

## Solvency II – QIS 3 and Beyond

34<sup>th</sup> Annual GIRO Convention

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### Topics

- QIS 2 and QIS 3 Headlines
- QIS 3 Overview
- Market Value Margins
- QIS 3 – SCR Formula
- QIS 3 –MCR Formula, Group Issues and Questionnaire
- Internal Models
- Some Thoughts

## QIS 3 Overview

### Prior and Current QIS Studies

- Key input for Impact Assessment – several foreseen
- QIS 1 – 10/05 – end 12/05:
  - Technical Provisions in Life and Non-life
- QIS 2 – 5/06 – 7/06:
  - Solvency Requirements – SCR Standard Formula and Internal Models
  - Parameters used in the MCR and SCR
- QIS 3 – 4/07 – 7/07:
  - Refinement of SCR Standard Formula
  - Capital Requirement at Group Level
- QIS 4 – 4/08 – 7/08:
  - *Refinement of SCR Standard Formula and Other*
  - *Public Consultation process Jan to Feb 2008*
- QIS 5 – ?:

## QIS 2 and QIS 3 Headlines

### QIS 2 - Respondents

#### Number of respondents

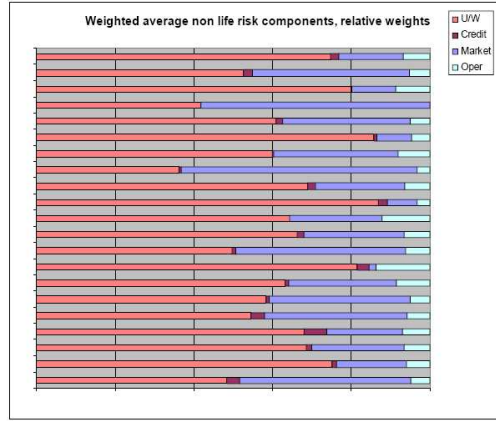
Type of undertaking	Small	Medium	Large	Total
Life undertakings	38	73	50	161
Health undertakings	8	11	3	22
Non-life undertakings	89	101	46	237
Pure reinsurers	5	2	6	13
Respondents providing data for both life and non-life business	15	33	27	81
<b>All respondents</b>	<b>155</b>	<b>220</b>	<b>132</b>	<b>514</b>
<i>of which Mutual undertakings (included above)</i>	39	51	16	108

CEOPS QIS 2 Report December 2006

- 514 Companies from 23 countries took part in QIS 2
  - Compared to 312 from 19 countries for QIS 1

## QIS 2 and QIS 3 Headlines

### QIS 2 – Non-Life Capital by Risk Category



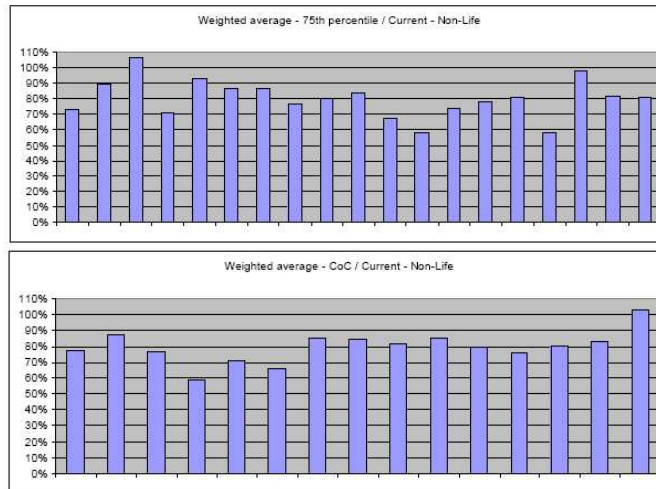
- 21 participating countries with non-life companies
  - ~ 60% of SCR U/W risk
  - ~ 30% of SCR Market risk
  - ~ 7% of SCR Operational risk
  - ~ 3% of SCR Credit risk
- Modules recalibrated and changed for QIS 3

CEOPS QIS 2 Report December 2006

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## QIS 2 and QIS 3 Headlines

### QIS 2 – Risk Margin: 75<sup>th</sup> Percentile and Cost of Capital vs Current



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## QIS 2 and QIS 3 Headlines

### QIS 2 – Some Observations

- Overall – Non-Life
  - Technical provisions generally - decreases
  - Capital requirement - increases
  - Available Capital - increases
  - Capital Availability / Capital Requirement Ratio – increases (For most respondents)
  
- Comparison of 75<sup>th</sup> percentile and Cost of Capital approaches
  - In most countries the differences were not significant
  - A majority of participants in each country prefer the cost of capital provision
    - Simplicity and economic interpretation
    - Approximate methods made available that did not require stochastic modelling
  - Cost of Capital – Most assumed that SRC / BE ratio remains constant during run-off
    - Market risk not included in these calculations by most participants

## QIS 2 and QIS 3 Headlines

### QIS 2 – Some Observations

- SCR Capital Calibration
  - Some risk modules and correlations – too prudent
    - e.g. Non-Life UW risk, Market risk and size factor
  - Market risk correlations - too high
    - e.g. equities and property, equities and interest rates
  - Non-Life UW risk market-wide volatility factors - too high
    - In particular for premium risk; size factor unsuitable for a number of mono-line players
  - Non-Life UW Formulae
    - Profitability and pricing trends will increase measured volatility
    - Reliability of historical combined ratios as an indicator of future loss
    - Does not allow for differences in non-proportional reinsurance programmes
    - Broad content with assumed correlations between lines of business
  
- Internal Models
  - Non-Life UW Risk – Internal Model capital < SCR placeholder capital
  - Credit Risk – Internal Model capital > SCR placeholder capital

## QIS 2 and QIS 3 Headlines

### QIS 3 – UK Respondents

- Total of 96 spreadsheets received
  - 46 from non-life firms
  - 39 from life firms
  - 11 from groups
- 70 completed questionnaires - many useful supplementary notes
  - More than 800 pages of qualitative comments covering all of the issues raised
  - Ad hoc email and verbal correspondence with firms over key technical and practical aspects of the exercise
- Size of participating firms:
  - 41 large
  - 27 medium
  - 17 small
- Market coverage by annual premium
  - 74% for non-life
  - 66% for life

## QIS 2 and QIS 3 Headlines

### QIS 3 – Overall Impact on Firms and Groups

- Calibration for QIS 3 still quite provisional
- Under QIS 3, most firms would see a reduction in their solvency ratios
  - Most well above 100%
- Some categories of firm observed a poor fit between QIS 3 SCR and Solvency I or ICAS – examples include:
  - Annuity providers (risk margins)
  - Linked life business (cat lapse rate)
  - Friendly societies (realistic provisions)
  - Motor insurers (premium and reserve risk calibration)
  - Some niche operators (diversification and granularity of classes of business)

## QIS 2 and QIS 3 Headlines

### QIS 3 – Summary of QIS 3 Output

- Non-life firms:
  - Underwriting risk is around 70% of SCR; Market risk a further 20%
  - As expected.
  - Balance of premium risk v reserve risk depends primarily on business mix
- Life firms:
  - Life underwriting risk had same weight as Market risk module
  - Expectations were that market risk should generally be greater.
  - Explanation may relate to a need to recalibrate parts of the underwriting risk module, e.g. lapse cat risk
- Operational risk and Credit risk:
  - Lower under QIS 3 than using internal models, reflecting a wider scope of risk measurement
  - More sophisticated the model, the higher the risk charge

## QIS 2 and QIS 3 Headlines

### QIS 3 – Summary of key perceived issues for UK firms

- Methodology / Calibration for Non-life underwriting risk
- Life:
  - Lapse Cat risk component for linked business
  - Annuity provisions – are these market consistent
  - Application of KC factor
- Design of MCR
- Use of Internal models
- Application of Solvency II to Groups
- Broad industry agreement that a single CoC measure at 6% was a poor fit, and that different values might be applied by class of business

## QIS 2 and QIS 3 Headlines

### QIS 3 – Other issues for UK firms

- Many other useful issues raised about suitability, practicability and calibration:
  - Risk margin assessment
  - Operational risk
  - Non-life Cat risk
  - Scope of credit risk module
  - Classification of own funds

## QIS 2 and QIS 3 Headlines

### QIS 3 – Use of Internal Models

- Many firms used internal model experience and output to inform both quantitative and qualitative responses to QIS3
  - Has provided FSA with valuable benchmark data and views on the suitability and practicability of the standard formula SCR
- In practice, FSA expect that most medium or large solo UK firms and almost all Groups, will use at least a partial internal model
- High level standards to be met by firms are set out in the draft Directive.
- FSA have carried out a parallel exercise looking at internal models v QIS3,
  - Initial focus on a small number of Non-Life and Life firms
- In principle: SCR standard formula > internal model SCR
- In practice: internal model SCR is considerably lower
  - ~ 50% x standard formula, Non-Life and Life
  - Increased sophistication and granularity of internal models
  - Conservatism of the standard formula calibration
  - Internal models providing a better fit for certain types of firm (e.g. specialist writers)

## QIS 2 and QIS 3 Headlines

### QIS 3 – Next Steps

- CEIOPS will discuss QIS3 results with representatives of the European industry [e.g. CEA] on 12 Oct 2007
- CEIOPS has been asked to deliver a complete draft QIS4 specification to the EC by 20 Dec 2007
  - incorporating lessons learned from QIS3
- QIS4 Specification, public consultation process: Jan to Feb 2008
- QIS4 will be launched in April 2008
  - Similar timetable to the 2007 QIS3 exercise

## Topics

- QIS 2 and QIS 3 Headlines
- QIS 3 Overview
- Market Value Margins
- QIS 3 – SCR Formula
- QIS 3 –MCR Formula, Group Issues and Questionnaire
- Internal Models
- Some Thoughts



## QIS 3 Overview

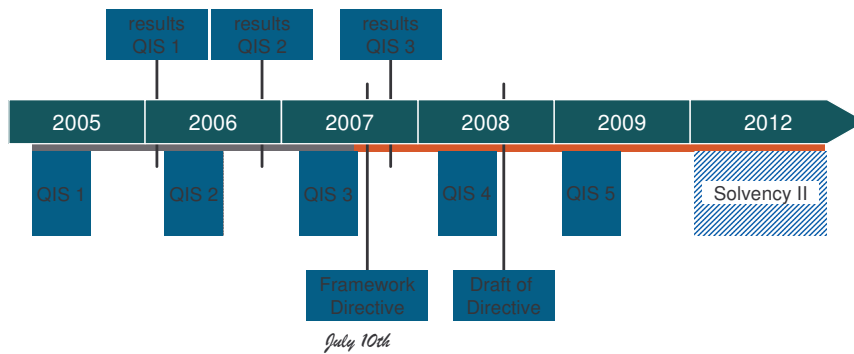
### QIS 3 Goals

- **Solvency Capital Requirement:**  
Capital:  $MV \text{ Assets} > MV \text{ Liabilities}$  after 1 year with a 99.5% probability
- Calculation of capital requirement by means of the **standard formula**
- **Practicality and suitability** of the design of the standard formula.
- **Suitability of calibration**
- Potential impact on **balance sheets**

### QIS 3 Technical Specification – Only Initial Proposals

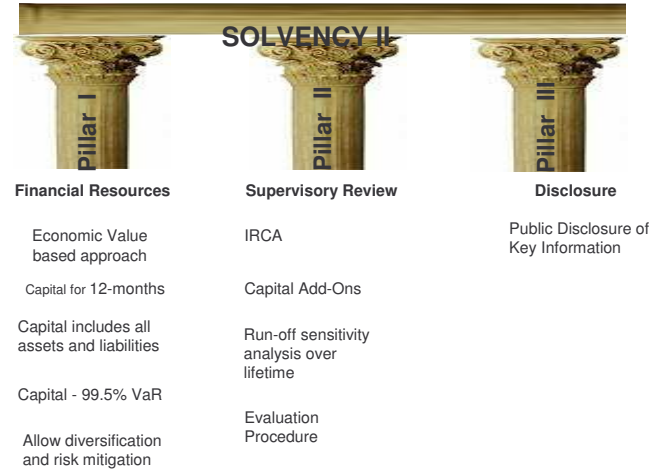
## QIS 3 Overview

### Solvency II Timeline



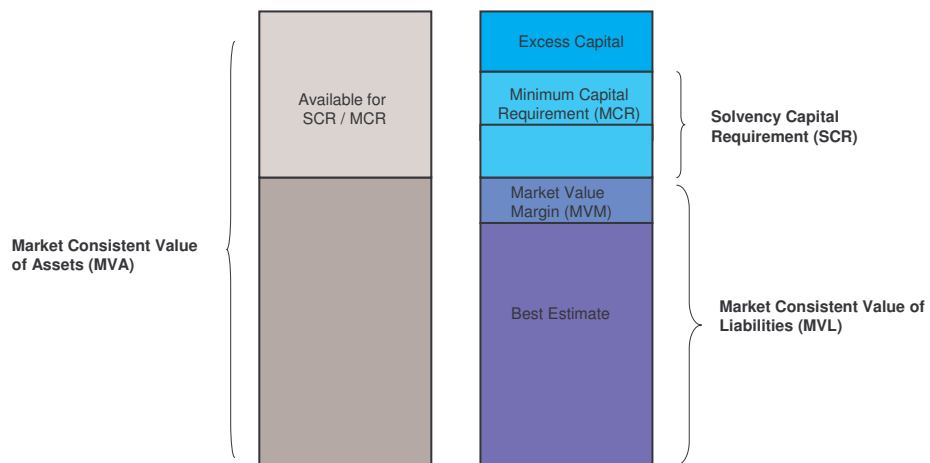
## QIS 3 Overview The Three Pillars

### 3-Pillar Approach



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## QIS 3 Overview Economic Balance Sheet



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## QIS 3 Overview

### Assets and Technical Provisions

- Assets
  - Valued at Market Value
  - Tradable Assets – Realisable Value
  
- Technical Provisions
  - Hedged Risks: Market-Consistent Values
  - Non-Hedged Risks: Best-Estimate + Market Value Margin (Cost of Capital)
    - *For Long-tail risks – alternative approaches to CoC can be used*
  - Gross and Net of Reinsurance

Market value margin

Best estimate liability  
(including cost of options and guarantees)

## QIS 3 Overview

### UK GAAP vs Economic Balance Sheet

Balance sheet	
UK GAAP Balance Sheet	
Assets	1000
Liabilities	900
Available capital	100
ECONOMIC BALANCE SHEET	
Assets	1025
Liabilities	881
<i>Best estimate</i>	831
<i>Risk margin</i>	50
Available capital	144

## QIS 3 Overview

### Technical Provisions: Best Estimate

- Technical Provisions comprise:
  - Claims Outstanding – Case reserves, IBNR and IBNER
  - Premium Provisions – UPR (including URR provision)
- Expected Present Value of Future Cashflows:
  - “*probability weighted averages of all future cash-flows (distributional outcomes)*”
  - At least 2 different methods should be applied
  - Gross and Net of Reinsurance
- Assumptions:
  - Realistic Actuarial Assumptions
  - Need to take account of risk factor probability distributions
- Discounting:
  - Risk-free discount rate - relevant liability duration
  - Expenses – expected value recognised in cashflows
- Reinsurance Default:
  - Assumes no reinsurer default
  - Assumes no own credit risk

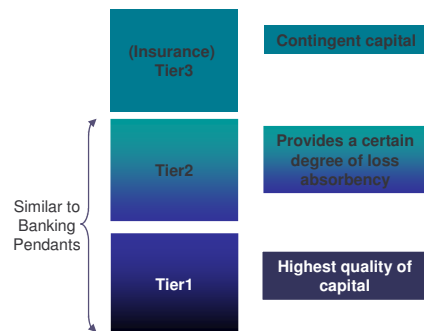
## QIS 3 Overview

### Non-Life Lines of Business

- Accident and health
  - Workers' compensation
  - Health
  - Others/default
- Motor, third party liability
- Motor, other classes
- Marine, aviation and transport
- Fire and other damage of property
- Third-party liability
- Credit and suretyship
- Legal expenses
- Assistance
- Miscellaneous non-life insurance
- Inwards reinsurance
  - Prop. inwards reinsurance as above,
  - Non-prop. inwards reinsurance
    - Property Business
    - Casualty Business
    - Marine, Aviation, Transport

## QIS 3 Overview

### Eligible Capital



- Companies asked to classify their capital into three tiers
- Capital is independent of accounting framework – market consistent valuation
- QIS 3 Assumption: Contingent Capital (T3) not available to cover the MCR

## Topics

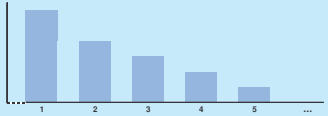
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## Market Value Margins

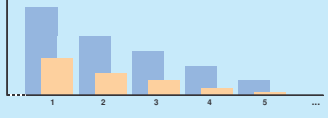
### Overview of the MVM Calculation

**Steps to calculate the Risk Margin under a Cost-of-Capital approach**

**1** Project the SCR for future years until run-off of the current liability portfolio



**2** Determine the cost of holding future SCR's, by multiplying the projected SCR by the CoC factor



**3** Discount the cost of holding future SCR's at the risk-free rate to get the CoC Risk Margin (RM)

$$RM = \sum_{i=1}^n CoC\_factor \times SCR_i \times v^i$$

- Project the SCR for future years until run-off
- Determine cost of holding future SCR's by multiplying projected SCR by the CoC factor (=6%)
- Risk Margin (MVM) - Discount the cost of holding future SCR's at the risk-free rate

## Market Value Margins

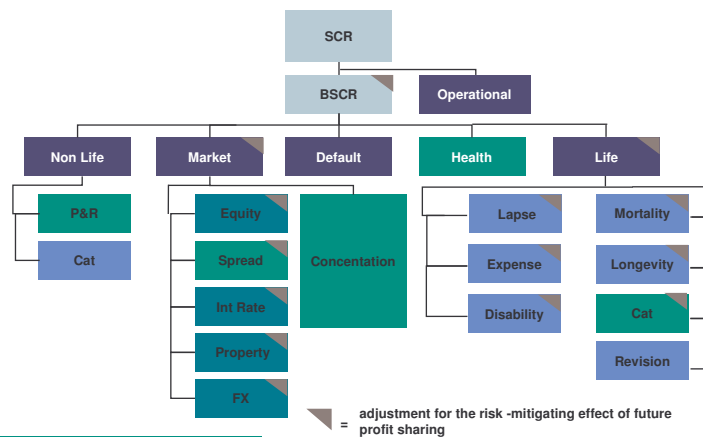
### Overview of the MVM Calculation

- What SCR should be used to determine the Cost of capital?
  - Future SCR's should be calculated using the standard approach:
    - SCR (t=1) - Underwriting risk; Operational risk; Market risk and Counterparty risk
    - SCR (t > 1) - does not include Market risk and Premium risk
  - Simplified approaches may be used to calculate future SCR's (t>1)
    - Proportional to Best Estimate of liabilities
- At what level is the SCR calculated for the CoC approach?
  - Latest information implies at the level of homogenous risk groups
  - Excludes diversification between different lines of business - conservative
  - Conservative "standalone" approach may be different in event transfer to 3<sup>rd</sup> party

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## QIS 3 – SCR Formula Overview of the SCR Calculation



Factors
Scenarios with simplified alternative
Scenarios

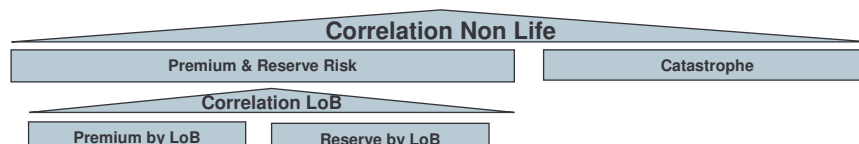
### QIS 3 – SCR Formula SCR - Correlation Matrix

	Market	Default	Life	Health	Non-Life
Market	1	-	-	-	-
Default	0.25	1	-	-	-
Life	0.25	0.25	1	-	-
Health	0.25	0.25	0.25	1	-
Non-Life	0.25	0.5	0	0	1

- Operational Risk Component removed from the diversification benefits
- Diversification effects of Future Profit Sharing captured

### QIS 3 – SCR Formula Non-Life Underwriting Risk

- Premium risk
  - Related to exposures earned next year
  - Risk that incurred losses plus expenses are larger than the earned premium
- Reserve risk
  - Related to prior year's business
  - Risk that carried reserves are insufficient to cover future payments
- Catastrophe risk
- Segmentation by LoB





## QIS 3 – SCR Formula

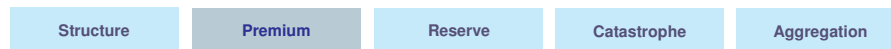
### Non-Life Underwriting Risk - Structure



- SCR is less responsive to UW Cycle
  - Removal of the Impact of expected profits / losses
- Capital Requirement (premium & reserve) = Volume Measure · Factor
- **Factor,  $\rho(\sigma)$ ,  $\sim 3 * \sigma$** 
  - Factor of 3 based on the 99.5% ile of a Log-normal distribution
  - $\sigma$  = combined volatility factor
  - $\sigma$  = calculated by aggregating the volatility factors for the 15 classes of business for reserve risk and premium risk
  - Using a 30 x 30 Correlation Matrix
- **Volume Measure** = Premium next year + Net Reserves

## QIS 3 – SCR Formula

### Non-Life Underwriting Risk - Premium



- Volatility factor is a function of
  - Market wide factor and
  - Company specific factor
- Company factor contribution increases if more historical experience is available
  - Company specific factors calculated from variation in historical loss ratios
- Market wide factor = market-wide estimate of the volatility for premium risk
  - 10% - Motor, Property, General Liability
  - 12.5% - Credit & Suretyship
  - 20% - Inwards Reinsurance

## QIS 3 – SCR Formula Non-Life Underwriting Risk - Reserve



- Volatility factor = Market wide factor
- Market wide factor = market-wide estimate of the std dev for reserve risk
  - 10% - Property, Credit & Suretyship
  - 12.5% - Motor Third Party Liability
  - 15% - General Liability, Marine / Aviation / Transport
  - 20% - Inwards Reinsurance

## QIS 3 – SCR Formula Non-Life Underwriting Risk – Premium and Reserve



- Table shows the impact of the different factors used in QIS 2 and QIS 3
  - Factors are expressed as a percentage of the premium volume
- The QIS3 factors have decreased....but LOB correlations have increased
  - Large Companies - Similar requirements
  - SME – Benefited the most – removal of size factors

Company	Multi line - 10 LOBs		Multi line - 5 LOBs		Mono line - 1 LOB only	
	QIS 2	QIS 3	QIS 2	QIS 3	QIS 2	QIS 3
Large (€1000m)	35%	37%	44%	40%	51%	56%
Medium sized (€500m)	46%	37%	44%	40%	51%	56%
Small (€50m)	84%	37%	110%	40%	76%	56%

### QIS 3 – SCR Formula Non-Life Underwriting Risk - Catastrophe



- CEIOPS has defined Regional and Trans-regional CAT scenarios
- For each scenario  $i$ , companies asked to assess impact on NAV  $Cat_i$ 
  - Either using scenario-based or
  - Market-Loss approach
- Non-Life CAT risk charge is determined as
  - $NL_{Cat} = \sqrt{\sum CAT_i}$
  - Sum over all catastrophes > 25% of the Cost of most severe scenario.

### QIS 3 – SCR Formula Non-Life Underwriting Risk - Aggregation



- Combined (Premium and Reserve) charge aggregated with Catastrophe Risk
  - Assuming independence (see correlation matrix below)

	Premium + Reserve	Catastrophe
Premium + Reserve	1	0
Catastrophe	0	1

## QIS 3 – SCR Formula

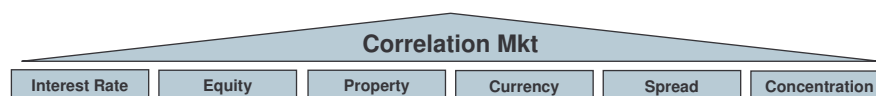
### Non-Life Underwriting Risk – In Summary

- SCR is less responsive to UW Cycle
  - Removal of the Impact of expected profits / losses
  - Company writes loss making business (e.g. soft market) → Lower capital
  - Company increases premium rates to increase profitability → Higher capital
- Calibration ? – little justification for the parameters
  - Size factor has been removed
  - More work required
- Reserve Risk – No company experience
- Premium Risk – Does not capture prospective risks
- CAT Risk – allowance of scenario approach

## QIS 3 – SCR Formula

### Market Risk

- Market risk arises from the level of volatility of market prices
- SCR for market risk is measured by analysing the impact on the balance sheet of movements in the level of financial variables through:
  - Scenario modelling
  - Simplified approaches or factors for some sub-modules
- Outputs for this module are:
  - Capital charge for market risk before profit sharing:  $SCR_{MKT}$
  - Risk mitigating effect of future profit sharing:  $KC_{MKT}$



### QIS 3 – SCR Formula Market Risk – Interest Rate Risk

Interest Rate	Equity	Property	Currency	Spread	Concentration
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- Shocks scenarios to assess the net impact of increase or decrease of interest rates based on term structure:

$$Mkt_{int} = \max \left\{ \begin{array}{l} \Delta NAV | \overset{0}{upwardshock} \\ \Delta NAV | downwardshock \end{array} \right\}$$

- Different shocks are applied to different maturities
- Impact should take into account any hedging instruments

### QIS 3 – SCR Formula Market Risk – Interest Rate Risk

Interest Rate	Equity	Property	Currency	Spread	Concentration
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- Example: If the 5-year interest rate equals 4% then the upwards “stressed” 5 – year interest rate = 4% x (1+0.56) = 6.24%

Maturity (years)	1	2	3	4	5	6	7
Relative change up	0.94	0.77	0.69	0.62	0.56	0.52	0.49
Relative change down	-0.51	-0.47	-0.44	-0.42	-0.40	-0.38	-0.37
Maturity (years)	8	9	10	11	12	13	14
Relative change up	0.46	0.44	0.42	0.42	0.42	0.42	0.42
Relative change down	-0.35	-0.34	-0.34	-0.34	-0.34	-0.34	-0.34
Maturity (years)	15	16	17	18	19	20+	
Relative change up	0.42	0.41	0.40	0.39	0.38	0.37	
Relative change down	-0.34	-0.33	-0.33	-0.32	-0.31	-0.31	

## QIS 3 – SCR Formula

### Market Risk – Equity, Property and Currency Risks

Interest Rate

Equity

Property

Currency

Spread

Concentration

- Shock scenarios applied to all assets and liabilities:
  - Equity shocks - 2 different types of equities with different volatilities. (Diversification effect is recognised between them)
  - Currency takes - worst of a rise or fall of foreign currency against local currency
- Certain alternative investments treated like equity (i.e. hedge funds, SPVs)
- Hedging arrangements should be taken into account
- Also testing an Alternative - duration of the liabilities

## QIS 3 – SCR Formula

### Market Risk – Equity Risk

Interest Rate

Equity

Property

Currency

Spread

Concentration

- Equity risk results from volatility of market prices for equities
  - Different stresses for global equity and other equity
- Allowance made for corresponding movement in hedging instruments
- Equity stress = Net Asset Value \* volatility factor

Equity Stress	Global	Other
Global	32%	45%

Correlation	Global	Other
Global	1.0	0.75
Other	0.75	1.0

## QIS 3 – SCR Formula

### Market Risk – Property and Currency Risks

Interest Rate    Equity    **Property**    Currency    Spread    Concentration

- **Property**
  - Property risk arises from the level or volatility of market prices of property
  - Property risk is the immediate effect on the net value of asset and liabilities expected in the event of a 20% fall in real estate benchmarks
  - Allowance is made for the investment policy e.g. hedging arrangements or gearing
  
- **Currency**
  - Currency risk is the immediate effect expected on the net value of asset and liabilities in the event of a 20% change (greater of a rise or fall) in value of all other currencies against the local reporting currency
  - Allowance is made for the individual currency positions and investment policy e.g. hedging arrangements or gearing

## QIS 3 – SCR Formula

### Market Risk – Spread Risk

Interest Rate    Equity    Property    Currency    **Spread**    Concentration

- Spread risk arises from volatility of credit spreads over risk-free interest rate (term)
- Government bonds do not have a charge
- Capital requirement :

$$Mkt_{sp} = \sum_i MV_i \bullet m(dur_i) \bullet F(rating)$$

- Function F:

Rating	AAA	AA	A	BBB	BB	B	CCC	NR
F(Rating)	0.25%	0.25%	1.03%	1.25%	3.39%	5.60%	11.2%	2%

- Function m:

$$m(dur_i) = \begin{cases} \min(dur_i; 8) & \text{if } rating_i = BB \text{ or } NR \\ \min(dur_i; 6) & \text{if } rating_i = B \\ \min(dur_i; 4) & \text{if } rating_i = CCC \\ dur_i & \text{otherwise} \end{cases}$$

## QIS 3 – SCR Formula

### Market Risk – Concentration Risk

Interest Rate    Equity    Property    Currency    Spread    **Concentration**

- Concentration risk arises from additional volatility of concentrated asset portfolios and permanent losses of value due to the default of an issuer
- Only counterparty concentration risk is taken into account
- Calculation is done in four steps:
  - Calculate net exposure. Sum of the exposures across asset classes
  - Calculate excess exposure above a concentration threshold (which varies by rating of the counterparty)
  - Calculate charge per 'name' as a function of excess exposure (parameters of the function not intuitive)
  - Aggregate individual charges (independence assumed)

## QIS 3 – SCR Formula

### Market Risk – Concentration Risk

Interest Rate    Equity    Property    Currency    Spread    **Concentration**

- Aggregation assumes independence:  $Mkt_{conc} = \sqrt{\sum_i Conc_i^2}$
- Individual concentration charges:  $Conc_i = Assets_{xt} \cdot XS_i \cdot (g_0 + g_1 \cdot XS_i)$
- Excess exposure:  $XS_i = \max\left\{0; \frac{E_i}{Assets_{xt}} - CT\right\}$

Rating	CT
AA-AAA	5%
A	5%
BBB	3%
BB or lower	3%

Rating	g0	g1
AA-AAA	0.1840	0.0401
A	0.2684	-0.0163
BBB	0.3862	-0.0416
BB or lower	0.9227	-0.4314



### QIS 3 – SCR Formula Market Risk – Correlation Matrix

	Interest	Equity	Property	Spread	Conc.	Currency
Interest	1	-	-	-	-	-
Equity	0	1	-	-	-	-
Property	0.5	0.75	1	-	-	-
Spread	0.25	0.25	0.25	1	-	-
Conc.	0	0	0	0	1	-
Currency	0.25	0.25	0.25	0.25	0	1

- Correlation Factors reduced compared to QIS 2

### QIS 3 – SCR Formula Market Risk – Treatment of Free Assets

- Placeholder approach envisage to stress all assets, i.e. including those backing free surplus (i.e. assets - technical provision – SCR - other liabilities)
- Participants invited to provide alternative SCR (and MCR) calculations subject to exclusion of free assets from market risk
- Calculation is iterative:
  - Calculate the SCR based on all assets and use calculation to identify free assets
  - Use above to identify assets not needed to cover technical provisions and SCR
  - Exclude these assets and repeat the SCR calculation
  - Repeat this calculation until the SCR no longer changes significantly

## QIS 3 – SCR Formula

### Market Risk – In Summary

- No consideration of government bonds
- Concentration risk included
- Decrease of calibration factors
- Decrease of correlation factors – however some are still high
- Hedging taken into account
- Concentration risk parameters  $g_0$  and  $g_1$  are not intuitive
- Treatment of equities for concentration risk

## QIS 3 – SCR Formula

### Counterparty Default Risk

- Counterparty default risk is the risk of default of a counterparty to risk mitigating contracts like reinsurance (RI) and financial derivatives (FD)
- Replacement Cost at default is the exposure measure
  - Gross - Net Provisions + Extra Premium - paid minus recoveries
- Probability of Default for a counterparty is derived from external ratings

Rating	PD
AAA	0.002%
AA	0.01%
A	0.05%
BBB	0.24%
BB	1.20%
B	6.04%
CCC or lower	30.41%

### QIS 3 – SCR Formula Counterparty Default Risk

- Capital requirement = Sum of charges  $Def_i$  for reinsurance and financial derivatives
- Initially R, a measure of the correlation of default is calculated for both the reinsurance exposures and the financial derivatives.

$$R = 0.5 + 0.5 \cdot H \quad (H = \text{Herfindahl index for respective contract})$$

- For  $R = 0.5$  where  $Def_i = RC_i \cdot N \left[ (1-R)^{-0.5} \cdot G(PD_i) + \sqrt{\frac{R}{1-R}} \cdot G(0.995) \right]$

$RC_i$  = replacement cost of RI or FD for counterparty  $i$

$PD_i$  = Probability of default of counterparty  $i$

$N$  = Cumulative standard normal distribution ( $G$  = Inverse of  $N$ )

- For  $R = 1$   $Def_i = RC_i \cdot \min(100 \cdot PD_i; 1)$
- For intermediate values of  $R$   $Def_i$  is linearly interpolated between these two values

### QIS 3 – SCR Formula Counterparty Default Risk - Example

- Consider a homogenous portfolio of 1, 2, 5 ... 1000 exposures with a total replacement cost of €1m. All reinsurers are assumed to have the same rating.
- Then the capital requirements  $SCR_{def}$  are as follows:

Replacement Cost		SCR - Counterparty Default Risk						
n	per Reinsurer	AAA	AA	A	BBB	BB	B	Lower
1	1,000,000	2,000	10,000	50,000	240,000	1,000,000	1,000,000	1,000,000
2	500,000	959	5,231	26,652	119,179	451,653	736,517	975,928
5	200,000	751	4,277	21,983	95,014	341,983	683,821	971,113
10	100,000	682	3,959	20,426	86,960	305,427	666,255	969,509
20	50,000	647	3,800	19,648	82,932	287,148	657,472	968,706
50	20,000	626	3,705	19,181	80,516	276,181	652,203	968,225
100	10,000	619	3,673	19,025	79,710	272,526	650,446	968,064
1000	1,000	613	3,644	18,885	78,985	269,236	648,865	967,920

## QIS 3 – SCR Formula

### Counterparty Default Risk – In Summary

- Allowance for counterparty default (not under QIS 2)
- Approach seems unnecessarily complicated
- Calibration ?
- Replacement costs may not be available

## QIS 3 – SCR Formula

### Operational Risk

- Operational risk is the “ risk of loss arising from inadequate or failed internal processes, people, systems or from external events.”
- Operational risk is a stand alone risk - not subject to any diversification allowance.
- Capital requirement is Minimum of:
  - A loading 30% of the basic SCR
  - The higher of:
    - 3% of Gross EP for Life and 2% of Gross EP for Non-life and Health insurance
    - 0.3% of Gross TP for life and 2% of Gross TP for Non-life and Health insurance

$$SCR_{op} = \min \left\{ Op_{load} \cdot BSCR; \max \left\{ \begin{array}{l} 0.03 \cdot Earn_{life} + 0.02 \cdot Earn_{nl} + 0.02 \cdot Earn_h; \\ 0.003 \cdot TP_{life} + 0.02 \cdot TP_{nl} + 0.002 \cdot TP_h \end{array} \right\} \right\}$$

## QIS 3 – SCR Formula

### Operational Risk – In Summary

- Factors in the calculation reduced since QIS 2
- No allowance for Diversification with other major risk groups
- No incentives for improving operational and management processes
- Calibration

## QIS 3 – SCR Formula

### Life Underwriting Risk

- Life Underwriting Risk is the risk arising from life insurance contracts:
  - Associated with both the perils covered
  - Processes followed in the conduct of the business
- Market Risk SCR → impact on Balance Sheet of changes in the assumptions used to project liability cash flows:
  - Scenario simulation except for Catastrophe risk
  - Use of simplified approaches allowed for smaller undertakings
- Outputs are:
  - Capital charge for life underwriting risk before profit sharing:  $SCR_{LIFE}$
  - Risk mitigating effect of future profit sharing:  $KC_{LIFE}$



## Topics

- QIS 2 and QIS 3 Headlines
- QIS 3 Overview
- Market Value Margins
- QIS 3 – SCR Formula
- QIS 3 –MCR Formula, Group Issues and Questionnaire
- Internal Models
- Some Thoughts

## QIS 3 – MCR Formula MCR Requirements

- Objectives: An MCR which is simple, robust and objective
- Calibration: One-year time horizon, 90% VaR target level of confidence.
- The following were being tested:
  - Modular approach with alternative market risk methods
  - CEA approach as a % of the SCR (33%)
- Impact of a minimum monetary floor for the MCR

## QIS 3 – Group Issues

### Group Issues - Overview

- First time group issues have been included in a QIS exercise
- QIS 3 were seeking to understand:
  - Size and sources of group diversification
  - Application of the principle of transferability
  - Size and nature of group specific risks
  - Assess difficulties in carrying out the calculations for groups
- Quantitative and qualitative information on internal models also being sought
- Two Alternative approaches are being tested for groups
  - Main method:
    - Aggregation of results from individual entities
    - Adjustment for non transferability of assets
  - Alternative method:
    - Apply standard approach to consolidated data as if the group is a single entity
    - Adjustments for non-transferability of profits

## QIS 3 – Questionnaire

### Questionnaire - Overview

- Two qualitative questionnaires were issued (in addition to the quantification)
  - Solo (31 questions)
  - Groups (39 questions)
- Questionnaires include:
  - Questions that all participants should answer
  - Others that subject to availability and applicability
- Focus of both questionnaires are:
  - Practicability
  - Suitability of methodology and calibration
  - Resource availability
  - Suggested simplifications and approaches

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## Internal Models

### The Role of Internal Models

- QIS 3 Participants encouraged to calculate:
  - Capital by “Internal Models” and for each of the risk modules
- Partial Internal Models welcome:
  - Interest Rate and Equity Risk in particular (Banking Expertise)
- Issues:
  - Disaggregation of Output from Models to level of Granularity required
  - Risk Classification
  - Valuation bases may be different
- Supervisory Powers (Suggestions):
  - Should have the option to require companies to set up:
    - Partial or Full Model
  - Prior approval of Internal Model required
    - Power not to grant or withdraw

### **CEIOPS plans to publish a further consultation paper on Internal Models**



## Internal Models

### Internal Model Approval Process

- The design of a practical Internal Model Approval Process is a non-trivial issue
- CEIOPS - Approval for an internal model for an undertaking's SCR calculation should be subject to a Use, Calibration, and Statistical Quality test ("CP 20")
  - **Use Test** – Is the actuarial model used relevant for and used within risk management
  - **Calibration Test** – Is the SCR computed by the undertaking a fair, unbiased estimate of the risk as measured by the common SCR target criterion?
  - **Statistical Quality Test** – are the data and methodology underlying both internal and regulatory applications sound and sufficiently reliable to support both satisfactorily

## Topics

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## Some Thoughts Issues

- SCR Standard Formula:
  - One Size fits all:
    - Formulae – Model risk ?
    - Parameters – Parameter risk ?
    - Differentiation by territory ?
  - Factors to Net Financials - Premiums and Reserves
  - VaR vs TailVaR and Percentile

### **Are the Use of Internal Models Inevitable (UK: ICA vs ECR)**

- SCR Correlation:
  - Determination of parameters ~ Economic or Underwriting Cycle ?
  - Some of the relationships look odd
  - Insurance Risk and Credit Risk
    - Credit Risk – Expected Reinsurance Recoveries (not Stressed level)
- Cost of Capital – Basis and Assumptions
  - A series of 99.5% VaR 12-month calculations – Non-trivial
- Internal Models – Role, Validation and Approval Process