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

Article 111 and 304

Equity risk sub-module

(former Consultation Paper 69)

Table of contents

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 Paper aims at providing advice with regard to the calibration of the equity risk sub-module as required by the Solvency II Level 1 text[2]. The relevant parts of the Level 1 text are set out in section 2 below.

2. Extract from Level 1 Text

Legal basis for the implementing measure

Article 105 – Calculation of the Basic Solvency Capital Requirement
[…]
5. The market risk module shall reflect the risk arising from the level or volatility of market prices of financial instruments which have an impact upon the value of the assets and liabilities of the undertaking. It shall properly reflect the structural mismatch between assets and liabilities, in particular with respect to the duration thereof.

It shall be calculated, in accordance with point 5 of Annex IV, as a combination of the capital requirements for at least the following sub-modules […]

(b) the sensitivity of the values of assets, liabilities and financial instruments to changes in the level or in the volatility of market prices of equities (equity risk); […]

Article 106 - Calculation of the equity risk sub-module: symmetric adjustment mechanism

1. The equity risk sub-module calculated in accordance with the standard formula shall include a symmetric adjustment to the equity capital charge applied to cover the risk arising from changes in the level of equity prices.

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

[2] Directive 2009/138/EC of the European Parliament and of the Council of 25 November 2009 on the taking-up and pursuit of the business of Insurance and Reinsurance (Solvency II), Official Journal, L 335, 17 December 2009, http://eur-lex.europa.eu/JOHtml.do?uri=OJ%3AL%3A2009%3A335%3ASOM%3AEN%3AHTML

2. *The symmetric adjustment made to the standard equity capital charge, calibrated in accordance with Article 104(4), covering the risk arising from changes in the level of equity prices shall be based on a function of the current level of an appropriate equity index and a weighted average level of that index. The weighted average shall be calculated over an appropriate period of time which shall be the same for all insurance and reinsurance undertakings.*

3. *The symmetric adjustment made to the standard equity capital charge covering the risk arising from changes in the level of equity prices shall not result in an equity capital charge being applied that is more than 10 percentage points lower or 10 percentage points higher than standard equity capital charge.*

Article 111 – 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 methods, assumptions and standard parameters to be used, when calculating each of the risk modules or sub-modules of the Basic Solvency Capital Requirement laid down in Articles 104 and 105 and 304, the symmetric adjustment mechanism and the appropriate period of time, expressed in the number of months, as referred to in Articles 106, and the appropriate approach for integrating the method referred to in Article 304 related to the use of this method in the Solvency Capital Requirement as calculated in accordance with the standard formula;*

Article 304 – Duration based equity risk sub-module

1. *Member States may authorise life insurance undertakings providing:*

    (a) *occupational-retirement-provision business in accordance with Article 4 of Directive 2003/41/EC, or*

    (b) *retirement benefits paid by reference to reaching, or the expectation of reaching, retirement where the premiums paid for those benefits have a tax deduction which is authorised to policyholders in accordance with the national legislation of the Member State that has authorised the undertaking;*

    and where

    (i) *all assets and liabilities corresponding to this business are ring-fenced, managed and organised separately from the other activities of the insurance undertakings, without any possibility of transfer, and*

(ii)   the activities of the undertaking related to points a) and b), in relation to which the approach referred to in this paragraph is applied, are carried out only in the Member State where the undertaking has been authorised, and

(iii)   the average duration of the liabilities corresponding to this business held by the undertaking exceeds an average of 12 years,

to apply an equity risk sub-module of the Solvency Capital Requirement, which is calibrated using a Value-at-Risk measure, over a time period, which is consistent with the typical holding period of equity investments for the undertaking concerned, with a confidence level providing the policyholders and beneficiaries with a level of protection equivalent to that set out in Article 101, if the approach provided for in this Article is only used in respect of those assets and liabilities referred in point i). In the calculation of the Solvency Capital Requirement these assets and liabilities shall be fully considered for the purpose of assessing the diversification effects, without prejudice to the need to safeguard the interests of policyholders and beneficiaries in other Member States.

Subject to the approval by the supervisory authorities, the approach set out in subparagraph 1 shall only be used if the solvency and liquidity position as well as the strategies, processes and reporting procedures of the undertaking concerned with respect to asset – liability management are such as to ensure, on an on-going basis, that it is able to hold equity investments for a period which is consistent with the typical holding period of equity investments for the undertaking concerned. The undertaking shall be able to demonstrate to the supervisory authority that this condition is verified with the level of confidence necessary to provide policyholders and beneficiaries with a level of protection equivalent to that set out in Article 101.

Insurance and reinsurance undertakings shall not revert to applying the approach set out in Article 105, except in duly justified circumstances and subject to the approval of the supervisory authorities.

2.   The Commission shall submit to the European Insurance and Occupational Pensions Committee and the European Parliament, by 31 October 2015, a report on the application of the approach set out in paragraph 1 of this Article and the supervisory authorities' practices adopted pursuant to paragraph 1 of this Article, accompanied, where appropriate, by any adequate proposals. This report shall address in particular cross-border effects of the use of this approach in a view to preventing regulatory arbitrage from insurance and reinsurance undertakings.

Other relevant Level 1 text for providing background to the advice

Article 28 – Maintaining financial stability and pro-cyclicality

Without prejudice to the main objective of supervision as set out in Article 27 Member States shall ensure that, in the exercise of their general duties, supervisory authorities shall duly consider the potential impact of their decisions on the stability of the financial systems concerned in the European Union, in particular in emergency situations, taking into account the information available at the relevant time.

In times of exceptional movements in the financial markets, supervisory authorities shall take into account the potential procyclical effects of their actions.

3. Advice

3.1 Introduction

3.1.1 Background

3.1. The advice on equity risk set out in this paper follows the scenario-based approach tested in QIS4, as well as following the QIS4 approach in dividing equities into the two categories "global" and "other".

3.2. Since QIS4, the structure of the equity risk sub-module has evolved significantly. As indicated by the extracts from the Level 1 text set out above, there are two possible ways to calculate the equity risk capital charge: as well as the standard approach there is also the possibility (where permitted, and restricted to certain types of liabilities) to use the "duration dampener" approach of Article 304.

3.3. For the "standard" approach, a symmetric adjustment mechanism applies, as set out in Article 106[3]. The Commission has clarified that this mechanism is required to operate such that the equity shock lies within a band of 10% either side of the underlying standard equity stress.

3.4. The calibration of the "standard" approach as set out below therefore looks firstly at the underlying standard equity stress, which is calibrated to the 99.5% VaR level for both global and other equities. The symmetric adjustment mechanism then overlays the standard charge to arrive at the full standard approach.

3.5. In calibrating the symmetric adjustment mechanism, CEIOPS has considered the following objectives:

- avoid that insurance and reinsurance undertakings are unduly forced to raise additional capital or sell their investments as a result of unsustained adverse movements in financial markets;

- discourage/avoid fire sales which would further negatively impact the equity prices – i.e. prevent pro-cyclical effect of solvency capital requirements which would in times of stress lead to an increase of capital requirements and hence a potential de-stabilising effect on the economy.

These objectives are discussed in more detail below.

3.6. An additional development to the equity risk sub-module as compared with the approach tested in QIS4 is the inclusion of an equity volatility stress.

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[3] The Commission has clarified that the symmetric adjustment mechanism does not apply to the equity risk sub-module as calculated in accordance with Article 304.

Some stakeholders considered this to be an important component missing from the SCR standard formula approach – see for example the CRO Forum's paper on Calibration Principles dated May 2009. The calibration of the equity volatility stress is set out towards the end of this paper.

3.2 Standard equity capital charge – "global" equities – majority view

Scope

3.7. The category of "global" equities covers equities listed in EEA or OECD countries. This is the same as the definition used in QIS4.

Calibration

3.8. Our starting point for the calibration of the "global equities" stress is to consider the standard (underlying) equity stress scenario. In order to calibrate the standard equity stress we have carried out analysis using data from the MSCI World Developed Price Equity Index. This index consists of equities listed in 23 developed countries located across Americas, Europe and Pacific Basin[4]. The use of this index coincides with the QIS4 definition of "global" equities as those listed in EEA and OECD countries.

3.9. In carrying out our analysis we have been able to build on the QIS4 calibration by including data from the stressed market conditions over the last 18 months.

3.10. Simplified facts about the distribution of equity and other financial returns agree that at longer horizons returns appear to be normally distributed. The exact distribution of financial returns remains an open question; however, at weekly, daily and higher frequencies the equity return distribution displays definite non-normal qualities.

3.11. One such characteristic that arises across financial assets, from foreign exchange returns and property to commodities is "fat tails". Fat tails are defined as tails of the distribution that have a higher density than that predicted under the assumption of normality.

3.12. The graph below demonstrates these distinct differences for annual returns. The graph on the left depicts the frequency distribution of annual holding period returns derived from the MSCI World Developed index. The sample spans a daily period of 36 years starting from the conception of the index in 1973 and ends in 2009. The x-axis graphs the annual holding period returns ranging from a minimum of -51% to a maximum of 69.3%, while the y-axis graphs the probability of occurrence. The graph on the right depicts the estimated density, termed the 'empirical density', with the theoretical normal density function. There is a balance to be struck

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[4] Further information on the MSCI Barra International Equity Indices can be found at
http://www.mscibarra.com/products/indices/equity/index.jsp

between an analysis based on the richest possible set of relevant data and the possibility of distortion resulting from autocorrelation. In this case, we have chosen to take a rolling one-year window in order to make use of the greatest possible quantity of relevant data .

3.13. We now have clear evidence of the excess leptokurtosis (i.e., "peakness" of the green line) and skewness underpinning our graph. Under the assumption of normality, skewness is set to zero, and kurtosis is equal to 3.
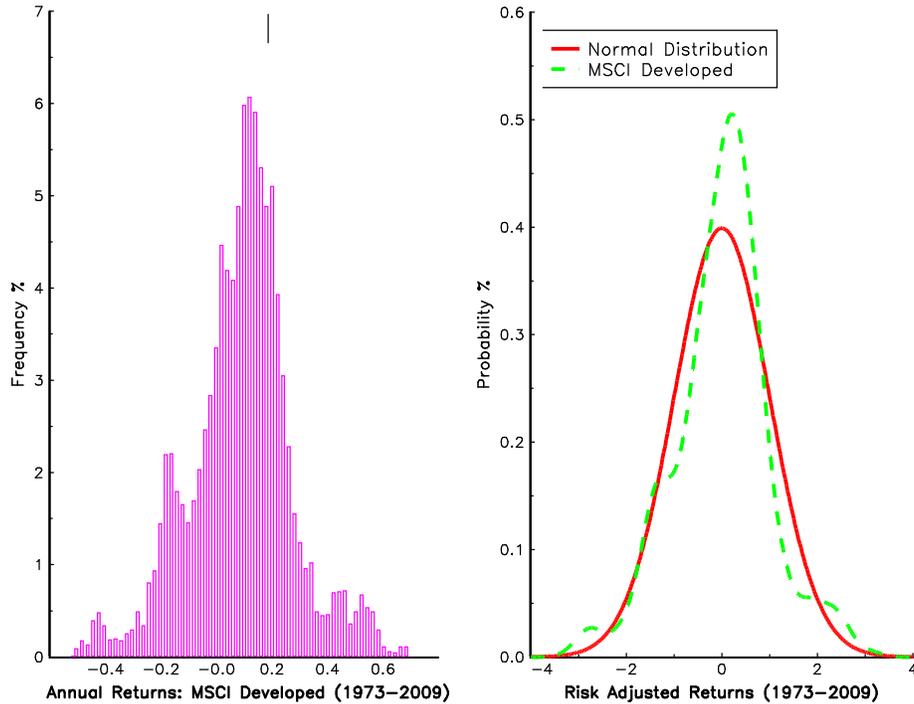
3.14. In addition to the MSCI World Developed price index, we investigate the statistical features of its constituent indices. These are the MSCI Americas, the MSCI Europe and MSCI Pacific Developed Price equity indices. The table below shows selected percentiles and statistical features derived from the corresponding annual returns using daily data:

Percentiles	MSCI World	MSCI Americas	MSCI Europe	MSCI Pacific
100.00%	65.58%	50.44%	62.53%	143.86%
99.95%	63.92%	49.98%	59.76%	141.44%
99.50%	56.96%	44.15%	50.39%	129.38%
99.00%	52.44%	40.06%	45.77%	124.77%
97.50%	46.65%	36.73%	37.61%	114.35%
50.00%	9.47%	10.10%	11.45%	3.81%
2.50%	-32.93%	-35.88%	-46.06%	-33.78%
1.00%	-42.05%	-40.25%	-50.92%	-37.59%
0.50%	**-44.25%**	**-42.42%**	**-52.89%**	**-38.85%**
0.05%	-50.93%	-49.29%	-57.69%	-41.93%
0.00%	-51.94%	-49.93%	-57.95%	-44.03%
Mean	7.43%	8.03%	7.08%	12.03%
St. Deviation	18.16%	17.75%	19.48%	36.21%
Kurtosis	72.01%	22.02%	81.29%	122.08%
Skewness	-17.95%	-66.91%	-81.91%	116.44%
Normal VAR	**39.34%**	**37.69%**	**43.09%**	**81.24%**
Empirical VAR	**44.25%**	**42.42%**	**52.89%**	**38.85%**

3.15. Given the non-normality of equity returns demonstrated in the data above, it can be concluded that the VaR figure of 39%, reflecting the MSCI World equity index, obtained by making the assumption of normality understates the equity stress due to incorrect assumptions about the tails of the distribution.

3.16. We replicate our analysis using the corresponding MSCI total return indices. These are recorded on a monthly as well as quarterly basis commencing at the beginning of 1970. A daily record of these indices is also kept commencing in 2002. Below, we compare selected statistical features and percentiles of annual holding returns computed from the total return and price indices using monthly data:

	MSCI World TR	MSCI World PR
100.00%	65.82%	62.62%
99.95%	63.93%	61.39%
99.50%	53.94%	55.94%
0.50%	**-42.12%**	**-43.70%**
0.05%	-46.16%	-48.83%
0.00%	-46.21%	-49.88%
Mean	**10.04%**	**7.52%**
St deviation	17.31%	18.11%
Kurtosis	94.54%	76.49%
Skewness	-30.62%	-21.71%
Normal VaR	**34.53%**	**39.14%**
Empirical VaR	**42.12%**	**43.70%**

3.17. The obvious difference between the two indices is the reinvested dividend yields, which is equal to 2.52% at the mean level[5] but less than 1.6% at the tail.

3.18. We use further the daily price index series to imply the worst 10 annual and daily holding period returns. The daily returns are set out in the table below. These results emphasise the importance of setting capital requirements of (re)insurance undertakings by making inferences using the tail of the distribution.

	Daily return	Date
1	-9.33%	20/10/1987
2	-7.91%	19/10/1987
3	-6.43%	29/09/2008
4	-6.41%	15/10/2008
5	-6.19%	01/12/2008
6	-6.07%	22/10/2008
7	-5.90%	06/10/2008
8	-5.76%	06/11/2008
9	-5.74%	26/10/1987
10	-5.74%	20/11/2008

3.19. Extreme value theory provides further insight into the behaviour of tails of a distribution. Critical questions relating to the probability of a market crash or boom require an understanding of the statistical behaviour expected in the tails. Below, we have estimated the generalised extreme value (GEV) distribution using maximum likelihood based on the daily returns recovered from the MSCI data. Using the estimated parameters, we recovered the tail VAR, which produces a -11.5% result for the one-day stress in the 1 in 200 event or the 99.5th percentile.

Confidence interval	VaR-GEV
66.67%	-2.65%
80.00%	-3.28%
85.71%	-3.73%
90.00%	-4.25%
91.67%	-4.54%
93.33%	-4.91%
95.00%	-5.42%
97.50%	-6.84%
99.00%	-9.23%
99.50%	-11.50%

3.20. The results of the extreme value theory analysis show that the 99.5% VaR level for daily returns is more extreme than the worst daily return over the period tabulated in paragraph 3.17.

3.21. Turning to consider annual returns, over the last year, well-diversified equity portfolios (i.e., mimicking the MSCI) have halved in value: as can

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[5] The MSCI total return methodology reinvests dividends in the indices on the day the security is quoted ex-dividend. The above total return series is quoted gross of tax. The amount reinvested is the entire dividend distributed to individuals resident in the country of the company, but does not include tax credits.

be seen below, the most severe observation was an equity fall of 52% over the year to 5 March 2009:

	Annual return	Date
1	-51.55%	03/05/2009
2	-51.49%	09/03/2009
3	-51.46%	06/03/2009
4	-51.31%	03/03/2009
5	-51.19%	02/03/2009
6	-50.73%	27/10/2008
7	-50.24%	20/11/2008
8	-49.86%	04/03/2009
9	-49.71%	27/02/2009
10	-49.36%	26/02/2009

3.22. Taken together, the above analysis leads to a **stress of 45% for global equities**. The majority of CEIOPS' Members supports this stress of 45% for global equities. An alternative equity stress, which consists of applying a 39% stress to global equities, is being supported by a minority of CEIOPS' Members. One Member State supports a 32% stress.

3.23. The results above compare with a stress of 32% per the QIS4 Technical Specification.

3.24. In case of a fall of equity returns as defined in the equity stress scenario, the loss of basic own funds of the undertaking may exceed the loss directly connected to the equity portfolio (i.e. loss in market value minus net dividends), because the portfolio may cover discounted liabilities. The run-off of the discounted best estimate over the one year time horizon produces a technical loss in the amount of the discount rate. The discounting of technical provisions is based on the expectation that the undertaking will earn (at least) the discount rate. If the assets have a negative performance, the discount rate usually causes an additional technical loss. This loss is not allowed for in the equity stress for reasons of practicability.

3.3 Standard equity capital charge – "global" equities – minority view

Index selected:

3.25. In order to calibrate the standard equity stress, the analysis has been based on data from the MSCI Europe Index.

3.26. The reasons for selecting this index lie in the consistency with the assumption of a reasonably well geographically diversified portfolio allocated in Europe similar to the portfolio of an undertakings which would be likely to use the standard formula.

3.27. Furthermore, this index would result in a more prudent calibration than the MSCI World where a higher diversification can lead to a lower calibration

Period selected:

3.28. The period selected runs from 01/01/1998 to 01/07/2009.

3.29. Reasons for the selection of this time period are two-fold. On the one hand, the period is long enough to include recent crises like the one corresponding to the 2001-2002 crisis. On the other hand, it is short enough to consider the actual economic conditions of Europe which are quite different from the conditions prevailing during for example the crisis of 1929.

Calibration proposal for the standard equity charge:

3.30. When examining the tail of the distribution of equity indexes, it can be observed that while the 2001-2002 crisis presented a maximum inter-annual fall of 'MSCI Europe index' of almost 44 per cent, the current crisis has repeatedly climbed above such level: there are days where the inter-annual fall of the selected index has been above 48 per cent.

3.31. Considering that the current crisis is at the extreme of the tail necessary to achieve a 1-200 year confidence level, this means that the upper bound for the maximum inter-annual fall (49 per cent), should be considered as the upper limit of the equity dampener interval.
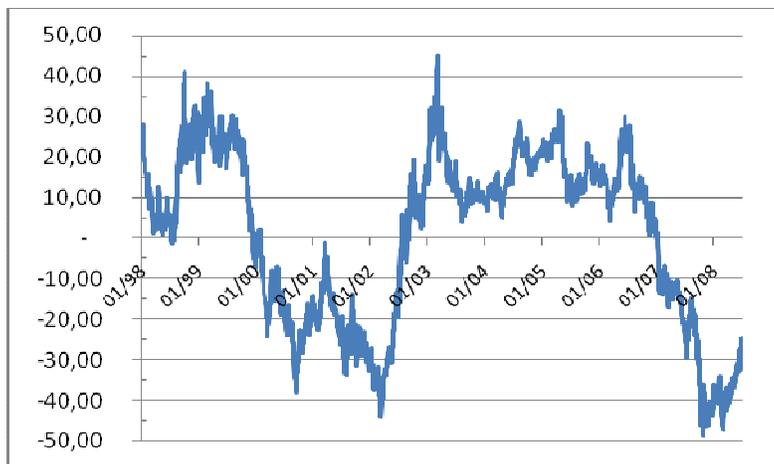
3.32. To set the calibration of the standard equity charge, the calibration of the upper limit of the equity dampener interval is used together with the application of article 105a (3) of the Level 1 text, with the 10 percentage points limits, which allows to set the calibration of the standard equity charge at 39%.

3.33. The lower limit of the equity charge after application of the symmetric dampener should then be set at 29%.

3.4 Symmetric adjustment mechanism

3.34. In calibrating the symmetric adjustment mechanism, CEIOPS has considered the following objectives:

- allow sufficient time for undertakings to rebalance their profile in a stressed scenario;

- avoid unintended pro-cyclical effects (in particular a rise in the equity charge in the middle of a crisis);

- ensure that the equity charge remains sufficiently risk sensitive;

- prevent fire sales of assets;

- avoid undertakings having to adjust their risk profile frequently solely as a result of movements in the equity capital charge;

- avoid any incentive to invest in one or the other asset class;

- allow the adjustment to be set independently of the standard equity stress.

3.35. CEIOPS' calibration of the symmetric adjustment mechanism is based on the following formulation:

adjusted capital stress = standard capital stress + adjustment x beta,

where the adjustment term is $\dfrac{I_t - \frac{1}{n}\sum\limits_{s=t-1}^{t-n} I_s}{\frac{1}{n}\sum\limits_{s=t-1}^{t-n} I_s}$ and the adjusted capital stress is

subject to a band of ±10% either side of the standard capital stress.

In the adjustment term, I_t is the value of the MSCI Developed index at time t.

The beta is calculated from a regression of the index level on the weighted average index level.

3.36. The formulation above is based on equal weightings for each of the days within the reference period. It would be possible to construct instead a symmetric adjustment mechanism that gives different weighting to different points within the reference period. For example, one possibility could be to apply exponentially decaying weights to data points further back in time. However, this would add a degree of complexity to the approach that is arguably too great for a standard formula methodology.

3.37. CEIOPS has tested four possible reference periods: 22 trading days (1 month), 90 trading days (4 months), 130 trading days (half a year) and 260 trading days (1 year). The results are shown in the charts below. In these charts, the vertical axis represents the equity stress (with underlying

standard stress of 45%, although as already explained this starting point is irrelevant). The dashed lines show the ±10% constraints on the adjusted equity stress.
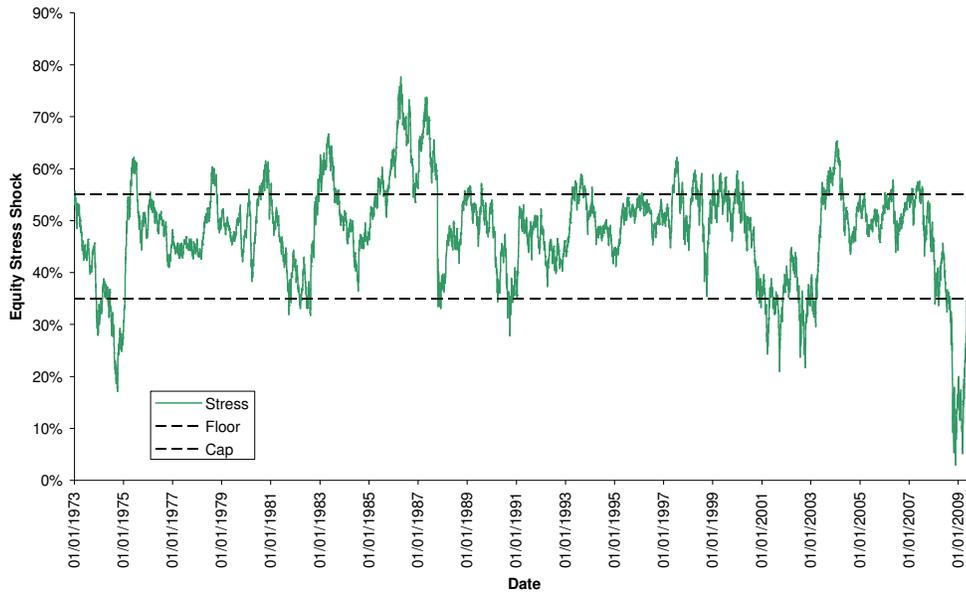
MSCI Symmetric Dampener using 22 day Moving Average
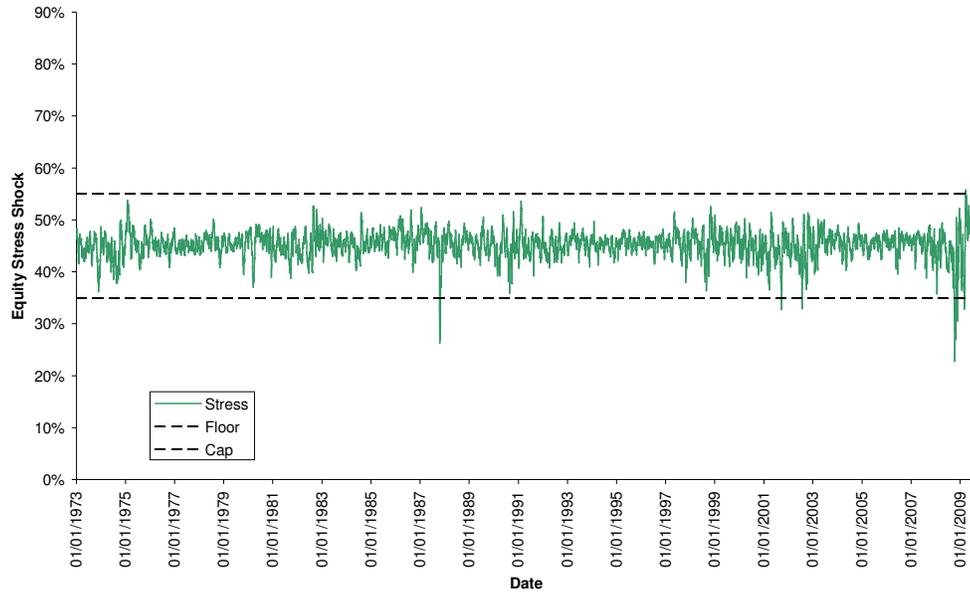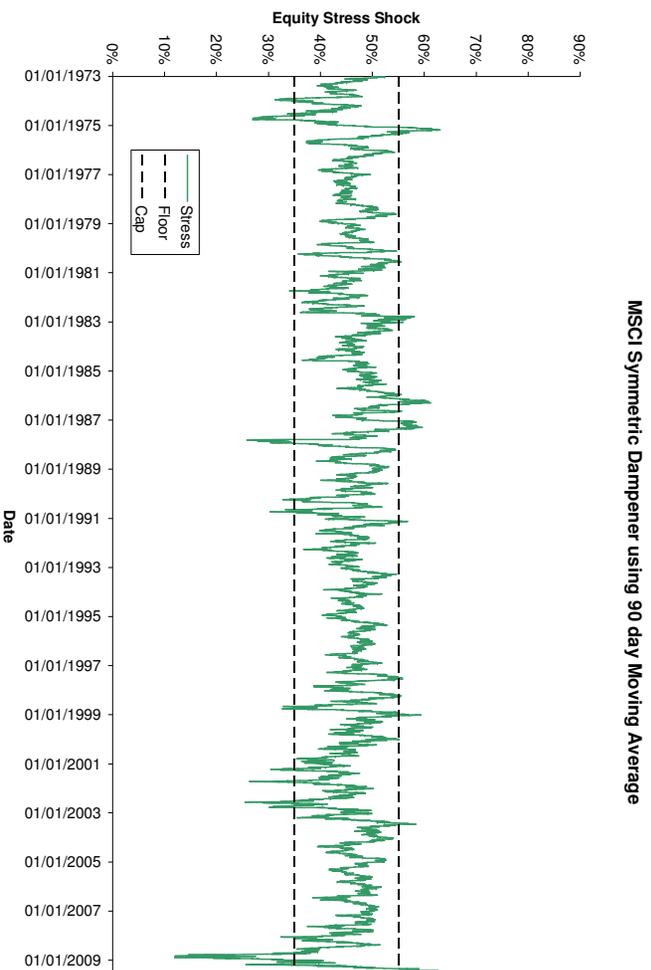
MSCI Symmetric Dampener using 90 day Moving Average

Equity Stress Shock

Date

MSCI Symmetric Dampener using 130 day Moving Average

Equity Stress Shock

Date
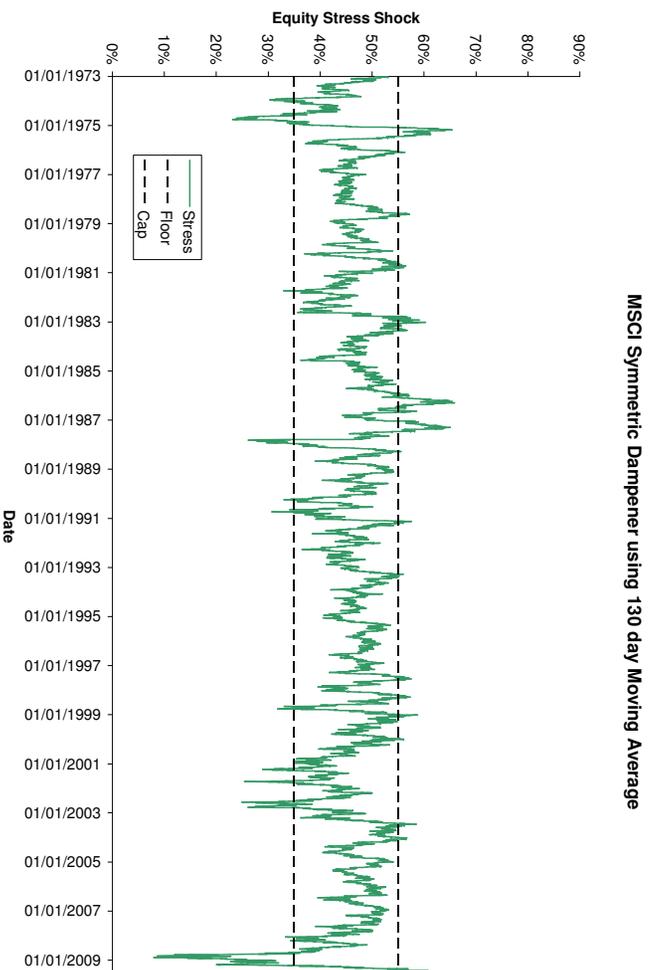
MSCI Symmetric Dampener using 260 day Moving Average

3.38. The betas for these examples are as follows:

Averaging period (days)	Beta
22	99.63%
90	98.23%
130	97.21%
260	96.06%

3.39. In practice, the betas will depend on the weighted average quantities at the time of calculation. However, the same beta will apply at any point in time for all firms using the standard formula approach. The simplifying assumption that beta = 1 could be made, although as shown in the table above this is not the exact theoretical calibration.

3.40. One proxy for the risk-sensitivity of the calibration is to consider the proportion of time for which the equity stress (after having the symmetric adjustment mechanism applied) remains at the limits of the ±10% band. For example, a calibration of the symmetric adjustment mechanism that results in an equity stress that is 10% above the underlying 99.5% VaR level for a prolonged period could be considered not to be sufficiently risk sensitive during that period.

3.41. The table below shows the proportion of observations falling outside the band of ±10%, based on the period from 1973 to 2009:

| Averaging period (days)	Pr{within 10% band}
22	99.62%
90	92.90%
130	86.44%
260	67.39%

3.42. These results demonstrate that as the reference period increases, the 10% band is hit more frequently. This is because there is a greater probability of finding more extreme equity returns within a longer averaging period. This idea is explored further below.

3.43. It is important to note here that due to the construction of the symmetric adjustment mechanism, the choice of averaging period can be made independently of the choice of standard equity stress.
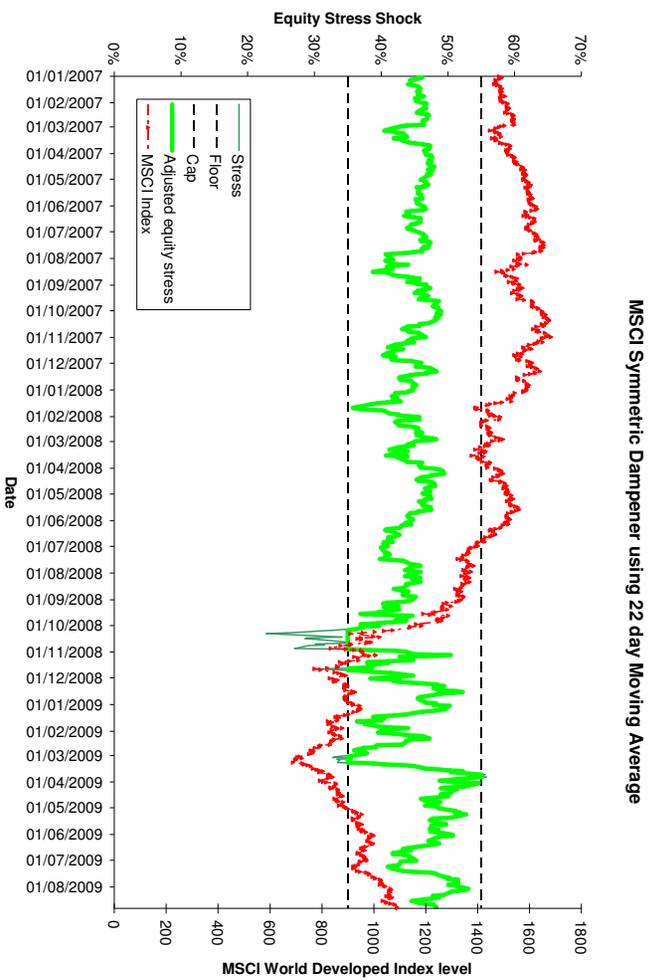
3.44. The analysis discussed above already leads to the conclusion that a shorter reference period leads to greater stability in the adjusted equity charge. Referring back to the objectives in paragraph 3.34, the choice of calibration will need to strike a balance, however, taking into account

   • sufficient time for undertakings to rebalance their risk profiles

   • the need to discourage or avoid fire sales of equities

   • retaining adequate risk-sensitivity

3.45. CEIOPS also examined how the symmetric adjustment mechanism would have worked during the period of equity market falls during 2007-2009. For reference, the MSCI world index is shown in the chart below:

MSCI world index 2007-2009
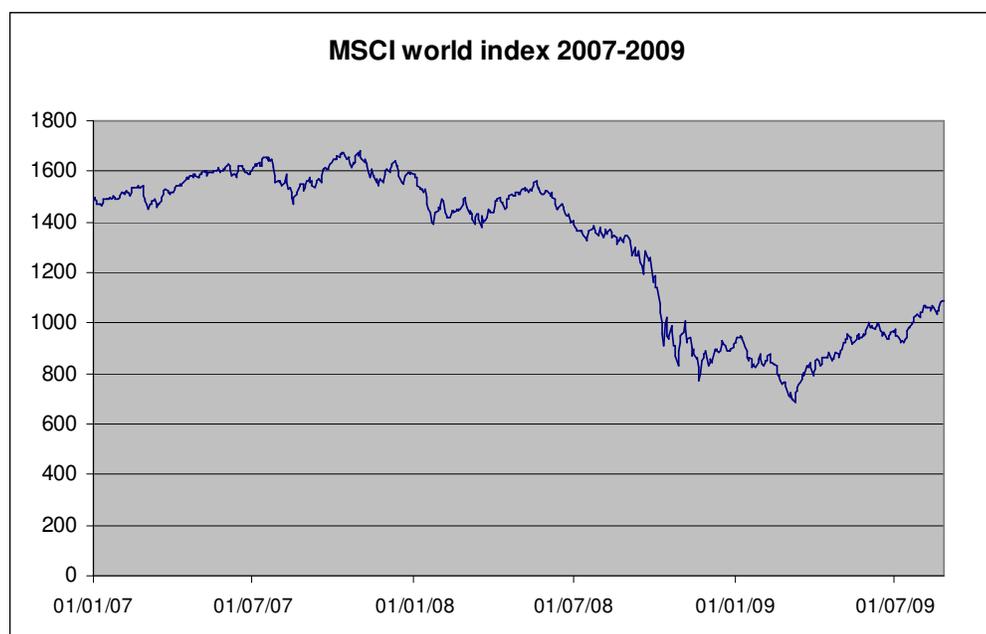
3.46. The results for the equity stress calculated using the four symmetric adjustment mechanisms are plotted below. Here, the vertical axis shows the stress level (unconstrained by the ±10% band) and the horizontal axis covers the same time period as in the chart of the MSCI index in paragraph 3.45.

MSCI Symmetric Dampener using 90 day Moving Average

MSCI Symmetric Dampener using 22 day Moving Average

MSCI Symmetric Dampener using 260 day Moving Average

Legend:
- Stress
- Floor
- Cap
- Adjusted equity stress
- MSCI Index

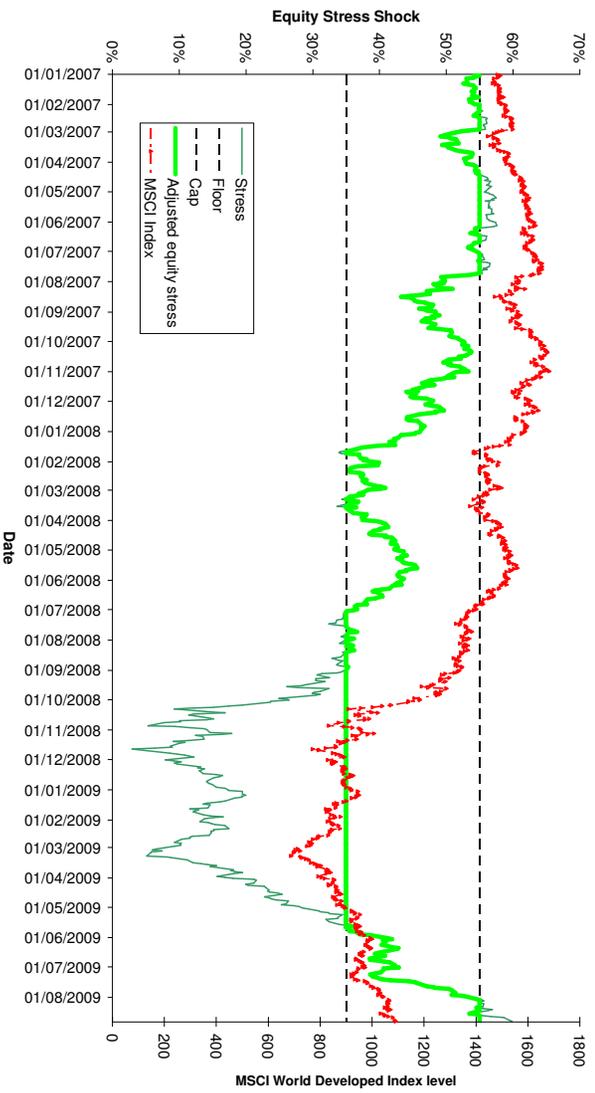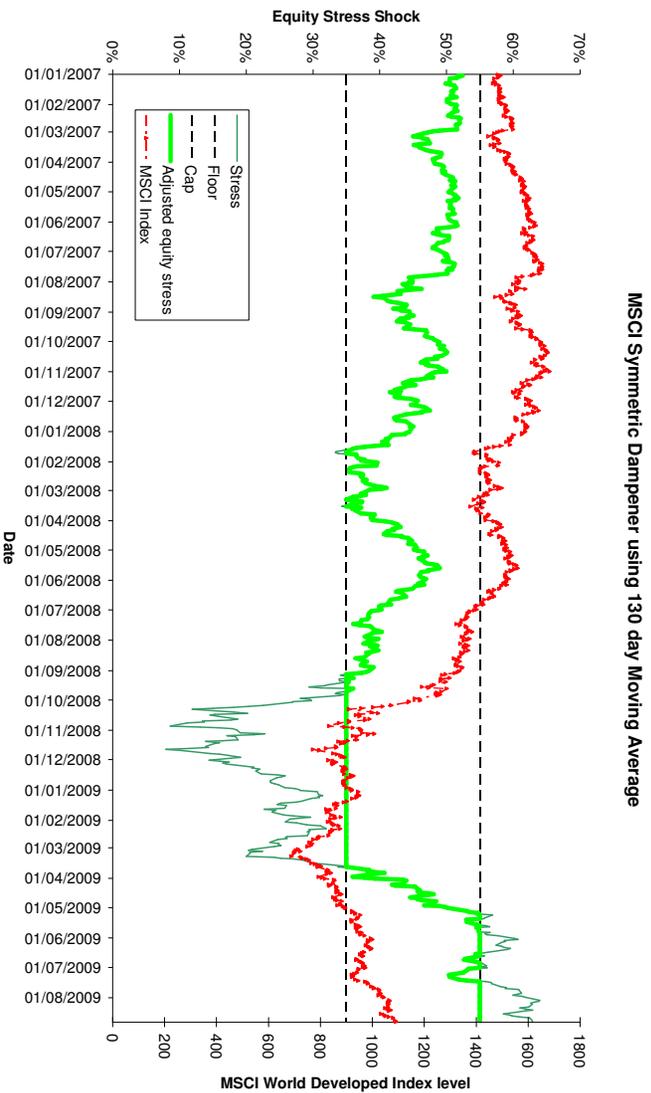Equity Stress Shock (vertical axis): 0%, 10%, 20%, 30%, 40%, 50%, 60%, 70%

Date (horizontal axis): 01/01/2007, 01/02/2007, 01/03/2007, 01/04/2007, 01/05/2007, 01/06/2007, 01/07/2007, 01/08/2007, 01/09/2007, 01/10/2007, 01/11/2007, 01/12/2007, 01/01/2008, 01/02/2008, 01/03/2008, 01/04/2008, 01/05/2008, 01/06/2008, 01/07/2008, 01/08/2008, 01/09/2008, 01/10/2008, 01/11/2008, 01/12/2008, 01/01/2009, 01/02/2009, 01/03/2009, 01/04/2009, 01/05/2009, 01/06/2009, 01/07/2009, 01/08/2009

MSCI World Developed Index level: 0, 200, 400, 600, 800, 1000, 1200, 1400, 1600, 1800

MSCI Symmetric Dampener using 130 day Moving Average

Legend:
- Stress
- Floor
- Cap
- Adjusted equity stress
- MSCI Index

Equity Stress Shock (vertical axis): 0%, 10%, 20%, 30%, 40%, 50%, 60%, 70%

Date (horizontal axis): 01/01/2007, 01/02/2007, 01/03/2007, 01/04/2007, 01/05/2007, 01/06/2007, 01/07/2007, 01/08/2007, 01/09/2007, 01/10/2007, 01/11/2007, 01/12/2007, 01/01/2008, 01/02/2008, 01/03/2008, 01/04/2008, 01/05/2008, 01/06/2008, 01/07/2008, 01/08/2008, 01/09/2008, 01/10/2008, 01/11/2008, 01/12/2008, 01/01/2009, 01/02/2009, 01/03/2009, 01/04/2009, 01/05/2009, 01/06/2009, 01/07/2009, 01/08/2009

MSCI World Developed Index level: 0, 200, 400, 600, 800, 1000, 1200, 1400, 1600, 1800

3.47. Averaging periods of 90 days or more tend to capture the "macro" trends, while 22 day or 90 day averaging periods also respond to short-term dips or rises in the index level.

3.48. It is also useful to tabulate the adjustments to the equity capital charge that would have applied at the end of 2008, where a positive number increases the capital charge. As can be seen, a 22 day adjustment period would generate a stress higher than the underlying standard stress, whereas a longer adjustment period would reduce the capital charge (to the minimum possible, for the cases of 130 and 260 day adjustment periods).

	22 days	90 days	130 days	260 days
capped adjustment (within +/-10%)	3%	-10%	-10%	-10%

3.49. The corresponding figures at the end of June 2003, just at the upturn of the equity market after the 2001-3 crash would have been as follows. This case is interesting to examine because it shows how the capital charge behaves as the market begins to lift out of a crash scenario (so may be indicative of a possible year-end 2009 scenario). For all but the 22 day adjustment period, the equity charge would be higher than the underlying standard stress. In the case of the 260 day averaging period, the capital charge would be almost the highest possible, even though undertakings might still be "fragile" as they come out of the equity crash period.

	22 days	90 days	130 days	260 days
capped adjustment (within +/-10%)	-1%	7%	9%	9%

3.50. In this context, CEIOPS notes that where, in a falling market, a longer reference period leads to a lower capital charge, this has potential for moral hazard, in that undertakings may take on inappropriately large equity investments. This would worsen any pro-cyclical effects at low points in the equity cycle.

3.51. Further, undertakings may move away from other asset types such as bonds or properties, where there is no counter-cyclical charge, if they know already that the capital charge for equities will provide counter-cyclical relief.

3.52. Finally, it is important to bear in mind the interaction with the ladder of supervisory intervention and processes that would apply while an undertaking recovers its SCR coverage.

3.53. On the basis of the above analysis, an **averaging period of one year** is proposed. A minority CEIOPS' Members has expressed its preference for an averaging period of three years or more. The analysis and results of applying an averaging period of three years are being presented in Annex C.

3.54. It is also possible to vary the beta factor within the calibration of the symmetric adjustment mechanism. A reduction in beta would result in a more stable capital charge. This could be considered advantageous to address the case where markets have begun to rise after a period of depression, as in paragraph 3.49. In such cases it might not be appropriate to apply a disproportionately high adjusted equity charge, as this could result in fire sales and other pro-cyclical consequences. A reduction in beta (applying throughout the cycle) would serve to mitigate this risk.

3.55. The graph below illustrates the application of a beta = 0.5 factor to the 130 day reference period. Compare with the graph on paragraph 3.46.

MSCI Symmetric Dampener using 130 day average and adjusted beta = 50%
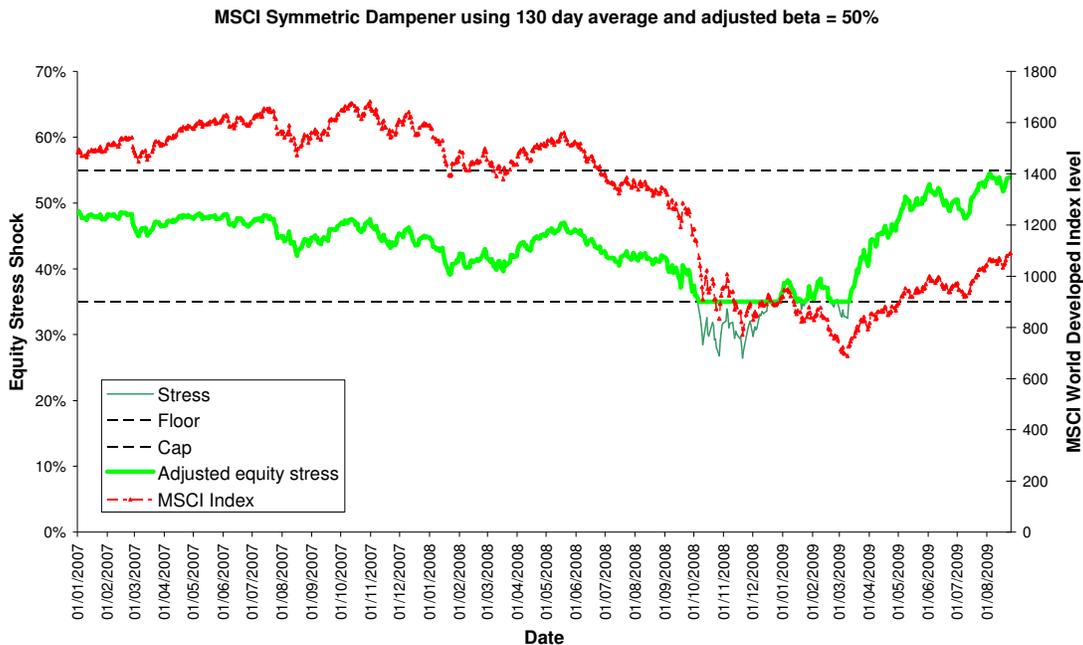
3.56. A suitable choice of beta could therefore be combined with an appropriately chosen reference period to ensure that the variation in equity risk charge remains sufficiently sensitive but does not require undertakings to change their investment profile frequently solely as a result of changes in the equity risk capital requirement.

3.5 "Other" equities

Scope

3.57. The category "other equities" comprises equities listed in countries other than EEA and OECD countries, non-listed and private equities, hedge funds, commodities and other alternative investments. For collective investment vehicles, line with the requirements set out in Doc 40/09, a

look through test should be used to determine where best to classify the equity.

Calibration

3.58. Using non-parametric methodology in the same way as for the global equity class, we have analysed indices representative of the "other equities" category.

3.59. The results of this analysis, at the 99.5% empirical VaR level, are as follows:

Equity type	Index	Proposed Stress
Private Equity	LPX50 Total Return	-68.67%
Commodities	S&P GSCI Total Return Index	-59.45%
Hedge Funds	HFRX Global Hedge Fund Index	-23.11%
Emerging Markets	MSCI Emerging Markets BRIC	-63.83%

3.60. The results demonstrate rather wide variation between the different classes of "other" equities. We note that due to challenges surrounding the composition of the index (particularly relating to the private equity index), the richness of data available, and selection bias within indices, the results must be considered with an overlay of expert judgement.

3.61. CEIOPS notes strong industry feedback on the granularity of the risk charge, however, given the challenges of performing a reliable analysis as detailed above, as well as the difficulty of practically splitting the "other" equity charge into sub-categories CEIOPS considers that a single stress for 'Other Equities' is appropriate.

3.62. The empirically calculated private equity charge above is likely to be somewhat overstated, and the hedge fund charge understated; there is also likely to be a small (although difficult to quantify) diversification benefit between the four categories. For these reasons, CEIOPS recommends an overall charge of **55%** for the other equity category.

3.63. One Member State expresses the minority view that the "other" charge should be set to 42%.

3.64. CEIOPS proposes that the same symmetric adjustment mechanism should be applied for "other" equities as for "global" equities. The rationale for this proposal is that

• This avoids introducing undue complexity to the equity risk sub-module;

• The same arguments for the calibration of the symmetric adjustment mechanism apply for "other" equities as for "global" equities;

- The "other" equities category is wide-ranging, and therefore it is unlikely that more granular analysis of the components of this category would lead to any more satisfactory result for the calibration of the symmetric adjustment mechanism.

Aggregation of capital charges for global and other equities

3.65. This Paper also considers the way in which the capital charges for "global" and "other" equities are combined. Below, CEIOPS tabulates the tail correlation between the MSCI World price indices and the specific indices which we consider as included in as 'other equity':

Equity Type	Index	Correlation
Private Equity	LPX50 Total Return	83.59%
Commodities	S&P GSCI Total Return Index	44.72%
Hedge Funds	HFRX Global Hedge Fund Index	77.31%
Emerging Markets	MSCI Emerging Markets BRIC	-52.82%

3.66. CEIOPS notes a potential diversification benefit between the other equity types, but considers it to be low and difficult to calibrate, so proposes that the standard formula contains no diversification benefit within the other equity sub-module (an implicit correlation of 1).

3.67. Based on the information contained in 3.65 CEIOPS proposes to retain the **correlation of 75% between "global" and "other" equities** as tested in QIS4. The capital charge for all "other" equity types would be simply added together before being correlated with the capital charge for "global" equities using the above correlation factor.

3.6 Equity volatility

3.68. Many insurers are sensitive to changes in equity volatility whether through the investments they hold (equities and equity derivatives) or through equity-linked options and guarantees embedded in their liability portfolio. As a result, equity volatility has an impact particularly on insurers writing traditional participating business, investment-linked business and other investment contracts.

3.69. CEIOPS recognises the existence of the equity volatility risk during the stressed scenario.

3.70. CEIOPS has used data on the Standard & Poors 500 index (SPX) from the Chicago Board Options Exchange to inform the calibration of the equity volatility stress[6]. This index represents a diversified set of equities listed

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[6] CBOE SPX Index Volatility reflects a market estimate of future volatility, based on the weighted average of the implied volatilities for a wide range of strikes. 1st and 2nd month expirations are used until 8 days from expiration, then the 2nd and 3rd are used.

on developed markets. The volatility data is based on at-the-money 1 month/30 day options.

3.71. The charts below show the empirical distributions for this volatility data, over the period 1991 to 2009. It can clearly be seen that, as with the equity returns, the observed distribution is non-normal.
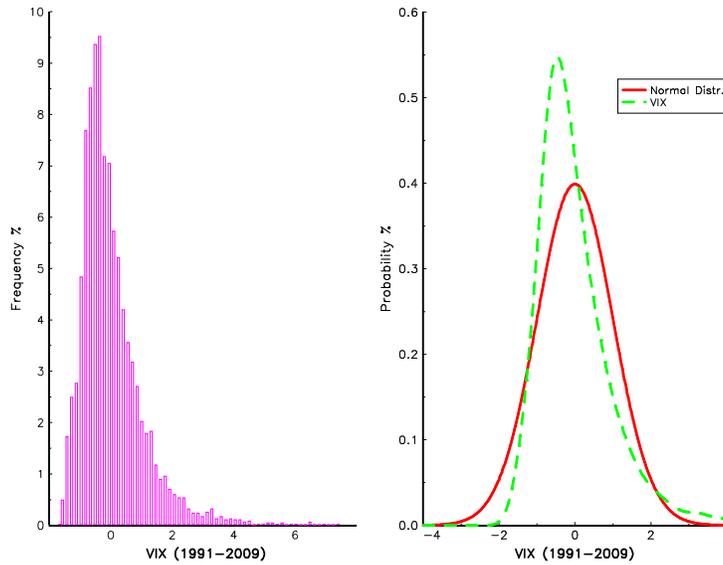
3.72. As with the calibration of the standard equity capital charge, rather than making assumptions about parameters in order to calculate the VaR levels, we have worked with the empirical distribution. The results of this analysis are shown in the table below. Note that the percentage changes in the right hand column are relative changes in volatility.

Confidence level	Annual % Changes
1	320%
99.95%	280%
99.5%	186%
99%	158%
97.5%	116%
95%	86%
90%	61%
80%	35%
70%	20%
60%	9%
50%	-1%
40%	-7%
30%	-14%
20%	-22%
10%	-30%
5%	-39%
1%	-51%
0.5%	-53%
0.05%	-58%
0	-59%
mean	9%
vol	42%
skew	1.8268
excess kurtosis	5.7618

3.73. This analysis would lead to relative stresses of -50% (downward direction) and +190% (upward direction) for the volatility of global equities.

3.74. In general, however, the option features embedded in insurers' portfolios are of somewhat longer term – several years. However, data on longer-term equity options is generally sparse and is strictly over-the-counter. The availability of data deteriorates for term longer than 5 years, with only limited data available for terms longer than 10 years.

3.75. The assumption of 5 years as a typical equity option term can be made in order to arrive at an appropriate equity volatility calibration without introducing complexity that is excessive for a standard formula approach. However, where appropriate, an internal model approach could allow for a more granular or sophisticated calibration.

3.76. Limited data[7] available for 5-year at-the-money implied volatility on the Eurostoxx 50 index, for example, indicates approximately doubling of volatility over the period from mid 2007 to mid 2008. Comparison against the 1-month implied volatility shows that in general the 5-year implied volatility is less volatility than the 1-month implied volatility, and tends to suffer comparatively lower shocks.

3.77. An analysis of 5-year at-the-money FTSE100 options produces a 99.5% VaR level of 60% based on daily data covering May 2006 to March 2009. (Note that data limitations restrict the length of data series that can be used here).

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[7] See **Modelling challenges and Replicating Portfolios** delivered at the European Actuarial Academy April 2009 by Manuel Sales

3.78. The CRO Forum's report "Calibration Principles for the Solvency II Standard Formula" noted that in their calculations of 99.5% VaR, UK firms were typically assuming a relative equity volatility shock of around 45-55%[8]. However, this survey of undertakings did not incorporate the experience of the financial crisis, and therefore it might be expected that this stress assumption could be revised upwards in the light of recent experience.

3.79. Investigation of the data for 5-year options reveals "step changes", akin to regime shifts, in volatility. A more sophisticated modelling methodology could incorporate these, for example by using a Poisson process to model the arrival of such shifts, but this is beyond the scope of the standard formula.

3.80. In conclusion, the considerations outlined above lead to an equity volatility stress calibration consisting of a **relative volatility stress of 50% in the upward direction**, by assuming that the relative strengths of the up and down stresses are similar for 5-year options as for 1-month options we arrive at a **downward relative stress of 15%** where relevant.

3.81. We note that equity volatility and equity stress have a correlation of less than 1, i.e. it can be observed in the market that when equity prices rise, equity volatility does not always also rise. However the correlation is high, especially for the extreme movements which are likely to occur in a 1:200 year event. For this reason we propose a **correlation coefficient of 0.75** between equity volatility up and equity level stresses, and a **correlation coefficient of 0** between equity volatility down and equity level stresses. We envisage that total global equity capital would be calculated using this correlation, as would total other equity capital. The correlation factors described in paragraph 3.67 would then be applied to create an overall equity capital charge. This would usually entail firms performing separate 'volatility' stress, and 'level' stress runs, and aggregating the results using the correlation matrix approach.

3.82. In line with the arguments set out in paragraph 3.64 we propose that the same calibration for equity volatility be used for "other" equities as for "global" equities, to avoid introducing disproportionate complexity.

3.7 Overall equity capital charge

3.83. For each category of equity (i.e. "global" and "other") the total capital charge including volatility will be the maximum of the two quantities

$$\text{Mkt}_{vol}{}^{Up} = \Delta NAV|_{vol\_up, \, equities\_down} \quad \text{and} \quad \text{Mkt}_{vol}{}^{Down} = \Delta NAV|_{vol\_down, \, equities\_down}$$

3.84. The combination of the "global" and "other" equity charges then proceeds as per paragraph 3.65 above.

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[8] The report stated this as an increase to 32%-34.5% over a base assumption of 22% for implied equity volatility.

3.8 Duration approach according to Article 304

3.85. The design of the equity risk sub-module referred to in article 304 should be based on the following principles:

3.86. The directive sets, when considering a 1-year horizon, a level of confidence of 99,5%. Considering a holding period of T years and assuming temporal independence of events, it can be assumed that an equivalent level of confidence is $99,5\%^T$.

3.87. Considering an insurer collecting a premium S_0 at date t=0 in exchange for the promise to pay a capital $K_T = S_0 e^{rT}$ at date T, where r is the risk free rate. The premium is invested in equity. The model of the value S_t of this asset will be supposed to evolve over time according to a geometric brownian motion: $\dfrac{dS}{S} = \mu dt + \sigma dw,$

3.88. The equity charge (called SCRT) is derived from these hypothesis (see annex 2) :

$$\frac{SCR_T}{S_0} = 1 - \exp\left[\left(\mu - r - \frac{\sigma^2}{2}\right)T - \sigma\sqrt{T}Q(T)\right],$$

3.89. For prudence and in order to be consistent with the property submodule calibration, an absolute floor for the equity charge is set at 22%.

3.90. This leads to the following calibration, with μ=10%, r=5%, σ follows the Campbell Viceira pattern (see Annex 3) :

Equity charge

t : holding period

Equity charge — × QIS3 — – – QIS4 "Mid-cycle"
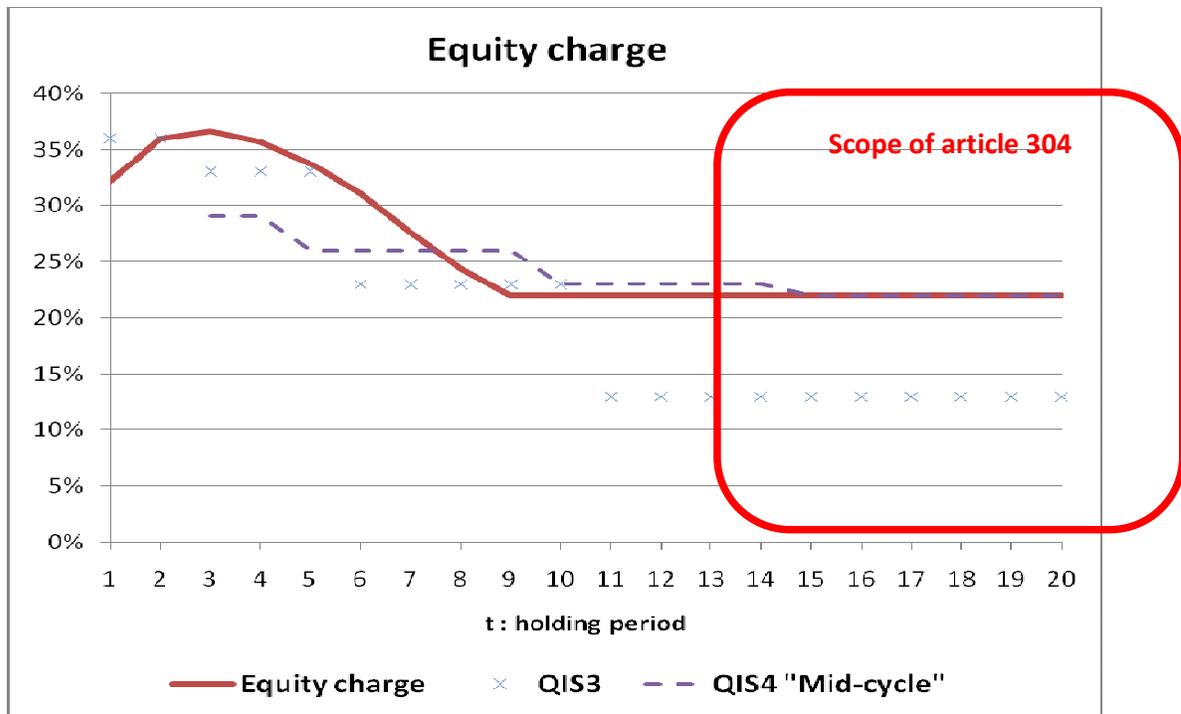
3.2.2 CEIOPS' advice

General comments and objectives

3.91. The advice on equity risk set out in this paper follows a scenario-based approach, and divides equities into the two categories "global" and "other".

3.92. As set out in the Level 1 text, there are two possible ways to calculate the equity risk capital charge: as well as the standard approach there is also the possibility (where permitted, and restricted to certain types of liabilities) to use the "duration dampener" approach of Article 304.

3.93. For the "standard" approach, a symmetric adjustment mechanism applies, as set out in Article 106[9]. The Commission has clarified that this mechanism is required to operate such that the equity shock lies within a band of 10% either side of the underlying standard equity stress.

3.94. The calibration of the "standard" approach as recommended below therefore looks firstly at the underlying standard equity stress, which is calibrated to the 99.5% VaR level for both global and other equities. The symmetric adjustment mechanism then overlays the standard charge to arrive at the full standard approach.

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[9] The Commission has clarified that the symmetric adjustment mechanism does not apply to the equity risk sub-module as calculated in accordance with Article 304.

3.95. In calibrating the symmetric adjustment mechanism, CEIOPS has considered the following objectives:

- avoid that insurance and reinsurance undertakings are unduly forced to raise additional capital or sell their investments as a result of unsustained adverse movements in financial markets;

- discourage/avoid fire sales which would further negatively impact the equity prices – i.e. prevent pro-cyclical effect of solvency capital requirements which would in times of stress lead to an increase of capital requirements and hence a potential de-stabilising effect on the economy.

Calibration for "global" equities

3.96. The category of "global" equities covers equities listed in EEA or OECD countries

3.97. Based on the analysis set out in the explanatory text above, the underlying standard stress for global equities is calibrated at 45%. An alternative equity stress, which consists of applying a 39 % stress to global equities, is being supported by a minority of CEIOPS' Members. One Member State supports a 32 % stress (see Annex B).

The symmetric adjustment mechanism

3.98. In calibrating the symmetric adjustment mechanism, CEIOPS has considered the following objectives:

- allow sufficient time for undertakings to rebalance their profile in a stressed scenario;

- avoid unintended pro-cyclical effects (in particular a rise in the equity charge in the middle of a crisis);

- ensure that the equity charge remains sufficiently risk sensitive;

- prevent fire sales of assets;

- avoid undertakings having to adjust their risk profile frequently solely as a result of movements in the equity capital charge;

- avoid any incentive to invest in one or the other asset class;

- allow the adjustment to be set independently of the standard equity stress.

3.99. The symmetric adjustment mechanism shall be based on the following formulation:

adjusted capital stress = standard capital stress + adjustment x beta,

where the adjustment term is $\dfrac{I_t - \frac{1}{n}\sum\limits_{s=t-1}^{t-n} I_s}{\frac{1}{n}\sum\limits_{s=t-1}^{t-n} I_s}$ and the adjusted capital stress

is subject to a band of ±10% either side of the standard capital stress.

In the adjustment term, I_t is the value of the MSCI Developed index at time t. The beta term is set equal to 1.

3.100. The formulation above is based on equal weightings for each of the days within the reference period.

3.101. Due to the construction of the symmetric adjustment mechanism, the choice of averaging period can be made independently of the choice of standard equity stress.

3.102. Based on the analysis above, CEIOPS proposes an averaging period of one year. A minority CEIOPS' Members has expressed its preference for an averaging period of three years or more. The analysis and results of applying an averaging period of three years are being presented in Annex C.

3.103. The analysis discussed above leads to the conclusion that a shorter reference period leads to greater stability in the adjusted equity charge. Referring back to the objectives in paragraph 3.95, the choice of calibration will need to strike a balance, however, taking into account

• sufficient time for undertakings to rebalance their risk profiles

• the need to discourage or avoid fire sales of equities

• retaining adequate risk-sensitivity.

3.104. CEIOPS' recommendation on the averaging period also takes into account that in a falling market, a longer reference period leads to a lower capital charge; this has potential for moral hazard, in that undertakings may take on inappropriately large equity investments. This would worsen any pro-cyclical effects at low points in the equity cycle.

3.105. Further, undertakings may move away from other asset types such as bonds or properties, where there is no counter-cyclical charge, if they know already that the capital charge for equities will provide counter-cyclical relief.

Calibration for "other" equities

3.106. "Other" equities comprise equities listed in countries other than EEA and OECD countries, non-listed and private equities, hedge funds, commodities and other alternative investments.

3.107. Based on the analysis set out above, the charges for other equities should

be 55%.

3.108. We propose that the same symmetric adjustment mechanism should be applied for "other" equities as for "global" equities. The rationale for this proposal is that

- This avoids introducing undue complexity to the equity risk sub-module;

- The same arguments for the calibration of the symmetric adjustment mechanism apply for "other" equities as for "global" equities;

- The "other" equities category is wide-ranging, and therefore it is unlikely that more granular analysis of the components of this category would lead to any more satisfactory result for the calibration of the symmetric adjustment mechanism.

3.109. There is no diversification allowed between "other" equity types, but the correlation between the total capital charges of the "other" equity types and "global" equity types is set to 0.75.

Equity volatility

3.110. CEIOPS recognises the existence of the equity volatility risk during the stress scenario.

3.111. Firms should assess whether they are affected by equity volatility, and if so whether they are affected by an increase, a decrease or both.

3.112. Firms should calculate capital to hold based on a relative volatility stress of 50% in the upward direction, and a downward relative stress of 15% where relevant.

3.113. Firms may assume a correlation coefficient of 0.75 between equity level and upward equity volatility and a correlation coefficient of 0 between equity level and downward equity volatility.

Overall capital charge

3.114. For each category of equity (i.e. "global" and "other") the total capital charge including volatility will be the maximum of the two quantities

$$\mathrm{Mkt_{vol}}^{Up} = \Delta \mathrm{NAV}|_{vol\_up,\ equities\_down} \text{ and } \mathrm{Mkt_{vol}}^{Down} = \Delta \mathrm{NAV}|_{vol\_down,\ equities\_down}$$

3.115. The combination of the "global" and "other" equity charges then proceeds as per paragraph 3.109**Error! Reference source not found.** above

Duration approach according to Article 304

3.116. Undertakings applying the provisions of Article 304 will calculate the average holding period of their equity assets. For holding periods above 12 years, the equity risk capital charge will be 22%.

3.117. The equity capital requirement calculated according to Article 304 of the Level 1 text should be integrated in the SCR standard formula as follows:

The equity capital requirements calculated according to Article 304 and according to Article 105 should be summed up. The result should be aggregated with the other market risk capital requirements according to point 5 of Annex IV, using the correlation parameters specified according to Article 111d.

Annex A Article 304: calculation of the equity capital charge

A.1. Considering an insurer collecting a premium S_0 at date t=0 in exchange for the promise to pay a capital $K_T = S_0 e^{rT}$ at date T, where r is the risk free rate.

A.2. The premium is invested in equity. The value S_t of this asset evolves over time according to a geometric Brownian motion:

$$\frac{dS}{S} = \mu dt + \sigma dw,$$

where µ equals r plus the equity premium and σ is the annual volatility of equity returns. I.e. Log(ST) is normal with mean $(\mu - \sigma^2/2)T$ and variance $\sigma^2 T$.

A.3. The insurer has some reserve at date t=0 that is used as a collateral to the insurer's liability at date T. Let SCRT be the minimum reserve that guarantees that the probability of default at date T be smaller than 0.995^T.

A.4. We assume that the reserve is invested in the risk free asset. It implies that SCRT is implicitly defined by the following equality:
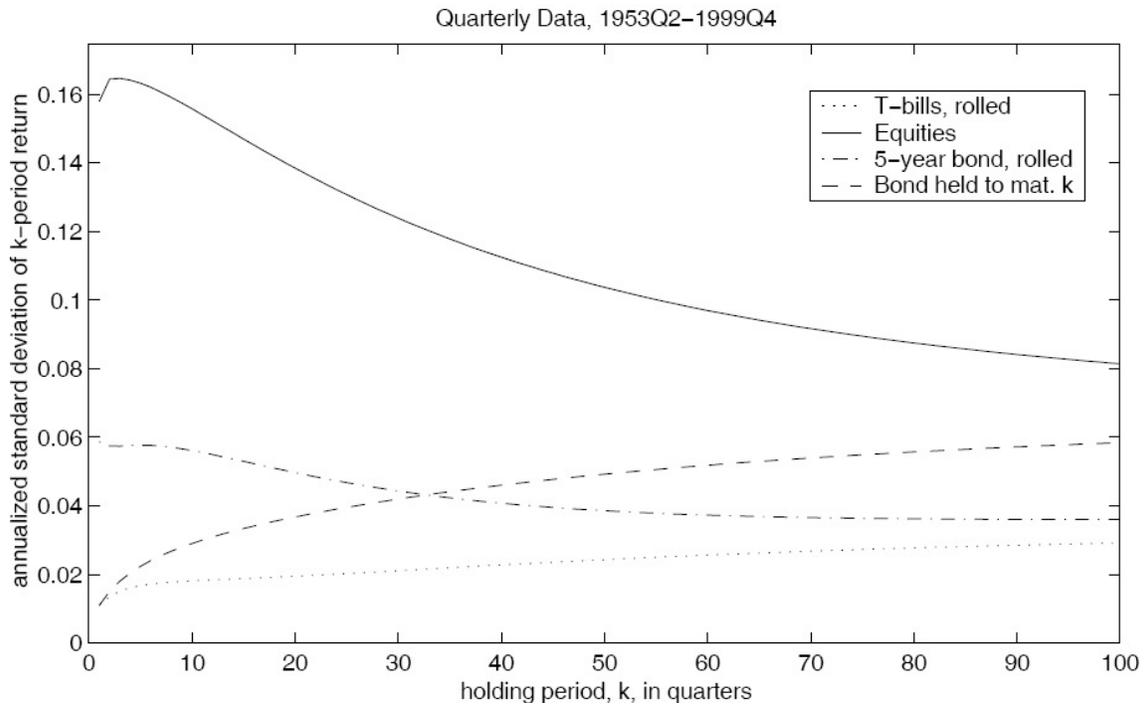
$$\Pr\left[\, SCT_T e^{rT} \mid S_T \geq S_0\, e^{rT} \right] = 0.995^T$$

A.5. We obtain that

$$\frac{SCR_T}{S_0} = 1 - \exp\left[\left(\mu - r - \frac{\sigma^2}{2}\right)T - \sigma\sqrt{T}Q(T)\right],$$

where Q(T) is the 0.995T quantile of the normal distribution.

A.6. σ is calibrated following the Campbell Viceira study :

Figure 1 Annualized standard deviations of real returns on US markets, VAR setup, period 1952-1999. Source: Campbell and Viceira (2002).

A.7.   Note : in the first years, the impact of the volatility of the equity motion is predominant over the impact of the trend of the motion. After a few years, the trend impact is predominant, leading to a progressive decreased in the risk incurred.

Annex B Alternative proposal on calibration of the standard equity charge according to Article 105 and 106 (minority view)

B.1. A model that derives the future equity returns distribution from the current position in the equity cycle was used in order both to calibrate the standard equity shock and to optimise the appropriate period of time for the symmetric adjustment mechanism. (See point paragraphs B.10-B.18 hereunder)

B.2. According to this model the standard equity shock should be set at 30% and the optimal period at 5 years.

B.3. In the following proposal the standard equity shock is being set at 32%, the value that was used and tested in QIS4.

B.4. As for the choice of the appropriate period of time for the adjustment mechanism that compares an equity index with its moving average during this appropriate period, a relevant criterion is the comparison of the calculated adjusted shocks with the real shocks in a back testing exercise for several possible values of this period of time.

B.5. From a solvency point of view, the methods should be compared on the following issues:

  – How often would the adjusted mechanism have underestimated the actual shock?

  – What would have been the maximum amount of underestimation?

B.6. The appropriate period of time should not underestimate the actual shock more than 1% of the time, and in these cases, the underestimation should be lower than 10% of the actual shock value.

B.7. The result of the back-testing exercise in (See point (b) paragraphs C.19-C.23 hereunder) shows that the optimal period would be to choose an adjustment on a period of 5 years, but the minimal period that would fit the criteria would be 3 years: this period of 3 years has been chosen in the following development:

We note:

MSCI(t) = MSCI Developed Markets World Index, price, monthly

MA(t) = moving average of the index calculated at date t over the last 36 months

$$= \sum_{i=t-36}^{i=t} MSCI(i) * \frac{1}{37}$$

D(t) = distance of the index to its moving average (in percentage)

$$= [MSCI(t) – MA(t)] / MA(t)$$

During the last 35 years, the MSCI equity index was in average 10% above its 36-month moving average. The standard deviation of this distance was of 17%.

MD = mean distance of the index to its moving average over the last 30 years = 10%

SD = standard deviation of the distance of the index to its moving average = 17%

B.8. As a consequence, in order to determine the equity charge, $D(t)$ will be compared to its average value MD and its standard deviation SD. Hence, it will be considered that :

- the equity market is mid-cycle when the equity index lies 10% above its moving average i.e. $D(t)=MD$;

- it is high in the cycle when it lies 27% or more above its moving average i.e. $D(t)>=MD+SD$;

- it is low in the cycle when it lies at least 7% below its moving average i.e. $D(t)<=MD-SD$.

B.9. The model described below allows the following calibration:

	Equity shock
$D(t)>=27\%$	42%
$D(t)> 10\%$ and $<27\%$	32% + 10% * (D(t)-MD)/SD
$D(t)=10\%$	32%
$D(t)>-7\%$ and $<10\%$	32% - 10% * (D(t)-MD)/SD
$D(t)<=-7\%$	22%

a. The model used in order to perform the calibration

B.10. The principle of the method is to build a model that derives the future equity returns distribution from the current position in the equity cycle. The current position in the equity cycle is calculated using the Hodrick-Prescott filter. For simplicity, this filter can be viewed as an enhanced version of a more basic method that calculates the position in the cycle as the difference between the current position of the equity market compared to its trend[10] over the last 8 years.

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[10] Linear trend

B.11. The model calculates the VaR by using a widely used bootstrapping technique :

- Three bootstrapped simulations are performed: one with a starting point where the markets are up in the cycle, one with a starting point where they are low and one with a starting point where they are at mid-cycle.

- For each simulation, ie for each position in the cycle, the bootstrapping technique provides a full distribution of equities returns over a 1-year horizon.

- For each simulation, ie for each position in the cycle, the VaR is calculated based on this distribution.

B.12. The method does not make any a-priori hypothesis on the distribution of equities returns (this advantage is due to the bootstrapping technique).

B.13. Model details :

In order to calibrate the equity SCR, the equities return was modelled using the following equation (vector auto-regressive –VAR- equation):

$$z_t = \Phi_0 + \Phi_1 z_{t-1} + \Phi_2 z_{t-2} + \Phi_3 z_{t-3} + v_t \quad (\text{Eq1})$$

where

$$z_t = \begin{bmatrix} xe_t \\ mc_t \end{bmatrix},$$

xet = log-return of equities in excess of risk-free rate (with dividend reinvested), mct = cyclical component.

B.14. The data used was MSCI Price and Gross Return Indices EUROPE from end of December 1973 to end of December 2008. The cyclical component was calculated using a Hodrick-Prescott filter, which has been the most widespread tool in economics to analyze cycles over the last 30 years (see Appendix). The filter splits the equity price index into a trend and a cyclical component, by using an enhanced linear regression. Applied on the studied data, the results are the following :
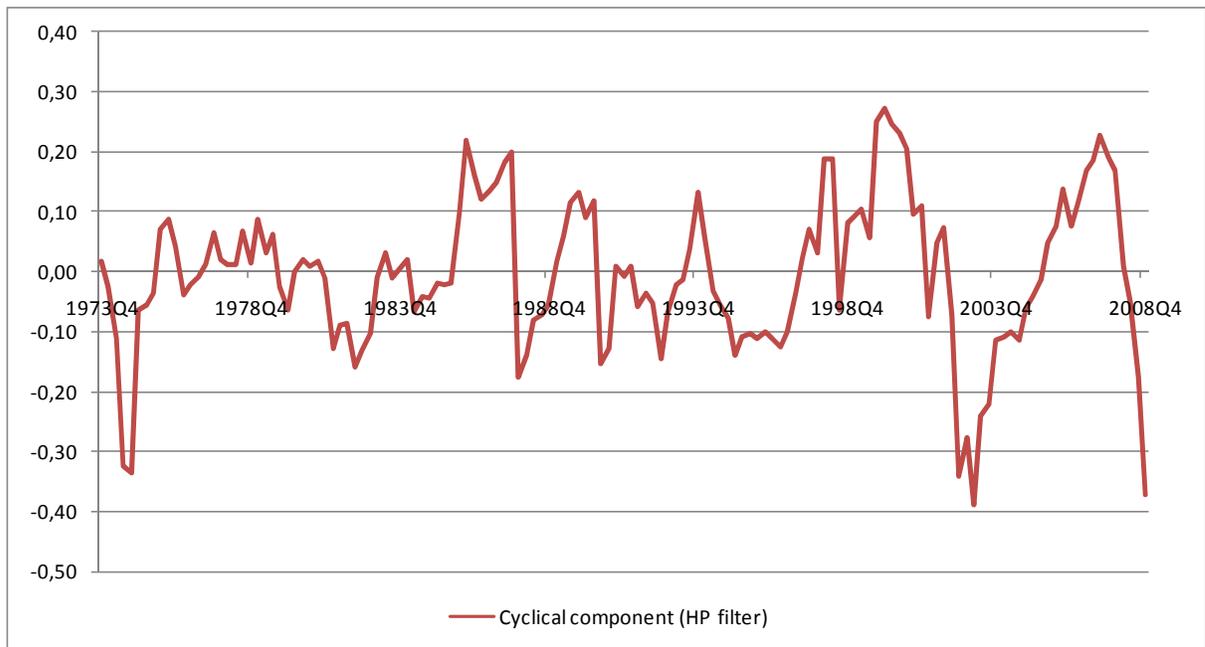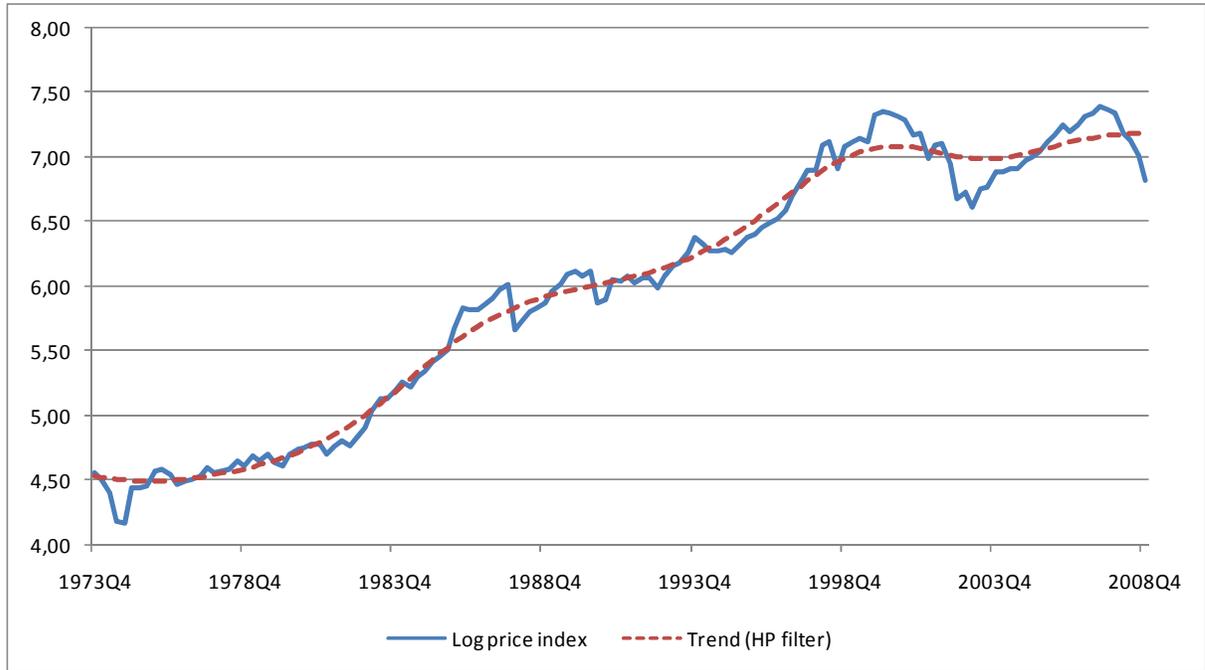
B.15. 400 000 paths were simulated over 20 years, by using the equation (Eq1) and adding bootstrapped residuals[11]. The VaR was computed as the 99,5% quintile of the returns distribution of the 400 000 simulations. In consequence, the model doesn't use any hypothesis on the shape of residuals (in particular no normality hypothesis).

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[11] When bootstrapping residuals, potential heteroscedasticity (i.e. segmentation of volatility) was taken into account. The technique used was the technique presented in CREATES Research Paper 2008-50, Testing for Co-integration in Vector Autoregressions with Non-Stationary Volatility, Giuseppe Cavaliere, Anders Rahbek and A.M.Robert Taylor

B.16. In order to apply the model, the mean and standard deviation of the HP cyclical component can be used :

Mean = 0
Stdev = 0,127

B.17. Choice of the relevant period for calculating the moving average :

Several possibilities for calculating the moving average where checked against this model:

	HP cycle	3-month moving average	6-month moving average	1-year moving average	2-years moving average	3-years moving average	4-years moving average	5-years moving average	6-years moving average	7-years moving average	8-years moving average
Correlation coefficient with HP cycle		0,40	0,48	0,57	0,68	0,73	0,75	0,75	0,72	0,69	0,66
T-student (H0 : not correlated)		4,72	6,06	7,70	10,18	11,68	12,30	12,28	11,42	10,36	9,69
Maximum underestimation of loss produced by the model	0%	12%	12%	12%	10%	7%	6%	5%	6%	8%	11%

B.18. The 60-month (5-year moving average) was chosen as it is the one that minimizes the potential VaR underestimation, while maintaining a high level of correlation with the HP-cycle results. The table above also shows that the methods using short moving averages produce higher underestimations of the VaR. For example, they already consider at the end of 2007 that the markets are in low cycles, while a method using a longer moving average will consider that markets are still up in the cycle (see illustration below). Indeed, methods using short term averages are myopic and only see the small initial market downturn of Q4 2007 hence considering that markets are low, while a method using a 5-year moving average takes into account the whole market increase of 2003-2007 and still considers that markets are high.

b. Article 106: equity capital charge using 3 years moving average, and back-testing from 3 months moving average to 5 years moving average.

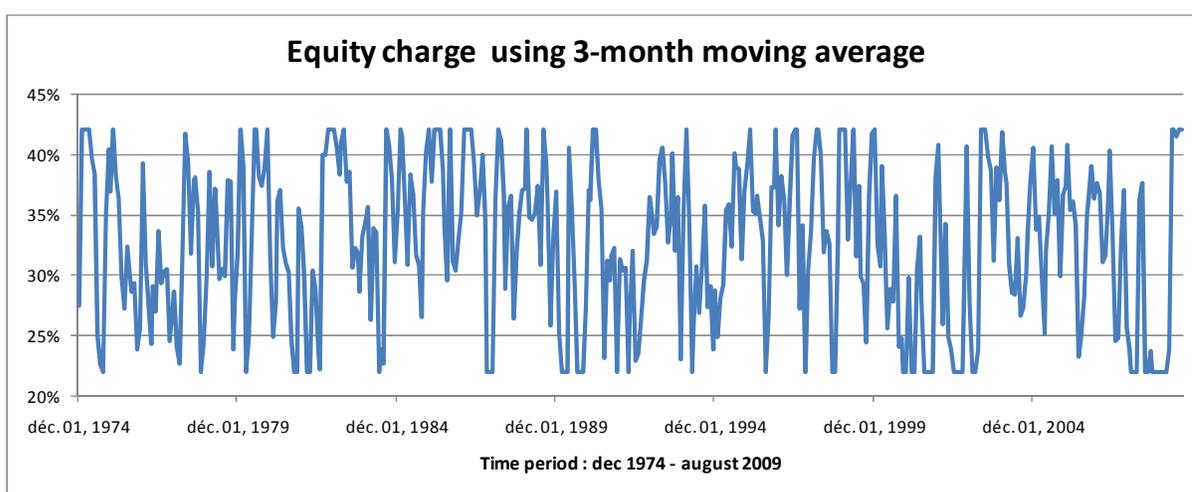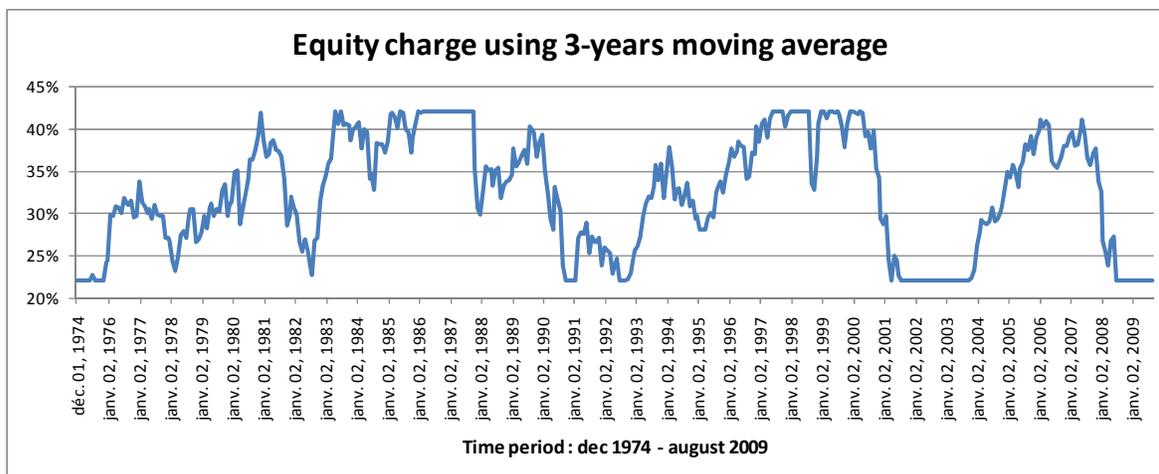B.19. Over the period 1974-2009, the equity charge would have been the following :
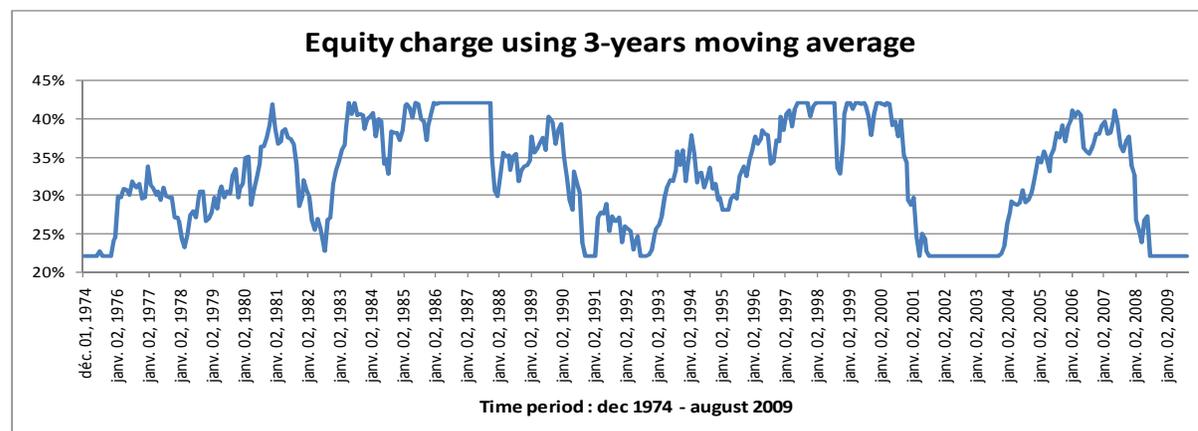
B.20. (The market is considered up in the cycle about 10-15% of the time, it is considered low in the cycle about 10%-15% of the time. Indeed, in times of stress, it appears normal to consider that markets are stressed during a few consecutive months. Similarly, bubbles do usually last for a few months.)

B.21. Back-testing of the model over the period 1974-2009 shows a good resilience :
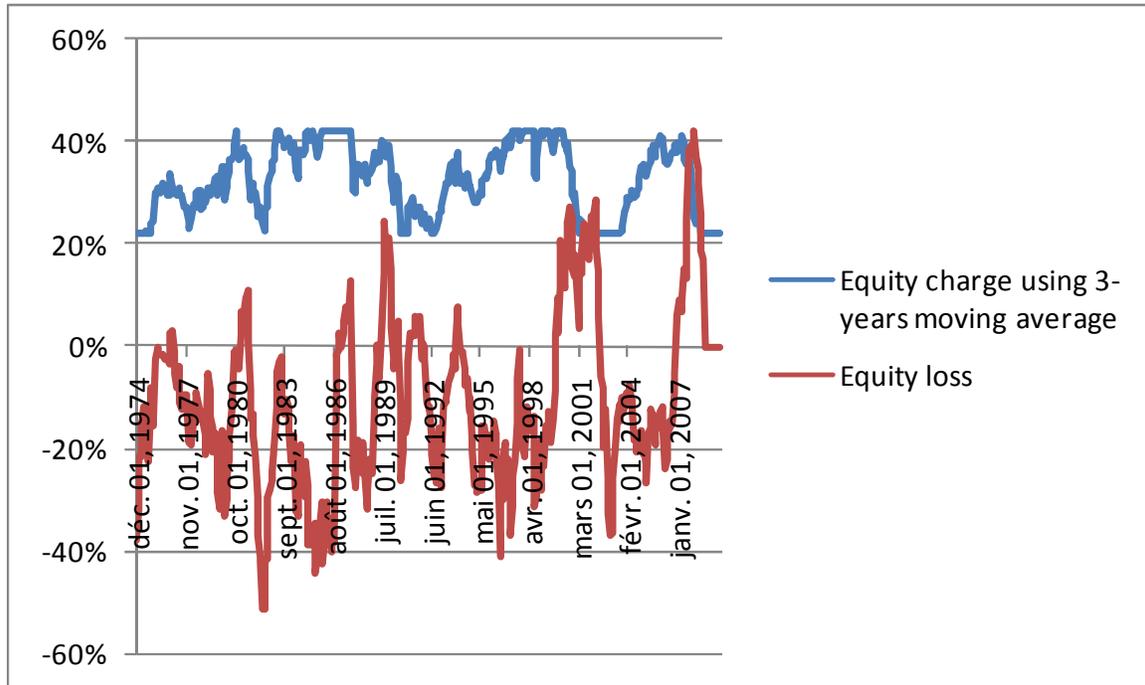
B.22. In contrast, using a short-term moving average leads to the amount of equity charge changing very often, making it unpredictable, and making financial steering impossible. The next figure shows how fast the equity charge will move if a short term dampener is used. For example, if a 3-month average is used, the equity charge in September 2009 would have been maximum, while it was minimum in March 2009.

Equity charge using 3-years moving average

Time period : dec 1974 - august 2009

Equity charge using 3-month moving average

Time period : dec 1974 - august 2009

B.23. Back-testing over the period 1974-2009:

The following table compares the periods of time according to:

- How often would the adjusted mechanism have underestimated the actual shock?

- What would have been the maximum amount of underestimation?

5-year m.a.	3-year m.a.	1-year	3-month m.a.
Percentage of underestimated points :			
0,7%	1,0%	1,7%	1,2%
Maximum amount of underestimation :			
6,0%	9,7%	13,0%	13,0%

Annex C Impact assessment on the Pillar I symmetric adjustment mechanism - Equity risk

C.1. In its Call for Advice of 1 April 2009, the Commission asked CEIOPS to contribute to the Commission's impact assessment of the Level 2 implementing measures.[12] To this end, a list of issues has been set up by the Commission and CEIOPS, identifying the Level 2 implementing measures that should be accompanied by an impact assessment. In November 2009, the Commission issued an updated list of policy issues and options. This impact assessment covers issue 8 of the list of policy issues and options.

1. Description of the policy issue

C.2. In article 106 of the Level 1 text, the Commission states that the equity risk sub-module should include a symmetric adjustment to the equity capital charge ("Pillar I symmetric adjustment").

C.3. This symmetric adjustment is a function of the current level of an appropriate equity index and a weighted average level of that index. The weighted average must be calculated over an appropriate period of time which shall be the same for all insurance and reinsurance undertakings.

C.4. This impact assessment deals with the issue of how the weighted average level is calculated, particularly over what period of time should the average be calculated.

2. Description of the policy options

Option 1: Between 0 and 3 months

Option 2: Between 3 and 6 months

Option 3: Between 6 and 12 months

Option 4: Exactly 12 months

Option 5: Between 12 and 36 months

Option 6: More than 36 months

3. Relevant objectives

C.5. The following operational objectives which have been awr out by the Commission for this issue are:

  • Introduce risk-sensitive harmonised solvency standard;

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[12] http://www.ceiops.eu/media/files/requestsforadvice/EC-april-09-CfA/EC-call-for-advice-Solvency-II-Level-2.pdf

- Harmonise supervisory powers, methods and tools;

- Promote compatibility of prudential supervision of insurance and banking" and to

- Promote compatibility of the prudential regime for EU insurers with the work of the IAIS and IAA;

C.6. CEIOPS considers furthermore that a symmetric adjustment can, and should, meet, these relate to incentives on asset class choice, and restrictions on asset dealing. These are discussed in point 5 ("Additional considerations"). Furthermore, CEIOPS underlines the importance of the adjustment mechanism in contributing to financial stability by taking into account potential pro-cyclical effects of capital requirements.

4. Impact on industry, policyholders and beneficiaries and supervisory authorities

Costs and benefits

- Industry

C.7. The impact on the industry is likely to be direct.

C.8. Since the aim of the equity adjustment is to avoid the onset of procyclical behaviour from the managers of the undertakings, given the design of the adjustment mechanism, the industry will benefit from not having to "fire sell" in case of equity shocks for the sake of the capital requirements.

C.9. The averaging period may have an impact on the adjustment period following the dampening effect.

C.10. A period of significantly less than a year runs the risk of producing capital charges which fluctuate based on extremely short term movements. There may be a practical issue for firms of a capital charge which is subject to too frequent change, making steering of the asset mix difficult.

C.11. A period of significantly more than one year introduces the serious risk that structural changes in the equity market are not reflected in the capital charge for equities, and hence results in a less than a 1:200 protection for policyholders for extended periods of time.

- Policyholders and beneficiaries

C.12. The choice for the averaging period on which the adjustment is being calculated would have an indirect impact on policyholder protection and none of the options would have a measurable different impact.

C.13. The mitigation of procyclicality and the pursuit of financial stability would ultimately benefit policyholders.

C.14. Without the symmetric adjustment, the undertaking might have to de-risk (selling assets at depressed prices which could lead to further market falls and further disposal requirements, or raising capital at expensive rates) ultimately □eopardizing the future of the undertaking, when it might be preferable to delay the disposals or capital raising until the market is more stable or the undertaking has had sufficient time to explore other venues to restore the level of own funds.

C.15. The average period chosen for this should achieve this in a similar fashion, although the period chosen has an impact on the risk sensitiveness and the ultimate reaction of the undertaking with regard to the stressed circumstances. Therefore, if the average period is too risk sensitive or not enough, stakeholders may feel this indirectly if the undertaking cannot take appropriate measures.

- Supervisory authorities

C.16. The costs and benefits for supervisors are indirect, but may lead to an increased need for monitoring the application of the adjustment mechanism, irrespective of the averaging period chosen. The monitoring of the post-adjustment solvency requirements will have to be taken into account too.

5. Comparison between the different options based on the efficiency effectiveness in reaching the relevant operational objectives

C.17. In choosing an averaging period, a key consideration is achieving a balance between the first two objectives, whilst ensuring that objectives 3 and 4 are met. It must be ensured that firms should hold sufficient capital at all times, that the charge for holding that capital is sufficiently risk sensitive whilst at the same time mitigating any potential pro-cyclical effects.

Introduce risk sensitive harmonised solvency standards

*Risk-sensitivity, and avoiding the possibility of a binomial shock*

C.18. Consultation Paper no. 47 on SCR Market Risk demonstrates that the larger the averaging period, the more observations fall outside of the 10% band. Extrapolating this analysis, averaging periods of significantly over 1 year are likely to approach a 'binomial' capital charge. In most cases,

either the observation will be more than 10% too low, or more than 10% too high, the charge would be consistently x+10%, and then quickly flip to x-10%.

C.19. This is considered undesirable, as it would indicate that the stresses are not sufficiently risk sensitive.

C.20. The following graph illustrates the situation with a 3-year moving average dampener.

**MSCI Symmetric Dampener using 3 year Moving Average**
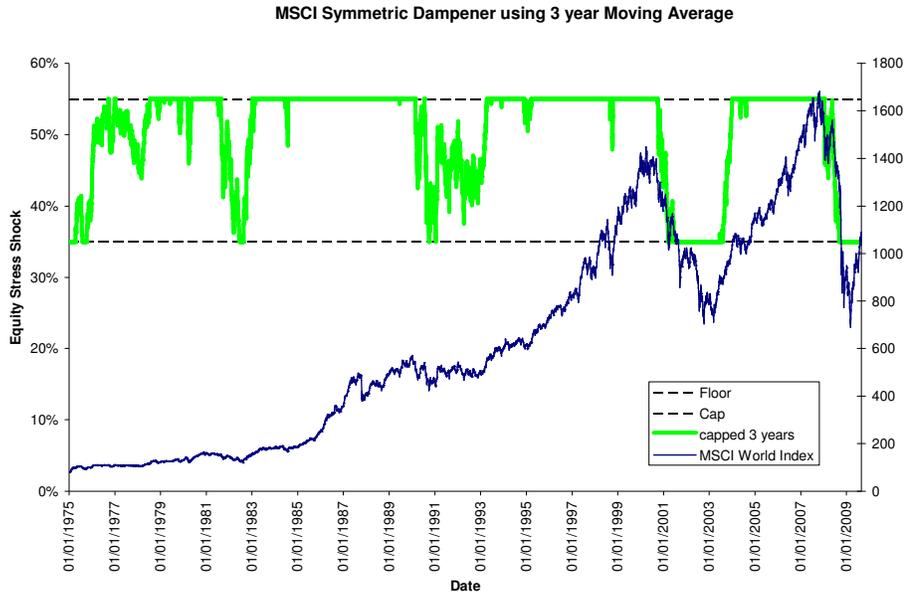
Risk-sensitivity, and adequate reflection of the equity cycle

C.21. It is important to ensure that the required capital charge does not change too frequently to reflect minor market movements. From an adequate risk management perspective, it is also extremely important to ensure that long term structural movements in equity markets are well reflected by the charge, and not dismissed as part of a cycle which may not exist.

C.22. It appears likely that a period of significantly less than a year runs the risk of producing capital charges which fluctuate based on extremely short term movements. In addition there may be a practical issue for firms of a capital charge which is subject to too frequent change, making steering of the asset mix difficult, as mentioned in the discussion of option 4 above.

C.23. A period of significantly more than one year introduces the serious risk that structural changes in the equity market are not reflected in the capital charge for equities, and hence results in a less than 1:200 protection for policyholders for extended periods of time. An example of a long term fall in equities which should not have resulted in a reduced capital charge would be the 1990's long term Japanese Equity market stagnation.

**Topix Symmetric Adjustment comparing 1 and 3 year Moving Average**
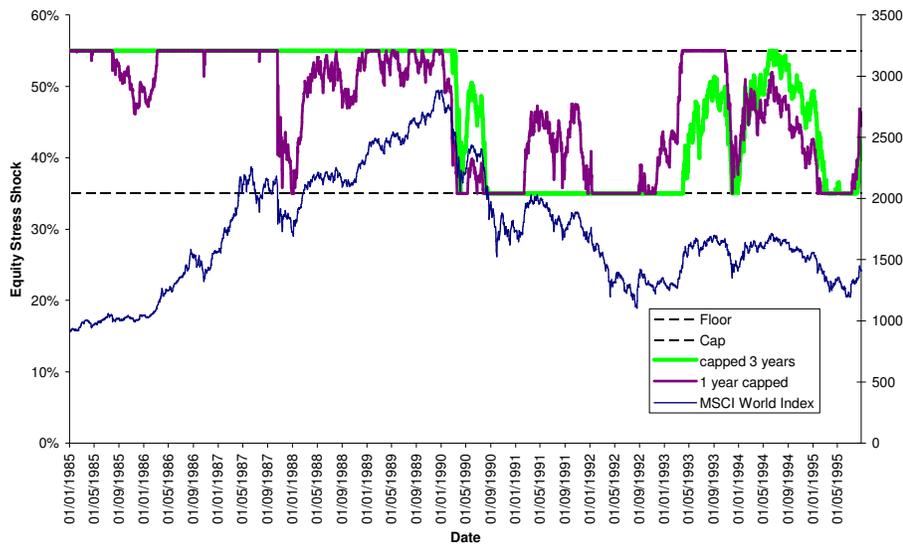
Under a three year averaging period, immediately after 1990 the stress would be set to 35% for three years following the crash. The structural change of the market would have been ignored, and as such policyholder protection may have been lower than a 1:200 stress. This example also illustrates how difficult it is to call stages of the cycle.

C.24. In choosing a period shorter than one year, such as in options 1, 2 or 3 there is a danger that the value of the equity capital charge might fluctuate within the same year between its extreme values[13], which creates an additional difficulty for the undertakings in the steering of their equity portfolios. For short term equity cycles, the delay is enough to prevent procyclical effect. However setting the appropriate period to less than a year, if the equity cycle is longer than a year, will still create a long term procyclical effect.

C.25. CEIOPS has performed some research on the pattern of the equity adjuster using 22, 90, and 130 days using the MSCI index.

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[13] The extreme values of the equity capital charge are bound by limits set in article 105a-3: "*The symmetric adjustment made to the standard equity capital charge covering the risk arising from changes in the level of equity prices shall not result in an equity capital charge being applied that is more than 10 percentage points lower or 10 percentage points higher than standard equity capital charge.*"
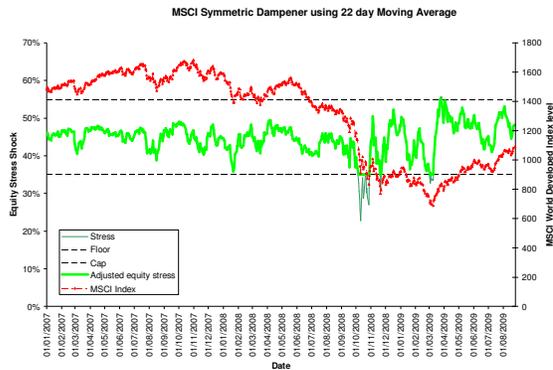
Using a 22 day moving average
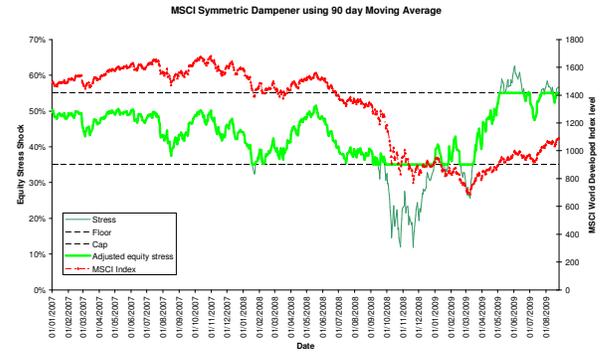
Using a 90 day moving average
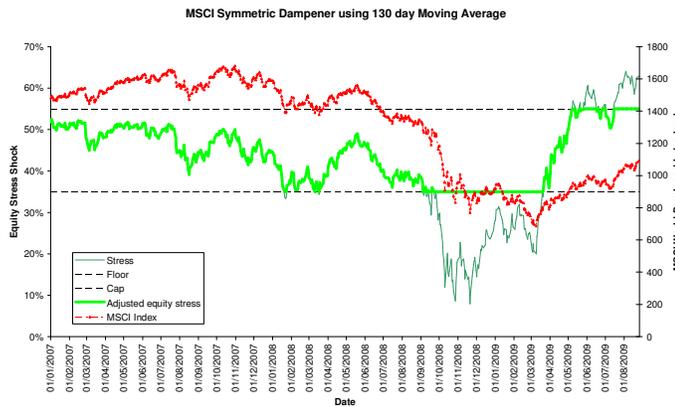
Using a 130 day moving average

C.26. As can be seen, the charge is prone to vary rapidly, making proper risk management difficult. It should also be noted that the rapid variations in the charge (especially for the shortest period) may make it difficult for a firm to re-balance their portfolio in times of crisis, and so the counter-cyclical aim may not be met.

C.27. Under the option between 12 and 36 months, the equity capital charge is stable over the period of the shock. For short and middle term equity cycles, the delay is enough to prevent procyclical effect.

C.28. However for the longer term equity cycles (6 years and above), setting the appropriate period to less than 3 years will still not offset the longer term procyclical dimension, leading to structural market changes being missed as discussed above in the Japanese Equity example.

C.29. As compared to Option 3, it can be expected however that the value of the equity capital charge is more stable and predictable within the same year, enhancing the steering of equity portfolios.

Risks of market distortion as mentioned above may increase under this option.

C.30. Under the option for an averaging period of more than 36 months, the equity capital charge is stable over the period of the shock. The delay is enough to prevent any procyclical effect for short to long term equity cycles. This may be well suited for undertakings with long duration liabilities. As described before, for undertakings with short duration liabilities, a risk-sensitivity concern arises with longer adjustment periods, because the equity capital charge is less risk sensitive the longer the adjustment period. This was well evidenced with the Japanese Equity example. Risks of market distortion and moral hazard as mentioned above may increase under this option.

Harmonisation of supervisory powers

C.31. With regard to the objective to harmonise supervisory powers, methods and tools, all the options give similar powers to supervisory authorities as the average period will be fixed for all Member States. Applying a harmonised adjustment to the equity risk charge throughout the EU will allow for harmonised measures from supervisors in reaction to crisis situations. Therefore, it is considered that all options achieve this objective in an equally efficient and effective manner.

Compatibility with the developments in IAIS and cross-sectoral consistency

C.32. The introduction of a dampening mechanism is in line with cross-sectoral developments, for example in the banking sector, where anti-cylical measures are being discussed, too. In addition to the analysis made, CEIOPS would like to point out the importance of the adjustment mechanism in contributing to financial stability by taking unintended pro-cyclical effects of capital requirements into account (in particular avoiding undertakings engaging in fire sales of assets under falling markets).

C.33. The introduction of a the adjustment promotes compatibility with international developments on the insurance sector for addressing the pro-cyclical behaviour of capital requirements and is in line with the conclusions of the G20, which recommended regulators to develop measures to mitigate pro-cyclicality. It can be expected that IAIS and IAA will develop equivalent measures to deal with this.

C.34. Furthermore, undertakings should be allowed sufficient time allowed for undertakings to rebalance their risk profile in an orderly manner under a stressed scenario, and adjustments solely as a result of movements in the equity capital charge should be avoided. Finally, particular incentives to invest in any specific asset class should be avoided.

C.35. The time period longer than 12 months may create a moral hazard for undertakings based on the view that the capital charge for equities makes equities as an asset class relatively 'cheap' or 'expensive' to hold.

C.36. For example if equities are in a long term slump, and have a low capital charge, insurance firms may consider that the holding of equities is cheap, and so make a decision to buy equities based not on the appropriateness of them to match their liabilities, but a way to take advantage of a lenient regulatory treatment. This would go against the spirit of the proposal. For the sake of cross-sectoral consistency, the right average period should help in preventing any regulatory arbitrage between the different sectors with regard to the holding of equities. Ultimately, the choice for the average period should aim at avoiding market distortions between sectors.

C.37. A long averaging period could produce two separate factors which may lead to a risk of market distortion:

a) If the capital charge is 'binomial' as described above. Each time it oscillates between being low and high, there would be an unnaturally large volume of equity trading from SII compliant insurance firms. This may distort the market, or may allow unnatural profits as market practitioners anticipate the trades.

b) If large numbers of firms are buying equities because they carry a low capital charge in a low market, regardless of their suitability or their true value, there is a risk that equities are being traded at inefficient prices. The corollary to this is that other asset classes would be sold perhaps depressing their value. The alternative in a sustained high market would also hold.

Conclusion

C.38. In general, the aim of the symmetric dampener is to allow firms to continue to hold sufficient capital to provide policyholders with protection against a 1 in 200 year shock but at the same time the equity charge needs to remain sufficiently risk sensitive.

C.39. As discussed in the main body of the equity calibration paper the majority of CEIOPS' Members considers that the 12 month period provides the most appropriate results and impacts, taking into consideration the objectives that need to be achieved. Regarding the objectives, an option of exactly 12 months strikes a balance between the shorter and longer term options.[14] Considering the main objectives, CEIOPS concluded that with this option, the objectives can be efficiently and effectively achieved.

C.40. However, a minority of CEIOPS' Members have expressed their preference for an averaging period of three years or more.

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[14] CEIOPS considers two other reasons for the appropriateness of a one year term, namely relating to 'moral hazard; and 'market distortion'. As these two reasons to not relate directly to the EC objectives, CEIOPS considers these in an annex to this impact assessment.