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## Equity Risk Solvency Capital Requirement

**Calibration, shortcomings and risks not considered.**

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# Contents

# Equity Risk

In this series, we apply the magnifying glass to how the standard formulae for selected SCR sub-modules were calibrated. We investigate the history behind the calibration, the risks that were excluded from the calibration, and potential shortcomings as a result. We also investigate the impact of alternative calibrations with updated, South Africa specific data.

This article on Equity risk is PART V of the series. *Mortality, Retrenchment, Property* and *Expense* risks were covered in PARTS I to IV.

## **1**  **Summary**

Risk Equity Risk is a component of the Solvency Capital Requirement (SCR)for all life and non-life insurers. The calibration of the equity standard for formula as per the Prudential Authority Financial Soundness Standards for Insurers (FSI) 4.1 is dependent on the data sets and assumptions as at the time of calibration. Since then, we have 12 years' additional data on which to base the calibration and assumptions. In this article, we investigate how the equity risk calibration would have changed allowing for the additional years of data; the empirical confidence level attached to recent significant industry events (e.g. COVID-19, KwaZulu-Natal floods); and the impact and appropriateness of the cap on the equity symmetric adjustment.

*This article is recommended reading for Head of Actuarial functions forming opinions on the adequacy of the SCR standard formula. In a wider sense, this article contains useful information for anyone wishing to understand the calibration, shortcomings and possible alternatives / updates of the equity risk standard formula.*

## **2**  **Background – Equity Risk Standard Formula and Calibration**

### Standard Formula

Equity price risk arises when the market value of assets and liabilities are sensitive to changes in the market prices for equities and their volatilities. According to the Prudential Standards Financial Soundness for Insurers (FSI) 4.1, the capital requirements for equity risk should be calculated as a combination of equity price risk and equity volatility risk (allowing for correlations between the two risks).

Equity price risk is split into four different categories for calculation purposes, that are combined using a correlation matrix – global, SA, infrastructure assets and other equity. A separate RSA equity risk component was created to allow for the additional diversification benefit of investing in RSA equities and in global equities. JSE data was used for this. The equity shock applied to each category, consists of a 'base' equity shock plus a symmetric adjustment:

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

| | Global | South Africa | Infrastructure assets | Other |
|---|---|---|---|---|
| *base equity shock*$_i$ | 39% | 43% | 33% | 49% |

The symmetric adjustment is published on a monthly basis by the Prudential Authority and varies based on current and three year moving average indices for each equity category. The symmetric adjustment is capped at +/-10% and results in a separate adjustment for each equity category. Amendments were made to the equity symmetric adjustment formula to address some of the identified shortcomings such smoothing of the adjustment and improving the lag effect (e.g. coming out of a bull market, the adjustment is positive even though equities have not outperformed)

Equity volatility risk relates to the sensitivities of the market value of assets and liabilities to changes in the expected future volatility of assets. FSI 4.1 prescribes an increase of 15% in all market-observed equity implied volatility assumptions up to 3 years, or realised equity volatilities for the past 12 months.

## Calibration

The calibration of the Equity risk price SCR submodule of the Prudential Standards Financial Soundness for Insurers (FSI) 4.1 was based on the Solvency II / CEOIPS calibration. Table 1 below compares Solvency II to SAM.
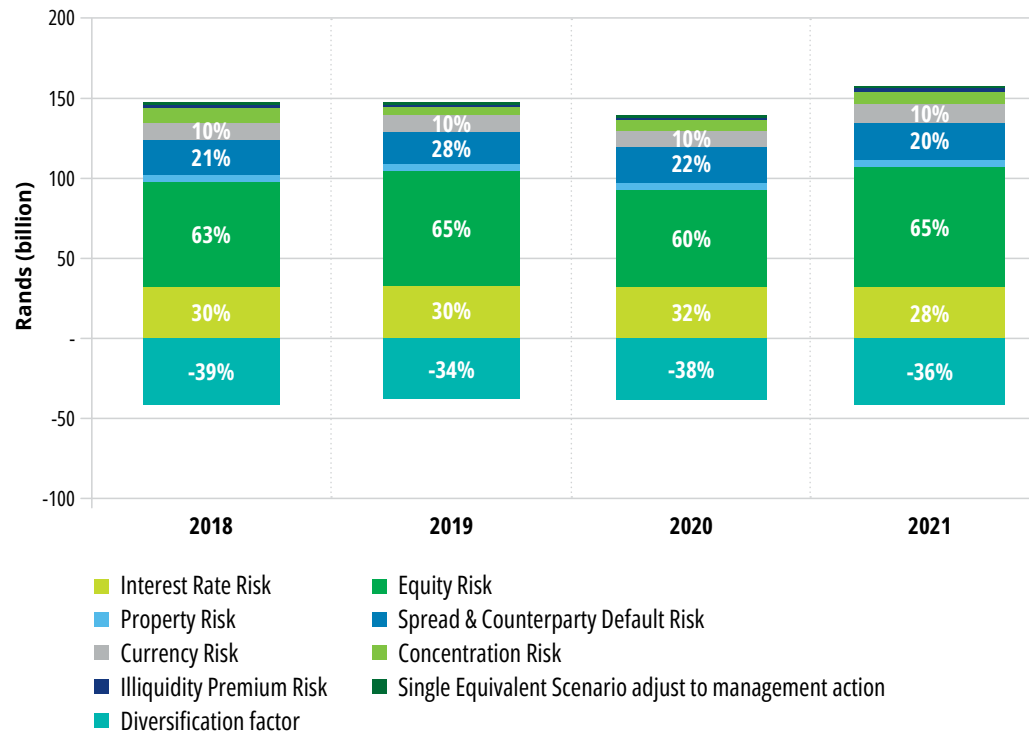
| Parameter | CEOIPS | FSI 4.1 |
|---|---|---|
| Global Equity stress | 45%, MSCI | 39%, MSCI |
| Other Equity stress | 55% | 49% |
| SA Equity stress | n/a | 43%, JSE |
| Averaging period for Symmetrical adjustment | 1 year | 3 years |
| Index used for calibration | MSCI World Index | JSE Allshare Index |
| Period used for calibration | 36 years | 50 years |
| Data frequency | Daily | Monthly |
| Worst 1-year experienced equity drop | 52% | 49.5% |
| Index standard deviation | 17.6% | 25.9% |

The equity volatility stress typically applies for insurers who hold options or other equity-based derivatives. The calibration of the stress was informed by volatility data of 1 month options from the S&P 500 index (SPX) over a period ending in 2009. The empirical distribution of the data was used and was clearly observed to be skewed towards the right. This analysis led to relative stresses of -50% (downward) and +190% (upward) for the volatility of global equities. However, option features embedded in insurance contracts are usually longer term. For simplicity and due to data limitations, 5 years was assumed as a typical equity option term. The volatility stresses were shifted to 5-year at-the-money implied volatility stresses using the Eurostoxx 50 index (2007 – 2008) and the FTSE100 index (May 2006 to March 2009), which resulted in a downward volatility stress of 15% and an upward volatility stress of 50%.

## 3 Potential shortcomings to consider when assessing relevance of standard formula stresses

There are various shortcomings and uncertainties contained in the equity risk submodule. Given equity risk usually forms a substantial part of the SCR (refer below figure), we will dive into some factors that insurers should consider the following when assessing the appropriateness of the standard formula.

### 2021 Life Insurance Industry Experience: Market risk components[1]

[1] https://www.resbank.co.za/content/dam/sarb/publications/prudential-authority/pa-insurers/insurance-sector-data/special-reports/2022/Life%20Industry%20Experience%20-%20Final.pdf

## Relevance of the data used in price stress calibration

The equity price calibration only allows for JSE Allshare data between Jan 1961 to Oct 2010, and MSCI is similarly outdated by over 12 years. Looking into JSE price data specifically and allowing for data to December 2022, results in a calculated shock of 35.8%, which is 3.7% lower than the 39.5% calculated shock as per the position paper. Note that the chosen percentage as used in FSI 4.1 is set at 43%. The investigation therefore indicates more than a 7% decrease in the base SA equity price shock.

## Relevance of the equity symmetric adjustment

The equity symmetric adjustment is currently capped at the range -10% to +10% which followed CEIOPS limits operating in a lower volatility environment. At the time of calibration, a long term total equity return of 12.5% was assumed (2.5%

from dividends on 10% from capital gains). If any of these change significantly, the parameters may become outdated. Additionally, and as we saw with Covid, the adjustment might not be sufficient to provide enough stability from one quarter to the next.

The figure below shows the symmetric adjustment using the JSE Allshare index over the period January 2000 to December 2022, as well as the upper and lower 10% bounds. The graph above shows that the capped range of -10% to 10% does not influence the symmetric adjustment in normal market conditions. The capped range only comes into effect when the market is experiencing significant growth or decline.
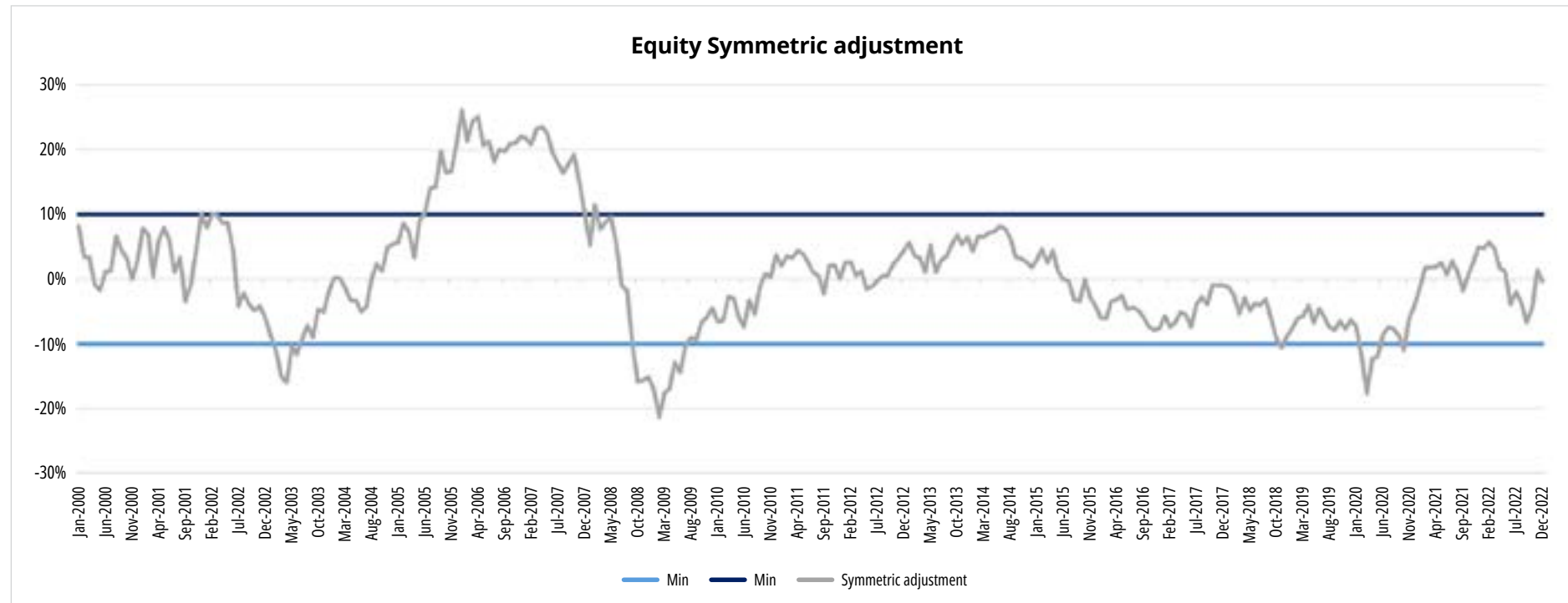


### Equity Symmetric adjustment

For quarterly / annual returns completed for February 2020 to May 2020 and October 2020, the cap on the symmetric adjustment caused insurers to shock their equity at a higher rate than what the shock otherwise would have been, if the cap had not been in place. As a result, the capital requirement during these months were overstated. To quantify this opportunity cost of holding excess solvency capital, equities would have to be shocked using both the capped and uncapped symmetric adjustments.

The opportunity cost was most severe for insurers with year-ends as at 31 March 2020, where the equity symmetric adjustment cap caused the equity shock to be 8% higher. By the time of the next quarterly submission (as at June 2020), the market had already started to stabilise, making the overstatement of capital requirements as at 31 March 2020 even more apparent.

## Specific assumptions made in parameterisation

At the time of calibration, there was a debate on whether the SA equity shock should be set at the same level as the global stress (39%) or whether it should be higher (the 43% that FSI 4.1 opted for). There are good reasons to motivate the higher 43% - SA is an emerging market with higher political risk; resource companies form a significant portion of the JSE index; the standard deviation of the JSE index is higher than the MSCI index. However, since the JSE is positively skewed (extremely good returns during the late 1970s) compared to the MSCI that is negatively skewed, much of the variance of the JSE comes from upside risk.

The correlation coefficient used within the Standard Formula is 75%. The Market Risk Working Group's analysis of the MSCI World Developed Markets Price Equity Index and the JSE AllShare Price index (January 1951 to October 2010) indicated a correlation of 65%. This may suggest that a correlation coefficient of 75% overestimates the risk.

The correlation also heavily depends on the type of entities that an insurance company invests in, e.g. if an insurer solely invests in two industries (locally and overseas) the correlation should be higher than if the insurer was invested in a range of industries.

## Nature of the insurers equity exposure and how it compares to what was assumed in the standard formula

Resource companies, which may be considered more risky shares, form a significant portion of the JSE Allshare index. Given that the JSE Allshare was used to determine the equity shock, this could mean that insurers are in fact exposed to less risk depending on the type of equity that they hold. On the other hand, often individual insurance companies are not as well diversified, i.e. exposed to more risk than assumed when calibrating the standard formula. Other factors regarding the nature of the insurer's equity risk exposure, to consider are:

**Liquidity:** Insurers invested directly in shares, instead of indices, may not have the same level of liquidity as assumed in the equity risk calibration.

**Investment funds:** When looking-through for the equity risk calculation, the assumption is that investment funds carry equal risk to holding shares directly. This assumption may not be appropriate.

**'Other equity':** This is a catch-all bucket which might not be an accurate representation of the risk carried by the insurer.

**'Global equity':** Insurers should consider their global equity exposure and whether an MSCI derived stress is appropriate.

## Listed overseas shares

If shares from an oversees company listed on the JSE is bought, currency risk is not applied because shares are issued in ZAR. This may not be appropriate depending on the type of shares, additional risks not captured in the equity risk module may apply.

## Possible exacerbating impact of management actions

Management actions might aggravate market movements - e.g. insurers acting in similar ways to mitigate true equity risk during turbulent times, decreasing the market value of equity even further. The SCR formula does not make allowance for this.

## Equity volatility calibration on South Africa specific data

As mentioned in section 2, the equity volatility stress was not re-calibrated to SA data. For insurers with substantial exposure to options or other equity based derivatives, CEIOPS provides the technique used for the volatility calibration which can be replicated.

**4** **Evaluation of the 'true' confidence level of the equity risk calibration for recent major stress events**

The equity risk stress as per FSI 4.1 is calibrated to a 99.5% confidence level. In this investigation, we test the adherence to this confidence level during recently observed stress events.

*Kwazulu-Natal Floods (8 April 2022 – 21 April 2022)*

The JSE Allshare daily change in index was considered from 1 April 2022 to 30 April 2022. The largest instantaneous decrease in the JSE AllShare index during this period, was observed from 8 April to 25 April. The instantaneous decrease observed was -7% which corresponds to a 1-in-8-year event.

*COVID-19 Pandemic*

The JSE AllShare annual change in index was considered from December 2018 to December 2022. The largest instantaneous decrease in the JSE AllShare index during this period, was observed on 31 March 2020. The instantaneous decrease observed was -21%, which corresponds to a 1-in-19 year event.

**5** **Conclusion**

By going deeper into the underlying thinking and data used in the calibration of the equity risk standard formula we are able to see the simplifications that were made, the factors that need to hold for those simplifications to be appropriate, as well as the timestamp used.

Insurers exposed to significant equity risk, or with types of equity exposure significantly different from that assumed in the standard formula, should consider incorporating some of the insights in this article into their Own Risk and Solvency Assessments.

**6** **Reference & further reading**

This article uses information from the SAM steering committee Position Paper 47 – *Equity risk (fsca.co.za)* and the CEIOPS' Advice for Level 2 Implementing Measures on Solvency II: *Article 111 and 204 Equity risk sub-module.*

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