities: Valuation of the liabilities; Valuation of the assets and Improved disclosure

Objectives of approaches



▪ Solvency II

- Deepen the integration of the EU insurance market
- Enhance the protection of policyholders and beneficiaries
- Improve the competitiveness of EU insurers and reinsurers
- Promote better regulation

IFRS Phase II

- Introduce a consistent measurement basis
- Improve transparency and comparability of financial reporting

MCEV Principles

- IFRS was not a realistic view of profit
- Aim to bring greater consistency and improved disclosure to EV reporting

Comparing the approaches



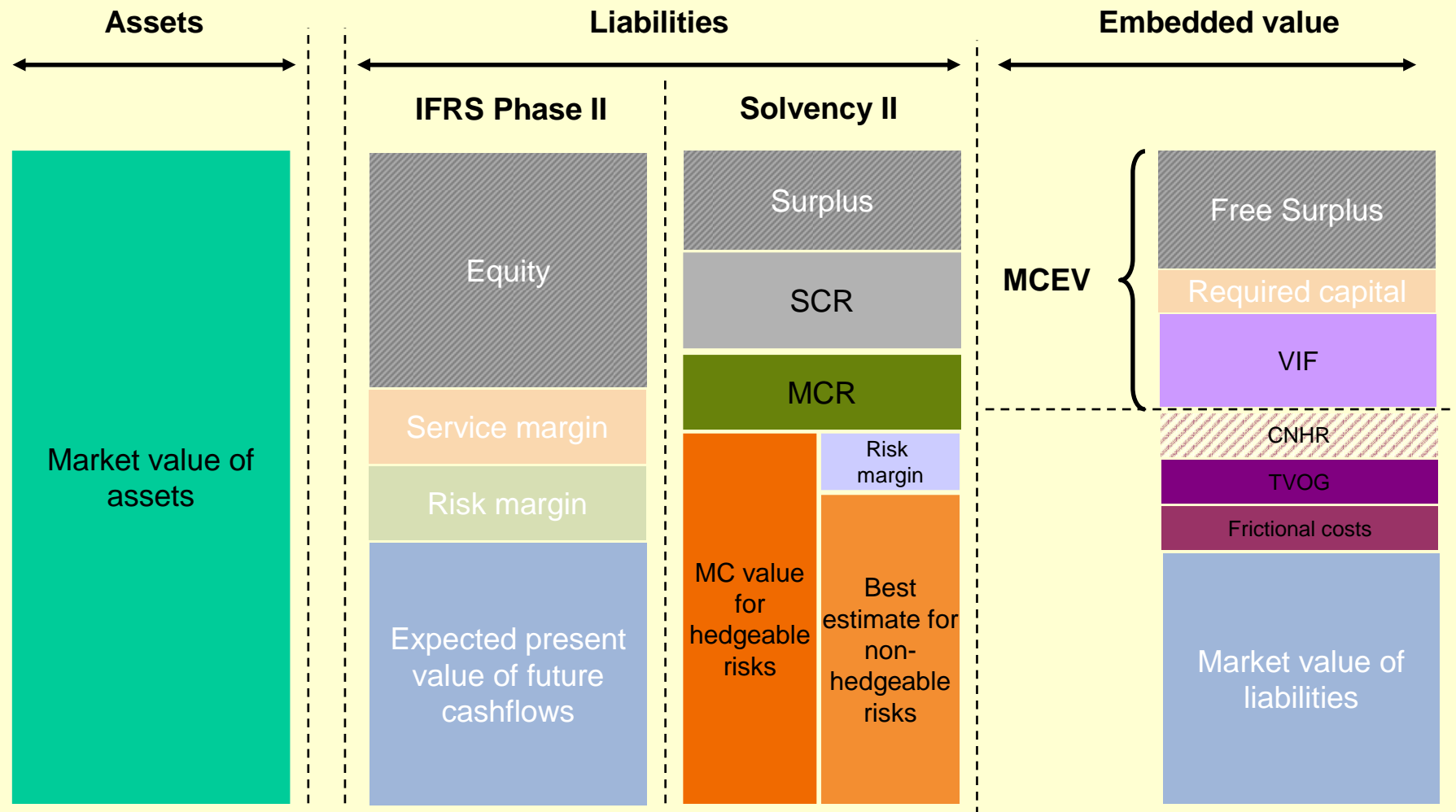
Purpose

Scope

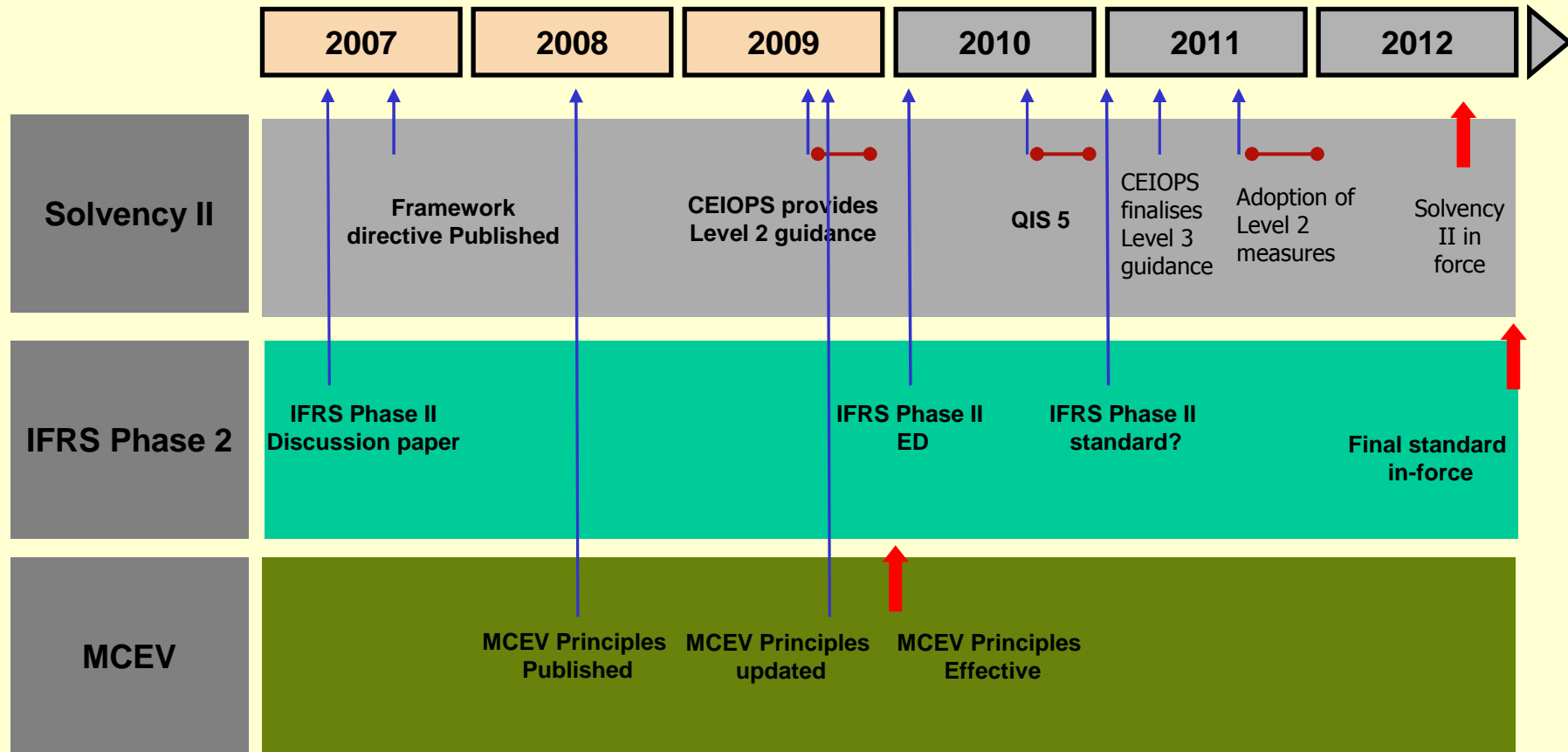
Coverage

Discount rate

Building blocks



High level timetable





- “Valuation standards for supervisory purposes should be compatible with international accounting developments, to the extent possible, so as to limit the administrative burden on insurance or reinsurance companies”
 - *Recital 28 of Solvency II Draft Framework Directive*

Looking forward



- They are still 3 different ways to value insurance liabilities
 - Will cause confusion!
- Solvency II and IFRS are conceptually similar
 - Very different objectives
- EV arose to compensate for inadequacy of IFRS/GAAP
 - Is there a future for MCEV?

QIS 4 results

Participation



- All 30 EEA member countries represented
- 1,412 companies participated
 - 351 Life undertakings
 - 62 Life undertakings in the UK
- Increase vs. QIS 3 – though not so much for Life
- Average time taken to complete QIS 4: 3.2 months
- 111 groups in QIS 4 vs. 51 groups in QIS 3

QIS 4 results

CEIOPS' QIS 4 European Results – Technical provisions



- **Life undertakings**

- Best estimate liabilities, cost of capital projections and counterparty default risk were the main causes of comment.
- Onerous modelling requirements
- Future discretionary benefits
- Costs of options and guarantees
- Weight to place on future large claims

- **Simplifications and proxies**

- Received well - benefited participation of small/medium companies
- But need clarification on application criteria
- Most used in:
 - Risk margin (i.e. projection of SCR)
 - Interest rate module of SCR
- Scope for revision
- Improvement in consistent use of methods

Source: CEIOPS's QIS 4 Results (18 November 2008)

QIS 4 results

CEIOPS' QIS 4 European Results – Technical provisions



- **Generally lower than Solvency I**
 - Absence of implicit margins for prudence
 - Recognition of anticipated profits on future premiums and charges (though not reflected in capital calculations)
 - Negative Best Estimates on given contracts reduce overall technical provisions
 - Removal of equalisation provisions
- **Risk margin**
 - Support for cost-of-capital approach
 - Concern over complexity
 - Many used simplifications
 - The 6% factor was questioned by many *again!* CEIOPS will consider CRO Forum research.
 - Suggestion of diversification between lines of business within risk margin

QIS 4 results

CEIOPS' QIS 4 European Results – MCR



- Corridor approach kept MCRs between 20% and 50% of respective SCR, however not risk sensitive
 - Debate as to justification for the specified corridor
- The linear approach is preferred by most Supervisors
 - Similar to existing Solvency I basis, using a percentage of premiums or technical provisions
 - Believed to provide an independent assessment from the SCR, however not sensitive to all risks of the entity
- **Most stakeholders still support the combined approach**
 - Fixed percentage of SCR or technical provisions
 - Preferred by the industry as believed to be more risk sensitive and would move inline with the SCR

Source: CEIOPS's QIS 4 Results (18 November 2008)

QIS 4 results

CEIOPS' QIS 4 European Results – SCR



- Issues on the appropriateness of calibration of
 - Equity risk
 - Counterparty risk
 - Deferred taxes
 - Operational risk
 - Correlation between risk categories and between solo entities within a group
- Further detailed guidance requested on
 - Calculation of impact of management actions
 - How deferred taxation should be incorporated into SCR due to different national tax laws
 - Calculation of counter-party credit risk considered to be too complex
- Life
 - Ring-fenced with-profits funds
 - Liquidity risk
 - Equity volatility
- Transferability of group own funds was difficult for many participants
 - Participation in Non-EEA entities
 - With-profit business
 - Minority interests
 - Hybrid capital

Source: CEIOPS's QIS 4 Results (18 November 2008)

QIS 4 results

CEIOPS' QIS 4 European Results – Internal models



- **Relatively small sample size**
 - Reasons for using internal model:
 - Better risk management and governance
 - Lower capital drivers
 - Wide variety of partial internal models in use
 - Many firms plan to use the standard formula as tested in QIS 4
 - Further work required by firms on:
 - Use test
 - Statistical quality
 - Calibration
 - Profit & loss attribution and validation
 - Etc
 - Generally a decrease in SCR using internal model, compared to the standard formula

Lower capital charge than standard formula	Higher capital charge than standard formula
<ul style="list-style-type: none">▪ SCR▪ BSCR▪ Market Risk - interest rate risk▪ Life underwriting risk - longevity & lapse risk▪ Health underwriting risk - short term risk▪ Non-Life underwriting risk▪ Premium/reserving risk	<ul style="list-style-type: none">▪ Operational risk▪ Equity risk▪ Property risk▪ Mortality risk

Source: CEIOPS's QIS 4 Results (18 November 2008)

What is an Internal Model?



- No definition was given by the Solvency II Framework Directive...
- ... but Industry bodies' attempts to define it as:
- “A risk management system developed by an insurer to analyse the overall risk position, to quantify risks and to determine the economic capital required to meet those risks” – *IAIS 2007*
- “The overall internal model process is much wider than a capital calculation “engine” and reflects the importance of the methods by which parameters are developed and how the output is used in the company’s decision making and risk management framework. A successful internal model will involve the integration of expertise across many disciplines” – *Institute & Faculty of Actuaries 2009*

What is an Internal Model: Risk Management System



- Continuous process used in implementation of strategy
- Senior responsibility
- ALL material risks covered
- Procedures to identify, assess, manage, monitor and report risks
- Reporting and feedback loops to ensure risk information is continuously monitored and managed (and challenged)
- Reports on effectiveness of risk function and on material risks faced
- A suitable ORSA process (as required by Article 44)



Not just the calculation engine!



Why use Internal Model?



- *From a firm's perspective:* Lots of incentives to do so!
 - Lower capital requirements → standard formula approach are most likely be calibrated conservatively (No always with QIS4 calibration)
 - Good risk management → better ratings from rating agencies → lower cost of capital
 - Competitive advantage in the market through additional insight provided by internal models
 - Important part of a company's ERM framework

From a regulator's perspective: To maintain a better market place

- The development of an internal model encourage firms to understand their risks better
- The industry as a whole would be better equipped to manage their risks and hence gain more confidence from the general public
- Achieve stability of the insurance markets (e.g. by avoiding systemic risk)

Model Approval Standards



- The Framework directive sets out 7 key tests which will have to be passed in order to set Pillar 1 capital requirements using an internal model rather than a standard formula:

- | | |
|---------------------------------|-------------|
| – Use test | Article 118 |
| – Statistical quality standards | Article 119 |
| – Calibration standards | Article 120 |
| – Profit and loss attribution | Article 121 |
| – Validation standards | Article 122 |
| – Documentation standards | Article 123 |
| – External models and data | Article 124 |

Foundation Principle:

“The undertaking’s use of the internal model shall be sufficiently material to result in pressure to improve the quality of the internal model”

CEIOPS (CP 56) have expanded this into 9 principles:

1. Senior management...shall be able to demonstrate understanding of the model
The internal model shall:
2. ...fit the business
3. ...cover sufficient risks to make it useful for risk management
4. ...be widely integrated into risk management system
5. ...be used to support and verify decision-making in the business
6. ...be used to improve the risk-management system
7. ...support and verify decision making
8. SCR shall be calculated at least annually, or after a significant change in risk-profile
9. Business unit should design the internal model in such a way that it facilitates the analysis of business decisions



- The CEIOPS has interpreted that the framework establishes 2 levels of responsibility for implementation of the internal model

Board and senior management

- Responsible for the governance of the internal model:
 - Approval of the internal model application
 - Delegating roles and responsibilities, including risk expert in senior management
 - Alignment with risk profile and company strategy
 - Allocation of resources

Risk management function

- Responsible for detailed implementation, defined in Article 43 of directive as:
 - Design and implementation
 - Testing and validation
 - Documentation
 - Analysing and reporting on the performance
 - Liaise closely with users and suggest improvements



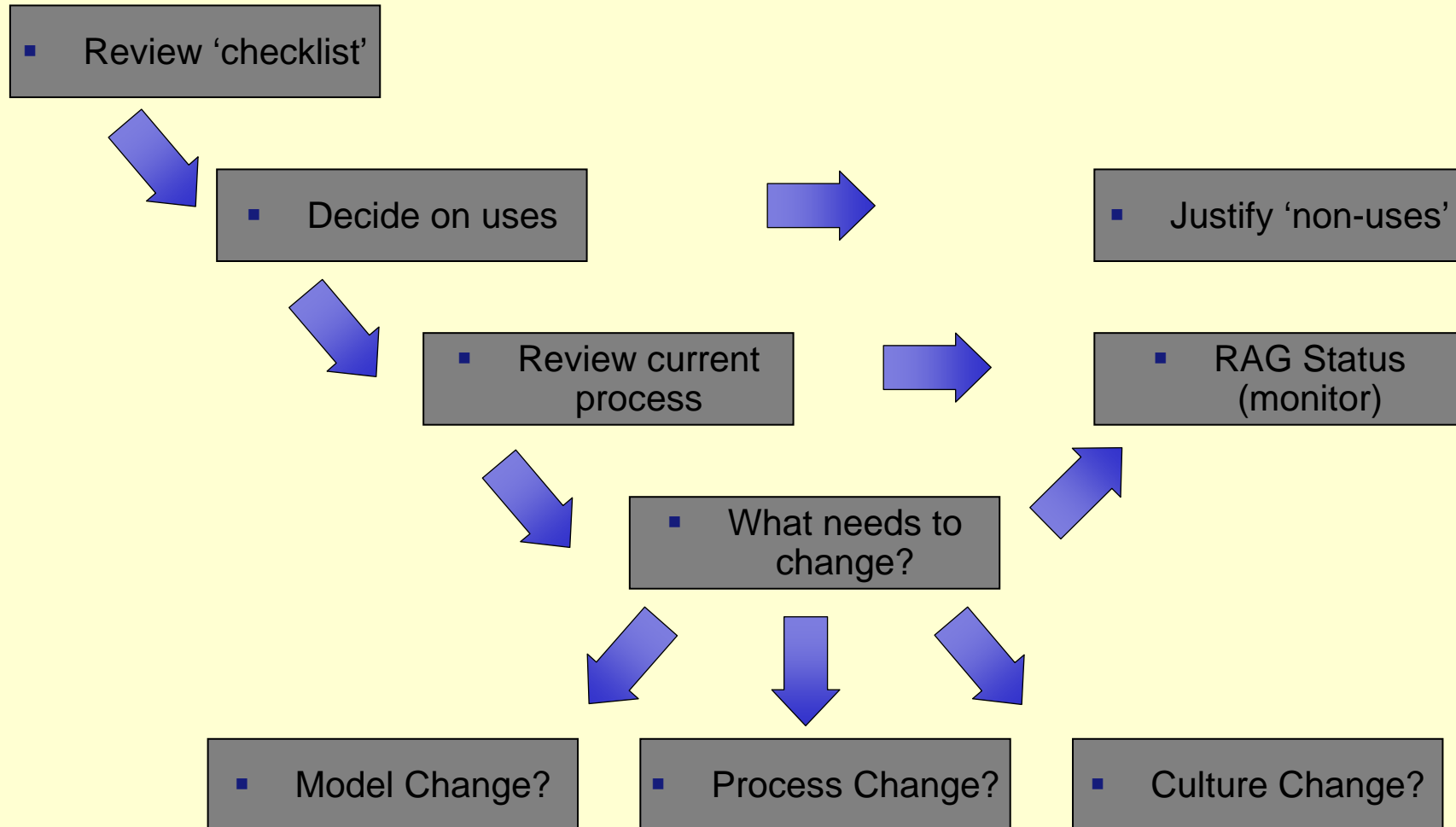
Many of these responsibilities currently sit within actuarial function



Potential uses of Internal Models – LOTS!

- Adequate pricing
- Assessing customer benefits, for example, bonus setting
- Asset / liability management
- Business planning / strategy
- Capital Management
- Development and monitoring of risk appetite
- Development of risk strategies
- Efficient use of capital
- Exposure management and limit setting
- External risk reporting
- Financial Reporting – internal model provides market valuations for IFRS
- Incentive / target setting
- Internal Risk monitoring (through MI)
- Investment decisions e.g. strategic, tactical and operational decisions
- M&A
- Measurement of material risks
- ORSA
- Other risk mitigation
- Portfolio transfer pricing
- Producing MI
- Product development / pricing
- Reconciliation between internal model outputs and internal and external financial reporting
- Reconciliation between internal model and the technical implementation of management actions, e.g. for with-profit business.
- Reconciliation between internal model and technical provisions
- Regulatory capital (SCR for solo and for groups)
- Reinsurance decisions e.g. strategic
- Reinsurance programme design
- Reinsurance strategy and development of reinsurance programme
- Reporting on MCEV / EV
- Reporting on business performance
- Reporting on performance including return on capital
- Reporting on technical provisions

Assessing the use test



Statistical Quality Standards – Article 119



- The key areas covered by Statistical Quality Standards are:
 - **The Probability Distribution Forecast**
 - Methodology and assumptions
 - Data
 - Use of Expert judgement
 - Risk ranking
 - Model coverage
 - **Diversification**
 - Recognition of Risk Mitigation
 - Guarantees and Options
 - Future management actions

Statistical Quality Standards – Article 119



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 - **Use of Expert judgement**
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 - Model coverage
 - Diversification
 - **Recognition of Risk Mitigation**
 - Guarantees and Options
 - **Future management actions**



- Directive requires that data is “accurate, complete and appropriate”
- Each company will need to set it’s own data quality policy, which will be documented and agreed with the supervisor
- Companies should be able to demonstrate that data is:
 - ...updated annually
 - ...free from material errors
 - ...consistent in time
 - ...sufficiently granular to support adequate actuarial and statistical techniques
 - ...relevant to portfolio and risks being analysed

Statistical Quality Standards

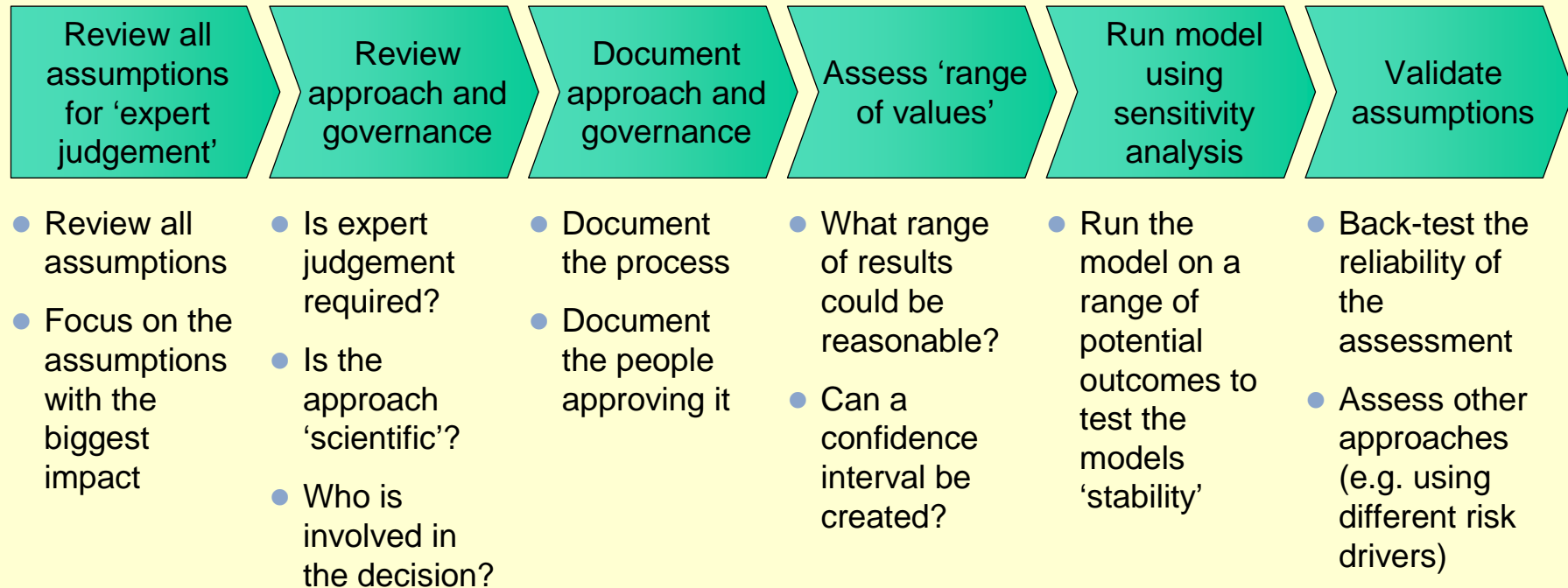
Use of expert judgement



- “Expert judgement is only admissible if it was derived using a scientific method and meets the following three requirements:
 - Empirical testing: Expert judgement must be falsifiable, refutable and testable
 - Validation and documentation: Expert judgement must be validated and documented
 - Error rate: Expert judgement must have a known or potential error rate, and standards concerning the operation of its methodology must exist and be maintained.”

Statistical Quality Standards

Assessing expert judgement



Statistical Quality Standards

Recognition of risk mitigation



- Entity will need to demonstrate that the risk mitigation technique is robust enough to achieve what the model says that it will
- CEIOPS set some standards:
 - Demonstrate that a risk transfer takes place from an economic perspective
 - Legal and continuously enforceable
 - Liquidity of asset and ability to value
 - A direct claim exists and counterparty has no right to nullify or change the terms
 - Assessment of secondary risks

Statistical Quality Standards Management actions



- No clear definition of where normal operational decisions stop and management actions start

- This requirement has serious implications:
 - Board must sign-off its intention to act in this way given a trigger event
 - Any management actions that deviate from this must be signed off before can be implemented
 - Significant deviations in management action from that assumed to be completed in the internal model should be referred to supervisor

Validation standards – Article 122



- What needs to be validated?
 - Data
 - Methods used
 - Assumptions
 - Expert judgement
 - Documentation
 - Systems / IT
 - Model governance
 - Use test
 - **Validation process**

■

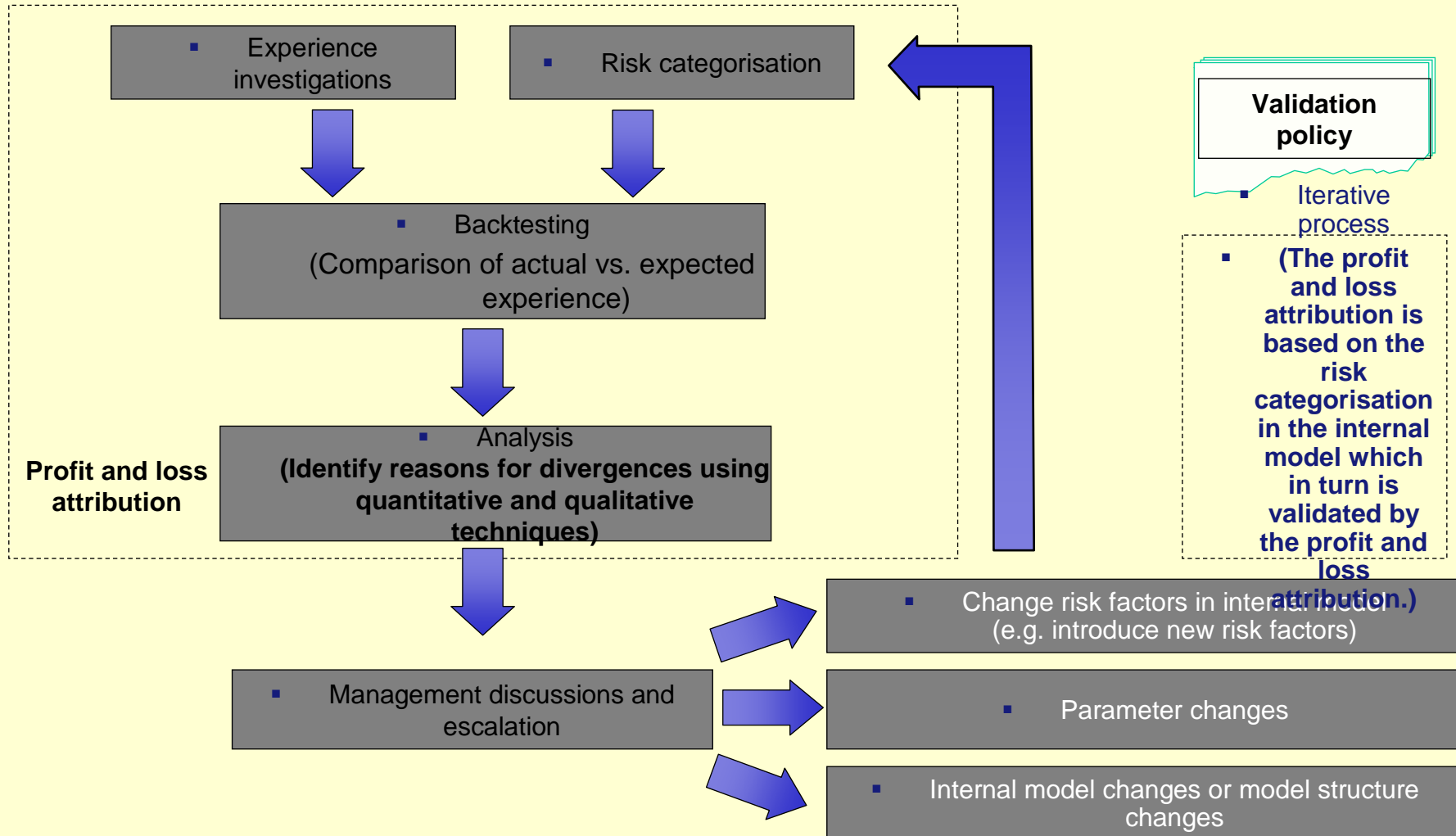


Not just the calculation engine!

Profit and loss attribution – Article 121

- Profit and loss attribution will be a key component of the model validation process and should be:
 - Performed using company's own definition of 'profit'
 - Performed at least annually
 - Reported by major business unit
 - Granular enough to drive improvement in the model
 - Identify further risks to be included in the internal model
 - Align with probability distribution function parameters, e.g. volatility or interest rate
- Also:
 - Insurers should be aware of differences to profit and losses in the value measures reported to stakeholders

Model validation cycle



Calibration standards – Article 120



- Directive sets a calibration standard of 99.5% VaR over a one-year period (Article 101)
- Model must be calibrated at least annually, but also when there are significant events or changes
- Insurers have the option to calibrate their model in different ways to Article 101 if they can demonstrate equivalence.

Therefore:

- It may be possible to use differing risk measures or time horizons between business lines or entities
- Different approach may lead to increased supervision and validation requirements

Documentation standards – Article 123

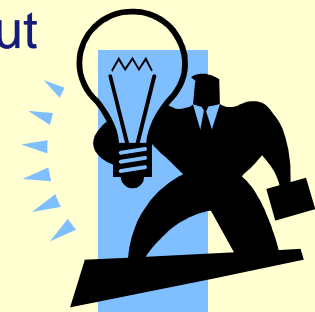


- The internal model will need to be underpinned by robust documentation, it is expected to include:
 - Demonstrate compliance with the 6 other tests
 - A detailed outline of the theory, assumptions, and mathematical and empirical basis underlying the model “*such that an independent, knowledgeable third party could, in principle, reproduce the model outputs*”
 - “*Rationale for the decision to adopt certain practices*”
 - Shortcomings of the model
 - All major changes
 - Document the documents
- Also:
 - Documentation will take into account the audience to which it is designed

External models and data



- “The use of a model and data obtained from a third party shall not be considered a justification for exemption from any of the requirements set out in Articles 118-123”
- Could be very difficult to achieve
- More likely that the following should be documented:
 - Capabilities of the model
 - Limitations on its use
 - Why it is appropriate for the purpose to which it is put



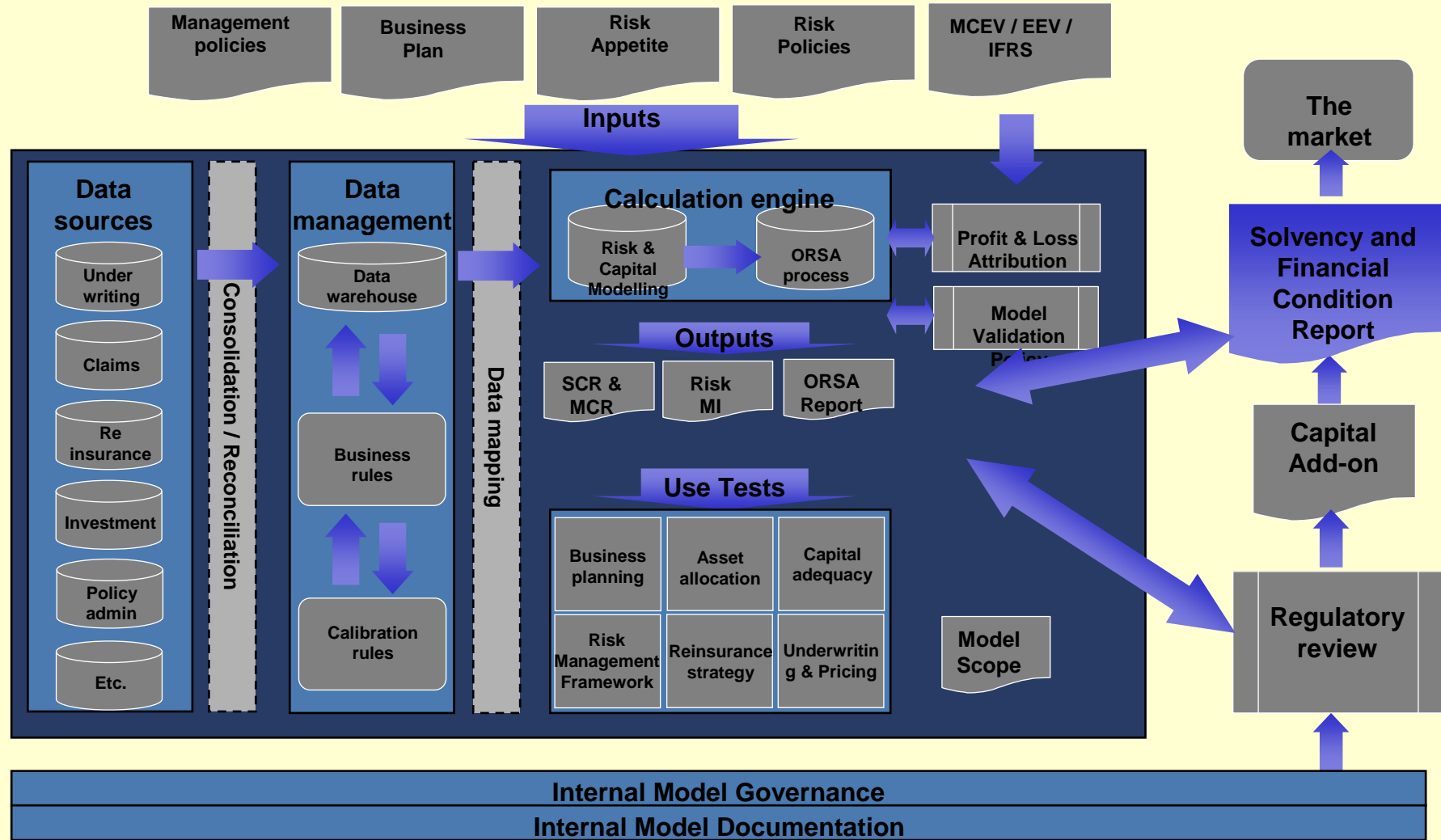
Don't use external models without thinking!

Issues with model approval process



- The validation process for internal models is currently unclear in some areas. This raises concerns over:
 - The standards required
 - Consistency between different regulators
 - Validation requirements become mechanical, which detracts from wider vision of what internal model should be

An Example of an “Internal Model”



Background to stress testing and dependencies



- Solvency II is expected to require a more robust approach to modelling risks and their aggregation via:
 - Requirement to derive an appropriate distribution function for each risk exposure
 - » “The generation of a probability distribution forecast as defined by Article 13(32) is a key feature of internal models” (Source: CP 56, Tests and standards for internal model approval)
 - » “Internal models that generate probability distribution forecasts with fewer data points may need more intensive validation and stricter governance” (Source: CP 56, Tests and standards for internal model approval)
 - A robust approach to aggregating risks, with special attention to tail dependency and non-linearity
 - » “modelling of dependencies and the aggregation mechanism requires special attention by the supervisory authority” (Source: CP 56, Tests and standards for internal model approval)
 - » “There should be meaningful support for claiming diversification effects...includes empirical/statistical analyses and expert judgement of causal relationships or a combination of both ” (Source: CP 56, Tests and standards for internal model approval)

Background to stress testing and dependencies



– Insurers

- The importance of a probability density function is that an improved understanding of the risk exposures and consistency between bases
- The importance of diversification is that it can create value

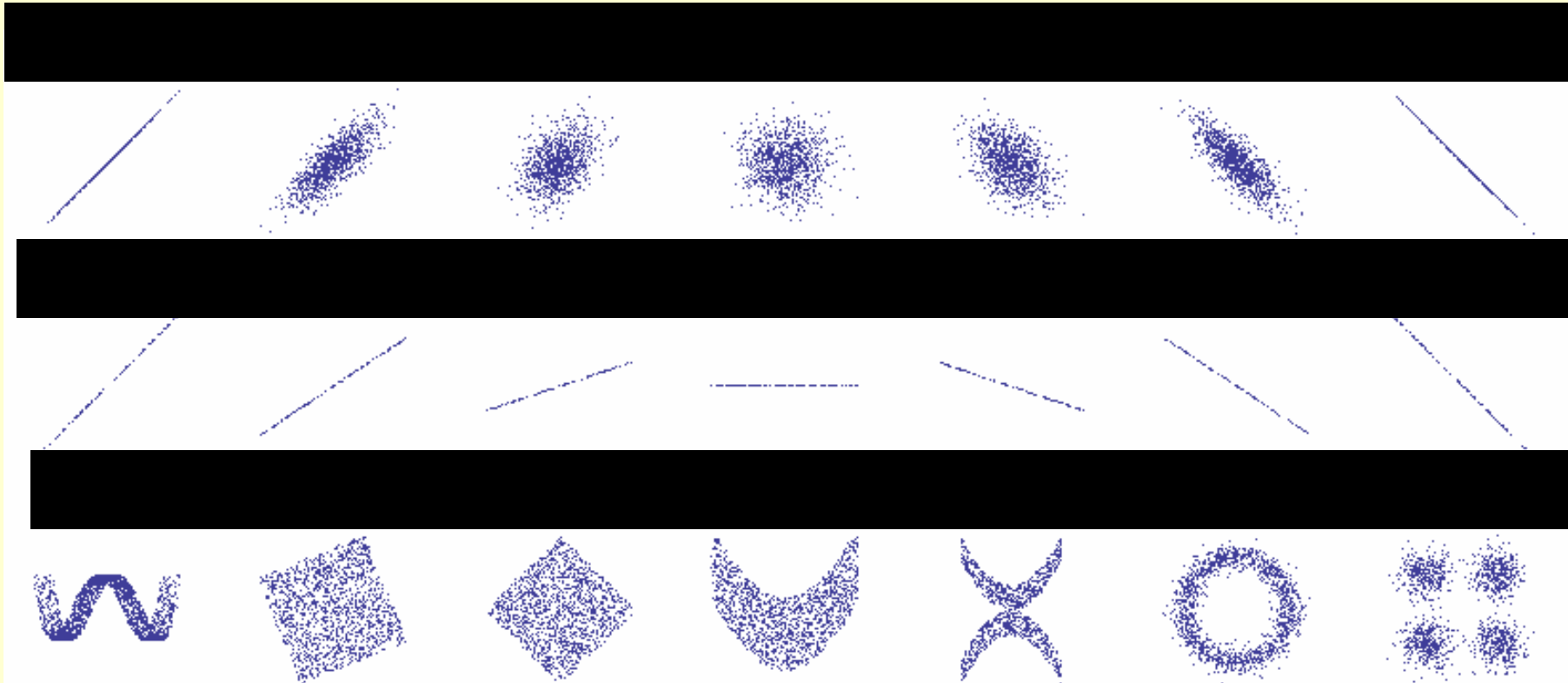
– Regulator

- The importance of a probability density function is that it provides a clear link from economic value and capital assumptions to regulatory capital
- The importance of diversification is that It can provide greater protection to policyholders

Correlations – A refresher



- What do you think the correlations are for each of these graphs?



So what?



- We have seen that:
 - Requirement of Solvency II regime to develop more sophisticated approach to modelling risks
 - Standard correlation approaches can fall short in modelling dependencies between risks
- There can be a benefit to companies of more sophisticated approach to modelling risks through:
 - Deeper understanding of exposures
 - Reduced governance / validation requirements
- So what should we do about it?

Comparing different approaches

Correlation matrix

- Pros
 - + **easy to communicate**
 - + **widely used and understood**
 - + **quick to calculate**
- Cons
 - doesn't capture non-linear dependency
 - doesn't capture tail correlation

Copula

(closed form)

Pros

- + better description of how dependency behaves in the real world but limited to off the shelf analytical formula
- + quantitative techniques developed for calibration

Cons

- more complicated to explain to senior managers
- require lots of data/information for model calibration which is unlikely to be available
- top down approach

Copula

(empirical form)

Pros

- + can be coded in ALM software (e.g. Moses, Prophet) as a dependency formula
- + can reflect the business knowledge and management understanding of product design and customer profile
- + possible to include feedback loops

Cons

- more complicated to explain
- less analytically tractable

There are many risks distributions and potential dependencies to consider



Risk	Issues with generating a probability distribution	Dependencies
Equity	Well-developed field of study, but extreme tail dependency remain a difficulty	Property, spreads, lapses, operational
Property	Modelled as a class of equity, but more difficult due to the lack of clean data	Equity, Interest rates, spreads
Interest Rate	Well-developed field of study, but interest rate model used needs to be considered carefully as each model has different behavior	Equity, property, spreads, currency
Spread	No clear view. Various approaches such as structural models or time series modelling have been used	Equity, currency
Currency	Good data set for main economies, although it is complicated due to interest rate linkage	Interest rates
Mortality	Data	Longevity dependence
Longevity	Data	No short term dependence on Interest rates, but a long term dependence could be extremely important
Disability	Data	Longevity
Lapse	Data	Macro-economics, GDP, unemployment
Expense	Data	Operational risk, inflation

Conclusions



- Understanding diversification is important for companies and regulators alike though for different reasons
- Regulators are getting more sophisticated so firms should expect more stringent requirements to be met when defining the nature of important dependency relationships within their business
- Correlation matrices will still be important under Solvency II
- Non-linear dependence and tail dependence are not captured by correlation matrix method but can be captured using a copula
- Companies should at least understand copula approaches and be able to rationalise their decision to use correlation matrices and apply more sophisticated approaches where key non-linear dependencies exist in their business
- But, need to strike a balance between capturing dependence accurately and communication to the Board– **both** are important for risk management

Discount rate issues



- What should be the ‘risk-free’ rate basis used to discount either liquid liabilities or liabilities generally?
- In the absence of reliable market information on discount rates – for example at longer durations – how should the ‘risk-free’ rate be extrapolated beyond the information derived from markets?
- What allowance – if any – should be made for the varying liquidity characteristics of liabilities in corresponding ‘risk free’ discount rates? Both for provisions and for SCR?

With hindsight the questions would have been better addressed in this order!

All EU and other significant currencies need to be addressed.

Task force consensus that these are real questions without simple solutions!

Potentially conflicting objectives

- The implicit prudential objective is to ensure that as far as practicable provisions are determined on a basis which discounts probability-weighted cash flows so as to reflect the time value of money but excluding any element of compensation for the risk of default. The purpose is to afford meaningful protection for policyholders.
- Another implicit objective is to achieve a market-consistent balance sheet such that assets and liabilities can to the greatest extent practicable be managed such that values fluctuate consistently. The purpose is stability and sustaining the confidence of stakeholders.

These distinct purposes are not necessarily capable of simple reconciliation. Accounting generally faces this challenge, especially in relation to pensions.

Basic 'risk-free' rate

- Long-standing convention that borrowing by a government in its own currency is risk-free because of the power of taxation. Historically government looked to insurers and pension funds as buyers of its debt. Domestic default highly unusual.
- There are however various difficulties:
 - Government bond yields not uniquely conclusive as to risk-free because of technical influences.
 - Government debt may be of relatively short average duration.
 - The euro is the currency of several governments whose debt may be valued very differently by financial markets.

Basic 'risk-free' rate

- In major trading currencies, derivative interest rate markets for exchange ('swap') of fixed and floating yields over a wide range of durations have expanded enormously and are recognised as a more comprehensive source of discount rate information than government bond markets.
- Other derivative instruments relevant to 'market consistent' valuation are priced by reference to swap rates.
- These instruments are priced by reference to various floating interbank rates for each currency, for example 6 month EURIBOR. These floating rates are generally fixed daily based on information sharing.
- Specifically for euro, the swap market is a principal reference as it overcomes the problem of different government bond spreads.
- There are however still difficulties:
 - Interbank rates for any meaningful duration can apparently be distorted by liquidity hoarding and banking system risk.
 - Swap rates may be distorted, and the relationship between swap and bond rates distorted, by technical considerations.

Some convergence of views



- Historically – particularly for euro - CEIOPS argued for AAA government bond rates while industry argued for swaps based on 6-month EURIBOR. GC argued for hybrid of overnight-based swaps (EONIA) and weighted average of government bond yields (say 50/50).
- Positions have moved:
 - Greece difficulties and changing relationship of bond and swap rates have muted CEIOPS views.
 - Industry accepts that residual banking system credit risk must be excluded from swap-based rates.
 - GC acknowledges that OIS are liquid only up to 5-10 years and that blending with other swap and/or bond rates is not simple and may be difficult to replicate.
- Several questions remain (and the answers are not necessarily stable):
 - Whether or how to blend OIS and more liquid term swaps?
 - Swap-based rates may be preferable on grounds of replicability / ALM but what are the implications if these are lower than AAA government bonds?
 - Higher of ‘OIS/adjusted swap’ and ‘weighted average government by duration is logical but messy?
 - What about other currencies?

Extrapolation



- Issue arises from the structure of capital markets in any given currency:
 - Range of and average of durations of government debt?
 - Range of and average of durations of other fixed-interest instruments or contracts in the currency?
 - Scope and liquidity of interest rate derivative markets?
- Liability origination also is highly relevant – to what extent are policyholders being given guarantees beyond the scope of any feasible hedging – voluntarily or involuntarily?
- Issue is very significant – particularly in respect of currencies beyond major blocs (USD, JPY, EUR, GBP) – significant losses incurred in Asia due to secular reductions in inflation
- Extrapolation is effectively estimating the terms (range of terms) on which it would be economically rational to borrow/invest at durations where no market exists at present.

Extrapolation



- Mathematical or economical – growing consensus that extrapolation should have regard to some far-off macroeconomic anchoring perspective.
- Growing consensus that this should be an ‘ultimate’ forward rate – say 100 years hence – consisting of:
 - Real rate of interest *plus*
 - Ultimate rate of inflation *plus*
 - Term premium *minus*
 - Convexity adjustment
- The first two elements are much the more significant but are also volatile quantities to estimate
- A neutral or best estimate central extrapolation is fairly feasible but may give rise to a requirement for a significant risk margin to deal with uncertainty
- Extrapolation by reference to historic series is unsound – particularly because of secular variations in inflation trend.

Liquidity and valuation



- You have to choose between two variable interest deposit accounts – one with funds withdrawable at accumulated balance immediately and the other with funds withdrawable at accumulated balance but only following 30 days notice – which if either should offer the higher rate?
- Economists accept that immediate access to funds has utility and value – all other things being equal, a more liquid instrument will have a higher value than an otherwise exactly similar less liquid one.
- Accounting for banking business effectively recognises this in that historically based accounting effectively includes an implicit prospective liquidity differential.
- What should be the approach in respect of insurer (solvency) accounting?

Liquidity and valuation



- Consider two forms of product:
 - A deposit which accumulates at a variable rate X determinable from time to time by the insurer over up to 10 years but is withdrawable by the policyholder for the accumulated balance at any time.
 - A deposit which accumulates at a variable rate X' (always $\geq X$) determinable from time to time but withdrawable at the end of 10 years only.
- What is the value of $X' - X$?
- One approach is to consider the additional yield which the insurer may be able to capture in the certainty that assets will not have to be realised within 10 years.
- Evidence suggests that in normal circumstances the additional yield is small but that at times of stress it can increase dramatically because of changes in the relative prices of liquid and illiquid assets.
- If X' is higher than X in rational pricing, then it is reasonable in principle to take a similar differential into account in accounting and solvency valuation.

Liquidity and valuation



- Some clear difficulties:
 - Few if any insurer liabilities are wholly certain as to timing;
 - It is not possible unequivocally to distinguish between credit loss uncertainty and illiquidity components of risky asset spreads;
 - There is a ‘Heisenberg’ effect – illiquid assets are by definition unreliably priced, or if a price is reliable the asset cannot be said to be illiquid. (However the balance sheet reflects prices of all assets, reliable or not.)
- Nevertheless there is a growing consensus that the durability of the Solvency 2 framework is enhanced by attempting to recognise the degree of variation in the liquidity characteristics of liabilities.

Liquidity and valuation



- Alternative/complementary techniques for ‘measurement’ of liquidity differentials in asset markets:
 - Paired comparisons
 - Merton model
 - ‘Negative basis’ – asset spread less cost of CDS protection
- These offer results which can vary over time and as between currencies and which are very susceptible to technical influences.
- Nevertheless:
 - There always is a liquidity differential
 - It appears to increase slightly with outstanding duration
 - It applies in all major currencies
 - It was highly significant during the massive deleveraging of late 2008 and early 2009

Where we are



- Consensus that issue cannot be ignored.
- Accepted by CEIOPS that it should have a bearing on value of illiquid liabilities in the ‘stressed spread’ scenario.
- Consensus on ‘proportion of observable asset spread in excess of some threshold’ conceptual model
- Significant difficulties remain in relation to:
 - Quantification
 - What past data to take into account?
 - Linkage to ‘basic risk-free’ rate?
 - Pros and cons of methods
 - Extrapolation – we believe this should be throughout term structure
 - Application to various elements of liabilities

Liability classification by liquidity – possible example

Class ('bucket')	Policyholder optionality definition	Specific inclusions	Proportion of full liquidity differential to be applied
Liquid	Explicitly guaranteed encashment terms continuously available	All liabilities with an outstanding duration of less than one year; all non-life liabilities other than structured settlements /annuities	zero
Near-liquid	Continuous or near-continuous encashment available on terms which constrain the discretion of the insurer to reflect illiquidity circumstances		15%
Intermediate	All other	Participating business (other than liquid or substantially illiquid)	45%
Near-illiquid	Encashment rights of the policyholder are constrained and/or the insurer is able freely to reflect illiquidity in encashment terms		75%
Substantially illiquid	No policyholder options affecting timing of cashflows		90%

Conclusions!?



- Market microstructures are subject to constant changes
- There are knowns, known unknowns, and unknown unknowns!
- Real issue may be to achieve institutions and processes which can balance not entirely consistent objectives of safety and stability.
- Practical workability may be a more important objective than theoretical coherence.

Thanks to many colleagues, especially Mark Chaplin!

Thank You



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