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Draft CEIOPS' Advice for Level 2 Implementing Measures on Solvency II:

SCR STANDARD FORMULA

Article 109(1c)

Correlations

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CEIOPS e.V. – Westhafenplatz 1 - 60327 Frankfurt – Germany – Tel. + 49 69-951119-20
Fax. + 49 69-951119-19 email: secretariat@ceiops.eu; Website: www.ceiops.eu

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1. Introduction

1.1. In its letter of 19 July 2007, the European Commission requested CEIOPS to provide final, fully consulted advice on Level 2 implementing measures by October 2009 and recommended CEIOPS to develop Level 3 guidance on certain areas to foster supervisory convergence. On 12 June 2009 the European Commission sent a letter with further guidance regarding the Solvency II project, including the list of implementing measures and timetable until implementation.[1]

1.2. This Consultation Paper aims at providing advice with regard to the choice of the correlation parameters applied in the SCR standard formula to aggregate capital requirements on module and sub-module level as requested in Article 109(1c) of the Solvency II Level 1 text ("Level 1 text"). [2]

2. Extract from Level 1 Text

2.1 Legal basis for implementing measure

Article 109 - Implementing measures

1. In order to ensure that the same treatment is applied to all insurance and reinsurance undertakings calculating the Solvency Capital Requirement on the basis of the standard formula, or to take account of market developments, the Commission shall adopt implementing measures laying down the following:

[…]

(c) the correlation parameters, including, if necessary, those set out in Annex IV, and the procedures for the updating of those parameters;

[…]

2.2 Other relevant Level 1 text for providing the background to the advice

Article 101 - Calculation of the Solvency Capital Requirement

[…]

3. The Solvency Capital Requirement shall be calibrated so as to ensure that all quantifiable risks to which an insurance or reinsurance undertaking is exposed are taken into account. It shall cover existing business, as well as the new business expected to be written over the next twelve months. With respect to existing business, it shall cover unexpected losses only.

[1] See http://www.ceiops.eu/content/view/5/5/

[2] Text adopted by the European Parliament on 22 April 2009, see http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//NONSGML+TA+20090422+SIT-03+DOC+WORD+V0//EN&language=EN.

It shall correspond to the Value-at-Risk of the basic own funds of an insurance or reinsurance undertaking subject to a confidence level of 99.5% over a one-year period.

Article 104 - Design of the Basic Solvency Capital Requirement

[…]

3. The correlation coefficients for the aggregation of the risk modules referred to in paragraph 1, as well as the calibration of the capital requirements for each risk module, shall result in an overall Solvency Capital Requirement which complies with the principles set out in Article 101.

ANNEX IV - Solvency Capital Requirement (SCR) standard formula

1. *Calculation of the Basic Solvency Capital Requirement*

The Basic Solvency Capital Requirement set out in Article 104(1) shall be equal to the following:[3]

$$Basic\ SCR = \sqrt{\sum_{i,j} Corr_{i,j} \times SCR_i \times SCR_j}$$

where SCRi denotes the risk module i and SCRj denotes the risk module j, and where "i,j" means that the sum of the different terms should cover all possible combinations of i and j. In the calculation, SCRi and SCRj are replaced by the following:

- SCR non-life denotes the non-life underwriting risk module;
- SCR life denotes the life underwriting risk module;
- SCR health denotes the health underwriting risk module;
- SCR market denotes the market risk module;
- SCR default denotes the counterparty default risk module.

The factor Corr i,j denotes the item set out in row i and in column j of the following correlation matrix:

i \ j	Market	Default	Life	Health	Non-life
Market	1	0.25	0.25	0.25	0.25
Default	0.25	1	0.25	0.25	0.5
Life	0.25	0.25	1	0.25	0
Health	0.25	0.25	0.25	1	0
Non-life	0.25	0.5	0	0	1

2. *Calculation of the non-life underwriting risk module*

[3] CEIOPS remark: The first summation sign under the square root appears to be a printing error.

The non-life underwriting risk module set out in Article 105(2) shall be equal to the following:

$$SCR_{non-life} = \sqrt{\sum_{i,j} Corr_{i,j} \times SCR_i \times SCR_j}$$

where SCRi denotes the sub-module i and SCRj denotes the sub-module j, and where "i,j" means that the sum of the different terms should cover all possible combinations of i and j. In the calculation, SCRi and SCRj are replaced by the following:

- *SCR nl premium and reserve denotes the non-life premium and reserve risk sub-module;*
- *SCR nl catastrophe denotes the non-life catastrophe risk sub-module.*

3. *Calculation of the life underwriting risk module*

The life underwriting risk module set out in Article 105(3) shall be equal to the following:

$$SCR_{life} = \sqrt{\sum_{i,j} Corr_{i,j} \times SCR_i \times SCR_j}$$

where SCRi denotes the sub-module i and SCRj denotes the sub-module j, and where "i,j" means that the sum of the different terms should cover all possible combinations of i and j. In the calculation, SCRi and SCRj are replaced by the following:

- SCR mortality denotes the mortality risk sub-module;
- SCR longevity denotes the longevity risk sub-module;
- SCR disability denotes the disability - morbidity risk sub-module;
- SCR life expense denotes the life expense risk sub-module;
- SCR revision denotes the revision risk sub-module;
- SCR lapse denotes the lapse risk sub-module;
- SCR life catastrophe denotes the life catastrophe risk sub-module.

4. *Calculation of the market risk module*

Structure of the market risk module
The market risk module, set out in Article 105(5) shall be equal to the following:

$$SCR_{market} = \sqrt{\sum_{i,j} Corr_{i,j} \times SCR_i \times SCR_j}$$

where SCRi denotes the sub-module i and SCRj denotes the sub-module j, and where "i,j" means that the sum of the different terms should cover all possible combinations of i and j. In the calculation, SCRi and SCRj are replaced by the following:

- SCR interest rate denotes the interest rate risk sub-module;
- SCR equity denotes the equity risk sub-module;
- SCR property denotes the property risk sub-module;
- SCR spread denotes the spread risk sub-module;
- SCR concentration denotes the market risk concentrations sub-module;
- SCR currency denotes the currency risk sub-module.

3. Advice

3.1. Explanatory text

3.1.1. Previous advice

3.1. In its "Further advice to the European Commission on Pillar 1 issues" (CEIOPS–DOC–08/07, March 2007)[4], further elaborating on its previous advice to the tenth Call for Advice from the Commission, CEIOPS recommended the use of correlation matrices for the aggregation of capital requirements. As to the choice of the correlation parameters the following safeguards were stated to be important:

- "to keep note of any dependencies that would not be addressed properly by this treatment;" i.e. by linear correlations,
- "to choose the correlation coefficients to adequately reflect potential dependencies in the tail of the distributions;"
- "to assess the stability of any correlation assumptions under stress conditions".

3.1.2. Background

3.2. The SCR standard formula as defined in the Level 1 text follows a modular approach. The overall risk which the insurance or reinsurance undertaking is exposed to is divided into sub-risks. For each sub-risk a capital requirement $SCR_{sub\text{-}risk}$ is determined. The capital requirements on sub-risk level are aggregated in order to derive the capital requirement for the overall risk.

3.3. A simple technique to aggregate capital requirements is the use of correlation matrices. The capital requirement for the overall risk is calculated as follows:

$$SCR_{overall} = \sqrt{\sum_{i,j} Corr_{i,j} \cdot SCR_i \cdot SCR_j}$$

where i and j run over all sub-risks and $Corr_{i,,j}$ denotes the entries of the correlation matrix, i.e. the correlation parameters.

3.4. According to Articles 104(1) and 105 of the Level 1 text, the aggregation of the capital requirements for the sub-risks of at least the following parts of the standard formula are done by means of correlation matrices:

- the Basic SCR,
- the capital requirement for non-life underwriting risk,
- the capital requirement for life underwriting risk, and
- the capital requirement for market risk.

[4] See http://www.ceiops.eu/media/files/publications/submissionstotheec/CEIOPS-DOC-08-07AdviceonPillarI-Issues-FurtherAdvice.pdf, paragraph 5.33

3.5. Moreover, the Level 1 text does not specify the aggregation method for certain other parts of the standard formula, for example for the health underwriting module or regarding any further subdivision of sub-modules for the above mentioned modules. Correlation matrices could also be used for these aggregation tasks.

3.6. The selection of the correlation parameters has a significant influence on the result of the SCR calculation. For example, if five capital requirements of equal size are aggregated, the result is 55% lower if the correlation parameter 0 instead of the parameter 1 is used to describe the relation between each pair of risks. Hence, the choice of correlation parameters has an impact on the level of diversification to be obtained within the SCR standard formula.

3.7. Having regard to complexity of this issue and the time pressure, CEIOPS will continue to explore the issue. CEIOPS would appreciate specific stakeholder feedback regarding analysis which they have undertaken.

3.1.3. Mathematical analysis of the aggregation technique

3.8. In the mathematical science, correlation matrices are used to aggregate standard deviations of probability distributions or random variables. In this case, the entries of the matrix are defined as linear correlation coefficients, i.e. for two random variables X and Y, the entry is

$$\rho = \frac{Cov(X,Y)}{\sqrt{Var(X)Var(Y)}}$$

3.9. The capital requirements that are aggregated in the standard formula are, from a mathematical point of view, not standard deviations but quantiles of probability distributions. However, this does not imply that it is an abuse of the concept of correlation matrices to apply it in the context of the standard formula. Because it can be shown that for multivariate normal distributions (or more general: for elliptic distributions), the aggregation with correlation matrices produces a correct aggregate of quantiles.

3.10. On the other hand, only for a restricted class of distributions the aggregation with linear correlation coefficients produces the correct result. In the mathematical literature numerous examples can be found where linear correlations do not well reflect the dependence between distributions and the use of linear correlations lead to wrong or even absurd aggregation results.[5]

3.11. Two main reasons can be identified for this aggregation problem:

- The dependence between the distributions is not linear; for example there are tail dependencies.

[5] See for example: P. Embrechts, A. McNeil, D. Strautmann: "Correlation and Dependence in Risk Managemement: Properties and Pitfalls" (2002) In: Risk Management: Value at Risk and Beyond, ed. M.A.H. Dempster, Cambridge University Press, Cambridge, pp. 176-223 (http://www.math.ethz.ch/~strauman/preprints/pitfalls.pdf). The authors provide a general analysis of the problems connected with linear correlations.
D. Pfeifer, D. Straßburger: "Solvency II: Stability problems with the SCR aggregation formula", Scandinavian Actuarial Journal (2008), No. 1, pp. 61-77 (http://www.staff.uni-oldenburg.de/dietmar.pfeifer/SCR_Pfeifer_Strassburger.pdf). The authors give examples for beta distributions.
A. Sandström: "Solvency II: Calibration for Skewness", Scandinavian Actuarial Journal (2007), No. 2, pp. 126-134. Sandström discusses a modification of the aggregation method to better allow for skewed distributions.

- The shape of the marginal distributions is significantly different from the normal distribution; for example the distributions are skewed.

3.12. Unfortunately, both characteristics are shared by many risks which an insurance or reinsurance undertaking is exposed to. Tail dependence exists both in underwriting risks (e.g. catastrophe events) and in market and credit risks. The current financial crisis is a good example of this. Market parameters (like credit spreads, property prices, equity prices or currency exchange rates) which have revealed no strong dependence under benign economic conditions simultaneously showed strong adverse changes in the last two years. Moreover, it became apparent that a change in one parameter had a reinforcing effect on the deterioration of the other parameters.

3.13. As to the second characteristic, it is known of the relevant risks of an insurance or reinsurance undertaking that the underlying distributions are not normal. They are usually skewed and some of them are truncated by reinsurance or hedging.

3.14. Because of these shortfalls of the correlation technique and the relevance of the shortfalls to the risks covered in the standard formula, the choice of the correlation factors should attempt to avoid misestimating the aggregate risk. In particular, linear correlations are in many cases not an appropriate choice for the correlation parameter.

3.15. Instead, the correlation parameters should be chosen in such a way as to achieve the best approximation of the 99.5% VaR for the aggregated capital requirement. In mathematical terms, this approach can be described as follows: for two risks X and Y with $E(X)=E(Y)=0$, the correlation parameter ρ should minimize the aggregation error

$$VaR(X+Y)^2 - VaR(X)^2 - VaR(Y)^2 - 2\rho \cdot VaR(X) \cdot VaR(Y).$$

3.16. This approach is a consequence of Article 104 of the Level 1 text. According to paragraph 3 of Article 104,

"the correlation coefficients for the aggregation of the risk modules referred to in paragraph 1, as well as the calibration of the capital requirements for each risk module, shall result in an overall Solvency Capital Requirement which complies with the principles set out in Article 101."

Article 101 stipulates that the SCR corresponds to the Value-at-Risk with a confidence level of 99.5%.

3.17. In the "Global Framework for Insurer Solvency Assessment" of the International Actuarial Association the term "tail correlation" is used to describe such an approach: [6]

"This 'correlation' need not be the standard linear correlation found in statistics text books. In particular, it could be a 'tail correlation' to incorporate the possibility of simultaneous adverse outcomes …"

[6] See paragraph 6.20 (http://www.actuaries.org/LIBRARY/Papers/Global_Framework_Insurer_Solvency_Assessment-public.pdf).

3.1.4. Independent risks

3.18. Several risks covered in the standard formula are believed to be independent. Often, a correlation parameter of 0 is considered to be the best choice for the aggregation of independent risks. However, this is not always the case. The following two examples try to illustrate this.

3.19. Example 1: Let X and Y be independent and both follow the continuous uniform distribution on [-1, 1]. Then VaR(X) = VaR(Y) = 0.99 and VaR(X+Y) = 1.8.[7] However, if VaR(X+Y) is calculated by aggregation of VaR(X) and VaR(Y) with the linear correlation coefficient of 0, the result is about 1.4, significantly lower than the correct result. The aggregation produces an accurate result if a correlation parameter of about 0.653 instead of 0 is used.

3.20. Example 2: The first example is easy to calculate, but it may look artificial as risks are usually not assumed to follow a uniform distribution. Instead, let X and Y be independent and both follow a centralised and truncated lognormal distribution. The underlying non-truncated lognormal distribution has a mean of 1 and a standard deviation of 0.1. It is capped at 0.2; this corresponds approximately to the 98% quantile of the distribution. The risks X and Y could be underwriting risks mitigated by non-proportional reinsurance or hedged investment risks.[8] Because of the capping at a quantile lower than 99.5%, VaR(X) = VaR(Y) = 0.2. By simulation VaR(X+Y) can be determined as about 0.34. The value for VaR(X+Y) that is calculated by aggregating VaR(X) and VaR(Y) with the linear correlation coefficient of 0 is 0.28 and therefore lower than the correct result. In order to achieve an aggregation result of 0.34, a correlation parameter of 0.445 instead of 0 needs to be used.

3.21. The examples demonstrate that the choice of the correlation parameter for independent risks is not straightforward. If the underlying distributions are not normal, positive correlation parameters may be appropriate.

3.22. In practice, although certain risks can be assumed to be independent, the selection of the correlation parameter is difficult. Often the shape of the underlying distribution is not known or it differs from undertaking to undertaking and over time. For example, even if the distribution of an underlying risk driver is known, hedging and reinsurance may have modified the net risk in an undertaking-specific way. If such uncertainties exist it appears to be appropriate to choose a slightly positive correlation parameter, for example 0.25 in order to avoid a systematic underestimation of the combined risk.

3.1.5. Market risk

3.23. In QIS4, the following correlation matrix was used:

	interest rate	equity	property	spread	currency	concen-tration
interest rate	1					

[7] The Values-at-Risk (VaR) in these examples are subject to a confidence level of 99.5%.
[8] The non-life premium and reserve risk module is based on lognormal distributions of this kind.

equity	0	1				
property	0.5	0.75	1			
spread	0.25	0.25	0.25	1		
currency	0.25	0.25	0.25	0.25	1	
concentration	0	0	0	0	0	1

3.24. During the current financial and economic crisis it became apparent that the dependence structure of market risk changes in stressed situations. Risk factors that have not revealed a significant correlation during ordinary market conditions showed a strong dependence in the crisis. It could also be observed that the risks had a reinforcing effect on each other.

3.25. For all risks that are covered by the market risk module a strong simultaneous change in market parameters was observed:

- Credit spreads widened in an unprecedented manner.
- The market price for equity fell stronger than during the crises in 1973 or at the beginning of the century. The MSCI world index dropped by 40% and the STOXX 600 by 46% in 2008.
- Interest rates fell sharply, for example for German 10 year Government bonds by 30% in the second half of 2008. The key interest rates of the U.S. Federal Reserve System and the Bank of England were set to historic lows.
- Property prices in some markets strongly decreased. In the United States the Case Shiller Index dropped by 19% in 2008. Similar declines could be observed in some European markets.
- Exchange rates were also quite volatile. For instance, the British Pound lost 24% against the Euro in 2008. Also the currencies of Iceland and some other states outside of the Euro zone came under pressure.

3.26. No diversification between the relevant market risk drivers during the financial crises was observable. Only where risks have a two-sided nature like interest rate risk or currency risk, market participants were able to offset risks if they were on the right side (for example short in Icelandic króna or short in interest rates).

3.27. For the calibration of the market risk module of the SCR standard formula the empirical evidence provided by the current crisis should not be ignored. It is not possible to decide whether the crisis is covered by the 99.5% confidence level or not. The fact that the current situation is generally being referred to as the most severe crisis since the Great Depression seems to indicate that the frequency is higher than that of a 1-in-200 event. In any case it seems reasonable to assume that in the 1-in-200 event, which the market risk module aims to cover, no higher diversification between the risks can exist than the one observed during the current crisis.

3.28. Consequently, the correlation factors of the market risk module should be increased to capture the market events during the current financial crisis.

3.29. There are fundamental economic reasons for high tail dependence of the market sub-risks:

3.30. A strong fall of equity prices as reflected in the equity sub-module (-45%/-60%) does not leave the other market parameters unaffected. A drastic change in equity prices of this scale indicates an economic recession and a severe reduction of undertakings' expected profit. Such a situation is usually accompanied with an increase of risk-aversion and higher default probabilities. Therefore, credit spreads can be expected to increase sharply as well. For the same reason the demand for property, in particular commercial property, can be expected to decrease leading to vacancies and lower property prices. On the other hand, if credit spreads widen as greatly as in the spread risk sub-module, it signals an increased risk aversion and higher default probabilities. These circumstances would certainly affect directly or indirectly the expected profits and the market value of stock corporations in a relevant way, causing a fall in equity prices. Similar arguments apply to property risk. All three risks are intrinsically connected via the economic conditions, so that in extreme situations, they relate to each other in a similar way as in a causal relationship. Therefore, higher correlation factors between these risks are appropriate.

3.31. A minority of CEIOPS Members proposes not to change the QIS4 correlation between interest rate and equities, set at 0 in QIS4, on the basis of the remaining open issues in the evidence needed, and the high impact of any change.

3.32. If these drastic changes in key market parameters take place it is likely that not all markets are affected in the same way and that currency exchange rates between the markets become volatile. On the other hand, strong movements in the exchange rates of main currencies can cause or reinforce the movements of other market parameters. These connections can be observed in the 1973 dollar crisis, the 1997 Asian crisis or the current financial crisis. Therefore, high correlation factors between currency risks and the other market risks can be adequate. On the other hand, currency risk is a two-sided risk. Depending on the currency mismatch, a fall in a currency exchange rate can cause a loss or a profit in the balance sheet of an undertaking. Taking this nature of currency risk into account, a medium correlation factor seems to be justified.

3.33. The monetary policy of the relevant central banks usually reacts to an economic downturn (and in particular to a fall in equity markets) by lowering the key interest rates. This can be observed for example in the 2001-2003 downturn where the ECB changed the key interest rate for the euro from 4.75% to 2% or the current crisis where rates fell from 4.25% to 1%. Similar reactions took place in the UK (6% to 3.5% and 5.75% to 0.5% resp.) and the US (6.5% to 1% and 5.25 to 0.25% / 0% resp.). These are direct reactions to the adverse movements of the market parameters which are addressed in the market risk module, such as equity prices, credit spreads, property prices and exchange rates. The central banks attempt to flood the market with cheap money in order to mitigate the worsening of these parameters. If key interest rates fall sharply in economic crisis situations, then so do the risk-free interest rates. Therefore a high correlation of the interest rate risk and the other market risks can be appropriate. On the other hand, like in the case of currency risk, interest rate risk is a two-sided. Depending on maturity and amount of liabilities and fixed-

income investments of the undertaking, either an increase or a decrease of interest rates can be a loss event. Taking this two-sided nature of currency risk into account, a medium correlation factor seems to be justified.

3.34. The correlation factors of concentration risk in relation to equity risk, spread risk and property risk depend on the definition of concentration risk. The concentration risk sub-module covers the additional loss (compared to a well-diversified portfolio) that the undertaking may incur if concentrations in the equity, bond or property portfolio exist.[9] Therefore, because of the definition of the concentration risk sub-module, the correlation factors should properly describe the dependence between the risk of concentrations in names, and the equity, spread and property risk. The correlation factors of concentration risk in relation to equity, spread and property risk should allow for diversification between property and equity/spread risk. (For example, there is diversification between equity risk and property concentration risk or between property risk and the risk of concentration in names.) Hence the correlations factors of concentration risk in relation to equity risk, spread risk and property risk should be 0.75.

3.35. The correlation factors of concentration risk in relation to the other risks, namely interest rate risk and currency risk, should be set in a consistent manner, reflecting the dependence of these risks and the triple consisting of equity risk, spread risk and property risk.

3.36. The correlation factors for market risk should be chosen as follows:

	interest rate	equity	property	spread	currency	concen-tration
interest rate	1					
equity	0.5	1				
property	0.5	0.75	1			
spread	0.5	0.75	0.75	1		
currency	0.5	0.5	0.5	0.5	1	
concentration	0.75	0.75	0.75	0.75	0.5	1

Impact of proposed changes

3.37. Compared to the QIS4 choice of the calibration factors, the proposed factors would lead to an increase of the market risk capital requirement of about 32%. This results in an increase of the Basic SCR of about 21% for life insurance and about 12% for non-life insurance. (See Annex A for more detailed results.).

[9] Cf. CEIOPS' Advice on SCR market risk module (CEIOPS-DOC-40/09, former CP47). The calibration procedure defined in Annex A determines the additional loss caused by the concentration. There is no diversification between this loss and the loss of the well-diversified portfolio.

3.1.6 Life underwriting risk module

3.38. In QIS4 the following correlation matrix was used:

	mortality	longevity	disability	lapse	expenses	revision	CAT
mortality	1						
longevity	-0.25	1					
disability	0.5	0	1				
lapse	0	0.25	0	1			
expenses	0.25	0.25	0.5	0.5	1		
revision	0	0.25	0	0	0.25	1	
CAT	0	0	0	0	0	0	1

3.39. There is no appropriate data base for the calibration of the life underwriting risk correlation factors. For the time being, the choice of these factors needs to be based on expert opinion.

Mortality risk and longevity risk

3.40. Between mortality risk and longevity risk, a high diversification can be assumed to exist. For one insured person, both risks can completely hedge each other. However, the same may not apply to sub-portfolios under mortality risk and sub-portfolios under longevity risk commonly held by insurance undertakings for the following reasons:

- The insured persons of both sub-portfolios may differ significantly. In particular, the sub-portfolio under mortality risk may relate to a different age cohort than the sub-portfolio under longevity risk. For example, the insured with a mortality cover may be young while the insured with a longevity cover may be old. A change in the mortality table may affect both sub-portfolios in such a way that losses in one sub-portfolio are not offset by profits in the other.

- Different tables may apply to the two sub-portfolios. For example, the tables may be based on different data bases and they may be updated independently. In this case, one table may be changed while the other one may remain unchanged. Again, no offset between profit and loss would be observed in such a case.

3.41. For these reasons, the correlation factor should not be -1. As in QIS4, a low negative value like -0.25 appears to be appropriate. This coincides with a suggestion made by CEA during the consultation of the QIS4 Technical Specifications.[10]

[10] Cf. row 152 in CEA's comment template on the QIS4 Technical Specifications (http://www.cea.eu/uploads/DocumentsLibrary/documents/1203525316_qis-4-ts-comments-consolidation.xls).

Expense risk

3.42. Some insurance events like lapse, disability and revision can lead to additional expenses for the undertaking. For example, in case of a mass lapse event the number of transactions increases drastically and the internal processes of the undertaking would need to be adjusted accordingly. Moreover, a revision of the economies for scale in relation to the future expensed would need to be made. In case of an increased probability of disability events or annuity revisions, the expenses for the assessment and management of these events will rise.

3.43. In order to allow for this causal connection, similar to QIS4, a medium correlation factor of 0.5 for lapse, disability and revision risk in relation to expense risk seems to be appropriate.

Other correlation factors

3.44. For all other pairs of risks, there is likely to be a low dependence or independence. A suitable correlation factor in this situation is 0.25. As explained in section 3.1.3 and illustrated in section 3.1.4, independence does not imply that a zero correlation factor is adequate. Since the risks captured in the life underwriting risk are likely to be similar to the example described in paragraph 3.20, an allowance for the deficiencies of the linear aggregation technique should be made in order not to miss the calibration objective of the standard formula.

3.45. The correlation factors for life underwriting risk should be chosen as follows:

	mortality	longevity	disability	lapse	expenses	revision	CAT
mortality	1						
longevity	-0.25	1					
disability	0.25	0.25	1				
lapse	0.25	0.25	0.25	1			
expenses	0.25	0.25	0.5	0.5	1		
revision	0.25	0.25	0.25	0.25	0.5	1	
CAT	0.25	0.25	0.25	0.25	0.25	0.25	1

Impact of proposed changes

3.46. Based of the results of QIS4, the impact of the suggested changes to the correlation matrix can be assessed. On average, for life insurance undertakings an increase of the life underwriting risk capital requirement by 11% and an increase of the Basic SCR by 2% can be expected. (See Annex A for more detailed results.)

3.1.7 Non-life underwriting risk module

3.47. In QIS4 the following correlation matrix was used:

	premium and reserve	CAT
premium and reserve	1	
CAT	0	1

3.48. The non-life underwriting risk module consists of two sub-modules: the non-life premium and reserve risk sub-module and the non-life catastrophe sub-module. The scope of the catastrophe sub-module is defined to cover extreme or exceptional events. If the sub-module fully captures the loss caused by these events and they occur independently from other loss events, the premium and reserve risk and catastrophe risk are independent.

3.49. However, the clear distinction between both risks may not be feasible in practice. For example, the catastrophe sub-module may cover an extreme event regarding the main lines of business that it affects, but side-effects of the event on other lines of business may not be modelled explicitly for reasons of practicability. Instead they may be addressed in the premium and reserve risk module, causing dependence between both sub-modules. These concessions to practicability should be taken into account in the choice of the correlation factor.

3.50. Even if premium and reserve risk and catastrophe risk are conceptually independent, a positive correlation factor may be appropriate. As explained in section 3.1.3 and illustrated in section 3.1.4, independence does not imply that a zero correlation factor is adequate. Since the risks captured in the life underwriting risk are likely to be similar to the example described in paragraph 3.20, an allowance for the deficiencies of the linear aggregation technique should be made in order not to miss the calibration objective of the standard formula.

3.51. Based on these reasons, the correlation factors for non-life underwriting risk should be chosen as follows:

	premium and reserve	CAT
premium and reserve	1	
CAT	0.25	1

Impact of proposed changes

3.52. Based of the results of QIS4, the impact of the suggested changes to the correlation matrix can be assessed. On average, for non-life insurance undertakings an increase of the non-life underwriting risk capital requirement by 7% and an increase of the Basic SCR by 3% can be expected. (See Annex A for more detailed results.)

3.1.8 Basic SCR

Correlation factor for life underwriting risk and health underwriting risk

3.53. The correlation factor for life underwriting risk and health underwriting risk in Annex IV of the Level 1 text is 0.25. This coincides with CEIOPS' previous advice as stated in CEIOPS-DOC-08/07 (Pillar I issues - further Advice) and the technical specification of QIS2 and QIS3. However, at the time this recommendation was made the scope of the health module was different from the scope defined in the Level 1 text and specified in CEIOPS' Advice on SCR health underwriting risk module (CEIOPS-DOC-43/09, former CP50). Because in earlier drafts of the standard formula (see for example the proposal of the Commission for the Solvency II directive, Article 105(4)[11]), the module was supposed to address the premium and reserve risk and the expense risk of a particular type of health insurance. The scope of the module in the adopted Level 1 text is much wider and should capture the risks of all health insurance products. According to CEIOPS' advice on the health underwriting risk module, the module should in particular cover the longevity, mortality, disability/morbidity, lapse and expense risk of life-like health insurance. Definition and modelling of these risks coincide with a few exceptions with the approach taken for the corresponding risks of the life underwriting risk module.

3.54. There is a high dependence between the risks of life insurance obligations and obligations for life-like health insurance. In particular, it can happen that the insured of the health portfolio and the life portfolio are the same. For example, policyholders may insure their longevity and health with the same undertaking. Moreover, as unbundling of health insurance riders from life insurance contracts is not always possible, some health obligations may me be assigned to the life underwriting risk module although their risk is equal to "pure" health obligations which are assigned to the health underwriting risk module.

3.55. Even if policyholders and obligations differ between the life and health portfolios, there can be a significant dependence. For example, the mortality rates of both portfolios are likely to be estimated from similar statistics. If the longevity trend of the life portfolio needs to be revised, then there is a high probability that also the longevity trend assumption for the health portfolio needs to be updated. Similar dependence exists for the mortality risk and disability/morbidity risk of both modules.

3.56. Another example would be the inflation risk that is captured in the expense risk sub-module of the life and health underwriting risk modules. Both modules address the expense inflation in relation to the internal processes of the insurer. Usually, there is no diversification between life and health insurance for this part of expense risk.

3.57. In relation to life and health catastrophe risk the strong dependence is quite obvious. A pandemic would affect both the life insurance and the health insurance portfolio at the same time.

3.58. If the correlation factor for life and health underwriting risk was low, it would offer the undertakings arbitrage opportunities. For example, an undertaking could offer the same health cover as a rider to life contracts and as a stand-

[11] Amended Proposal, 26.2.2008, COM(2008) 119 final
http://ec.europa.eu/internal_market/insurance/docs/solvency/proposal_en.pdf

alone product. If the rider cannot be unbundled its risks would be covered in the life underwriting risk module. The standard formula would take into account diversification effects between the risks of the health riders and the health stand-alone products that are unlikely to exist in reality.

3.59. For these reasons, the correlation factor for life underwriting risk and health underwriting risk should be changed from 0.25 to 0.75.

Correlation factor for health underwriting risk and non-life underwriting risk

3.60. The correlation factor for health underwriting risk and non-life underwriting risk in Annex IV of the Level 1 text is 0. This coincides with CEIOPS' previous advice as stated in CEIOPS-DOC-08/07 (Pillar I issues - further Advice) and the technical specification of QIS2 and QIS3. However, as already explained above, at the time this recommendation was made the scope of the health module was different from the scope defined in the Level 1 text and specified in CEIOPS' Advice on SCR health underwriting risk module (CEIOPS-DOC-43/09, former CP50). Because in earlier drafts of the health underwriting risk module (see the proposal of the Commission for the Solvency II directive), it did not address the risks of the non-life lines of business accident, sickness and workers' compensation. There is a low dependence between the risks of these lines of business and the other non-life lines of business. This correlation was quantified as 0.25 for QIS3 and QIS4. As the QIS4 version of the health module already included accident, sickness and workers' compensation, the correlation factor for health underwriting risk and non-life underwriting risk in the QIS4 Technical Specifications was set to 0.25. This change should also be made in the Level 2 implementing measures.

Correlation factor for market risk and counterparty default risk

3.61. The correlation factor for market risk and counterparty default risk in Annex IV of the Level 1 text is 0.25. The counterparty default risk module captures in particular the default risk in relation to financial derivatives. In case market parameters change significantly, the issuers of derivatives hedging against these changes may incur drastic losses. Hence there is an increased probability that the issuers default when the market parameters change, implying a dependence between market risk and counterparty default risk.

3.62. In relation to reinsurance default risk, such dependence seems to be taken into account in the correlation matrix because the correlation factors between counterparty default risk and non-life underwriting risk is 0.5.

3.63. Usually the issuers of financial derivatives are investment banks which have shown a high vulnerability towards market risk, in particular credit spread risk. Moreover, the deterioration of the solvency position of these banks accelerated the downturn of market prices.

3.64. For these reasons, the correlation factor for market risk counterparty default risk should be changed from 0.25 to 0.5.

Impact of proposed changes

3.65. Based of the results of QIS4, the impact of the suggested changes to the correlation matrix can be assessed. On average, an increase of the Basic SCR by 2% can be expected. (See Annex A for more detailed results.) This figure

does not take into account the changes to the scope of the health underwriting risk module compared to QIS4. The QIS4 health underwriting risk module did only include a particular type of life-like health insurance. The shift of all life-like health insurance will decrease the Basic SCR. The proposed increase of the correlation factor for life underwriting risk and health underwriting risk from 0.25 to 0.75 will mitigate this decrease in the Basic SCR.

3.1.9 Overall impact

3.66. Based of the results of QIS4, the combined impact of the suggested changes to all correlation matrices can be assessed. On average, an increase of the Basic SCR by 25% can be expected. For non-life insurance, the impact is 13% and for life insurance 24%. (See Annex A for more detailed results.)

3.1.10 Updating of correlation parameters

3.67. According to Article 109(1c) the implementing measures for the SCR standard formula should also specify the procedures for updating the correlation parameters.

3.68. For the time being, the calibration of the correlation factors needs to be based on general analysis of the risks' nature. From a technical point of view, the main obstacle for the calibration of the correlation factors is the lack of empirical data describing the dependence between the risks that the SCR should capture.

3.69. For some risks, for example most market risks, the shortage of data is unavoidable as each year only one observation of the risk (change in interest rate, equity index etc.) can be made. For other risks like the underwriting risks, often an observation per year and undertaking can be made. For instance the annual change in the lapse rate used for the calculation of the best estimate can be observed for each undertaking. The observations may not be independent, but they still provide useful information. However, these data were not collected in the past, mainly because the underlying observations were of limited importance for the current supervisory regime.

3.70. The calibration would improve if the analysis of risk dependence was supported by an evaluation of empirical data. For this purpose, the necessary information could be collected from the supervised undertakings in the future. The relevant data would for example be

- For life mortality risk: the change in assumed mortality rates,
- For lapse risk: the change in assumed lapse rates and the average lapse rate,
- For life expense risk: the changes in assumed expense and inflation rates,
- For non-life underwriting risk: the combined ratios per line of business.

3.71. The collection of such data would not only support the calibration of the correlation factors but also of the modules and sub-modules of the standard formula.

3.2 CEIOPS Advice

Choice of correlation parameters

3.72. The correlation parameters should be chosen in such a way to achieve the best approximation of the 99.5% VaR for the aggregated capital requirement.

3.73. In particular, the correlation parameters

- should deviate from linear correlation coefficients if the latter do not achieve this objective,
- might be different from zero for independent risks, and
- should allow for any tail dependence between risks.

Market risk module

3.74. The correlation factors for market risk should be chosen as follows:

	interest rate	equity	property	spread	currency	concentration
interest rate	1					
equity	0.5	1				
property	0.5	0.75	1			
spread	0.5	0.75	0.75	1		
currency	0.5	0.5	0.5	0.5	1	
concentration	0.75	0.75	0.75	0.75	0.5	1

3.75. A minority of CEIOPS Members proposes not to change the QIS4 correlation between interest rate and equities, set at 0, on the basis of the remaining open issues in the evidence needed, and the high impact of any change.

Life underwriting risk module

3.76. The correlation factors for life underwriting risk should be chosen as follows:

	mortality	longevity	disability	lapse	expenses	revision	CAT
mortality	1						
longevity	-0.25	1					
disability	0.25	0.25	1				
lapse	0.25	0.25	0.25	1			
expenses	0.25	0.25	0.5	0.5	1		
revision	0.25	0.25	0.25	0.25	0.5	1	
CAT	0.25	0.25	0.25	0.25	0.25	0.25	1

Non-life underwriting risk module

3.77. The correlation factors for non-life underwriting risk should be chosen as follows:

	premium and reserve	CAT
premium and reserve	1	
CAT	0.25	1

Basic SCR

3.78. The correlation matrix for the Basic SCR should be updated as follows:

- The factor for life underwriting risk and health underwriting risk should be changed from 0.25 to 0.75.
- The factor for health underwriting risk and non-life underwriting risk should be changed from 0 to 0.25.
- The factor for market risk and default risk should be changed from 0.25 to 0.5.

Updating of correlation factors

3.79. It should be considered to collect appropriate data from the supervised undertakings in the future to support the revision of the correlation factors.

Annex A - Impact of proposed changes in correlation factors

A.1. This annex estimates the impact on the SCR of the proposed changes in correlation factor compared to QIS4. The analysis is done for each module separately and for the overall change.

A.2. The analysis is restricted to the impact on the capital requirements of the modules and on the Basic SCR. It is not possible to derive a reliable estimate for the change of the SCR from the available QIS4 data. This is owed to the non-linearity in the adjustments for technical provisions and deferred taxes. Depending on the situation, the relative increase of the SCR can be higher or lower than the relative increase of the Basic SCR.

Estimation methodology

A.3. If a correlation factor is changed then the relative impact on the aggregate capital requirement depends only on the relative sizes of the aggregated capital requirements, but not on the absolute value of the capital requirements.

A.4. For the impact analysis, the relative size of the capital requirements for each module and sub-module was chosen to be the average relative size as measured in QIS4. For each national market, the QIS4 database provides the relative importance of a risk and sub-risk. In order to arrive at a European average relative sizes, these data were weighted with the number of undertakings that provided the data in the national market. This approach results in relative importance of the risks as follows:

	all business segments	life insurance undertakings	non-life insurance undertakings	composite undertakings	reinsurance undertakings	captive undertakings
market	78,1%	81,7%	54,6%	85,1%	51,4%	37,4%
counterparty	4,2%	4,7%	6,4%	1,4%	3,0%	3,3%
life	21,0%	37,7%	1,1%	17,2%	12,8%	1,1%
health	5,7%	1,0%	17,2%	4,0%	3,4%	6,2%
non-life	29,0%	0,0%	62,0%	21,8%	40,7%	79,9%
interest rate	31,5%	39,6%	18,5%	35,2%	9,1%	8,7%
equity	42,1%	41,5%	30,7%	50,6%	14,5%	13,9%
property	9,0%	8,3%	7,2%	10,4%	0,6%	0,1%
spread	11,8%	13,6%	5,5%	12,0%	21,4%	2,3%
concentration	7,3%	3,9%	8,2%	5,6%	17,0%	18,9%
currency	5,6%	6,1%	3,5%	2,6%	7,2%	4,0%
mortality	2,3%	3,5%	0,0%	2,6%	1,9%	0,3%
longevity	7,4%	10,4%	0,4%	4,8%	7,5%	0,1%
disability	3,1%	4,8%	0,5%	1,6%	2,9%	0,0%
lapse	10,0%	22,1%	0,2%	8,2%	2,5%	0,0%
expense	4,0%	7,0%	0,2%	4,6%	0,9%	0,0%
revision	0,1%	0,1%	0,1%	0,1%	0,0%	0,0%
life CAT	3,9%	5,3%	0,1%	3,3%	5,3%	1,0%
non-life p&r	25,1%	0,0%	57,2%	20,3%	30,7%	37,0%
non-life CAT	9,6%	0,0%	17,4%	5,5%	22,5%	61,7%

A.5. For single undertakings the impact of the proposed changes can differ significantly from the estimated impact in this analysis, if the relative importance of the undertakings' risks differs from the average order of risks.

Results

A.6. The proposed change in the correlation matrix of the market risk module would result in changes in capital requirements as follows:

	Change in module capital requirement	Change in Basic SCR
Life insurance undertakings	29%	21%
Non-life insurance undertakings	34%	12%
Composite undertakings	28%	22%
Reinsurance undertakings	52%	24%
Captive undertakings	54%	9%
All undertakings[12]	**32%**	**22%**

A.7. The proposed change in the correlation matrix of the life underwriting risk module would result in changes in capital requirements as follows:

	Change in module capital requirement	Change in Basic SCR
Life insurance undertakings	11%	2,0%
Non-life insurance undertakings	20%	0,0%
Composite undertakings	12%	0,7%
Reinsurance undertakings	21%	1,0%
Captive undertakings	9%	0,0%
All undertakings	**13%**	**1,0%**

A.8. The proposed change in the correlation matrix of the non-life underwriting risk module would result in changes in capital requirements as follows:

	Change in module capital requirement	Change in Basic SCR
Life insurance undertakings	0%	0%
Non-life insurance undertakings	7%	3%
Composite undertakings	6%	1%
Reinsurance undertakings	11%	4%
Captive undertakings	10%	7%
All undertakings	**8%**	**1%**

[12] Under this approach, the impact may be slightly overestimated with decreasing granularity of the analysis. In particular, it can happen that the calculated impact for "all undertakings" is higher than for all of the aforementioned segments.

A.9. The proposed change in the correlation matrix of the Basic SCR would result in changes in capital requirements as follows. It should be noted that one of the proposed changes, namely the increase of the correlation factor for health underwriting risk and non-life underwriting risk was already taken into account in QIS4.

	Change in Basic SCR
Life insurance undertakings	1,1%
Non-life insurance undertakings	0,9%
Composite undertakings	0,6%
Reinsurance undertakings	1,0%
Captive undertakings	0,3%
All undertakings[13]	**1,4%**

A.10. The proposed change in all correlation matrices would result in an overall change in capital requirements as follows:

	Change in Basic SCR
Life insurance undertakings	24%
Non-life insurance undertakings	13%
Composite undertakings	24%
Reinsurance undertakings	31%
Captive undertakings	17%
All undertakings	**25%**

[13] Under this approach, the impact may be slightly overestimated with decreasing granularity of the analysis. In particular, it can happen that the calculated impact for "all undertakings" is higher than for all of the aforementioned segments.

Annex B - Impact Assessment

1. Description of the policy issue

B.1. For undertakings using the standard formula to calculate their SCR, the extent of the diversification effects recognised in the non-life underwriting risk module as a result of the various correlation parameters (and/or interaction assumptions) across lines of business.

Brief description

B.2. The structure of the standard formula, by aggregating correlated risk modules, enables the recognition of the benefit of the diversification of these risks. Besides, where appropriate, diversification effects are taken into account in the design of each risk module (i.e. across sub-modules, where applicable) or sub-module (e.g. across lines of business and/or geographical areas).

B.3. The calculation of the group solvency capital requirement based on the consolidated balance sheet position of the group will lead to the recognition of further diversification effects amongst the different entities of a group.

B.4. The issue relates to the calibration of the various correlation parameters (and, where appropriate, design/calibration of the various interaction assumptions) underpinning the SCR standard formula, as well as their impact on the extent of diversification effects to be recognised at solo and group level. In this context, the following issue should be considered:

- Calibration of correlation parameters across lines of business (non-life underwriting risk)

2. Description of the policy options for the calibration of correlation parameters across lines of business and assessment of the impact

Option 1

B.5. **Option 1:** use QIS4 correlation parameters across lines of business.

B.6. The QIS4 correlation parameters are specified as follows:

CorrLob	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
1: M (3rd party)	1											
2: M (other)	0.5	1										
3: MAT	0.5	0.25	1									
4: Fire	0.25	0.25	0.25	1								

5: 3rd party liab	0.5	0.25	0.25	0.25	1							
6: credit	0.25	0.25	0.25	0.25	0.5	1						
7: legal exp.	0.5	0.5	0.25	0.25	0.5	0.5	1					
8: assistance	0.25	0.5	0.5	0.5	0.25	0.25	0.25	1				
9: misc.	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1			
10: reins. (prop)	0.25	0.25	0.25	0.5	0.25	0.25	0.25	0.5	0.25	1		
11: reins. (cas)	0.25	0.25	0.25	0.25	0.5	0.5	0.5	0.25	0.25	0.25	1	
12: reins. (MAT)	0.25	0.25	0.5	0.5	0.25	0.25	0.25	0.25	0.5	0.25	0.25	1

B.7. The QIS4 correlation parameters were based on a study performed by CEIOPS in preparation of QIS3 in 2007. Based on market data of German non-life insurers for the years 1988-2002 the correlations between the loss ratios of different lines of business were estimated. Where not a sufficient number of observations were available, the correlation parameter was based on expert opinion.[14]

B.8. CEIOPS acknowledges that the data basis is not ideal as it only covers the insurance market of one Member State. On the other hand, comparable data from other markets were not available. There are no indications that the correlations vary substantially with the market.

B.9. There seemed to be a broad consensus around the correlation coefficients that were used in the QIS4 specification for the non-life premium and reserve risk. In fact no comments were received on these correlations. It is assumed that the correlations as in QIS4 are neutral as to the orientation of the business by the undertakings and result in an adequate protection of the policyholder.

Option 2

B.10. **Option 2**: use lower than QIS4 correlation parameters across lines of business.

B.11. Lower correlations will result in a lower capital requirement and may discourage for sophisticated firms, the development of internal models and sound risk management. For less sophisticated firms however, lower correlations are likely to reduce the competitive disadvantage compared to undertakings using an internal model.

B.12. Depending on where the correlations are lowered there may be a shift towards that business that is the least capital intensive.

[14] See CEIOPS-FS-14/07 (QIS3 Calibration of the underwriting risk, market risk and MCR), pages 18-23. (http://www.ceiops.eu//media/files/consultations/QIS/QIS3/QIS3CalibrationPapers.pdf)

B.13. There may be an incidence on the premium level as lower capital requirements create some room for lower premiums. This is however an uncertain effect.

B.14. Lower correlation factors may lead to an underestimation of the 99.5 VaR calibration objective of the SCR and thereby reduce the protection of the policyholder.

B.15. CEIOPS has analysed the quantitative impact of a decrease of the correlation parameters. Based on QIS4 data the average distribution of premiums and technical provisions to the lines of business in the European market was determined. For an undertaking with this average business profile the sensitivity of the SCR for non-life premium and reserve risk was analysed.

B.16. For instance, if all correlation factors (apart from the diagonal values) were lowered by an absolute amount of 0.25, then the capital requirement for non-life premium and reserve risk would be **25% lower**. The corresponding correlation matrix is specified as follows:

CorrLob	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
1: M (3rd party)	1											
2: M (other)	0.25	1										
3: MAT	0.25	0	1									
4: Fire	0	0	0	1								
5: 3rd party liab	0.25	0	0	0	1							
6: credit	0	0	0	0	0.25	1						
7: legal exp.	0.25	0.25	0	0	0.25	0.25	1					
8: assistance	0	0.25	0.25	0.25	0	0	0	1				
9: misc.	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	1			
10: reins. (prop)	0	0	0	0.25	0	0	0	0.25	0	1		
11: reins. (cas)	0	0	0	0	0.25	0.25	0.25	0	0	0	1	
12: reins. (MAT)	0	0	0.25	0.25	0	0	0	0	0.25	0	0	1

Option 3

B.17. **Option 3**: use higher than QIS4 correlation parameters across lines of business.

B.18. The capital charge will be higher than under the previous options and a limitation of the production in those lines of business that generate the higher requirements is possible.

B.19. For sophisticated firms, higher capital charges may be an incentive to develop internal models and eventually lead to better control and management of the risks.

B.20. For less sophisticated firms however, the higher correlations may increase the competitive disadvantage of these undertakings compared to undertakings using an internal model.

B.21. Premiums may go up under this option but at the same time higher capital requirements also assure an increased level of policyholder protection.

B.22. The accessibility of the products that increase in price diminishes as policyholder income decreases.

B.23. The analysis explained in paragraph B.15 included also increases of the correlation parameters. For instance, if all correlation factors (apart from the diagonal values) were increased by an absolute amount of 0.25, then the capital requirement for non-life premium and reserve risk would be **21% higher**. The corresponding correlation matrix is specified as follows:

CorrLob	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
1: M (3rd party)	1											
2: M (other)	0.75	1										
3: MAT	0.75	0.5	1									
4: Fire	0.5	0.5	0.5	1								
5: 3rd party liab	0.75	0.5	0.5	0.5	1							
6: credit	0.5	0.5	0.5	0.5	0.75	1						
7: legal exp.	0.75	0.75	0.5	0.5	0.75	0.75	1					
8: assistance	0.5	0.75	0.75	0.75	0.5	0.5	0.5	1				
9: misc.	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	1			
10: reins. (prop)	0.5	0.5	0.5	0.75	0.5	0.5	0.5	0.75	0.5	1		
11: reins. (cas)	0.5	0.5	0.5	0.5	0.75	0.75	0.75	0.5	0.5	0.5	1	
12: reins. (MAT)	0.5	0.5	0.75	0.75	0.5	0.5	0.5	0.5	0.75	0.5	0.5	1

3. Operational objectives

B.24. The determination of the calibration between lines of business in non-life insurance falls under the scope of the following operational objectives:

- Introduce risk-sensitive and harmonized solvency standards
- Introduce proportionate requirements for small undertakings
- Promote compatibility of the prudential regime for EU insurers with the work of the IAIS and IAA
- Ensure efficient supervision of insurance groups and financial conglomerates

4. Comparison between the different options based on the efficiency and effectiveness in reaching the relevant operational options

B.25. The comparison and ranking of the policy options is based on the effectiveness and efficiency of each option in reaching the relevant objectives. Effectiveness is defined as the extent to which options achieve the objectives of the proposal. Efficiency is defined as the extent to which the objectives can be achieved at the lowest cost (cost-effectiveness).

B.26. Lower correlation parameters between lines of business are clearly not a preferred option as they only meet the option of proportionate requirements for small undertakings.

B.27. There is some value in higher parameters as this can clearly lead to better risk management although the risk of having higher premiums clearly constitutes a drawback.

B.28. Leaving the correlations at their current level is the third option and is an option around which a broad consensus exists. For the calibration exercise following QIS4, it was decided to keep the correlation parameters at their QIS3 level translating the broad support there is around these parameters.