



## Basis Risk, Procyclicality, and Systemic Risk in the Solvency II Equity Risk Module

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# Motivation of the paper

## Goals of Solvency II

**1. Protection of policyholders and beneficiaries**

-> 99.5% confidence level / survival probability

**2. Financial stability and fair and stable markets are other objectives**

-> adjustment term to prohibit fire sales

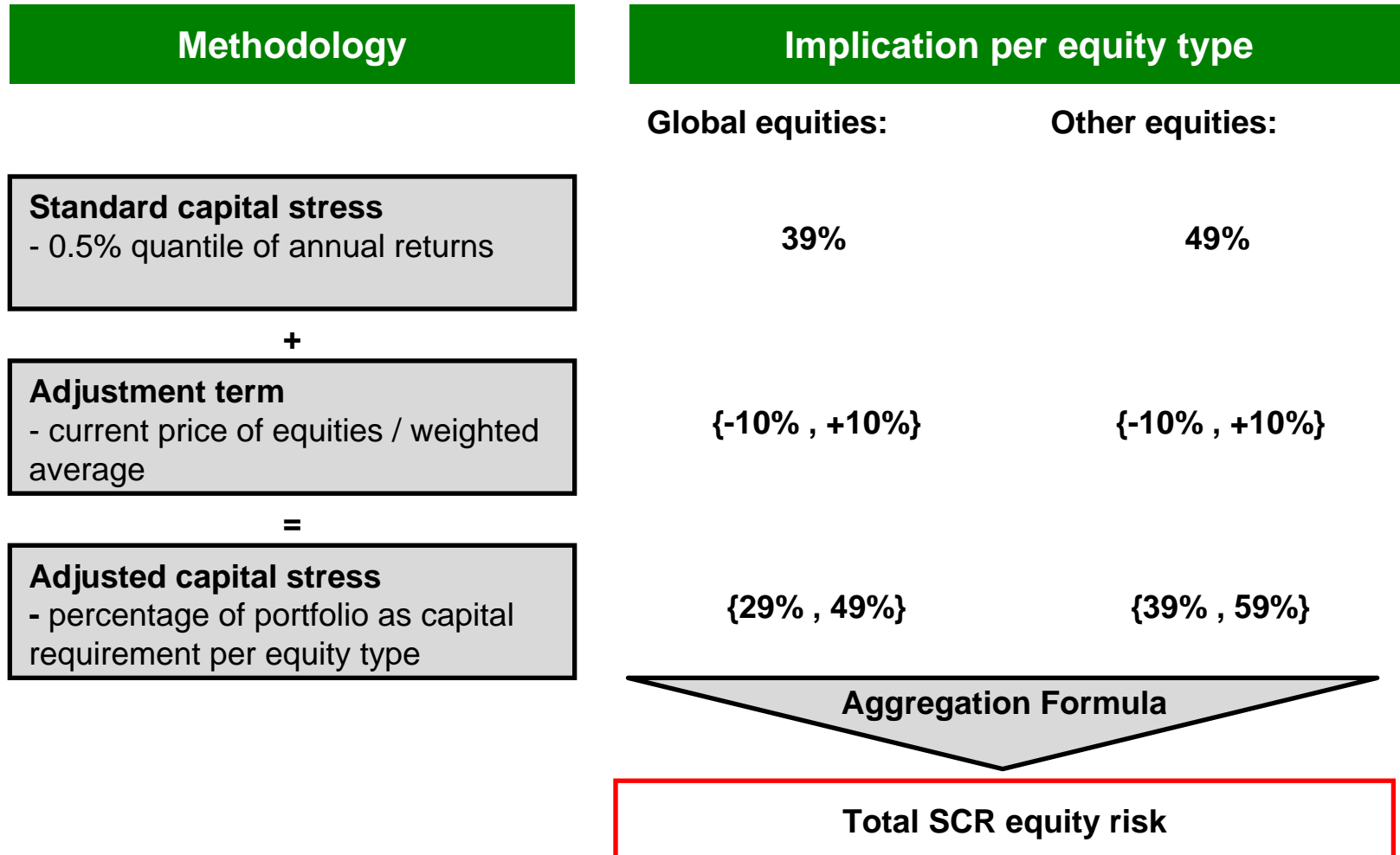
(Article 16, EU Directive)



**Are these goals achieved in the equity risk module?**



# A standard capital stress and an adjustment term make up the capital requirement for equity risk



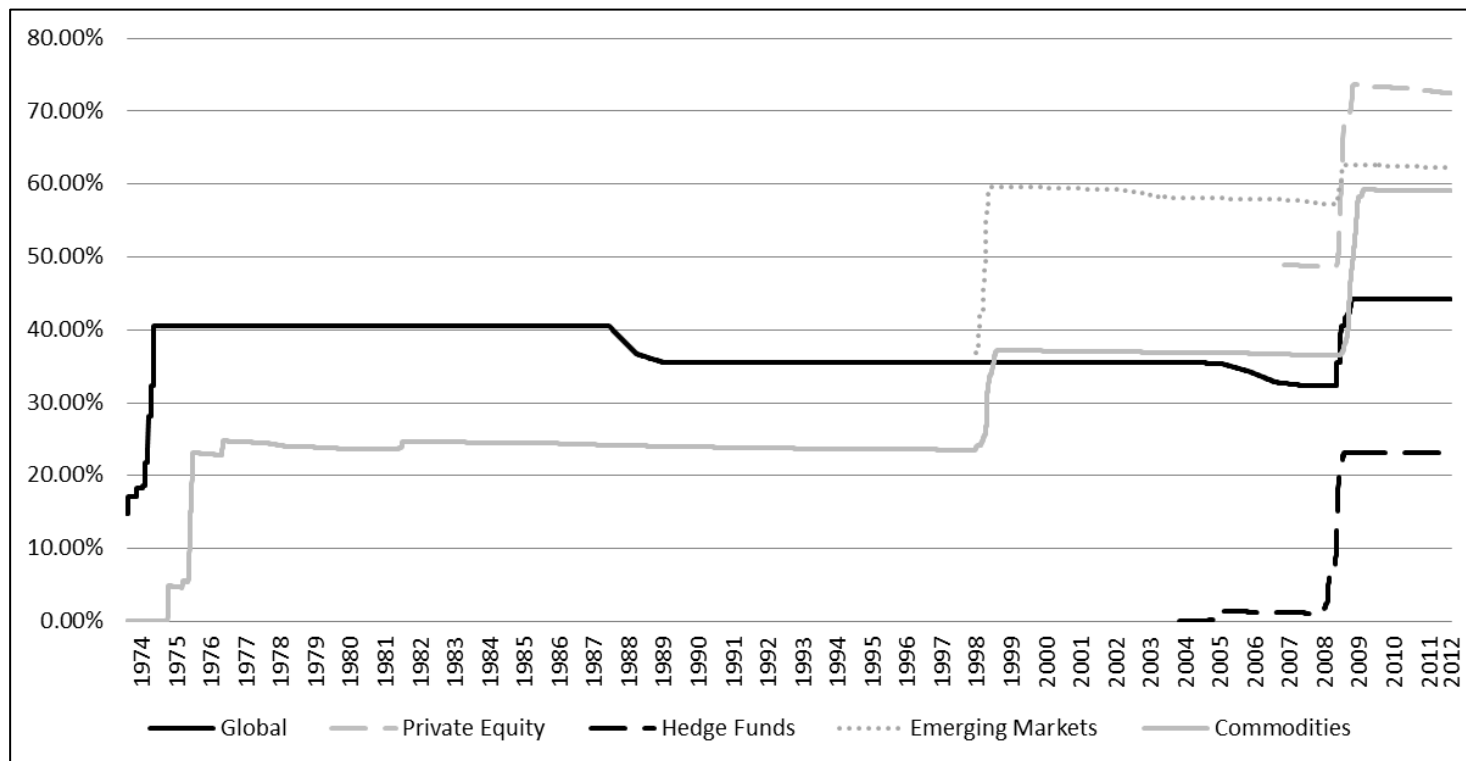


# We analyze the equity risk module in three steps

	What?	How?	Why?
1	<b>Sensitivity analysis</b>	Changing calibration parameters, e.g., time, correlation coefficients, returns definition	Goal I of Solvency II
2	<b>Basis risk</b>	Comparing requirements based on MSCI World index and stylized portfolios of European insurers	Goal I of Solvency II
3	<b>Systemic risk</b>	Testing if fluctuations in requirements correspond to systemic risk measures	Goal II of Solvency II

# Sensitivity analysis – time period

## Standard capital calculations at different points in time



**The standard capital stress is backward looking in nature.**



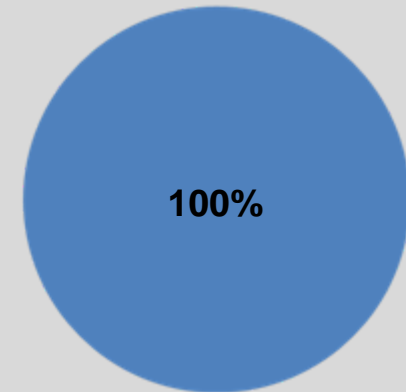
# Basis risk – changing of reference portfolios

## Assumption of standard capital stress OECD countries

### Current approach:

**Standard capital stress**  
- 0.5% quantile of annual returns of:

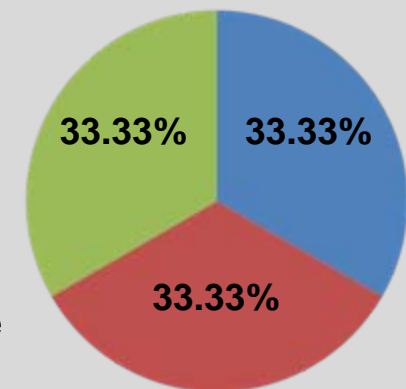
■ MSCI World  
Price index



### Alternative approach:

**Standard capital stress**  
- 0.5% quantile of annual returns of:

■ MSCI World Price  
index ex Europe  
■ MSCI Europe Price  
index ex Country  
■ MSCI Country Price  
index



## Basis risk results – standard capital stress

	Proposed (current approach)	MSCI World Portfolio (current approach)	Country Portfolio (alternative approach)	Maximal Deviation
<b>Austria</b>	<b>39%</b>	<b>44.25%</b>	<b>48.91%</b>	<b>-11.1</b>
<b>Germany</b>	<b>39%</b>	<b>44.25%</b>	<b>41.88%</b>	<b>-8.2</b>
<b>Greece</b>	<b>39%</b>	<b>44.25%</b>	<b>51.30%</b>	<b>11.0</b>
<b>Ireland</b>	<b>39%</b>	<b>44.25%</b>	<b>52.24%</b>	<b>-29.7</b>
<b>Sweden</b>	<b>39%</b>	<b>44.25%</b>	<b>41.40%</b>	<b>-12.1</b>
...				

**If more realistic portfolios are considered, standard capital stress of 39% is not sufficient.**



# Basis risk results – confidence levels of adjusted capital stress

	January 1975 – September 2008		September 2008 – January 2012	
	min	max	min	max
<b>Austria</b>	99.18%	100.00%	97.67%	99.77%
<b>Germany</b>	98.11%	100.00%	96.42%	100.00%
<b>Greece</b>	94.29%	100.00%	85.89%	98.42%
<b>Ireland</b>	98.19%	100.00%	93.21%	98.40%
<b>Sweden</b>	98.22%	100.00%	96.63%	100.00%
...				

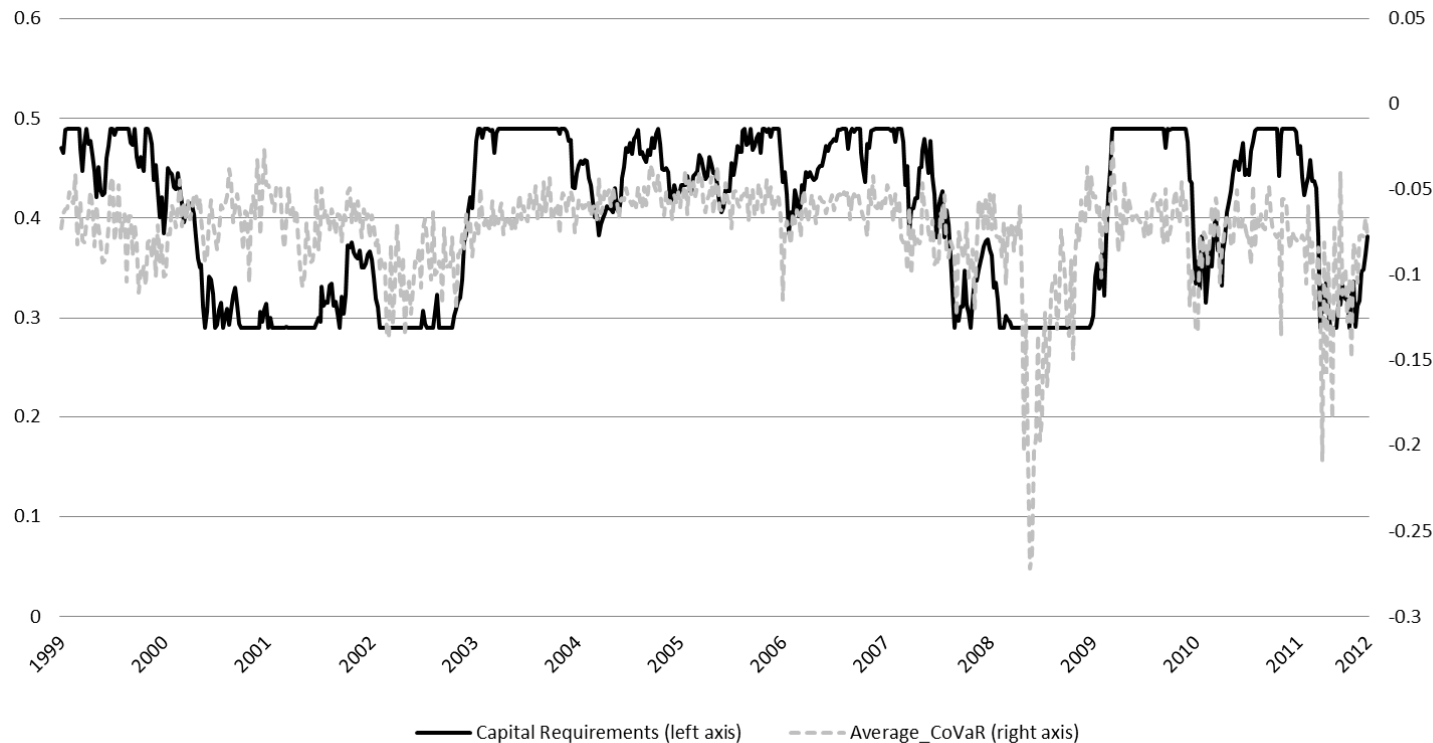
**Prescribed goal of Solvency II of a 99.5% confidence level is not reached anymore for some equity allocations.**





# Systemic risk – measures

## Adjusted capital stress and Conditional Value at Risk (Adrian and Brunnermeier 2011)

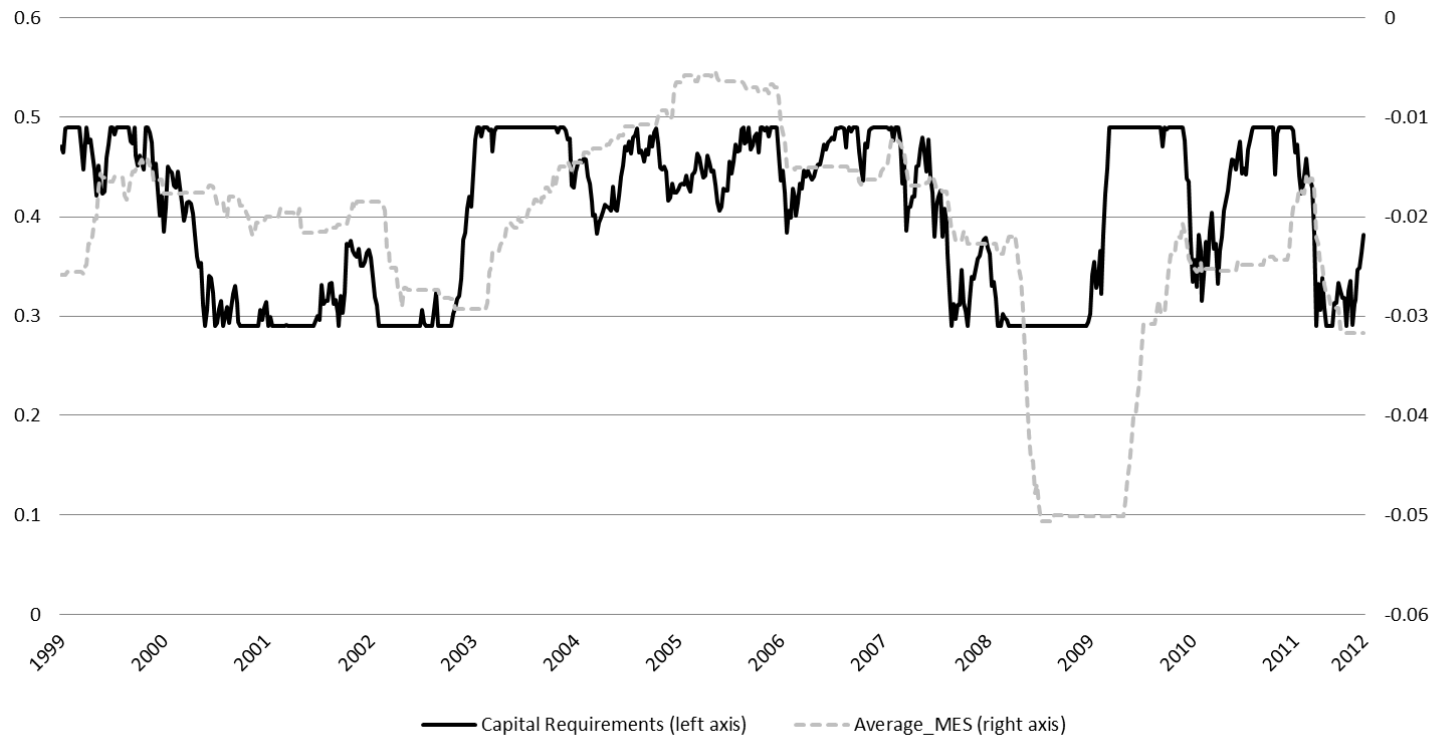


**According to CoVaR the symmetric adjustment mechanism reduces procyclicality.**



# Systemic risk – measures

## Adjusted capital stress and Marginal Expected Shortfall (Acharya et al. 2012)



**According to MES the symmetric adjustment mechanism reduces procyclicality.**

# Tests show that adjusted capital stress and systemic risk measures are related

## Correlation

	Correlation Coefficients			Correlation Coefficients	
	CoVaR	MES		CoVaR	MES
Total Average	0.429***	0.361***	Ireland	0.423***	0.343***
Austria	0.403***	0.290***	Italy	0.442***	0.360***
Belgium	0.461***	0.345***	Netherlands	0.441***	0.359***
Denmark	0.444***	0.391***	Norway	0.419***	0.323***
Finland	0.419***	0.419***	Portugal	0.483***	0.375***
France	0.405***	0.373***	Spain	0.428***	0.355***
Germany	0.421***	0.373***	Sweden	0.364***	0.419***
Greece	0.354***	0.274***	Switzerland	0.364***	0.355***
			UK	0.421***	0.380***

## Granger causality

### Granger Causality Test

Capital Requirements -> CoVaR	34.95***
CoVaR -> Capital Requirements	0.85
$\Delta$ Capital Requirements -> $\Delta$ MES	1.30
$\Delta$ MES -> $\Delta$ Capital Requirements	0.37

## VAR model

	Capital Requirements	CoVaR
Capital Requirements (-1)	0.921***	0.472***
Capital Requirements (-2)	0.072	-0.43***
Capital Requirements (-3)	-0.02	-0.02
CoVaR (-1)	0.062**	0.368***
CoVaR (-2)	-0.004	0.202***
CoVaR (-3)	-0.019	0.244***

## VEC model

	$\Delta$ Capital Requirements	$\Delta$ MES
$\Delta$ Capital Requirements (-1)	-0.055*	0.002*
$\Delta$ Capital Requirements (-2)	0.056*	-0.001
$\Delta$ Capital Requirements (-3)	0.068*	-0.003*
$\Delta$ MES (-1)	-0.561	0.220***
$\Delta$ MES (-2)	-0.377	0.220***
$\Delta$ MES (-3)	0.659	0.061*



# Conclusion

## Goals of Solvency II

### 1. Protection of policyholders and beneficiaries

-> 99.5% confidence level / survival probability

- The standard capital stress is backward looking.
- The standard capital stress is very sensitive to different calibration parameters.
- There is a substantial basis risk and for many equity allocations the adjusted capital stress is too low for most of the time.

### 2. Financial stability and fair and stable markets are other objectives

-> adjustment term to prohibit fire sales

- Systemic risk measures and adjusted capital stress correspond, so procyclicality is successfully reduced by the symmetric adjustment mechanism.



# Thank you for your attention

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## Selected References

**European Parliament, and European Council**, 2009. On the Taking-Up and Pursuit of the Business of Insurance and Reinsurance (Solvency II) 2009/138/EC. *Official Journal of the European Union*:155.

**Adrian, T., Brunnermeier, M.K.**, 2011. CoVaR. NBER - Working Papers.

**Acharya, V.V., Pedersen, L.H., Philippon, T., Richardson, M.**, 2012. Measuring Systemic Risk. Working Paper.

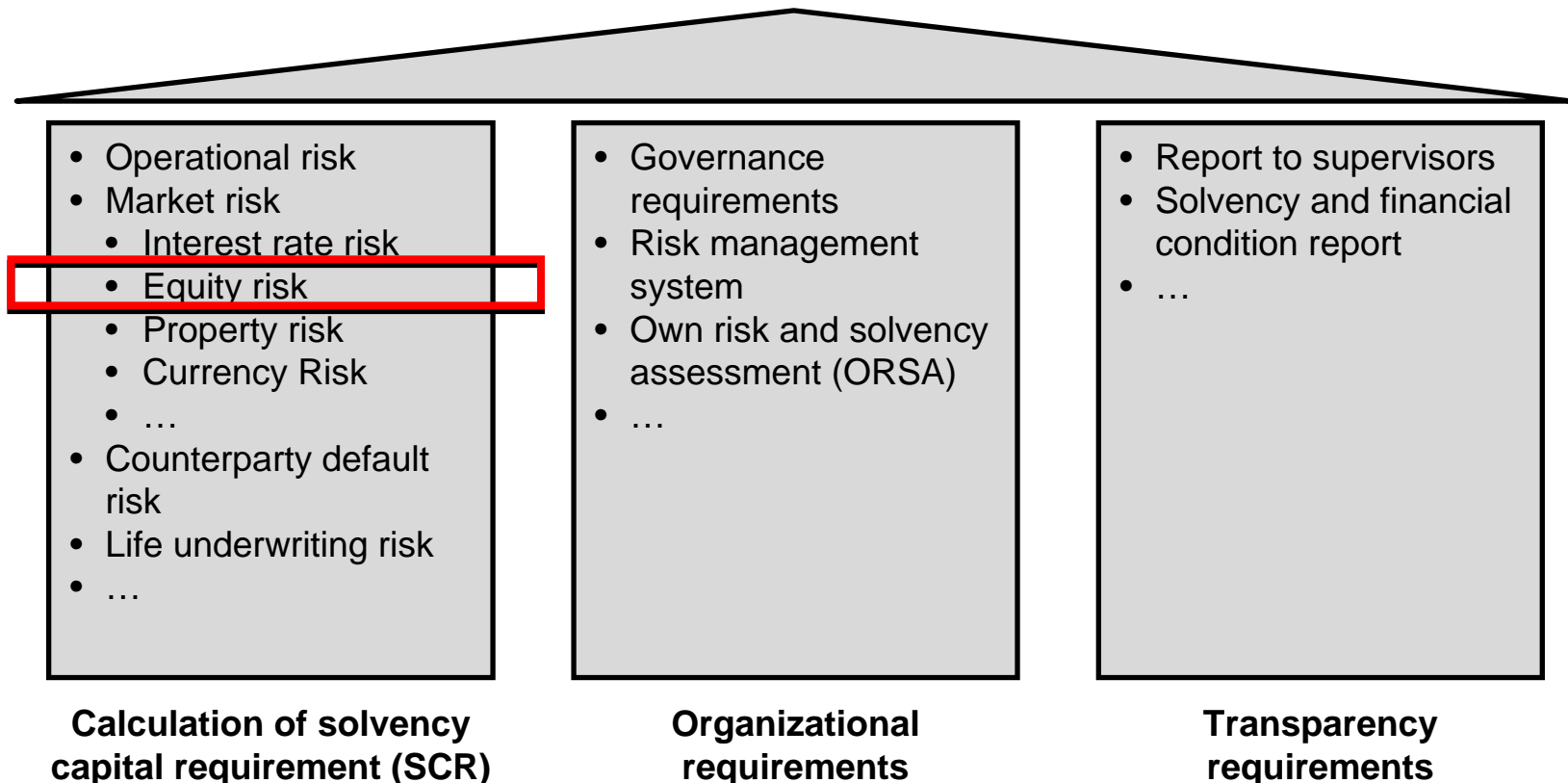


# Backup



# Solvency II is the new regulatory framework for insurers in the European Union

## The three pillars of Solvency II







# Sensitivity analysis

## Methodology

### Standard capital stress

- 0.05% quantile of annual returns

+

### Adjustment term

- current price of equities / weighted average

=

### Adjusted capital stress

- percentage of portfolio as capital requirement per equity type

## Implication per equity type

Global equities:

Other equities:

39%

49%

{-10% , +10%}

{-10% , +10%}

{29% , 49%}

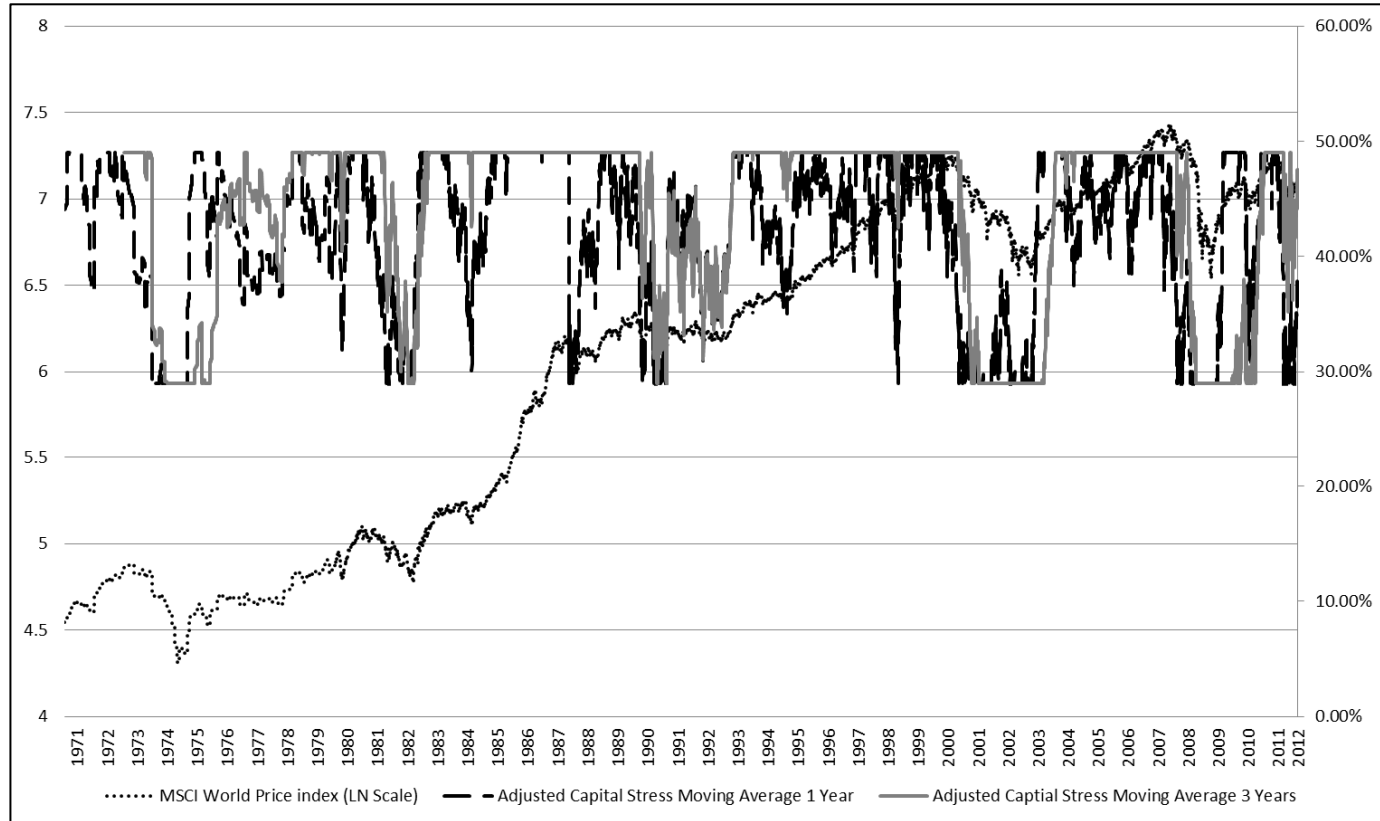
{39% , 59%}

Aggregation Formula

Total SCR equity risk

# Sensitivity analysis – moving average period

**Adjusted  
capital  
stress**



**Longer reference periods lead to less deviations from the 99.5% confidence level, but lead also to binominal capital requirements.**

# Procyclicality – standard capital stress and adjustment term applied to country portfolios

## Methodology

