Solvency Assessment and Management:

Steering Committee

Position Paper 47[1] (v 4)

Equity Risk

EXECUTIVE SUMMARY

1. INTRODUCTION AND PURPOSE

This discussion document considered the IAIS standards and guidance, extracts of the Solvency II Directive and the CEIOPS consultation paper relevant to capital requirements in respect of equity risk. It sets out the recommendations of the Capital Requirements Task Group with regards to the solvency capital requirements in respect of equity risk, more specifically the proposed

- Structure of the equity risk sub-module
- Equity level shocks
- Symmetric adjustment
- Removal of the duration based approach

This document does not make recommendations around the treatment of participations or the possible inclusion of implied volatility stresses in the capital requirement. These topics will be covered in separate Discussion Documents.

2. INTERNATIONAL STANDARDS: IAIS ICPs

The following "Insurance Core Principle" of the IAIS is relevant to this discussion document:

- ICP17 – Capital Adequacy

This ICP sets out high level guidance on the setting of solvency capital requirements. There is no specific mention of equity risk in particular.

3. EU DIRECTIVE ON SOLVENCY II: PRINCIPLES (LEVEL 1)

The following articles in the EU Directive on Solvency II are directly or indirectly relevant to equity risk:

- **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.

[1] Position Paper 47 (v 4) was approved as a FINAL Position Paper by the SAM Steering Committee on 27 March 2015.

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

- **Article 100 – General Provisions**
- **Article 101 – Calculation of Solvency Capital Requirements**
- **Article 104 – Design of the Basic Solvency Capital Requirement**
  1. The Basic Solvency Capital Requirement shall comprise individual risk modules, which aggregated in accordance with point (1) of Annex IV. It shall consist of at least the following risk modules:
     a. ..
     d. Market risk

  .....

  4. Each of the risk modules referred to in paragraph 1 shall be calibrated using a Value-at-risk measure, with a 99.5% confidence level, over a one-year period
- **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 (4) of Annex IV, as a combination of the capital requirements for at least the following sub-modules:
     a. ...
     b. The sensitivity of the value 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.
  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 the standard equity capital charge.
- **Article 109 – Simplifications in the standard formula**
- **Article 111 – Implementing measures**
- **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 policy holders in accordance with the national legislation of the Member State that has authorised the undertaking;

where

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

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 pursued only in the Member State where the undertaking has been authorised; and

iii. the average duration of the liabilities corresponding to the 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 policy holders and beneficiaries with a level of protection equivalent to that set out in Article 101, ...

4. MAPPING ANY PRINCIPLE (LEVEL 1) DIFFERENCES BETWEEN IAIS ICP & EU DIRECTIVE

There are no differences between the IAIS ICP and Solvency II Level 1 principles.

5. STANDARDS AND GUIDANCE (LEVELS 2 & 3)

5.1 IAIS standards and guidance papers

The following standard and guidance papers are relevant for this discussion document:

- Standard No. 2.1.1 on the structure of regulatory capital requirements
- Guidance paper No. 2.1.1 on the structure of regulatory capital requirements

The guidance paper describes the standards in more detail, but still only provides high level guidance. There is no specific mention of equity risk

5.2 CEIOPS CPs (consultation papers)

The level 2 advice (former CP69) covers the calibration approach of the equity risk sub-module. It follows a scenario-based approach, and divides equities into the two categories, namely “global” and “other”. It also covers the calibration and proposals around a symmetric adjustment mechanism and a calibration for the duration-based equity risk sub-module of article 304 in the Directive.

5.2.1 Global Equities

The main calibration was performed on the MSCI World Developed Markets Price Equity Index annual returns from 1973 to 2009. A rolling one-year window was analysed in order to get the richest possible dataset, notwithstanding the distortions resulting from autocorrelation this would introduce. The distribution of these returns was compared to the normal distribution and was found to have excess skewness and leptokurtosis compared to the normal distribution.

The following table shows these statistics:

Percentiles	MSCI World
100.00%	65.6%
99.95%	63.9%
99.50%	57.0%
99.00%	52.4%
97.50%	46.7%
50.00%	9.5%
2.50%	-32.9%
1.00%	-42.1%
0.50%	**-44.3%**
0.05%	-50.9%
0.00%	-51.9%
Mean	7.4%
St. Deviation	18.2%
Kurtosis	72.0%
Skewness	-18.0%
Normal VaR	**39.3%**
Empirical VaR	**44.3%**

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

The corresponding total return index was also analysed, which resulted in a 99.5% Empirical VaR that was 1.6% lower than that of the price index.

The ten most severe observations were also listed with the most severe observation being an equity fall of 52% for the year to 5 March 2011. Extreme value theory was also used to show that the estimate generalised extreme value VaR for daily returns was worse than the largest one day equity drop observed.

Based on this, CEIOPS proposed an equity **stress of 45% for global equities.** A minority view was to propose an equity stress of 39%, which was based on a MSCI Europe Index.

5.2.2 Other Equity

The empirical 99.5% VaR was calculated for the following indices:

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%

Based on this, CEIOPS recommended a **stress of 55% for other equities.** A minority view was that the stress should have been 42%.

5.2.3 Aggregation of global and other equity capital charges

Based on the tail correlations between the MSCI World Index and the Other equity indices shown above, CEIOPS recommended a **correlation assumption of 75% between "global" and "other" equities.**

5.2.4 Symmetric adjustment mechanism

The formula for the symmetric adjustment is specified in Article 106 of the Directive, with the only parameter necessary to calibrate being the reference period for the moving average. CEIOPS has back tested four possible reference periods on the MSCI World Index: 1 month, 4 months, 6 months and one year. Based on this analysis, CEIOPS have proposed an **averaging period of one year**. A minority view was that an averaging period of 3 years or more should be used.

5.2.5 Equity Volatility

CEIOPS has calibrated the volatility stresses to be a **relative volatility stress of 50% in the upward direction** and a **downward relative stress of 15%** where relevant. CEIOPS has also recommended 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.

5.2.6 Duration-based approach

CEIOPS recommends that for average holding periods of longer than 12 years for the qualifying liability types, the equity charge will be 22%.

5.4 Mapping of differences between above approaches (Level 2 and 3)

The following table compares the CEIOPS recommendations with what was specified in QIS5.

Parameter	CP69 recommendation	QIS5
Global Equity Stress	45%	39%
Other Equity Stress	55%	49%
Averaging period for Symmetrical Adjustment	1 year	3 years
Symmetric Adjustment (Uncapped)	+10% (+18%)[2]	- 9% (-9%)
Aggregation	0.75	0.75
Equity Volatility	+50% / -15%	None
Duration-based approach	22%	22%

6. ASSESSMENT OF AVAILABLE APPROACHES GIVEN THE SOUTH AFRICAN CONTEXT

6.1 Calibration methods for the South African context

Calibrating a 1 in 200 year event in a statistically coherent way would require many multiples of 200 years of equity data. However, only about 50 years of data is available for a JSE index and the CEIOPS calibration was based on only 36 years of data. Although there are a number of methodologies and theories that can be used to try and overcome and the lack of data, significant judgment is involved in calibrating a 99.5% 1 year VaR.

The simplest method of calibrating 99.5% VaR is probably fitting a normal distribution to historic returns as was done by CEIOPS. A key disadvantage of this method is that it would not capture possible “fat tails” in the empirical distribution, which could result in under estimating the 99.5% VaR. Although equity returns exhibit excess skewness (“fat tails”) for short holding periods (such as 1 day), the distribution of returns tend to normality as the holding period increases. Given that the SCR is defined as a 1 year VaR, the calibration should be based on a 1 year holding period. Although the skewness of equity returns would usually mean that this method of applying the normal distribution would understate the VaR, the extent thereof is less than when considering a shorter (e.g. 1 day) holding period. However, given that the RSA equity returns actually exhibited positive skewness, the empirical VaR was considered rather than the Normal VaR as the positive skewness would in fact have exaggerated the Normal VaR.

In addition to this method, the working group also used the following methods to estimate a 99.5% VaR:

- Bootstrapping of log-returns
- Fitting a Gaussian distribution to the log returns
- Fitting a student-t distribution to the log returns

[2] Not shown in the consultation paper, but calculated according to CP proposals.

- Fitting a normal distribution to the excess over the 10 year rolling mean returns

These methods resulted in higher 99.5% VaR measures than simply fitting a normal distribution. However, it is the opinion of the Market Risk Working Group that in the interest of obtaining an equivalent level of protection to that of Solvency II, a similar method should be used than what was used in the calibration by CEIOPS. Adjustments or alternative methods should only be considered where it is believed that there is a structural difference between South Africa and European market conditions. One such a difference that was considered is the higher interest rate and inflation environment in South Africa. This has an impact on the extent that the unwinding of the discount rate in the liabilities makes the instantaneous shock estimation of the 1 year VaR less accurate compared to a projection method. CEIOPS has explicitly ignored this in their calibration for reasons of practicability (see par. 3.24 in former CP69). This is described further in Appendix C. However, given that most South African Insurer's liabilities are rand denominated, this interest rate differential does not, on its own, warrant a higher equity risk charge for South African versus Global equities held on local balance sheets.

Ultimately, the task group has decided to apply a pragmatic approach in finalising the calibration parameter with the majority view that the RSA equity shock should be between the Empirical and Normal VaR, given the problems of both described above.

6.2 Calibration Results

In order to check the consistency in methodology, the Market Risk Working Group has analysed the MSCI World Developed Markets Price Equity Index and the JSE Allshare Price index in a consistent manner. CEIOPS has however used data with daily frequency, while the Market Risk Working Group only had a monthly frequency available. There was therefore a small difference between the MSCI results from CEIOPS and the Market Risk Working Group.

The following table summarises the results:

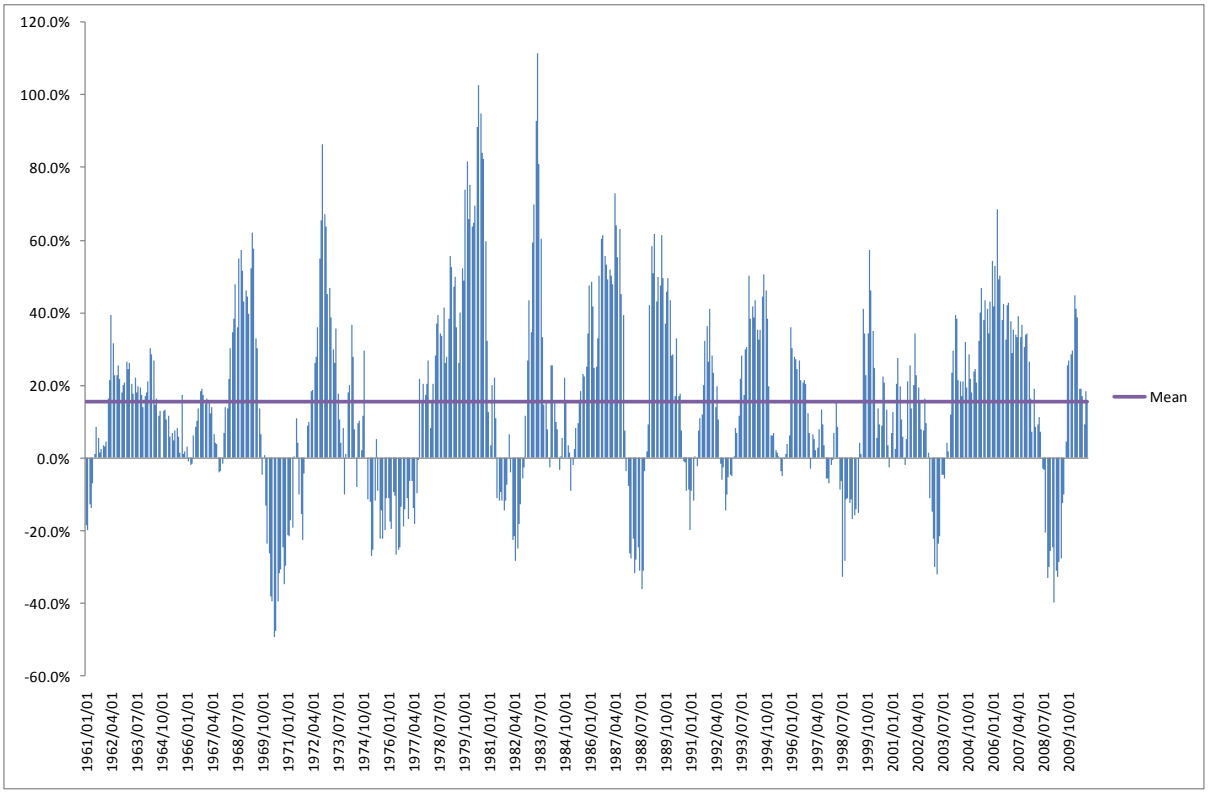
Percentiles	MSCI World (CEIOPS)	MSCI World (SAM)	JSE Allshare
100.00%	65.6%	62.4%	111.4%
99.95%	63.9%	61.3%	108.9%
99.50%	57.0%	54.7%	93.0%
99.00%	52.4%	52.3%	84.1%
97.50%	46.7%	44.7%	68.4%
50.00%	9.5%	10.4%	14.7%
2.50%	-32.9%	-27.7%	-31.1%
1.00%	-42.1%	-42.7%	-36.3%
0.50%	-44.3%	-43.9%	-39.5%
0.05%	-50.9%	-47.6%	-48.9%
0.00%	-51.9%	-48.4%	-49.5%
Mean	7.4%	8.4%	15.5%
St. Deviation	18.2%	17.6%	25.9%
Kurtosis	72.0%	89.7%	25.6%
Skewness	-18.0%	-21.8%	34.0%
Normal VAR	39.3%	37.0%	51.3%
Empirical VAR	44.3%	43.9%	39.5%

The JSE Allshare price index returns were used with monthly frequency from January 1961 to October 2010. The following table shows the 10 worst annual returns on the JSE index:

End of Year	Change in Price index
1970/05/31	-49.5%
1970/06/30	-47.5%
2009/02/28	-39.8%
1970/04/30	-39.5%
1970/07/31	-39.4%
1970/03/31	-38.3%
1988/08/31	-36.2%
1970/11/30	-34.9%
2008/10/31	-33.0%
2009/04/30	-32.8%

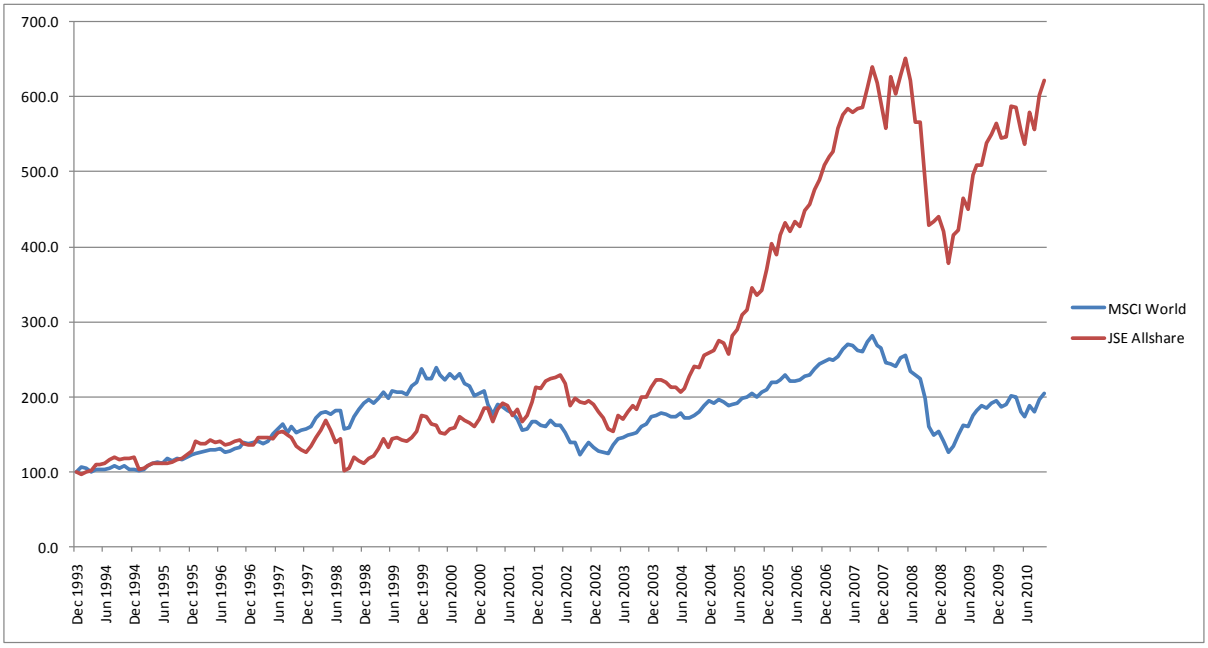
The worst equity drop of 49.5% in the JSE Price index is in fact similar to, or slightly less than, the worst drop of 52% in the MSCI World Index.

It is interesting to note that the Allshare returns are in fact positively skewed compared to the MSCI index returns being negatively skewed. This is probably due to extremely good returns during the late 1970's (see the graph below).



The correlation coefficient between the monthly returns of the MSCI World Price Index versus the Allshare Price Index for the period from 1994 to 2010 was **65%**.

The following graph plots these two indices, with base values set to 100 at 1993/12/31.



6.3 Symmetric Adjustment

The symmetric adjustment formula under QIS5 has the following disadvantages:

a) Even in stable market conditions where equity prices gradually increase in line with expectations, the moving average will lag the index and will therefore result in a positive symmetrical adjustment (i.e. larger equity stress) even though equities has not outperformed. The adjustment is therefore not truly symmetrical and is expected to be positive more times than negative over the long term.

b) The calibration of the QIS5 symmetrical adjustment seem to be almost binomial in that the limits of either +10% or -10% would have applied for extended periods of time when calculated based on the JSE Allshare index over the past 18 years. See Graph 3 in Appendix A.

c) A situation may arise for specific companies, where the symmetric adjustment may cause the solvency position to appear better after a market shock and worse after a sharp increase in equity markets. An example of such a company is where the only equity risk relates to the assets backing own funds. See Appendix B for such an example.

Industry feedback have also criticised these drawbacks of the QIS5 symmetrical adjustment. Subsequently to QIS5, the draft Solvency II Implementation Measures seem to have adjusted the symmetrical adjustment formula to read as follows:

$$SymAdj = min\left[10\%;\ max\left(-10\%;\ a \cdot \left(\frac{CI - AI}{AI} - b\right)\right)\right]$$

Where,

CI = Current Index value

AI = 3 year moving daily average index (equal weightings)

a = 50%

b = 8%

The parameter *a* has the impact of dampening the symmetrical adjustment itself and therefore prevent the characteristic of almost being a binomial adjustment (either +10% or -10%) as was the case in the QIS5 and SAQIS1 formula.

The parameter *b* aims to address the drawback whereby the Symmetrical Adjustment would always be positive in a bull market, even if it is a moderate / normal bull run.

This formula could be reverted to the previous formula, through simply setting the parameter *a* = 100% and the parameter *b* = 0%. Optimising this formula would therefore require optimal values to be found for the following three parameters:

1. The term over which the moving average is calculated
2. Parameter *a*
3. Parameter *b*

A number of different combinations of parameters have been tested (see Appendix A) and in SAM QIS3 the following parameters were used:

1. Moving average term = 3 years
2. Parameter a = 50%
3. Parameter *b* = 8%.

Given that a 3 year moving average is used in the formula, parameter *b* aims to remove approximately 1.5 years of expected returns in order to give a zero symmetric adjustment when the equity market has yielded stable returns that were in line with expectations over the previous 3 years. Historic returns were considered in deciding on an appropriate assumption for the purpose of calibrating this parameter. A long term expected total equity return of 12.5% was assumed, split as 2.5% dividends and 10.0% capital gains. Given that the JSE Allshare index is a price index, the capital gains (as opposed to total return) part should be used for the *b* parameter. Furthermore, given that parameter *b* should reflect approximately 1.5 years' return, the recommended value for parameter *b* is 15% (1.5 x 10.0%). It is acknowledged that this parameter may become outdated if the interest rate, inflation and other market conditions change. However, this could be said of many other calibration parameters and it is therefore recommended that this parameter be "hardcoded" as 15% rather than linked to some market indicator for the purpose of simplicity. As with many other calibration parameters, this may have to be re-calibrated in future if there are significant changes in the market conditions.

The recommended symmetric adjustment parameters for RSA and "Other" equities under SAM are therefore:

1. Moving average term = 3 years
2. Parameter a = 50%
3. Parameter *b* = 15%.

The recommended parameters for Global equities remain as follows:

1. Moving average term = 3 years
2. Parameter a = 50%
3. Parameter *b* = 8%.

(Graph 4 in Appendix A shows the impact of the parameters used in SAM QIS3, while Graph 5 shows the impact of the recommended parameters.)

6.4 Duration-based equity sub-module

The duration-based equity sub-module in the EU Directive is aimed at Pensions business. Such business will be out of scope under SAM, and it is therefore recommended that this sub-module be removed under SAM.

6.5 Treatment of Strategic Participations

The special treatment of participations required under Solvency II is only applicable to the Solo view of the insurer's solvency position. The reason for this is that under the Group view, the detailed (risk-based) solvency requirements are calculated from the ground up for each Participation, which is then aggregated into a group view using either a consolidation or deduction and aggregation method.

When considering the most appropriate treatment of participations in the Solo view under SAM, the purpose of the Solo view (as opposed to the Group view) should firstly be understood. The following are two alternative interpretations of the purpose of the Solo view in respect of participations:

- See the investment in participations similar to any other investment that is subject to market risk.
- Aim to find a proxy method that will approximate the Solvency position of the insurer as if the full Group view method of consolidation has been applied.

Another (seemingly South African specific) issue to consider is what the appropriate treatment of participations are where it is used to back policyholder liabilities where the policyholders bear a significant portion of the investment risk.

These issues will be covered in a separate discussion document that will consider both the treatment from a capital required and a capital resources perspective and make a recommendation.

6.6 Impact of the approaches on EU 3rd country equivalence

The Market Risk Working Group has aimed to perform the calibrations consistently with CEIOPS, and therefore believe that the recommendation will fulfil the 3rd country equivalence requirements.

6.7 Comparison of the approaches with the prevailing legislative framework

The market risk component of the current SAP104 CAR calculation is also an instantaneous stress. It is however a combined stress for all asset classes, and therefore not comparable with the separate risk modules of QIS5. It has also been calibrated to a 95% confidence interval compared to Solvency II's 99.5%. It would therefore be expected that the Solvency II shock percentage should be significantly higher than the SAP104 CAR stress parameter.

The SAP104 equity stress is 30% if dividend yields are below 4% and 20% if dividend yields are above 5%. The stress factors are linearly interpolated if dividend yields are between 4% and 5%. These factors, however, has been calibrated to a 95% confidence interval.

6.8 Treatment of hedge funds

The Task Group agreed that all hedge funds should fall into the "Other" equity category (similar to Solvency II), notwithstanding the fact that some types of hedge funds may be designed to be less volatile. The arguments for this approach are that:

- There is a vast range of hedge fund types, some of which use gearing strategies, that could potentially be more volatile, and short positions for which an appropriate treatment would complicate the standard formula.
- There is no reliable method for distinguishing between different types of (or levels of risk within) hedge funds, and setting different capital charges for hedge funds would be an inappropriate complication of the standard formula.
- There is a lower level of regulation applicable to hedge funds compared to other types of investment funds or unit trusts.
- The mix of the underlying assets is less predictable, and even if the look-through principle could be applied the exposures at any point in time would not remain applicable for long.
- Past experience of operational failures of hedge funds and the need to adjust return data for the inherent survivorship bias would complicate or invalidate any attempt at a calibration.

6.9 Conclusions on preferred approach

There is significant judgement involved in calibrating such an extreme (1 in 200 year) event in the absence of sufficient data. Therefore, the overriding principle used in the recommendation was to use methodologies as close as possible to that used by CEIOPS, while applying judgement in respect of areas where SAM should deviate from the QIS5 specifications. From the analysis shown in section 6.2 there is not a clear reason for the RSA equities stress to differ significantly from the Global equity stress.

The following, however, appears to be areas where there might be reasons for deviating from the QIS5 parameters:

a) A separate RSA equity component should be created. Although the correlation between RSA Equities and Global equities is high, it does appear as if there is some diversification benefit to investing both locally and internationally.
b) The new proposed symmetrical adjustment formula appears to solve the drawbacks of the QIS5 formula, and it is therefore the preferred approach.
c) The symmetrical adjustment formula should be calibrated separately for RSA Equities and Global Equities.
d) The treatment of strategic participations will be covered in a separate discussion document.

There is, however, not consensus on whether the RSA equity should attract a higher capital charge than global equity. The majority view is that the base RSA equity stress should be 43% (i.e. 4% higher than the global equity stress), while the minority view is that it should be 39% which is the same as the global equity stress. Both views agreed that there should be a 75% correlation assumption between RSA and global equity stresses.

Judgment was used in deciding on the 43% shock, as this a level between the Empirical and Normal VaR observed in section 6.2. Arguments for a higher RSA equity shock (43%) include the following structural differences between the JSE and MSCI indices:

- The standard deviation of JSE index has been higher than the MSCI index (25.9% vs 17.6%), i.e. the JSE tends to deviate more from the expected return. This is supported by the comparison of the empirical VARs after adjusting for differences in expected returns (JSE: 15.5%, MSCI: 8.4%) to determine the risk relative to expectation.
- RSA is an emerging market (as opposed to developed markets) with higher political risk and more exposure to the rest of Africa.
- Resource companies, which may be considered more risky shares, form a significant portion of the JSE index.

Arguments for setting the RSA equity shock at the same level (39%) as for Global equities include:

- Comparisons of the Empirical VaRs and maximum drawdowns between the MSCI and JSE indices, do not suggest a material difference in equity risk.
- Although the standard deviation of the JSE has been greater, it has been positively skewed compared to the negatively skewed MSCI returns. Much of the standard deviation therefor reflects “upside risk”.

7. RECOMMENDATION

It is recommended that the following adjustments be made to the Solvency II QIS5 formula for the purpose of SAM:

1. Add a South African specific sub-module
2. Change the Symmetrical Adjustment formula
3. Separate symmetrical adjustments should be calculated for Global and South African equities, and the adjustment used for the “Other” equity class should be the same as for the South African equity class.
4. The duration-based equity sub-module should be removed since this applies to Pensions type business only, which falls outside the scope of SAM.

The treatment of participations and the possible inclusion of volatility stresses will be covered in a separate discussion document.

The South African equities class should only include equities listed on the JSE. Since the All Share index was used in the calibration, it is appropriate to also include dual listed shares (listed on the JSE) that were purchased on the JSE in the South African class. The shocks in the currency sub-module should not be applied to these shares, since the holdings are in South African Rand. However, if such a dual listed share was purchased on an offshore exchange, it should be included in the Global equity class and the currency shock in the currency sub-module should also be applied as the holding would be denominated in the offshore currency.

The Solvency II description for the “Other” equity class should be kept unchanged, specifically regarding the fact that any asset that has not been covered elsewhere in the market risk module should be included in the “Other” equity class. The principle of substance over form should apply when allocating assets to specific risk modules. For example, many preference shares exhibit properties akin to fixed interest assets. Such preference shares should be included in the interest rate risk and spread/credit risk sub-modules. However,

preference shares that exhibit traits of a combination of fixed interest and equities assets should be included in the "Other" equity component of the equity risk sub-module. Furthermore, the "other" equity class also serves as a "catch all", where any asset that does not seem to fit the descriptions of assets covered in any of the other sub-modules (e.g. commodities), should be included in the definition of "Other" equities.

The following table summarises the equity shocks for the different classes:

Category	Stress Formula
Global	39% + A
South African (majority view)	43% + B
South African (minority view)	39% + B
Other	49% + B

Where

A = Symmetrical adjustment based on the MSCI World Developed Markets Price Index

B = Symmetrical adjustment based on the JSE Allshare Equity Price Index

It is recommended that the following formula be used to calculate these symmetrical adjustments on the respective indices:

$$SymAdj = min\left[10\%;\ max\left(-10\%;\ 50\% \cdot \left(\frac{CI - AI}{AI} - b\right)\right)\right]$$

Where,

CI = the current value of the respective index

AI = the 3 year moving average of the respective index.

b = 8% for Global Equities, and

= 15% for South African and Other Equities

The following is the proposed correlation matrix between these categories:

	Global	South African	Other
Global	1	0.75	0.75
South African	0.75	1	0.75
Other	0.75	0.75	1

The recommended text for the subordinate legislation is set out below. Refer to Discussion Document 106 (Implied Volatility Risk) for further detail on the equity volatility components.

Equity risk (Mkt_{eq})

Description

Equity risk arises from the level or volatility of market prices for equities. Exposure to equity risk refers to all assets and liabilities whose values are sensitive to changes in equity prices.

For the calculation of the risk capital requirement, hedging and risk transfer mechanisms should be taken into account according to the principles of *[appropriate subordinate legislation reference]*. However, as a general rule, hedging instruments should only be allowed with the average protection level over the next year unless they are part of a rolling hedging programme that meets the requirements set out in *[appropriate subordinate legislation reference]*. For example, where an equity option not part of such a rolling hedge programme provides protection for the next six months, as a simplification, insurers should assume that the option only covers half of the current exposure.

Where insurance or reinsurance undertakings hold short positions in equity (including put options), these should be netted off against long equity positions for the purposes of determining the equity risk charge only if the short position meets the requirements to be considered as an acceptable risk mitigation technique for the purposes of the calculation of the SCR with the standard formula.

Any other short equity exposure should be ignored when calculating the equity stress in the equity risk sub-module of the standard formula. The residual short equity exposure should not be considered to increase in value after application of the downward shock to equity values. Counterparty default risk impairments should be made to the risk mitigating effect of risk mitigating contracts, as specified in *[appropriate subordinate legislation reference]*.

Equity risk is determined as the aggregated value of two sub-modules, namely “Price” and “Volatility” – more detail will follow below.

The entire equity risk shocks should be assumed to arise from industry-wide events.

Input

The following input information is required:

BOF	=	Basic Own Funds

Output

This module delivers the following output:

$Mkt_{eq,price,global}$	=	Capital requirement for “global” equity price risk
$Mkt_{eq,price,SA}$	=	Capital requirement for “SA” equity price risk
$Mkt_{eq,price,other}$	=	Capital requirement for “other” equity price risk
$Mkt_{eq,price}$	=	Capital requirement for equity “Price” risk
$Mkt_{eq,vol}$	=	Capital requirement for equity “Volatility” risk
Mkt_{eq}	=	Capital requirement for equity risk

Calculation

The capital requirement for equity risk is determined as follows:

$$Mkt_{eq} = \sqrt{\sum_{i,j} CorrEq_{i,j} \cdot Mkt_{eq,i} \cdot Mkt_{eq,j}}$$

Where *i* and *j* refer to “price” and “vol” and where the correlation matrix *CorrEq* is defined as:

CorrEq	*Price*	*Volatility*
Price	1	0.5
Volatility	0.5	1

Equity “Price” Risk

For the determination of the capital requirement for equity “price” risk, the following split is considered: equities listed in regulated markets in the countries which are members of the EEA or the OECD ("Global equity" category), South African equities listed on the JSE (“SA equity” category) and other equities (“Other equity” category). "Other" comprises equity listed only in emerging markets (excluding South Africa), non-listed equity, hedge funds and any other investments not included elsewhere in the market risk module, including assets that are subjected to equity risk where a look-through approach was not possible.

The calculation is carried out as follows:

In a first step, for each category *i* a capital requirement is determined as the result of a pre-defined stress scenario for category *i* as follows:

$$Mkt_{eq,price,i} = max(\Delta BOF | equity\ shock_i; 0)$$

where

equity shock$_i$ = Prescribed fall in the value of equities in the category *i*

Mkt$_{eq,price,i}$ = Capital requirement for equity “price” risk with respect to category *i*

and where the equity shock scenarios for the individual categories are calculated as:

$$equity\ shock_i = base\ equity\ shock_i + symmetric\ adjustment_i$$

The *base equity shock*$_i$ parameters are as follows:

	Global	*SA*	*Other*
base equity shock$_i$	39%	43%	49%

The symmetric adjustment should be calculated as follows:

$$symmetric\ adjustment_i = min\left[10\%;\ max\left(-10\%;\ a \cdot \left(\frac{CI_i - AI_i}{AI_i} - b\right)\right)\right]$$

where,

CI_i = Current Index value for category *i*

AI_i = 3 year moving daily average index (equal weightings) for category *i*

a = 50%

b = category dependent parameters as set out below.

The *b* parameters and indices to be used in the calculation of CI_i and AI_i are:

Category	*Index*	*b*
Global	MSCI World Developed Markets Price Index	8%
SA	JSE Allshare Equity Price Index	15%
Other	JSE Allshare Equity Price Index	15%

The capital requirement $Mkt_{eq,price,i}$ is determined as the immediate effect on basic own funds expected in the event of an immediate decrease of *equity shock*$_i$ in the value of equities belonging to category *i* taking account of all the participant's individual direct and indirect exposures to equity prices.

In the case that the *ΔBOF* calculation results in a negative capital requirement, then the equity stress *i* should be replaced by an equal but opposite stress. In this case, all short positions in equity should be taken account of, whether it is classified as risk mitigation techniques or not.

For the determination of this capital requirement, all equities and equity type exposures have to be taken into account, including private equity as well as certain types of alternative investments, excluding equity owned in an undertaking which forms part of the same group in which case the approach for the treatment of participations applies.

The treatment of participations is specified in *[appropriate subordinate legislation reference]*.

Where a causal relationship exists between equity “price” changes and policyholder behaviour, the policyholder behaviour should be allowed for within the calculation of $Mkt_{eq,price}$ and/or its sub-components (“Global”, “SA”, “Other”).

Alternative investments should cover all types of equity type risk like hedge funds, derivatives, managed futures, investments in SPVs etc., which cannot be allocated to spread risk or classical equity type risk, either directly, or through a look through test.

The equity exposure of mutual funds should be allocated on a “look-through” basis as specified for collective investments funds in *[appropriate subordinate legislation reference].*

In a second step, the capital requirement for equity "price" risk is derived by combining the capital requirements for the individual categories using a correlation matrix as follows:

$$Mkt_{eq,price} = \sqrt{\sum_{rxc} CorrIndex^{rxc} \cdot Mkt_{eq,price,r} \cdot Mkt_{eq,price,c}}$$

where

$CorrIndex^{rxc}$	=	The entries of the correlation matrix *CorrIndex*
$Mkt_{eq,price,r}$, $Mkt_{eq,price,c}$	=	Capital requirements for equity price risk per individual category according to the rows and columns of correlation matrix *CorrIndex*

and where the correlation matrix *CorrIndex* is defined as:

CorrIndex	*Global*	*South African*	*Other*
Global	1	0.75	0.75
South African	0.75	1	0.75
Other	0.75	0.75	1

The result of the scenarios should be determined under the condition that the value of future discretionary benefits can change and that the insurer is able to vary its assumptions in future bonus rates in response to the shock being tested. The resulting capital requirement is $Mkt_{eq,price}$.

APPENDIX A – Symmetrical Adjustment Formula calibration

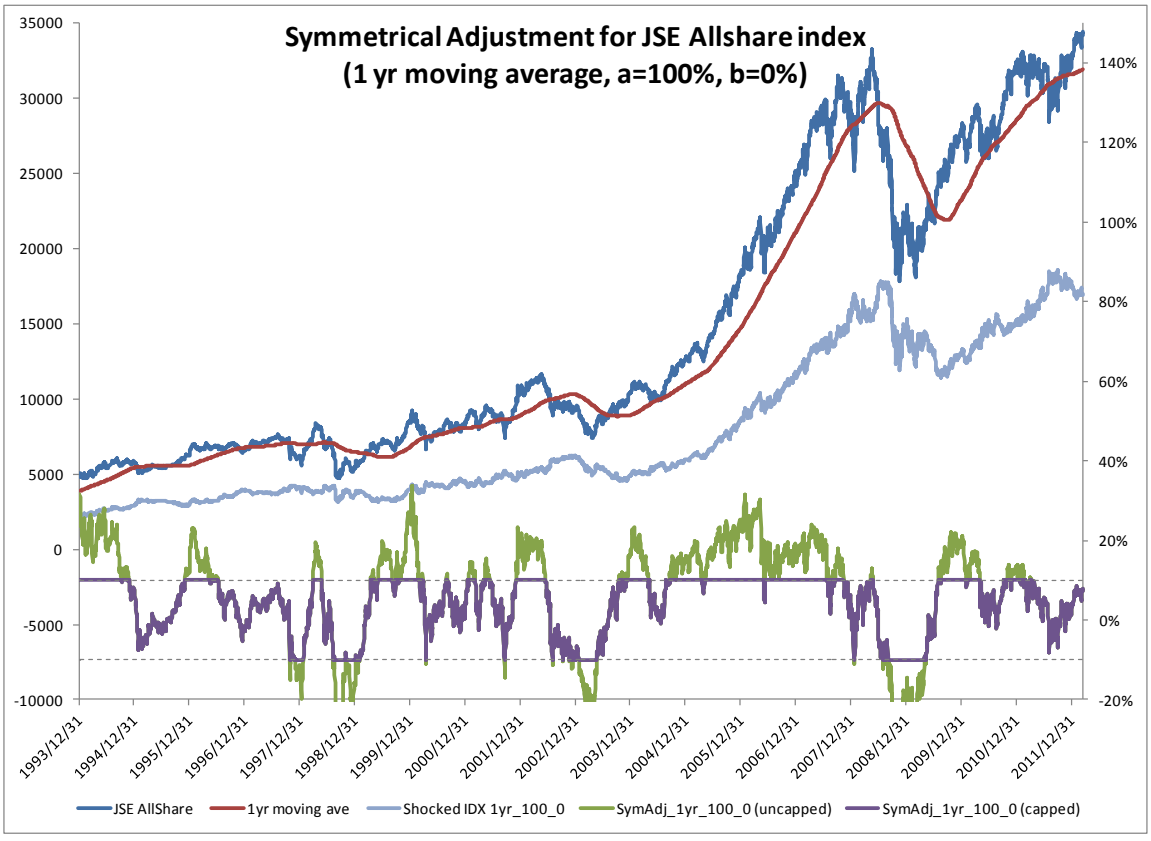
The following graphs show the impact of four different options for the symmetrical adjustment formula. The different options tested here are:

- 1 year vs. 3 year moving averages
- *a* = 100% vs. *a* = 50%
- *b* = 0% vs. *b* = 8% vs. *b* = 15%

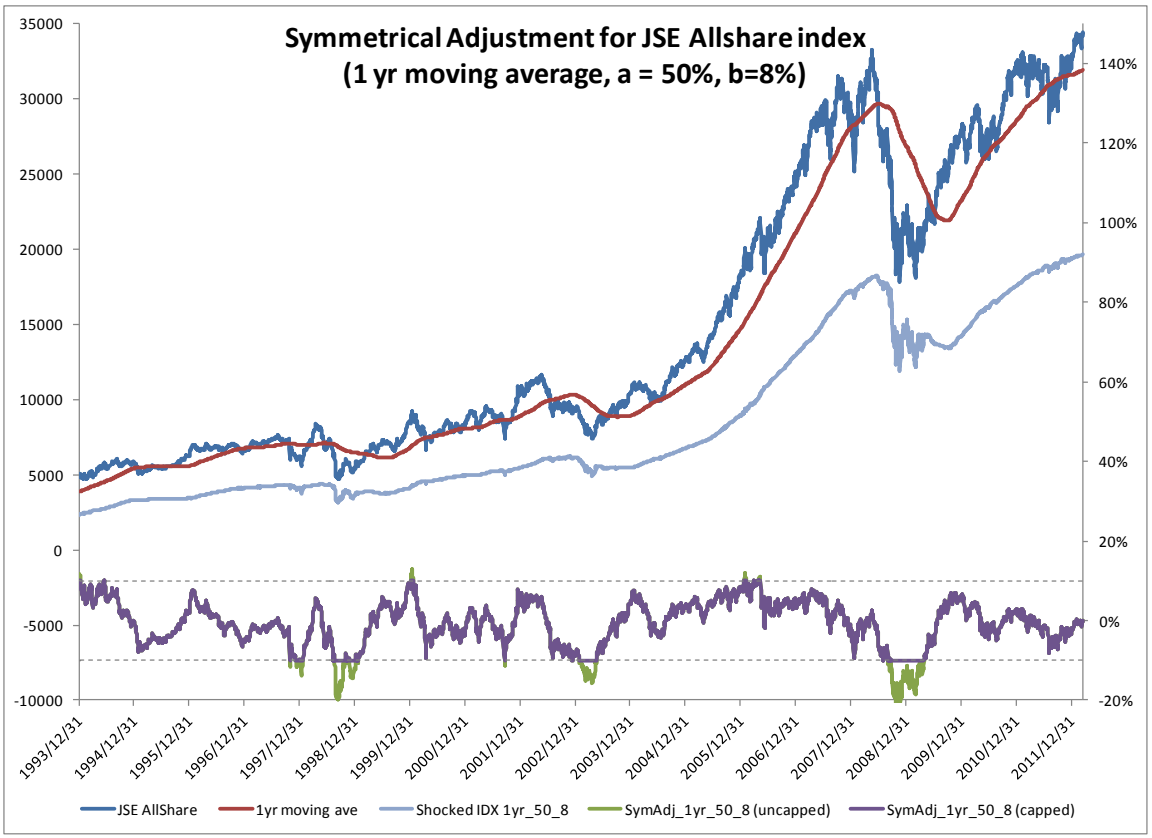
The different lines mean the following:

Dark Blue :	Actual JSE Allshare index
Red :	Moving Average of JSE Allshare index (either 1 year or 3 year as indicated)
Light Blue :	The value of the index after the equity risk shock has been applied to it. The shock applied here is calculated as the 43% base shock plus the (capped) symmetrical adjustment at that date. A smooth progression in this line would indicate that the symmetrical adjustment has achieved the goal of stabilising the equity risk SCR of day-to-day equity movements.
Green :	The symmetrical adjustment before being capped between -10% and +10% (as indicated by the dashed lines) – read from right hand scale
Purple :	The symmetrical adjustment after being capped between -10% and 10%. – read from right hand scale

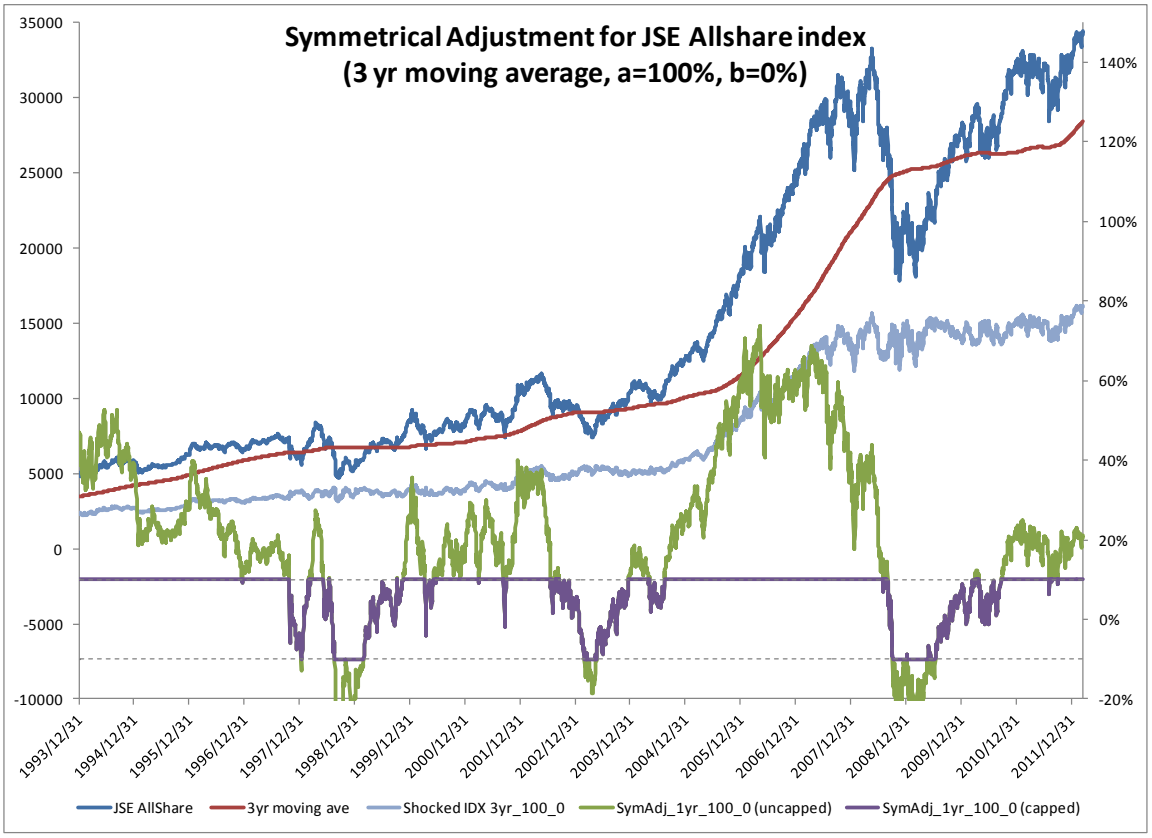
Graph 1



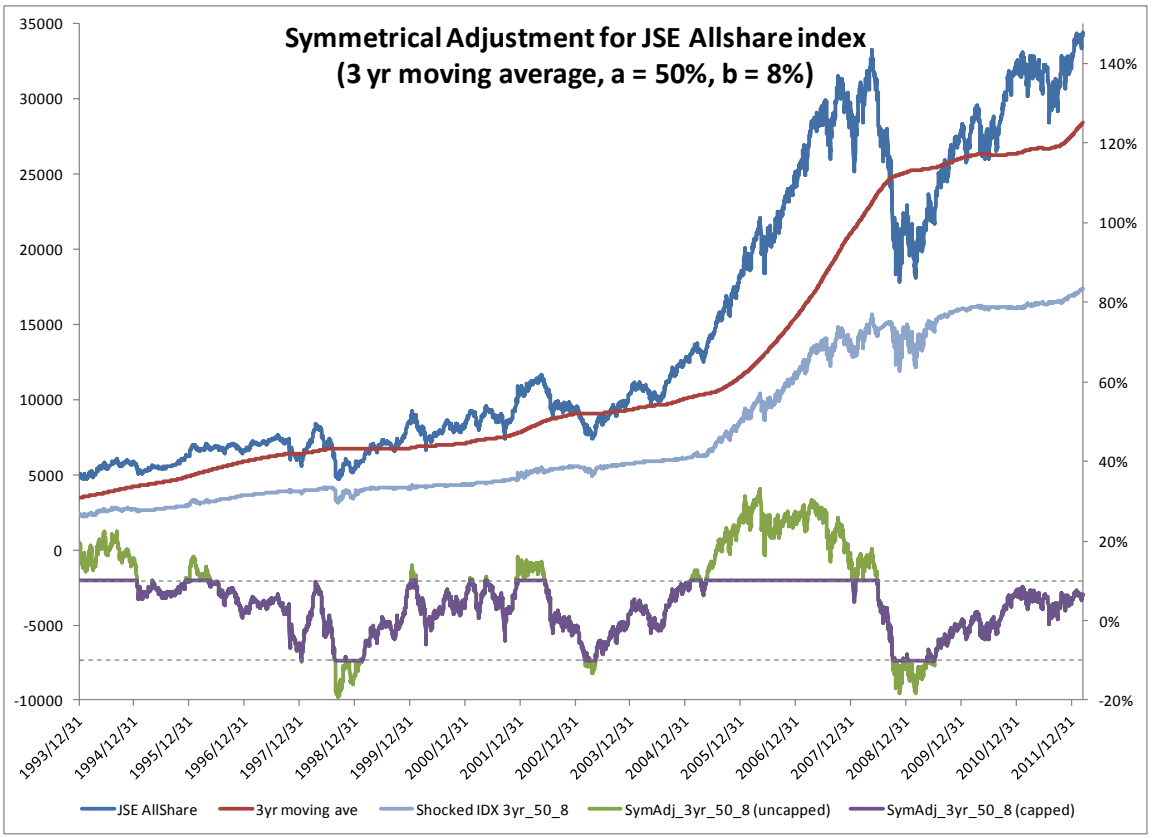
Graph 2



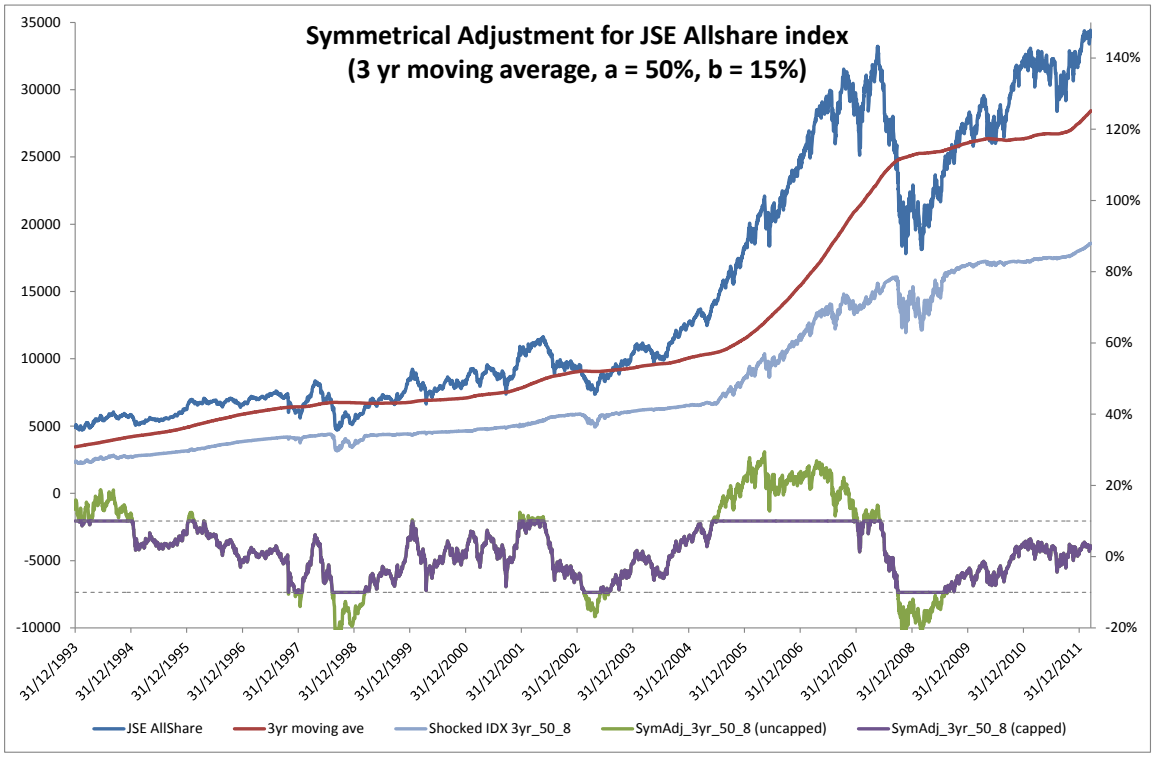
Graph 3 – QIS5 parameters



Graph 4 –SAM QIS3 parameters



Graph 5 - Recommended parameters



APPENDIX B – Example of where the QIS5 symmetric adjustment is not appropriate

Consider the case where the relevant equity index has just increased in value above the moving average. The insurer's equity assets have increased in value, as has its equity risk capital requirement. The increase in the capital requirement is due to two factors:

1. The increase in the value of the insurer's equity holdings will mean that the equity stress is being applied to a greater Rand value of assets. This will mean that the Rand value of the fall in the assets will be larger, resulting in a larger equity risk capital requirement.
2. The increase in the relevant equity index will have caused an increase in the equity stress percentage through the symmetric adjustment, resulting in a larger equity risk capital requirement.

Intuitively, the growth in the insurer's assets due to the appreciation of equities should be greater than the growth in the insurer's equity risk capital requirement. If this is not the case, then the insurer's capital position will have worsened as a result of its assets having increased in value. Including the symmetric adjustment as it stands could lead to this result.

Take the following fictitious example:

– The adjustment factor is calculated using monthly intervals over a one year period.
– The beta factor is constant at 100%.
– The standard equity stress is 43%.
– The level of the equity index is flat at 100 for t=1 to 12.
– The level of the equity index drops to 90 at t=13, and then rises to 110 at t=14.
– The insurer has R100 of assets, invested entirely in equity. These behave exactly as the index upon which the adjustment factor is calculated.

For comparative purposes, initially assume that there is no adjustment factor.

Time step (months)	Index Level	Weighted average for last 12 months	Final adjustment to the stress	Equity Assets (R)	Increase in Equity (R)	Equity Cap. Req. (R)	Change in Equity Cap. Req. (R)	Capital Position (R)
12	100	100.0	0.0	100	0	43.0	0.0	57.0
13	90	100.0	0.0	90	–10	38.7	–4.3	51.3
14	110	99.2	0.0	110	20	47.3	8.6	62.7

Table 1: Illustration of capital position with no adjustment factor

Table 1 shows that the capital position worsens with the loss and improves with the profit. This is because the change in the value of the assets is greater than the change in the capital requirement, which is sensible.

Time step (months)	Index Level	Weighted average for last 12 months	Final adjustment to the stress	Equity Assets (R)	Increase in Equity (R)	Equity Cap. Req. (R)	Change in Equity Cap. Req. (R)	Capital Position (R)
12	100	100.0	0.0	100	0	43.0	0.0	57.0
13	90	100.0	–0.1	90	–10	29.7	–13.3	60.3
14	110	99.2	0.1	110	20	58.3	28.6	51.7

Table 2: Illustration of capital position with an adjustment factor

The following can be seen from Table 2:

– In month 13, the company makes a loss of R10. However, its capital position has improved. This is because the capital requirement has decreased by R13.3 (as opposed to only R4.3 in Table 1).
– In month 14, the company makes a profit of R20. However, its capital position has worsened because its capital requirement has increased by R28.6 (as opposed to only R8.6 in Table 1).

It is felt that the results in Table 2 are not sensible, and that the calculation of the adjustment factor should be amended to prevent such cases occurring.

APPENDIX C – Error caused by the unwinding of the discount rate

In order to illustrate the shortcoming of the CEIOPS approach regarding the unwinding of the discount rate, the following highly simplified example is considered:

- A fixed liability cashflow of R110.00 in t = 1 year
- Assets of R220.00, all invested in equity
- Assume that the risk free rate is (and always was) a constant 10%
- Based on this discount rate, the current Best Estimate Liability is R100.
- When fitting a normal distribution to historic equity returns, you achieve a very good fit with a mean of 10% and a standard deviation of 23.3%. This results in a 1-year 99.5% VaR of -50%. This distribution is then used to project equity returns for VaR purposes.

The following results are obtained when projecting the balance sheet 1 year into the future based on the 99.5% percentile:

	t = 0	**t = 1 (before cash outflow)**
Assets	R220	R110
Liability	R100	R110
NAV	R120	R 0

This balance sheet therefore has just enough assets to meet the 1-year 99.5% VaR SCR requirements.

The implementation of the SCR calculations, however, is based on instantaneous shocks which is a practical solution to approximate the above type of 1-year balance sheet projection. The following results are obtained when performing an instantaneous shock calculation based on the calibration of -50% for equity risk on the same balance sheet:

	Current	**Shocked**
Assets	R220	R110
Liabilities	R100	R100
NAV	R120	R10
Delta NAV		- R110

From this calculation it appears that the balance sheet has R10 surplus above the SCR requirement. This error is caused by the effect of the unwinding of the discount rate in the liabilities. Although this error might not have been significant for the European calibrations (given that there interest rates are generally low) this would have a greater impact for a South African calibration given its higher interest rates.