Calibration recommendation for the correlations in the Solvency II standard formula

10 December 2009

CRO FORUM

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1. Executive summary

The CRO Forum welcomes the opportunity to contribute to the calibration of the standard formula through this paper on correlations.

This document is a follow-up to our position paper published last May: *'Calibration Principles for the Solvency II Standard Formula"*. The paper provides our recommendation on the methodology to calibrate market risk correlation factors as well as a counter-proposal for the correlation matrix as suggested by CEIOPS in its Consultation Paper n°74. The final chapter of this document also briefly addresses the correlations for non-market risk.

The calibration of dependencies of risk factors is among the most difficult tasks when setting up a capital model. The recent financial crisis has highlighted that the dependence structure of market risk can change in stressed situations.

However, correlation parameters should be set in accordance with the envisioned risk tolerance of a 1-in-200 year loss (individual shocks x correlation), not higher and not lower. The calibration approach should not result in accounting for the worst possible correlations between all pair-wise risks, as observed for short periods of time during the observed period which included the financial crises. Otherwise, the aggregate 1-200 year correlations across all risks will be much too conservative and together not be supported by history or what is plausible in the future.

We strongly believe that proposed correlation matrices from CEIOPS need to be revised due to the following reasons:

- The empirical evidence for the calibration needs to be well documented/disclosed;
- Correlations in the standard model should be considered in conjunction with the calibration of the shocks to target a 1-in-200 level. Indeed, the diversification benefit implied by the CEIOPS proposal on market risk correlation matrix (16%) is equivalent to the diversification benefit effectively experienced in the financial markets in the year of the financial crisis in 2008; which is in fact quite conservative, as (i) in parallel the new calibrations for some individual shocks already reproduce the worst shocks observed ever (and even sometimes more), and (ii) the period with the worst correlation observed does not necessary coincide with the period with the worst shocks (see section 2.1 on back-testing);
- Some correlation factors might give the wrong incentive: eg. high correlation between equities and interest rates (which is a two-sided risk) may encourage companies to offset / neutralise risks for one specific scenario, but it would dramatically increase the risk associated to a reverse scenario. This may create incentives for companies to manage their risks in a manner that optimises the SCR, but is not necessarily optimal from a risk management perspective;
- We do not support CEIOPS' position on the use of non-zero correlations for independent pairs. We recognise the shortcomings of the aggregation technique for particular (non-elliptical) distributions in the case of independence. However, we think it is not valid to use this argument to increase all zero correlations (to at least 25%) without providing evidence on the shape or class of the probability distributions. This applies in particular to some updated factors for the underwriting risk correlations (CAT, lapse) that have been arbitrarily increased by 0.25 as a crude adjustment; and
- We challenge CEIOPS proposal to modify the correlation matrix for the basic SCR (market, default, life, health, non-life), that is part of the Annex IV of the Directive, because the determination of these new correlation factors, especially for Health/ Life, should be documented and not only based on general considerations.

In performing this analysis on correlation for market risks, we adopt principles for calibrating the correlations (cf. Chapter 2 / 2.2) with a systematic analysis of all the available statistics rather than focus on one particular metric or observation period. We see four major points to be highlighted:

- Overall, given the lack of exhaustive data to make evident statistical conclusions, the calibration must, by necessity, reflect an element of subjectivity and "expert opinion".
- Most insurers (including small to medium size) hold portfolios diversified across sector, rating and/or geography. Hence, correlation observations from only one pair of indices (e.g. S&P 500 vs Merrill Lynch "A" US corporates) may lead to an overstatement of correlation. The calibration should in a way reflect portfolio diversification effects within particular cells of the matrix.
- The standard formula matrix, by necessity, makes simplifying assumptions and is not granular (e.g. unlike the SST approach, it does not reflect different geographies). Correlations are only one way of specifying interdependency between risks (alternatives include copulae and structural dependency and, again, correlations are a pragmatic simplification). As a result the proposed correlations will require approximate adjustments to allow, partially, reflection of such subtleties in the dependency structure. For some factors, we decided to define ranges for the correlations. When choosing a point within the range, it is important to ensure that the corresponding correlation matrix will remain positive definite.
- Additionally we want to point out that these proposed correlations for the standard formula do not necessarily represent the "benchmark" of what our member firms are using in their internal models, nor do they constitute a recommendation for the assumptions that any individual company should adopt for their own internal model purposes. As expressed above, estimating tail correlations is a difficult, and in a way subjective, task at each individual company level and thus the industry has a range of different viewpoints on this.

The following table presents the CRO Forum's proposals for market correlation under the standard formula:

Legend: (*) Static correl is the correlation over the last 10 year period with monthly return (cf. table 4 in each section)

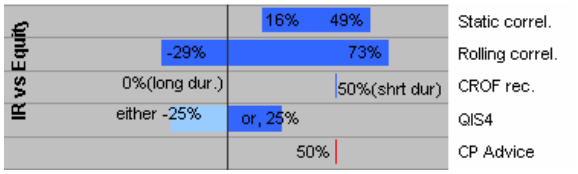
(*) Rolling correl is the rolling correlation with monthly return over a 2 year window (cf. table 4 in each section)

Interest Rate vs Equity

1 From our analyses we have observed that the period with the worst correlation observed does not necessarily coincide with the period with the worst shocks. It is therefore not relevant to retain the highest correlation ever observed.

2 Interest Rate risk is two-sided in nature, therefore correlation is highly dependant on the Interest Rate position in the portfolio (duration)

The CRO Forum recommends that for portfolios with short durations (which is the more common situation), a correlation of 0.5 seems to be appropriate; whereas for a portfolio long in duration a correlation of 0 would be appropriate (conservative assumption).



See section 3-1

Interest Rate vs Spread

1 We have observed that the period with the worst correlation observed does not necessarily coincide with the period with the worst shocks. It is therefore not relevant to retain the highest correlation ever observed.

2 Interest Rate risk is two-sided in nature, therefore correlation is highly dependant on the Interest Rate position in the portfolio (duration)

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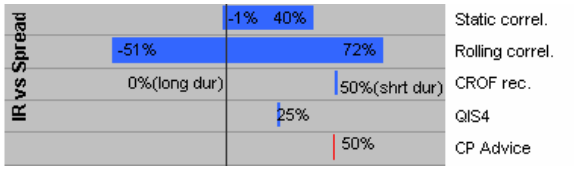


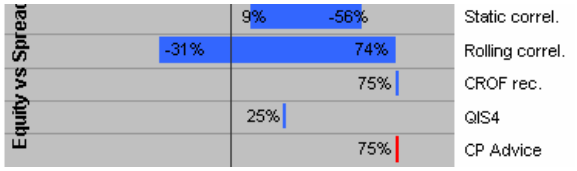
See section 3-2 (convention negative correlation)

Equity vs Spread

1 CEIOPS factor of 0.75 is at the top end of the range of observed 2 year rolling correlations (max observed 0.78 on 10 years period), which in itself is highly unstable.

2 However, our analysis shows that peaks in correlation coincide with negative peaks in the return, and there is a non-economic relationship that argues for a strong relationship in times of severe crisis.

We therefore recommend that for this specific factor, a high correlation of 0.75 is used.

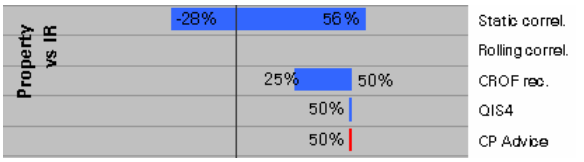


See section 3-3 (convention negative correlation)

Property vs Interest Rate

We tend to agree with the CEIOPS's factor of 0.5.

However given the country specificities of real estate for Germany and Switzerland (time lag observed in the drop of the prices), we recommend using a range from a low to a medium level [0.25;0.5].

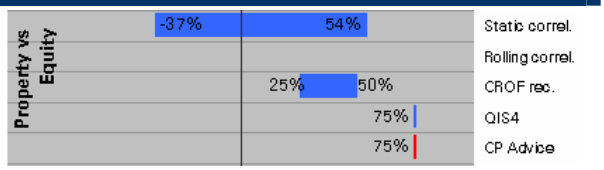


See section 4-1

Property vs Equity

Correlations are material (around 0.5) but clearly below 0.75

Given the country specificities of German and Switzerland real estate market, we recommend a low to medium range [0.25;0.5].

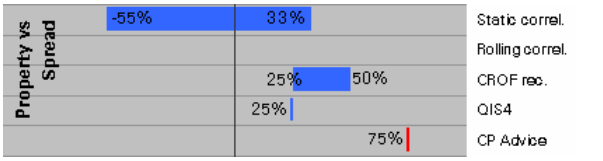


See section 4-2

Property vs Spread

We share a similar argument as that under Equity vs Property.

Instead of using a point, we recommend a range to include low to medium levels [0.25;0.5].



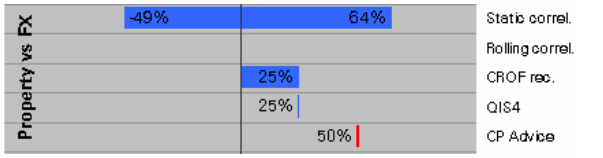
See section 4-3 (convention negative correlation)

Property vs FX

In a diversified FX portfolio we observe fairly moderate correlation.

We recommend a range from zero to low level. Any significant correlation ignores that FX can in fact be a diversifier in event risk scenarios.

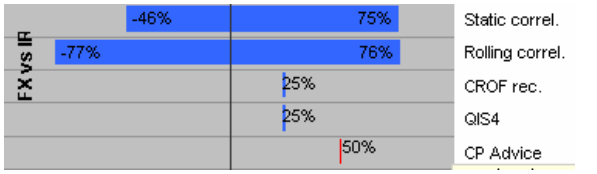
We therefore recommend a low correlation [0;0.25]



See section 4-4

FX vs Interest Rate

During the crisis correlations between FX and Interest Rate were more extreme - moves were in both directions. We therefore suggest a medium level at 0,25 to reflect highly diversified FX portfolio.

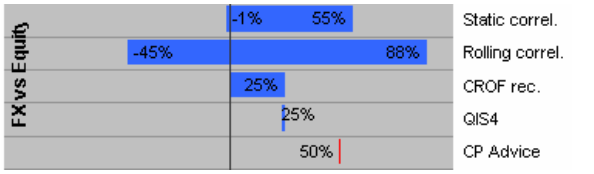


See section 5-1

FX vs Equity

In a diversified FX portfolio we observe fairly moderate correlation.

We recommend to set the correlation at a zero to low level [0;0.25]. Any significant correlation ignores that FX can in fact be a diversifier in event risk scenarios.

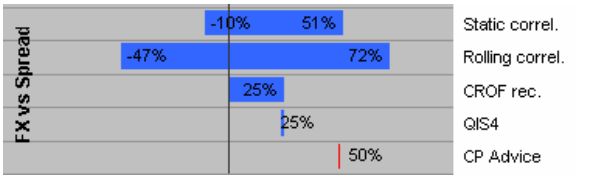


See section 5-2 (convention negative correlation)

FX vs Spread

A similar argument can be made here as that used under Equity vs FX.

We recommend to set the correlation at a zero to low level [0;0.25]. Any significant correlation ignores that FX can in fact be a diversifier in event risk scenarios.



See section 5-3

Concentration vs all other market risks

Concentration correlations have greater dependence on the individual portfolio than on the market movements. Concentration risk is not a stand alone risk, nor is it a risk that needs to be managed.

The concentration should be allocated to the underlying risk and let the correlations carry through.

We recommend a zero level as in QIS4.

We recommend a zero level as in QIS4.

See section 6

To summarise, the CRO Forum suggested factors for the market correlation are:

CorrMkt	*Interest Rate*	*Equity*	*Property*	*Spread*	*Currency*	*Concentration*
Interest Rate	1					
Equity	CROF: 0.5 / 0 CP74: 0.5 / QIS4: (0;+/-0.25)	1				
Property	CROF: [0.25;0.5] CP74: 0.5 / QIS4: 0.5	CROF: [0.25;0.5] CP74: 0.75 / QIS4: 0.75	1			
Spread	CROF: 0.5 / 0 CP74: 0.5 / QIS4: 0.25	CROF: 0.75 CP74: 0.75 / QIS4: 0.25	CROF: [0.25;0.5] CP74: 0.75 / QIS4: 0.25	1		
Currency	CROF: 0.25 CP74: 0.5 / QIS4: 0.25	CROF: [0;0.25] CP74: 0.5 / QIS4: 0.25	CROF: [0;0.25] CP74: 0.5 / QIS4: 0.25	CROF: [0;0.25] CP74: 0.5 / QIS4: 0.25	1	
Concentration	CROF: 0 CP74: 0.75 / QIS4: 0	CROF: 0 CP74: 0.75 / QIS4: 0	CROF: 0 CP74: 0.75 / QIS4: 0	CROF: 0 CP74: 0.75 / QIS4: 0	CROF: 0 CP74: 0.5 / QIS4: 0	1

2. Our Methodology

2-1 Back-testing over the last 10 years

The correlation matrix is by nature unobservable, and thus it is quite difficult to visualise the extent to which a correlation matrix can be compared to what was empirically experienced in past years. The following section compares the diversification benefit actually experienced in financial markets over the last 10 years, and particularly during the financial crisis in 2008, using the diversification benefit implied by the CEIOPS suggested correlation matrix.

The back-testing analysis is based on a hypothetical market portfolio example for an insurer:

2-1-a) Portfolio Assumptions

In EUR bn	Assets		Liabilities	
	Equity	5	Reserves	100
	Property	5		
	Gov Bonds	45		
	CredAAA	5		
	CredAA	15		
	CredA	20		
	CredBBB	5		
	Total	**100**	Total	**100**
Duration	7 years for bonds		9 years for liabilities	

2-1-b) Historical Market Returns (monetary losses in EUR bn)

Year	Equity	Property	Int rate			Credit					FX			Total
				Assets	*Liabilities (*)*		*AAA*	*AA*	*A*	*BBB*		*USD/EUR*	*GBP/EUR*	
1999	2.0	0.5	2.3	*-3.7*	*6.0*	0.2	*0.0*	*0.0*	*0.1*	*0.1*	4.9	*5.5*	*4.3*	10.0
2000	-0.3	0.5	-2.1	*7.6*	*-9.7*	-0.5	*0.0*	*0.0*	*-0.2*	*-0.3*	0.9	*2.2*	*-0.4*	-1.4
2001	-1.0	0.4	-0.7	*5.3*	*-6.0*	0.4	*0.1*	*0.1*	*0.2*	*0.0*	1.5	*2.0*	*1.0*	0.6
2002	-1.7	0.4	-2.0	*10.3*	*-12.3*	-0.2	*0.0*	*0.1*	*0.0*	*-0.3*	-3.6	*-5.1*	*-2.1*	-7.2
2003	0.9	0.4	-0.5	*3.9*	*-4.3*	1.2	*0.0*	*0.1*	*0.6*	*0.5*	-4.1	*-5.6*	*-2.6*	-2.0
2004	0.5	0.5	-2.6	*8.3*	*-10.9*	0.4	*0.0*	*0.1*	*0.2*	*0.1*	-1.2	*-2.4*	*0.0*	-2.4
2005	1.2	0.6	-2.7	*5.4*	*-8.1*	0.0	*0.0*	*0.0*	*0.0*	*-0.1*	2.9	*4.8*	*0.9*	1.9
2006	1.0	0.7	0.8	*-0.8*	*1.6*	0.2	*0.0*	*0.0*	*0.1*	*0.1*	-1.4	*-3.4*	*0.7*	1.3
2007	0.2	0.3	1.2	*1.5*	*-0.3*	-1.1	*-0.1*	*-0.3*	*-0.6*	*-0.2*	-3.0	*-3.2*	*-2.8*	-2.4
2008	-2.3	-0.3	-1.2	*9.2*	*-10.4*	-5.9	*-0.3*	*-0.9*	*-3.2*	*-1.5*	-3.1	*1.5*	*-7.7*	-12.9
Oct 2009	1.1	-0.3	0.4	*3.6*	*-3.3*	4.9	*0.1*	*0.7*	*2.0*	*2.0*	-0.2	*-2.1*	*1.6*	5.8
Max	-2.3	-0.3	-2.7			-5.9					-4.1			-15.3

(*) the liability interest rate calculations are based on government bond return indices

Realised Diversification = 1 – (12.9/15.3)

As a first step, we measure the market return from our standard market portfolio back tested over the last 10 years. For each asset class we calculate the highest losses (eg. EUR 2.3bn for equities in 2008, which is the combination of 5% exposure and a -46% return on the equity market). We then define the "realised diversification benefit" over this period by comparing the worst market return experienced from the asset portfolio in a specific year (12.9) with the sum of the worst individual return per asset class observed (15.3). Thus we compare the worst shocks over the last 10 years versus the shocks experienced in 2008. This leads to a "realised diversification benefit" of 16% (=1-12.9/15.3). This statistic illustrates that some diversification was in fact observed in the year of the crisis in 2008 (in contradiction to CEIOPS' claims in 3.26 of CP74).

As a second step, we measure the diversification benefit implied by the correlation matrix suggested by CEIOPS, applied to the solo SCR for each asset class (derived from the new shocks proposed in CP69 and CP74). The implied diversification on SCR is at the low level of 16% using the CP matrix. If we apply the same methodology to the QIS4 correlation matrix we obtain a diversification of 31%. The CROF proposed correlation matrix leads to a diversification of 21% and the SST matrix to a 24% diversification.

2-1-c) Solvency II Methodology

	New CPs shocks	Solo SCR
Interest rate risk	-39% for 7Y	3.9
Equity	-45%	2.25
Property	-30%	1.5
Spread	F(rating, maturity)	6.7
FX		0.8
Simple sum		**15.2**

Market SCR	with the CP matrix	**12.8**
	with QIS4 matrix	**10.5**
	with CROF matrix	**12.0**
	with SST matrix	**11.5**

Implied diversification	with the CP matrix	**16%**	=1-12.8/15.2
	with QIS4 matrix	**31%**	=1-10.5/15.2
	with CROF matrix	**21%**	=1-12.0/15.2
	with SST matrix	**24%**	=1-11.5/15.2

The analysis above highlights, in a simple way, that taking the worst possible correlations between all risks (observed for a very short time during the crisis at its peak) leads to a significant underestimation of the diversification benefit between all asset classes that exists naturaly in financial markets, even in an extreme stressed scenario.

Indeed, the diversification benefit implied by the CEIOPS proposal on market risk correlation matrix (16%) is equivalent to the diversification benefit effectively experienced in financial markets in the year of the financial crisis in 2008; which is in fact quite conservative, as (i) in parallel the new calibrations for some individual shocks already reproduce the worst shocks observed ever (and even sometimes more), and (ii) the period with the worst correlation observed does not necessary coincide with the period with the worst shocks.

2-1-d) Comparison of diversification per approach

Real World – 2008 crisis	16%
Solvency II - CP matrix	16%
Solvency II - QIS4 matrix	31%
Solvency II - CROF matrix	21%
SST - SST matrix	24%

2-2 Our principles for calibrating the correlations

The CRO Forum Internal Model Benchmarking study (January 2009) provides an overview of the approaches used by our members to assess dependencies of market risks within their internal models. The results show that 30% of them use the dependency assumptions embedded directly within vendor models, 20% systematically base their factors on the analysis of financial time series, and 50% use the analysis of financial time series in conjunction with judgment overlay.

In theory the matrix should actually reflect the correlations of the **risk impacts** (e.g. the monetary loss in NAV from an increase in yields) and not the **risk drivers** themselves (e.g. the yield itself), these are close but not always the same. This is a criticism commonly made of most correlation analyses, however we can justify our approach as a practical compromise: we use risk driver correlations that are generally a good proxy for the correlation of impacts, and will normally hold (unless the impact moves in the opposite direction to the driver and/or is non-linear – in those special cases we make an adjustment to the final parameter to allow for the effect - eg. changing the sign).

In performing this analysis on correlation for market risks, we adopt the following principles for calibrating the correlations:

- A range of different correlation statistics (e.g. static vs rolling, monthly vs weekly) and time series indices (e.g. S&P vs NASDAQ vs Dow Jones) exist. The calibration should take into account all the available statistics rather than focus on one particular metric or observation period. There is an extensive body of literature on correlations and analysis of time series, evidencing that the choice of correlation analytic dramatically affects the results.
- Basing the analysis purely on annual movements will give us insufficient data on which to make any statistically credible estimates. In contrast, reducing the time step to daily returns leads to the introduction of auto-correlation and other noise (e.g. differences in international time zones). We have therefore chosen monthly time steps in order to obtain a larger dataset on which to make more reliable conclusions. Hence, a balance between autocorrelation and a lack of data has been achieved.
- The “rolling correlation” method over a stressed period provides some insights into the behaviour and instability of correlation in such conditions. However, due to the short observation window it does not give us statistically fully credible estimates (because of the small number of data points: 24 observations over the period [1.7.2007; 30.6.2009] with monthly return).
- The “static correlation” method over a suitably long historic period provides us with many more data points with which we can make a more statistically credible estimate of correlation.
- Overall, given the lack of exhaustive data to make evident statistical conclusions (max 10 years in Euro zone, about 20 years in the US), the calibration by necessity must reflect an element of subjectivity and “expert opinion”.

We see also three important points to be highlighted:

- Most insurers (including small to medium size) hold portfolios diversified across sector, rating and/or geography. Hence, correlation observations from only one pair of indices (e.g. S&P 500 vs Merrill Lynch "A" US corporates) may lead to an overstatement of correlation. The calibration should in a way reflect portfolio diversification effects within particular cells of the matrix.
- The standard formula matrix, by necessity, makes simplifying assumptions and is not granular (e.g. unlike the SST approach, it does not reflect different geographies). Correlations are only one way of specifying interdependency between risks (alternatives include copulae and structural dependency and, again, correlations are a pragmatic simplification). As a result the proposed correlations will require approximate adjustments to allow, partially, reflection of such subtleties in the dependency structure. For some factors, we decided to define ranges for the correlations. When choosing a point within the range, it is important to ensure that the corresponding correlation matrix will remain positive definite.
- We want also to point out that these proposed correlations for the standard formula do not necessarily represent the "benchmark" of what our member firms are using in their internal models, nor do they constitute a recommendation for the assumptions that any individual company should adopt for their own internal model purposes. As expressed above, estimating tail correlations is a difficult, and in a way subjective, task at each individual company level and thus the industry has a range of different viewpoints on this.

2-3 Illustration of our methodology

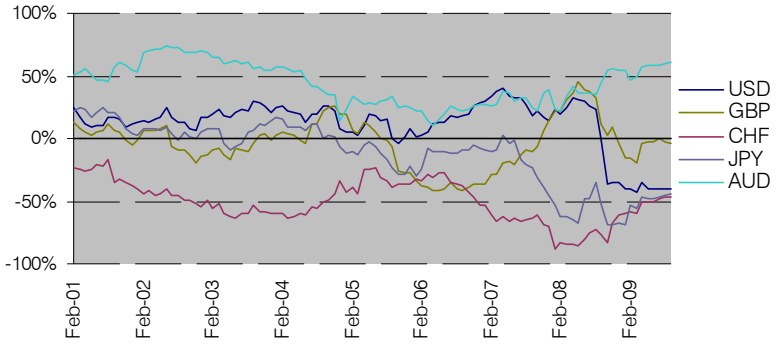
For the next parts of this note, we will present our analysis consistently using the following systematic approach:

- We begin with an analysis of the time series available. In order to limit tables, we restrict all tables/ graphs in the core presentation to monthly returns (all of these tables are also available in weekly returns on demand);
    - Table 1 provides an overview of the static correlation over the whole historic period available ([01.01.1999 – 30.09.2009]) based on monthly returns (static correlation).
    - Graph 2 illustrates the 2 Y rolling correlation based also on monthly returns (24 points at each date to evaluate the correlation) that illustrates the (in-)stability of correlation over time.
    - Graph 3 illustrates to what extent the worst observed rolling correlations between 2 risks are not synchronized with the worst possible individual shock events observed for the two asset classes considered.
    - Table 4 summarizes the data analysis during the crisis period (1st July 2007 - 30th June 2009) and the whole historic period (([01.01.1999 – 30.09.2009]).

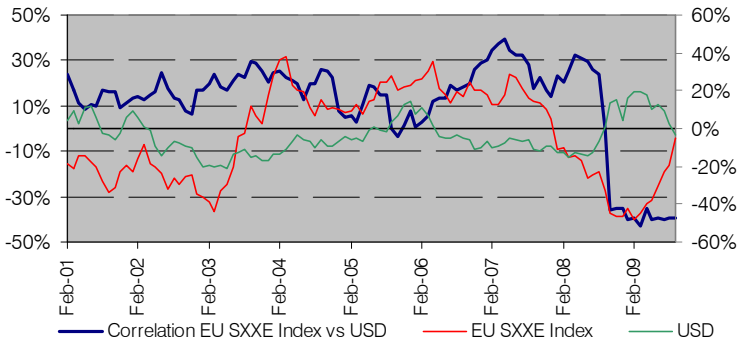
Table 1: Overview of the static correlation over the whole historic period available (monthly return over 10 years):

	USD	GBP	CHF	JPY	AUD
EU SXXE Index	-2%	1%	-45%	-14%	52%
US SPX Index	-20%	-5%	-45%	-17%	53%
UK ASX Index	-12%	-16%	-43%	-14%	51%
CH SMI Index	0%	3%	-46%	-6%	44%
JP NKY Index	-16%	-4%	-44%	-27%	43%
AU AS51 Index	-15%	-6%	-36%	-22%	40%

Graph 2: 2Y Rolling correlation based on monthly returns (vs EU SXXE Index)



Graph 3: 2Y Rolling correlation based on monthly return compared with Underlying annual returns



(1) Left axis: 2Y rolling correlation

(2) Right axis: moving annual return for the 2 Underlyings

Table 4: Summary of data analysis (min/ max observed over 2 Years windows)

		"Crisis period" (1st July 2007 - 30th June 2009)			Whole 10-year period (1st January 1999 - 30th September 2009)		
	Indices	Static(1)	Max(2)	Min(2)	Static(1)	Max(2)	Min(2)
FX vs Equity	EU SXXE Index vs USD	-40%	33%	-43%	-2%	40%	-43%

(1) The Static correlation of monthly observations over the relevant period.

(2) The max/min of the rolling 2 year correlation over the relevant period.

- The tables and charts will be followed by a short paragraph presenting the rationale for the correlation, mainly based on macro-economic considerations.
- We conclude the CRO Forum recommendation by incorporating both the pure time series analysis and an expert view. For some factors, we decided to define ranges for the correlations.
- One caveat: when choosing a point within the range, it is important to ensure that the corresponding correlation matrix will remain positive definite.

3. Correlation of Interest Rate / Equity / Spread

3-1 Interest rate versus equity

Based on monthly returns our investigation revealed the following correlations for equity indices vs. swap rates based on a history of 10 years.

3-1 Table 1: Overview of the static correlation over the period [01.01.1999 – 30.09.2009] with monthly returns:

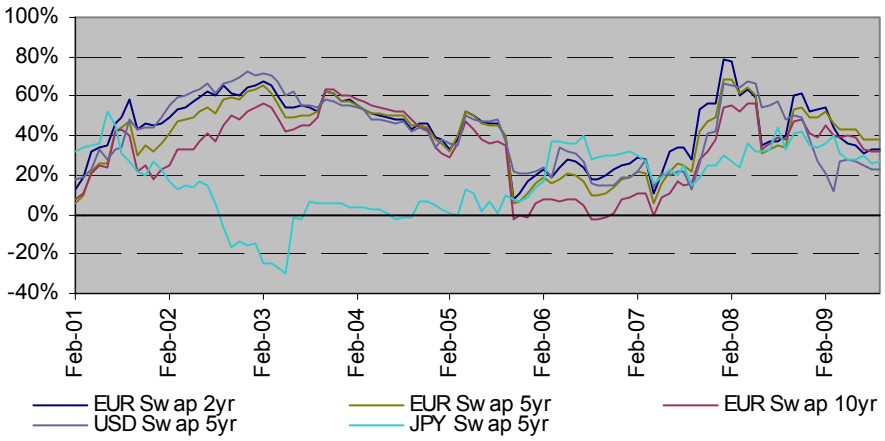
	EU SXXE Index	US SPX Index	UK ASX Index	CH SMI Index	JP NKY Index	AU AS51 Index
EUR Swap 2yr	41%	36%	34%	40%	30%	30%
EUR Swap 5yr	38%	34%	31%	35%	30%	29%
EUR Swap 10yr	32%	27%	25%	28%	24%	24%
USD Swap 2yr	41%	30%	30%	41%	25%	24%
USD Swap 5yr	37%	24%	26%	34%	18%	21%
USD Swap 10yr	31%	19%	20%	28%	12%	18%
GBP Swap 2yr	28%	30%	19%	29%	26%	28%
GBP Swap 5yr	27%	30%	20%	28%	26%	26%
GBP Swap 10yr	18%	16%	11%	21%	13%	13%
CHF Swap 2yr	34%	30%	24%	34%	23%	22%
CHF Swap 5yr	26%	27%	20%	26%	22%	22%
CHF Swap 10yr	22%	23%	17%	20%	17%	18%
JPY Swap 2yr	11%	18%	9%	9%	30%	13%
JPY Swap 5yr	13%	16%	9%	12%	32%	14%
JPY Swap 10yr	15%	15%	10%	13%	34%	16%
AUD Swap 2yr	39%	41%	34%	37%	31%	36%
AUD Swap 5yr	33%	33%	28%	30%	28%	28%
AUD Swap 10yr	28%	26%	21%	24%	21%	18%

(*) Positive correlation means a drop of interest rates combined with a drop of equity

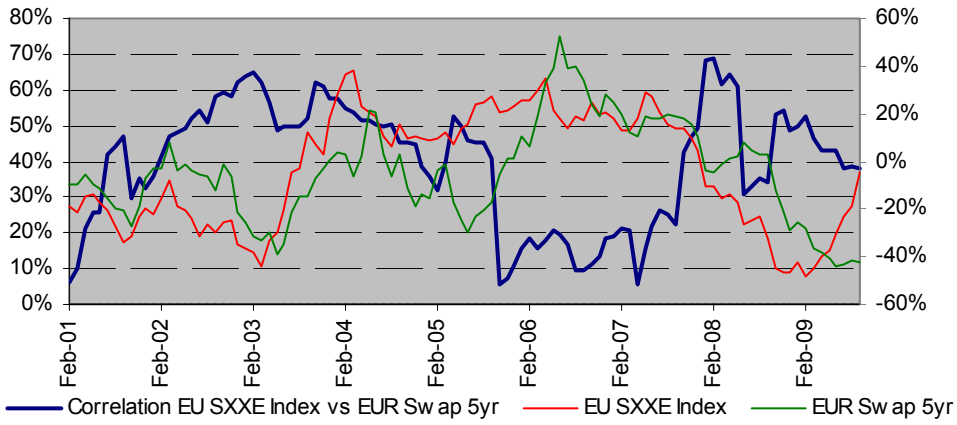
Based on this analysis a range of correlations between 9% and 41% can be observed. There is a tendency for correlations to decrease with increasing term nodes / maturities of swap rates (except for JPY). Correlations do not seem to depend on the currencies, e.g. EU SXXE Index show the same level of correlations vs. EUR-Swap and USD Swap rates (except for JPY-Swap where correlations are significantly lower).

As shown in the following diagram correlations between interest rates and equities are extremely volatile. The data exhibits changes of more than 0.5 over the course of 10 years where observations are based on a 2 year rolling window. The volatility is independent of the choice of specific equity index).

3-1 Graph 2: 2Y Rolling correlation based on monthly returns (vs EU SXXE index)



3-1 Graph 3: 2Y Rolling correlation based on monthly return compared with Underlying annual returns

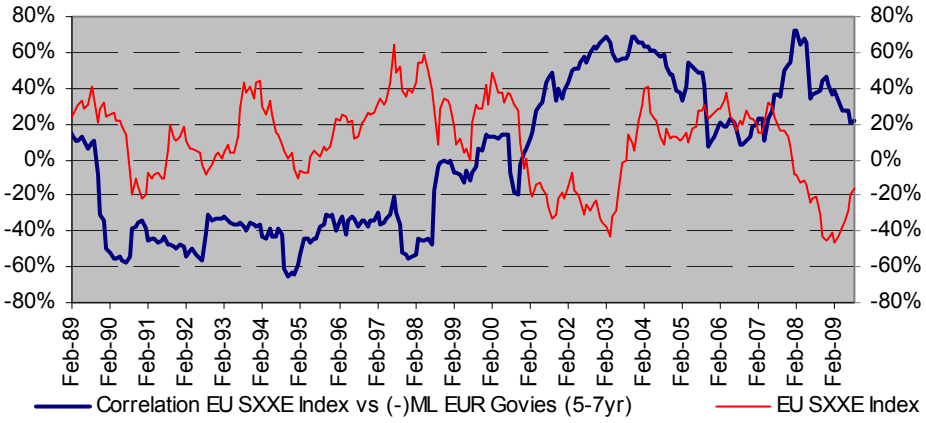


(1) Left axis: 2Y rolling correlation

(2) Right axis: moving annual return for the 2 Underlyings

Given the importance of this correlation factor, we have extended the analysis to cover a longer period using the Merrill Lynch EUR Govies 5-7 years:

3-1 Graph 3 bis: 2Y Rolling correlation based on monthly return compared with Underlying annual returns



(1) Left axis: 2Y rolling correlation

(2) Right axis: moving annual return for the Underlying

This graph highlights that the correlation observed over the last 10 years is directionally different from the correlation observed in the 20th century (i.e. the sign of the correlation has reversed). It illustrates also that the point at which the rolling correlation is at its strongest (either positive or negative) does not necessary coincide with the points in time at which the worst shocks happen.

A comparison between the correlations observed specifically during the crises period and those across the whole observation period shows that there have been periods with correlations both higher and lower than those observed during the financial crisis. This again indicates that correlations observed over a shorter period tend to be unstable. The graph also shows some observations in the time series where interest rates fall whilst equities are rising, or vice versa.

3-1 Table 4: Summary of data analysis (min/ max observed over 2 Years windows)

		"Crisis period" (1st July 2007 - 30th June 2009)			Whole 10-year period (1st January 1999 - 30th September 2009)		
	Indices	Static	Max	Min	Static	Max	Min
Equity vs Interest Rate	EU SXXE Index vs EUR Swap 5yr	**43%**	69%	22%	**38%**	69%	5%
	EU SXXE Index vs USD Swap 5yr	**27%**	68%	12%	**37%**	73%	12%
	EU SXXE Index vs GBP Swap 5yr	**17%**	46%	15%	**27%**	66%	-16%
	EU SXXE Index vs JPY Swap 5yr	**28%**	44%	15%	**13%**	52%	-29%
	US SPX Index vs EUR Swap 5yr	**49%**	59%	16%	**34%**	68%	-3%
	US SPX Index vs USD Swap 5yr	**17%**	64%	3%	**24%**	73%	-2%
	US SPX Index vs GBP Swap 5yr	**26%**	48%	7%	**30%**	64%	-24%
	US SPX Index vs JPY Swap 5yr	**30%**	42%	-9%	**16%**	58%	-28%

(1) The Static correlation of monthly observations over the relevant period.

(2) The max/min of the rolling 2 year correlation over the relevant period.

Interest rates may move up or down, and depending on the position (duration) in a portfolio, the interest rate moves might be either beneficial or detrimental (two-sided nature of interest rate risks). Equally, the correlations between interest rates and equity risks also depend strongly on the interest rate position in the portfolio.

In addition, some correlation factors might give the wrong incentive: eg. high correlation between equities and interest rates may encourage companies to offset/ neutralise risks for one specific scenario but it would dramatically increase the risk associated with a reverse scenario. This may incentivise companies to manage their duration in a manner that optimises the SCR, but is not necessarily optimal from a risk management perspective.

In conclusion with regards to this correlation between Interest Rate and Equity, we believe that a correlation of 0.5 (i.e slightly lower than the worst situation observed during the crisis period on 2Y rolling correlation, because of non-simultaneous shocks) seems appropriate for a portfolio with a short duration (ie. liabilities longer than assets); whereas for a portfolio with long duration a correlation of 0 would already be a conservative assumption.

3-2 Interest rate versus spread

Based on monthly returns our investigation revealed the following correlations for swap rates vs. credit spreads based on a history of 10 years (analysis based on corporate bond spread indices, 5-7 Y maturities).

3-2 Table 1: Overview of the static correlation over the period [01.01.1999 – 30.09.2009] with monthly returns:

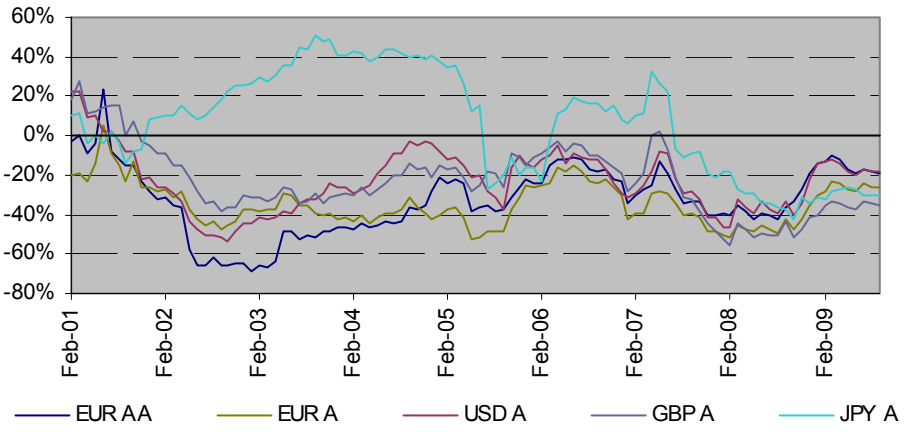
	EUR AAA	EUR AA	EUR A	USD AAA	USD AA	USD A	GBP AA	CHF AA	JPY AA	AUD AA
EUR Swap 2yr	-11%	-19%	-29%	-14%	-8%	-13%	-19%	-14%	1%	-13%
EUR Swap 5yr	-13%	-23%	-29%	-14%	-13%	-16%	-20%	-11%	-1%	-14%
EUR Swap 10yr	-12%	-21%	-24%	-11%	-12%	-14%	-16%	-9%	-2%	-12%
USD Swap 2yr	-12%	-28%	-37%	-19%	-21%	-27%	-27%	-17%	-1%	-28%
USD Swap 5yr	-14%	-29%	-36%	-17%	-24%	-28%	-26%	-13%	-7%	-32%
USD Swap 10yr	-15%	-28%	-32%	-13%	-22%	-26%	-21%	-10%	-7%	-32%
GBP Swap 10yr	-12%	-21%	-27%	-10%	-18%	-22%	-17%	-5%	-6%	-18%
CHF Swap 10yr	-2%	-10%	-12%	-7%	-3%	-5%	-4%	3%	2%	-13%
JPY Swap 10yr	-1%	-12%	-17%	-7%	-8%	-9%	-13%	-12%	0%	-13%
AUD Swap 10yr	-22%	-29%	-35%	-21%	-20%	-25%	-20%	-15%	-6%	-18%

(*) Negative correlation means a drop of interest rates combined with spread widening

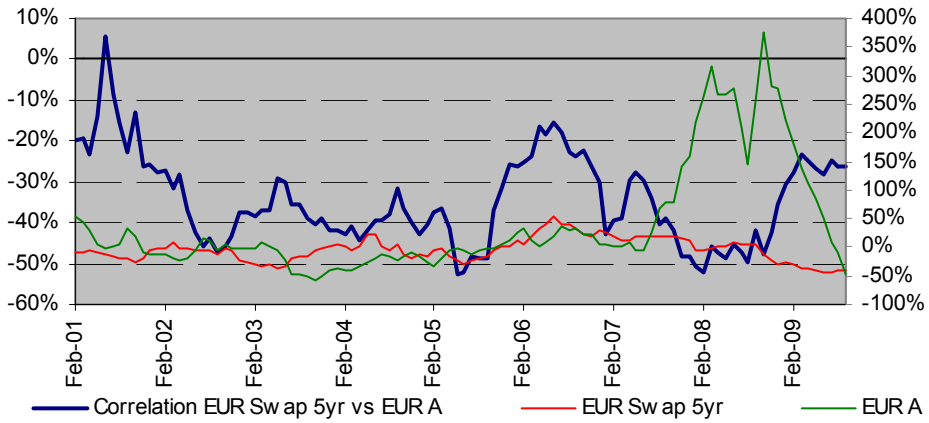
Based on this analysis a range of correlations between 5% and -42% can be observed. Within the same currency one is able to observe a tendency towards lower (i.e. more negative) correlations for lower ratings, indicating more pronounced reverse movements of spreads vs. the respective swap curve for lower ratings. This relation does not seem to hold true across currencies.

As shown in the following diagram, correlations between interest rates and credit spreads are extremely volatile and are able to change by more than 0.5 over the course of 10 years where observations are based on a 2 years rolling window (independent of the choice of the specific swap rate). This illustrates the importance of also taking the "static" historic correlations into account rather than relying entirely on the rolling correlations during stressed periods.

3-2 Graph 2: 2Y Rolling correlation based on monthly returns (vs EUR Swap 5yr)



3-2 Graph 3: 2Y Rolling correlation based on monthly return compared with Underlying annual returns



(1) Left axis: 2Y rolling correlation

(2) Right axis: moving annual return for the 2 Underlyings

Graph 3 illustrates that the point at which the rolling correlation is at its strongest (negative at Sept-08) coincides with the points in time at which the worst spread shocks occur, but this was not the case at the previous peak in March-05.

Furthermore, our data analysis has been done based on specific individual asset pairs (e.g. US "A" rated credits vs EUR Swap 10 Y), which would overstate the correlation. In reality insurers hold portfolios of Government and Corporate bonds that are well diversified by geography and credit rating. We would therefore expect the effective correlation to be lower than that implied by the individual asset pairs we have analysed.

3-2 Table 4: Summary of data analysis (min/ max observed over 2 Years windows)

		"Crisis period" (1st July 2007 - 30th June 2009)			Whole 10-year period (1st January 1999 - 30th September 2009)		
	Indices	Last	Max	Min	Static	Max	Min
Interest Rate vs Spread	EUR Swap 5yr vs EUR A	**-28%**	-23%	-52%	**-29%**	6%	-53%
	EUR Swap 5yr vs USD A	**-21%**	-12%	-47%	**-16%**	22%	-53%
	EUR Swap 5yr vs GBP A	**-37%**	-21%	-55%	**-25%**	27%	-55%
	EUR Swap 5yr vs JPY A	**-28%**	-7%	-43%	**1%**	51%	-43%
	USD Swap 5yr vs EUR A	**-37%**	-24%	-68%	**-36%**	5%	-68%
	USD Swap 5yr vs USD A	**-37%**	-15%	-69%	**-28%**	40%	-69%
	USD Swap 5yr vs GBP A	**-40%**	-21%	-72%	**-29%**	29%	-72%
	USD Swap 5yr vs JPY A	**-35%**	-9%	-47%	**-3%**	52%	-47%

(1) The Static correlation of monthly observations over the relevant period.

(2) The max/min of the rolling 2 year correlation over the relevant period.

To conclude, our analysis shows that peaks in correlation may coincide with negative peaks in the return, and there is an economic relationship that argues for a strong relationship in times of severe crisis.

So, for this correlation between Interest Rate and Spread, we recommend a correlation of 0.5 (i.e max observed during the crisis period on 2Y rolling correlation) which seems appropriate for a portfolio with a short duration (ie. liabilities longer than assets); whereas for a portfolio long in duration, a correlation of 0 would already be a conservative assumption.

3-3 Equity versus Spread

This section investigates the correlations for a selection of equity indices vs. spread indices using monthly returns and a history of *10* years.

This analysis looks at the correlation between equity price index movements vs credit spread index movements. (Note the sign convention - a fall in equities combined with a widening in spreads shows up as a negative correlation. The convention used in the CEIOPS matrix is for a positive sign to represent the correlation between a fall in equities and a widening in spreads.)

3-3 Table 1: Overview of the static correlation over the period [01.01.1999 – 30.09.2009] with monthly returns:

	EU SXXE Index	US SPX Index	UK ASX Index	CH SMI Index	JP NKY Index	AU AS51 Index
EUR AAA	-35%	-33%	-43%	-30%	-26%	-28%
EUR AA	-46%	-43%	-51%	-38%	-35%	-39%
EUR A	-54%	-50%	-57%	-46%	-45%	-48%
USD AAA	-44%	-45%	-49%	-41%	-38%	-39%
USD AA	-41%	-41%	-47%	-35%	-34%	-39%
USD A	-50%	-50%	-54%	-41%	-42%	-44%
GBP AAA	-34%	-33%	-43%	-32%	-31%	-37%
GBP AA	-39%	-36%	-48%	-39%	-34%	-43%
GBP A	-48%	-45%	-56%	-43%	-42%	-50%
CHF AAA	-26%	-22%	-28%	-23%	-17%	-17%
CHF AA	-31%	-27%	-34%	-29%	-21%	-21%
CHF A	-35%	-30%	-38%	-35%	-30%	-26%
JPY AAA	12%	11%	7%	14%	9%	6%
JPY AA	-14%	-17%	-15%	-7%	-11%	-17%
JPY A	-9%	-16%	-12%	-11%	-18%	-20%
AUD AAA	-33%	-35%	-36%	-33%	-26%	-37%
AUD AA	-27%	-22%	-29%	-25%	-14%	-21%
AUD A	-32%	-27%	-36%	-31%	-21%	-30%

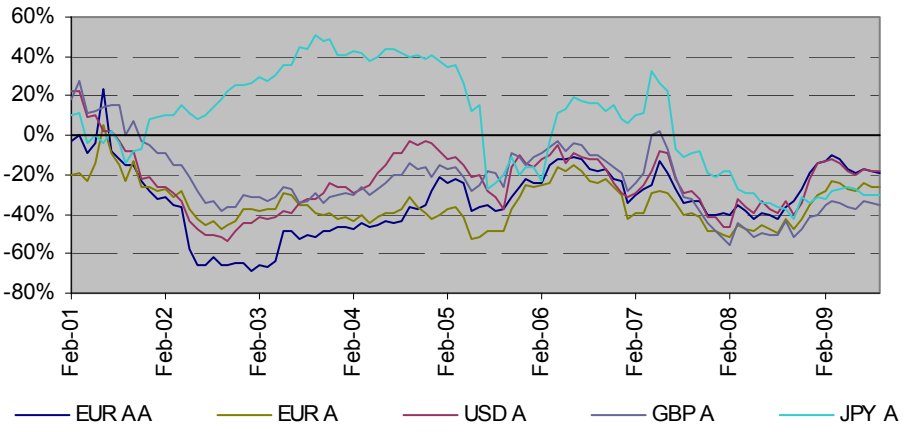
(*) Negative correlation means a drop of equity combined with spread widening

Excluding the Nikkei index from Japan (which seems to be an anomaly), the range of Static historic correlation is -57% to -14%. This suggests that the equity vs spread correlation within a particular geography is generally stronger than the cross-country cross-risk correlations (e.g. US SPX vs US AA correlation of -41% compared to US SPX vs EUR AA correlation of -33%). The analysis also suggests that credit rating has an impact on correlations.

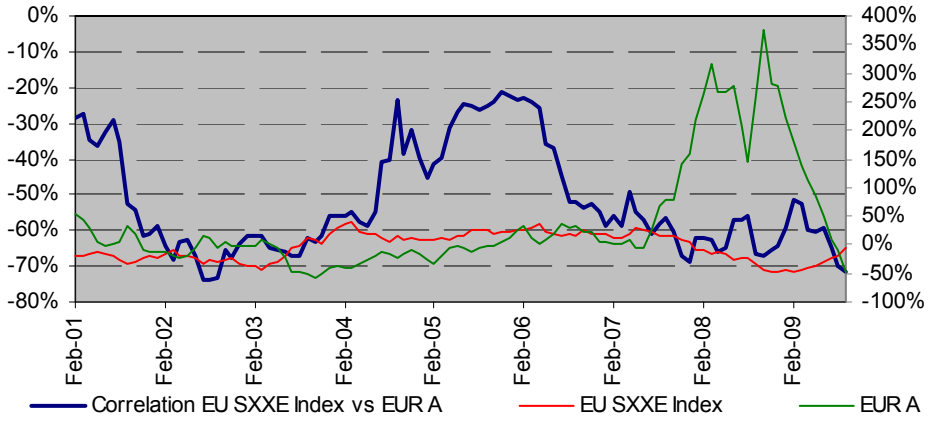
Insurers hold diversified portfolios (diversified across different countries, and/or different credit ratings). So the overall underlying correlation for a typical portfolio would need to reflect the weaker cross-country and cross-rating correlations. The CEIOPS matrix is not granular enough to explicitly model these effects. The single "equity vs spread" cross-risk correlation in the CEIOPS matrix therefore needs to be calibrated to implicitly reflect this diversification.

Note that the data analysis is based on price index movements vs spread index movements - for practical reasons this is used as a proxy to the correlation between total returns. However, we do not expect this to have a material effect on the conclusions.

3-3 Graph 2: 2Y Rolling correlation based on monthly returns (vs EU SXXE Index)



3-3 Graph 3: 2Y Rolling correlation based on monthly return compared with Underlying annual returns



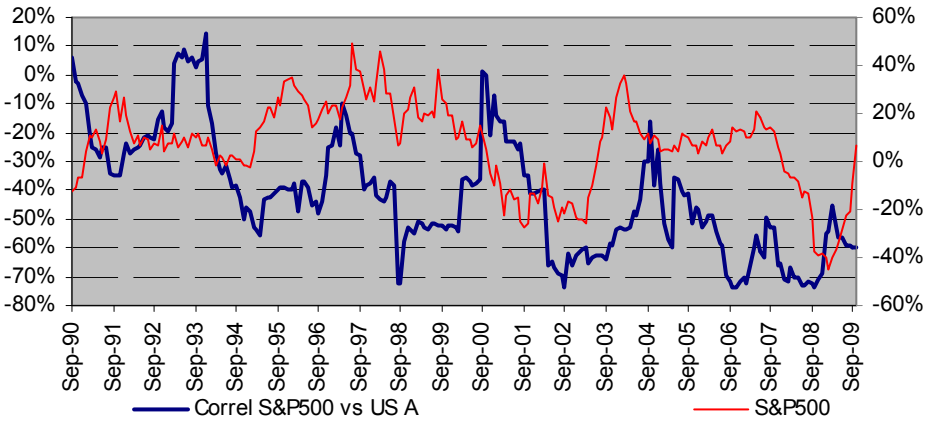
(1) Left axis: 2Y rolling correlation

(2) Right axis: moving annual return for the 2 Underlyings

Graph 3 illustrates that the point at which the rolling correlation is at its strongest for a fairly substantial period of time (from Jan08 to Sept09) coincides with the points in time at which the worst spread shocks also occur.

Given the importance of this correlation factor, we have extended the analysis on US data to cover a longer period. This analysis confirms the high correlation observed in periods of stress events.

3-3 Graph 3 bis: 2Y Rolling correlation based on monthly return compared with Underlying annual returns



(1) Left axis: 2Y rolling correlation

(2) Right axis: moving annual return for the Underlying

3-3 Table 4: Summary of data analysis (min/ max observed over 2 Years windows)

		"Crisis period" (1st July 2007 - 30th June 2009)			Whole 10-year period (1st January 1999 - 30th September 2009)		
	Indices	Static	Max	Min	Static	Max	Min
Equity vs Spreads	EU SXXE Index vs EUR A	**-59%**	-52%	-69%	**-54%**	-21%	-74%
	EU SXXE Index vs USD A	**-60%**	-49%	-71%	**-50%**	-13%	-71%
	EU SXXE Index vs GBP A	**-59%**	-48%	-68%	**-48%**	0%	-71%
	EU SXXE Index vs JPY A	**-16%**	-14%	-55%	**-9%**	31%	-55%
	US SPX Index vs EUR A	**-56%**	-44%	-67%	**-50%**	5%	-73%
	US SPX Index vs USD A	**-54%**	-43%	-74%	**-50%**	-7%	-74%
	US SPX Index vs GBP A	**-57%**	-39%	-69%	**-45%**	22%	-69%
	US SPX Index vs JPY A	**-22%**	-15%	-63%	**-16%**	25%	-63%

(1) The Static correlation of monthly observations over the relevant period.

(2) The max/min of the rolling 2 year correlation over the relevant period.

There is an obvious macroeconomic argument that equity markets and credit markets are closely related. The reason for this argument is that both equity and credit markets depend on market expectations of corporate profitability. The events during the recent crisis certainly support this view (although this was an unprecedented event and could arguably be worse than 1-in-200).

Taking all these elements into account, we agree with CEIOPS proposal on this specific factor of correlation between equity and spread at a high level of 75%.

4. Correlation of Property

The table below shows the correlations between the IPD property indices and equity / property listed equity/ Interest rate over the last ten years. It is evidenced that correlations depend on the nature of the property (residential, commercial), but it is obvious that real estate (prices, correlations) is country specific, depending notably on local factors such as public policy or local demographics pressure.

4 Table 1: Overview of the static correlation IPD[1] (European property investment market Indices) over the period [01.01.1999 – 31.12.2008] with quarterly returns:

Correlation	IPD France	IPD Germany	IPD Netherlands	IPD UK	CH IAZI	US NPPITR
All Property						
Listed Equities	43%	-18%	33%	46%	0%	50%
Property Listed Equities	36%	-29%	36%	57%	17%	45%
IR	35%	1%	44%	52%	-11%	43%
Retail						
Listed Equities	47%	14%	33%	45%		
Property Listed Equities	35%	-7%	36%	57%		
IR	37%	27%	44%	50%		
Office						
Listed Equities	40%	-20%	28%	44%		
Property Listed Equities	29%	-27%	26%	53%		
IR	36%	-5%	36%	51%		
Residential						
Listed Equities	37%	2%	26%	38%		
Property Listed Equities	42%	-11%	31%	39%		
IR	23%	18%	36%	26%		

IPD index: total return including revenue performance and capital performance

Listed Equities: SXEE, or local index for on EUR zone

Property Listed Equities: EPRA

Interest Rate (Swap 5yr: EUR, or local index for non EUR zone

Given the lack of data available for property, all analyses below are based on quarterly returns.

[1] IDP index: Pan European IPD Total Return All Property. Annual public data interpolated by IPD to give quarterly figures in France, Germany, Netherlands, Switzerland. Monthly figures for the UK are publicly available. IPD index is based on expert opinions and not transaction prices and covers about 50% of European Institutional Investors in Europe (investment market). Traditional private individual real estate is not covered in IDP data.

4-1 Property versus Interest rate

The analysis below shows the correlations between the previous property index and EUR/GBP/USD swap rates.

4-1 Table 1: Overview of the static correlation over the period [01.01.1999 – 31.12.2008] with quarterly returns:

	IPD France	IPD Germany	IPD Netherlands	IPD UK	CH IAZI	US NPPITR Index
EUR Swap 2yr	38%	-8%	49%	46%	-11%	51%
EUR Swap 5yr	35%	1%	45%	40%	-9%	42%
EUR Swap 10yr	37%	7%	45%	35%	-6%	38%
USD Swap 2yr	18%	-28%	22%	46%	-3%	41%
USD Swap 5yr	22%	-17%	30%	48%	-13%	43%
USD Swap 10yr	28%	-10%	40%	53%	-17%	49%
GBP Swap 2yr	32%	-8%	51%	56%	-22%	55%
GBP Swap 5yr	30%	-5%	47%	52%	-23%	49%
GBP Swap 10yr	34%	-2%	50%	53%	-21%	51%
CHF Swap 2yr	33%	-13%	40%	46%	-3%	47%
CHF Swap 5yr	34%	-2%	44%	43%	-11%	44%
CHF Swap 10yr	34%	5%	41%	37%	-15%	40%
JPY Swap 2yr	27%	-25%	15%	27%	16%	21%
JPY Swap 5yr	12%	-21%	10%	24%	5%	16%
JPY Swap 10yr	10%	-15%	12%	26%	-2%	19%

(*) Positive correlation means property prices and interest rate generally move into the same direction

The above analysis suggests that the correlations between interest rate and property are material. The Swiss IAZI or German IPD indices are however negatively correlated to interest rate.

Overall we tend to agree with the CEIOPS's factor of 0.5, but given the country specificities of real estate for Germany and Switzerland, we recommend the use of a range (including CEIOPS proposed factor) of [0.25; 0.5], versus 0.5 both in the new Consultation Paper and in QIS4.

4-2 Property versus Equity

In the following table we calculate the correlations between different property rate indices (IPD France, IPD Germany, IPD Netherlands, IPD UK, CH IAZI, US NPPITR) and different equity indices (Eurostoxx, FTSE All-Share, S&P 500). All data is sourced from Bloomberg or interpolated by IPD when necessary to get quarterly returns.

4-2 Table 1: Overview of the static correlation over the period [01.01.1999 – 31.12.2008] with quarterly returns:

	IPD France	IPD Germany	IPD Netherlands	IPD UK	CH IAZI	US NPPITR Index
EU SXXE Index	42%	-19%	33%	46%	7%	43%
US SPX Index	38%	-19%	34%	51%	-6%	50%
UK ASX Index	41%	-30%	22%	44%	1%	43%
CH SMI Index	42%	-31%	30%	49%	0%	49%
JP NKY Index	32%	-37%	25%	54%	5%	43%

(*) Positive correlation means property and equity prices generally move into the same direction

Similar to the findings from correlations of Property against Interest Rate, the analysis above suggests that the correlations between equity and property are material, however clearly lower than 0.75. The Swiss IAZI or German IPD indices are actually negatively correlated to equities.

We propose that the correlation between property and equity is set in the range of [0.25; 0.5], versus the 0.75 proposed both in the new Consultation Paper and in QIS4.

4-3 Property versus Spread

The correlation analysis below uses Merrill Lynch spread indices.

4-3 Table 1: Overview of the static correlation over the period [01.01.1999 – 31.12.2008] with quarterly returns:

	IPD France	IPD Germany	IPD Netherlands	IPD UK	CH IAZI	US NPPITR Index
EUR AAA	-24%	10%	-3%	-33%	9%	-9%
EUR AA	-9%	16%	0%	-37%	5%	-5%
EUR A	-19%	19%	-13%	-52%	11%	-22%
USD AAA	-25%	15%	-2%	-38%	12%	-12%
USD AA	-9%	14%	3%	-38%	15%	-3%
USD A	-14%	17%	-3%	-45%	11%	-11%
GBP AAA	-19%	7%	-9%	-37%	12%	-13%
GBP AA	-14%	10%	-8%	-43%	9%	-11%
GBP A	-22%	10%	-22%	-55%	16%	-29%
CHF AAA	-22%	4%	-1%	-8%	-1%	8%
CHF AA	-18%	16%	1%	-18%	-7%	3%
CHF A	-32%	27%	-7%	-39%	-10%	-21%

(*) Negative correlation means a drop of property prices combined with spread widening

The above analysis suggests that spread and property are negatively correlated, even if Swiss IAZI or German IPD indices are correlated to the contrary.

We therefore propose that the correlation between property risk and spread risk is set to a range of [0.25; 0.5], versus 0.75 in the new Consultation Paper and 0.25 in QIS4.

4-4 Property versus FX

The correlation analysis below uses various FX rates (USD, GBP, CHF, JPY, AUD) vs. EUR.

4-4 Table 1: Overview of the static correlation over the period [01.01.1999 – 31.12.2008] with quarterly returns:

	IPD France	IPD Germany	IPD Netherlands	IPD UK	CH IAZI	US NPPITR Index
USD	-5%	8%	17%	-6%	19%	-8%
GBP	39%	-4%	64%	62%	-7%	56%
CHF	-38%	20%	-31%	-46%	7%	-48%
JPY	-33%	11%	-24%	-44%	41%	-49%
AUD	19%	-7%	25%	34%	-26%	32%

(*) Positive correlation means property prices and FX price against EUR generally move in the same direction.

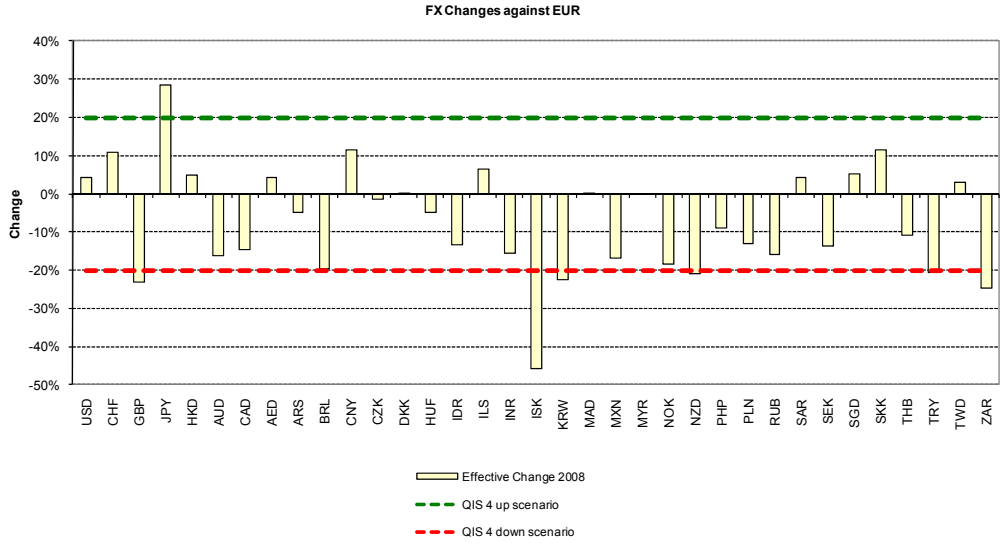
During the recent market crisis, we observed that the correlations between FX rates and property became more extreme. However, these moves were in both directions, dependent on the moves of the FX rates vs. EUR. Overall, in a diversified FX portfolio we could find a fairly moderate correlation between FX and property.

Again, we suggest a low positive correlation in the range of [0; 0.25], versus 0.5 in the new Consultation Paper and 0.25 in QIS4.

5. Correlation of FX

FX rates may move up or down depending on the FX positions in a portfolio. FX rate movements may be beneficial or detrimental (two-sided nature of FX risks). Likewise, the correlations between FX and the other market risks also have a high dependency on the FX positions in the portfolio.

Various currency rates do not normally rise or fall simultaneously. During 2008 some FX rates fell against the EUR (such as GBP, AUD, CAD, ISK), whilst others increased (such as USD, CHF, JPY, HKD).



For a diversified portfolio we can therefore assume a smoothing effect of upward-moving and downward-moving FX rates on the correlations between FX and the other market risks.

5-1 FX VS. Interest Rate

The analysis below shows the correlations between different FX rates and swap rates. FX rates (denoted by USD, GBP, CHF, JPY, and AUD) are the exchange rates vs the Euro (i.e., 1 USD expressed in EUR).

5-1 Table 1: Overview of the static correlation over the period [01.01.1999 – 30.09.2009] with monthly returns:

	USD	GBP	CHF	JPY	AUD
EUR Swap 2yr	8%	9%	-26%	-12%	13%
EUR Swap 5yr	6%	13%	-18%	-13%	14%
EUR Swap 10yr	8%	21%	-7%	-6%	13%
USD Swap 2yr	30%	33%	-24%	-2%	25%
USD Swap 5yr	33%	40%	-11%	1%	24%
USD Swap 10yr	33%	44%	-1%	2%	21%
GBP Swap 2yr	3%	28%	-20%	-18%	25%
GBP Swap 5yr	6%	37%	-16%	-13%	30%
GBP Swap 10yr	17%	51%	-6%	0%	25%
CHF Swap 2yr	13%	12%	-5%	-6%	8%
CHF Swap 5yr	8%	10%	-1%	-5%	9%
CHF Swap 10yr	4%	10%	7%	-1%	8%
JPY Swap 2yr	6%	2%	-15%	8%	18%
JPY Swap 5yr	10%	9%	-13%	11%	19%
JPY Swap 10yr	13%	17%	-7%	7%	18%
AUD Swap 2yr	-3%	18%	-21%	-20%	45%
AUD Swap 5yr	8%	26%	-18%	-17%	44%
AUD Swap 10yr	16%	38%	-16%	-12%	39%

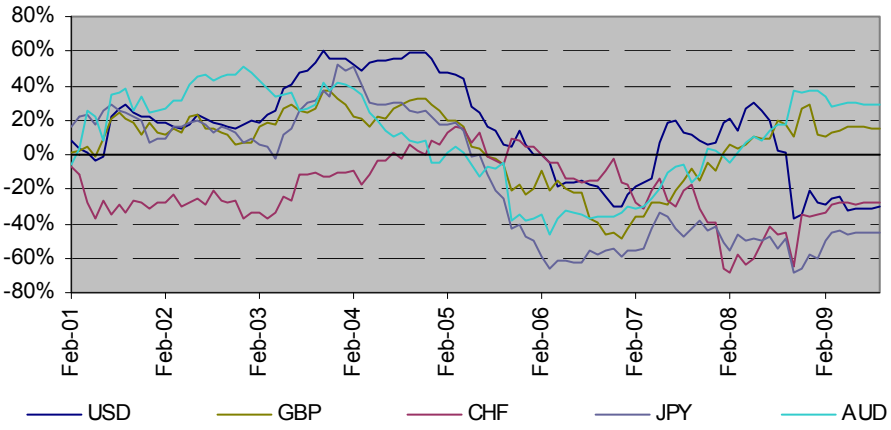
(*) Positive correlation is experienced where Interest Rate and FX price against EUR generally move in the same direction.

Based on a 10yr analysis we observe small to moderate correlations between FX rates and swap rates. In some cases they might even be negative, e.g. CHF or JPY.

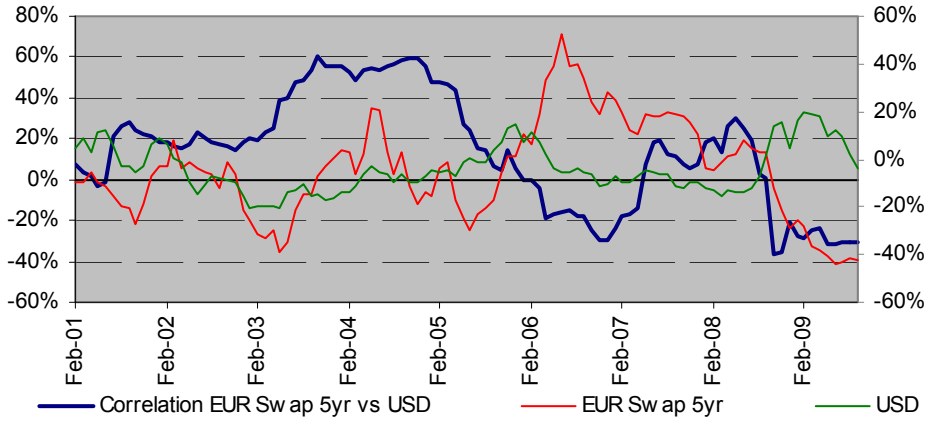
In stressed conditions such as those experienced during the recent market turmoil, correlations between FX rates and interest rates become more extreme. However, the moves can be in both directions dependent on the moves of the FX rates vs. EUR.

For falling FX rates, such as GBP in the last crisis, the correlations moved highly positive, whereas for rising FX rates the correlations became rather negative.

5-1 Graph 2: 2Y Rolling correlation based on monthly returns (vs EUR Swap 5yr)



5-1 Graph 3: 2Y Rolling correlation based on monthly return compared with Underlying annual returns



(1) Left axis: 2Y rolling correlation

(2) Right axis: moving annual return for the 2 Underlyings

An analysis of 2yr rolling correlations shows that the correlations between FX and interest rates are extremely volatile and can be either positive or negative. We therefore support the use of longer time horizons to calculate the correlations.

In addition, Graph 3 illustrates that the point at which the rolling correlation is at its strongest (Dec-04) does not coincide with the points in time at which the worst shocks happen.

5-1 Table 4: Summary of data analysis (min/ max observed over 2 Years windows)

		"Crisis period" (1st July 2007 - 30th June 2009)			Whole 10-year period (1st January 1999 - 30th September 2009)		
	Indices	Static	Max	Min	Static	Max	Min
FX vs Interest Rate	EUR Swap 5yr vs USD	**-31%**	30%	-37%	**6%**	61%	-37%
	EUR Swap 5yr vs GBP	**16%**	29%	-21%	**13%**	38%	-49%
	EUR Swap 5yr vs CHF	**-29%**	-17%	-68%	**-18%**	16%	-68%
	EUR Swap 5yr vs JPY	**-46%**	-39%	-68%	**-13%**	52%	-68%
	USD Swap 5yr vs USD	**33%**	44%	5%	**33%**	62%	-12%
	USD Swap 5yr vs GBP	**75%**	75%	0%	**40%**	76%	-36%
	USD Swap 5yr vs CHF	**-10%**	-9%	-77%	**-11%**	25%	-77%
	USD Swap 5yr vs JPY	**-2%**	0%	-60%	**1%**	40%	-60%

(1) The Static correlation of monthly observations over the relevant period.

(2) The max/min of the rolling 2 year correlation over the relevant period.

The overall correlation would be extremely dependent on the current FX portfolio. Due to the fact that the moves can be in either direction, we expect the overall correlation to be rather moderate for a diversified portfolio.

We therefore again suggest a low to medium positive correlation with a range [0.25; 0.5], including both the 0.5 in the new Consultation Paper and 0.25 from QIS4.

5-2 FX VS. EQUITY

In the following table we calculate the correlations between different FX rates (USD, GBP, CHF, JPY, HKD) vs. EUR and different equity indices (Eurostoxx, FTSE All-Share, S&P 500).

5-2 Table 1: Overview of the static correlation over the period [01.01.1999 – 30.09.2009] with monthly returns:

	USD	GBP	CHF	JPY	AUD
EU SXXE Index	-2%	1%	-45%	-14%	52%
US SPX Index	-20%	-5%	-45%	-17%	53%
UK ASX Index	-12%	-16%	-43%	-14%	51%
CH SMI Index	0%	3%	-46%	-6%	44%
JP NKY Index	-16%	-4%	-44%	-27%	43%
AU AS51 Index	-15%	-6%	-36%	-22%	40%

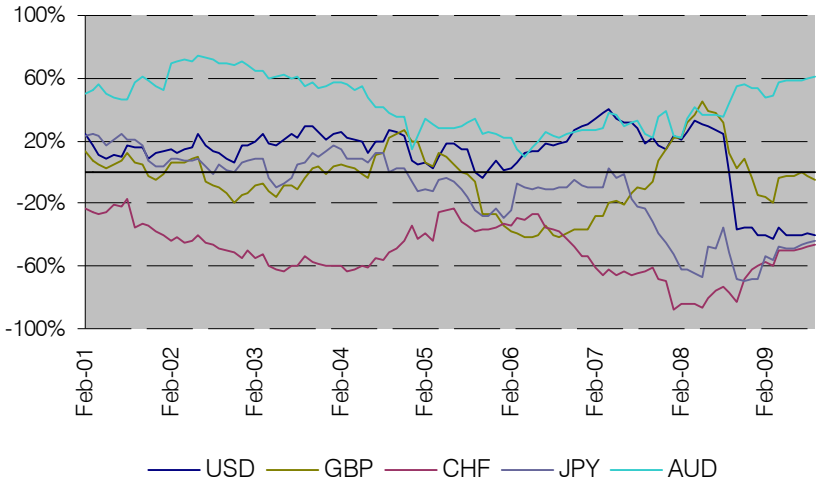
(*) Negative correlation reflects a drop of equity prices combined with FX increase price against EUR

During the recent crisis the correlations between FX and equity became highly negative for some of the most important currencies (rising FX rates and falling equity). FX was one of the few 'diversifiers' in the recent crisis.

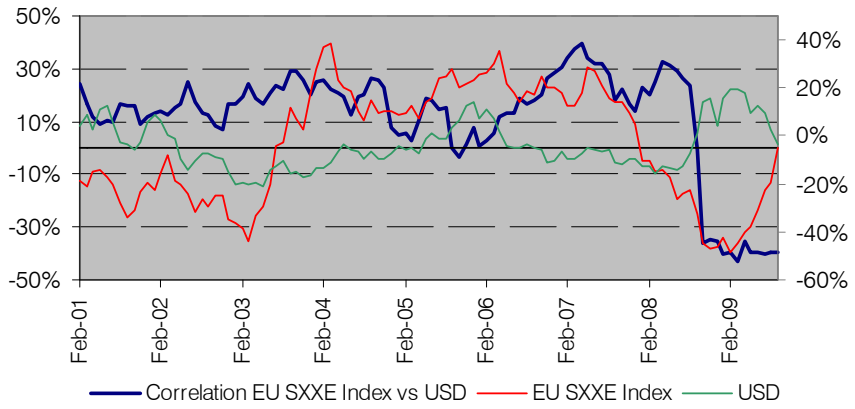
Further, over a longer time horizon the correlations between FX and equity are mostly negative, particularly between the local FX rate and the local equity index.

An analysis of the 2yr rolling correlations between the Eurostoxx (resp. S&P 500) and different FX rates shows that it is very difficult to set a single correlation factor between FX and equity. The overall correlation factor is highly dependant on the invested currencies. In a portfolio of diversified currencies, we can expect an overall moderate correlation due to different movements of the different currencies.

5-2 Graph 2: 2Y Rolling correlation based on monthly returns (vs EU SXXE Index)



5-2 Graph 3: 2Y Rolling correlation based on monthly return compared with Underlying annual returns



(1) Left axis: 2Y rolling correlation

(2) Right axis: moving annual return for the 2 Underlyings

The graphs above provide further evidence that the correlations can be positive or negative. Even within the same currency, changes over time from positive to negative and vice versa are not unlikely. We therefore think that the correlations should be measured over a long time period.

5-2 Table 4: Summary of data analysis (min/ max observed over 2 Years windows)

		"Crisis period" (1st July 2007 - 30th June 2009)			Whole 10-year period (1st January 1999 - 30th September 2009)		
	Indices	Static	Max	Min	Static	Max	Min
FX vs Equity	EU SXXE Index vs USD	**-40%**	33%	-43%	**-2%**	40%	-43%
	EU SXXE Index vs GBP	**-2%**	45%	-20%	**1%**	45%	-42%
	EU SXXE Index vs CHF	**-50%**	-50%	-88%	**-45%**	-17%	-88%
	EU SXXE Index vs JPY	**-48%**	-17%	-69%	**-14%**	24%	-69%
	US SPX Index vs USD	**-55%**	19%	-56%	**-20%**	29%	-56%
	US SPX Index vs GBP	**-11%**	40%	-27%	**-5%**	40%	-57%
	US SPX Index vs CHF	**-53%**	-43%	-88%	**-45%**	4%	-88%
	US SPX Index vs JPY	**-61%**	-32%	-79%	**-17%**	46%	-79%

(1) The Static correlation of monthly observations over the relevant period.

(2) The max/min of the rolling 2 year correlation over the relevant period.

In addition, we believe that setting the correlations between FX risk and equity to 75% would provide the wrong incentives; it punishes companies with a diversified FX portfolio, and it encourages companies to invest in high-risk currencies.

Particularly with respect to equity we would like to stress that these assets cannot be seen as local anymore and that the stress implied for EUR and non-EUR equities cannot be substantially different, which is currently the situation when considering the advice proposed by CEIOPS under Consultation Papers 69, 70 and 74 combined.

Therefore we suggest the correlation between FX and equity is set to a correlation band near to zero, [0; 0.25], versus 0.5 in the new Consultation Paper and 0.25 in QIS4.

5-3 FX VS. Spread

The correlation analysis below uses Merrill Lynch spread indices.

5-3 Table 1: Overview of the static correlation over the period [01.01.1999 – 30.09.2009] with monthly returns:

	USD	GBP	CHF	JPY	AUD
EUR AAA	8%	4%	23%	21%	-33%
EUR AA	4%	-4%	28%	26%	-46%
EUR A	8%	-2%	36%	29%	-50%
USD AAA	18%	10%	39%	29%	-37%
USD AA	13%	1%	31%	29%	-45%
USD A	16%	-3%	36%	27%	-48%
GBP AAA	12%	11%	29%	27%	-28%
GBP AA	4%	-3%	29%	24%	-38%
GBP A	14%	-1%	34%	33%	-42%
CHF AAA	2%	1%	24%	16%	-24%
CHF AA	0%	1%	26%	15%	-33%
CHF A	11%	0%	39%	22%	-27%
JPY AAA	-9%	-5%	-13%	-2%	-8%
JPY AA	8%	-8%	13%	13%	-18%
JPY A	-4%	-19%	36%	8%	-29%
AUD AAA	-2%	1%	34%	18%	-31%
AUD AA	-14%	-11%	16%	4%	-34%
AUD A	-8%	-10%	22%	3%	-34%

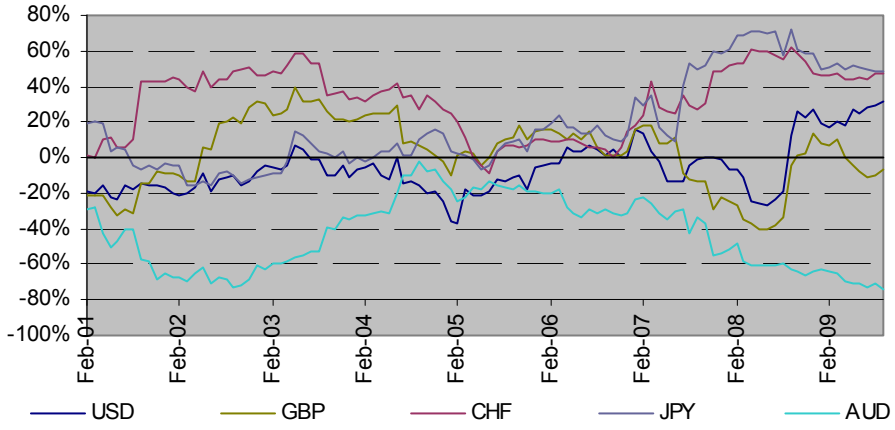
(*) Positive correlation reflects an increase of FX price against EUR combined with spread widening

The table above exhibits rather low long term correlations between FX rates and spread. In general, a positive correlation depicts spread widenings (resp. narrowings) simultaneous to an increase (resp. decrease) in the FX rate vs. EUR.

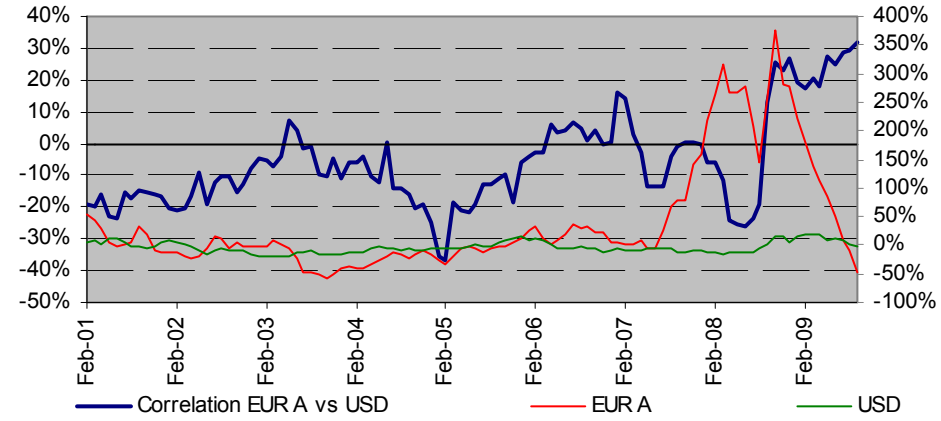
In stressed conditions such as those recently experienced, the correlations between FX rates and spread tend to get more extreme. However, the moves can be in both directions, dependent on the moves of the FX rates vs. EUR.

In the spread widening scenario, the correlations became negative for falling FX rates, such as the GBP and positive for rising interest rates such as USD or JPY. Overall, in a portfolio diversified in FX we experienced a smoothing effect due to the different behaviour of the different FX rates.

5-3 Graph 2: 2Y Rolling correlation based on monthly returns (vs EUR A)



5-3 Graph 3: 2Y Rolling correlation based on monthly return compared with Underlying annual returns



(1) Left axis: 2Y rolling correlation

(2) Right axis: moving annual return for the 2 Underlyings

The correlations between FX rates and spread are extremely volatile and could change from positive to negative and vice versa, even within the same currency. We therefore reiterate the use of static correlation based on the full historic dataset as a more reliable statistic than the rolling correlation.

5-3 Table 4: Summary of data analysis (min/ max observed over 2 Years windows)

		"Crisis period" (1st July 2007 - 30th June 2009)			Whole 10-year period (1st January 1999 - 30th September 2009)		
	Indices	Static	Max	Min	Static	Max	Min
FX vs Spread	EUR A vs USD	**25%**	27%	-26%	**8%**	32%	-37%
	EUR A vs GBP	**-8%**	14%	-40%	**-2%**	40%	-40%
	EUR A vs CHF	**45%**	62%	27%	**36%**	62%	-9%
	EUR A vs JPY	**51%**	72%	40%	**29%**	72%	-16%
	USD A vs USD	**23%**	35%	-31%	**16%**	40%	-31%
	USD A vs GBP	**-10%**	28%	-47%	**-3%**	47%	-47%
	USD A vs CHF	**39%**	67%	31%	**36%**	67%	-9%
	USD A vs JPY	**41%**	72%	33%	**27%**	72%	-9%

(1) The Static correlation of monthly observations over the relevant period.

(2) The max/min of the rolling 2 year correlation over the relevant period.

We suggest a low positive correlation with range [0; 0.25], versus 0.5 in the new Consultation Paper and 0.25 in QIS4.

6. Correlation of Concentration

We consider the correlations between concentration risk and the other market risks of 50% for FX, and resp. to 75% for interest rate, equity, spread and property, as unrealistic.

The correlations between the concentration risk and the other market risks depend on the underlying portfolio. An internal analysis of QIS4 results for Groups shows that for entities that have a concentration risk, most of the risk stems from government-related bonds (such as provinces or Bundesländer). An increase of the equity exposure would therefore effectively decrease the concentration risk, since it increases the asset base. Thus a negative correlation between concentration and equity risk would seem more appropriate in this case. The suggested correlation factor would give the wrong incentive.

Concentration correlations have greater dependence on the individual portfolio than on the market movements. Concentration risk is not a stand alone risk, nor is it a risk that needs to be managed. The concentration should be allocated to the underlying risk and let the correlations carry through.

So, we propose to keep the correlations between concentration risk and other market risk at 0%, as in QIS4. Where a company has a very concentrated portfolio an add-on could be set as part of the pillar II measures.

7. Independent pairs and other risk correlations

7-1 Disagreement on CEIOPS' position to use non-zero correlations for independent pairs

The Consultation Paper proposes that we should not use zero correlation for independent pairs (#3.1.4).

The aggregation method (using a correlation matrix) is based on the assumption that the risks are elliptically distributed - within the class of elliptical distributions correlations work fine for aggregating VaR. In particular, independent risk factors have zero correlation. The argument by CEIOPS is that the mathematics of the correlation matrix approach does not hold in situations where the variables are not multivariate normal or elliptically distributed. While this is true, it is not a justification for making an arbitrary adjustment as proposed. The latter is of particular importance as there are examples of marginal distributions (even skewed and truncated ones), too, where the aggregation method (square root formula) results in an overestimation of the joint VaR.

If CEIOPS believes that the risks do not follow an elliptical distribution (as in examples 3.19 and 3.20) the assumptions on the distributions should be made transparent for each individual risk distribution. A perturbation of the aggregation method (using perturbed correlation factors) should be derived from a transparent set of assumptions. The qualitative arguments used by CEIOPS in CP74 are not sufficient.

CEIOPS propose to correct for the fact that in reality the distributions are not elliptical by including arbitrary compensating adjustments to the correlation parameters. In our view this arbitrary adjustment is even more inaccurate than using the matrix without adjustment.

We therefore recommend that independent pairs are treated as having zero correlation, in line with the assumptions underlying the Var/Cov matrix approach, unless there is evidence that the typical type of two marginal risk distributions together with the aggregation method leads to a systematic underestimation of the joint VaR.

7-1-a) Non-Life and Life Risk correlations

While CAT risk is typically non-elliptical this is not evident for the other risk distributions. The aggregation of an elliptical and a non-elliptical distribution using the square root formula can produce all types of results; an overestimation as well as an underestimation. We believe underestimation is not typical and thus suggest keeping the correlation at zero, as in QIS4.

If for any reasons part of the CAT risk would be modelled in the premium and reserve risk module, this has to be absorbed as part of the pillar II measures, not in the correlation factors.

Correlation matrix of Non-Life underwriting risk in the standard formula:

Corr	*Premium and Reserve*	*CAT*
Premium and Reserve	1	
CAT	QIS4: 0 CEIOPS prop: 0.25	1

7-1-b) Life Risk correlations

We believe the shortcoming of the aggregation technique for particular distributions in the case of independence is not a valid argument for increasing the zero correlation in the sub risks of life and non-life underwriting risks where is has been used extensively by CEIOPS. CEIOPS should provide arguments as to why it believes that the life risk distributions are typically non-elliptical.

While CAT risk is typically non-elliptical this is not evident for the other risk distributions. As explained above on Non-Life, with aggregation of an elliptical and a non-elliptical distribution using the square root formula that can produce an overestimation as well as an underestimation, we suggest to keep a zero correlation as in QIS4.

The same holds for the correlations between mortality and lapse, disability and lapse, as well as the correlations between revision and mortality, revision and disability, revision and lapses. All those pairs can be considered to be independent and should therefore have zero correlation.

Correlation matrix of Life underwriting risk in the standard formula:

Corr	*Mortality*	*Longevity*	*Disability*	*Lapse*	*Expenses*	*Revision*	*CAT*
Mortality	1						
Longevity	QIS4:-0.25	1					
Disability	QIS4:0.5 CEIOPS prop: 0.25	QIS4:0 CEIOPS prop: 0.25	1				
Lapse	QIS4:0 CEIOPS prop: 0.25	QIS4:0.25	QIS4:0 CEIOPS prop: 0.25	1			
Expenses	QIS4:0.25	QIS4:0.25	QIS4:0.5	QIS4:0.5	1		
Revision	QIS4:0 CEIOPS prop: 0.25	QIS4:0.25	QIS4:0 CEIOPS prop: 0.25	QIS4:0 CEIOPS prop: 0.25	QIS4:0.25 CEIOPS prop: 0.5	1	
CAT	QIS4:0 CEIOPS prop: 0.25						1

7-2 Modified correlation matrix for the basic SCR

We would like to express concern with CEIOPS' proposal to modify the correlation matrix for the basic SCR (market, default, life, health, non-life), that is part of the Annex IV of the Directive. The determination of these new correlation factors should be documented and not only based on general considerations.

More specifically, our position on the 3 suggested increases is:

- Health UW risk vs Life UW risk at 0.75 (vs 0.25 in the Directive): this huge increase deserves explanation and documentation, which are not currently provided in this Consultation Paper. Different products within these two modules are exposed to different risks (e.g. mortality or longevity). CEIOPS's proposal implies a high correlation between a life product exposed to mortality risk and a health product exposed to longevity risk, this is implausible. The argument provided by CEIOPS can be best captured by a different aggregation technique such as proposed in Calibration Principles for the Solvency II Standard Formula (CROF, May 2009), namely aggregating risk types in the health and life sub module rather than directly aggregating health and life risk.
- Health UW risk vs Non-Life UW risk at 0.25 (vs 0 in the Directive, but 0.25 in QIS4): we tend to agree with this proposal, as it is at least consistent with the approach retained in QIS4.
- Market risk vs Default Risk at 0.5 (vs 0.25 in the Directive): we tend to agree with arguments expressed by CEIOPS and in fact it is consistent with the factor retained in some Internal Models of our members.

Correlation matrix of Basic SCR in the Directive (Annex IV):

CorrMkt	*Market*	*Default*	*Life*	*Health*	*Non Life*
Market	1				
Default	0.25 CEIOPS prop: 0.5	1			
Life	0.25	0.25	1		
Health	0.25	0.25	0.25 CEIOPS prop: 0.75	1	
Non Life	0.25	0.5	0	0 CEIOPS prop: 0.25	1

Appendix

Summary of time series used for the analysis:

Risk Factor	Region	Bloomberg Code	Frequency Data Points	Start date of data	Description
Equity	Eurozone	SXXE Index	Daily	31/03/1987	The Dow Jones EURO STOXX (Price) Index is a capitalization-weighted index which includes countries that are participating in the EMU. The equities use free float shares in the index calculation. The index was developed with a base value of 100 as of December 31, 1991. This index uses float shares.
	US	SPX Index	Daily	30/12/1927	Standard and Poor's 500 Index is a capitalization-weighted index of 500 stocks. The index is designed to measure performance of the broad domestic economy through changes in the aggregate market value of 500 stocks representing all major industries. The index was developed with a base level of 10 for the 1941-43 base period.
	UK	ASX Index	Daily	10/04/1962	The FTSE All-Share Index is a capitalization-weighted index comprising of the FTSE 350 and the FTSE SmallCap Indices. The index was developed with a base value of 100.00 as of April 10, 1962.
	CH	SMI Index	Daily	01/01/1999	
	JP	NKY Index	Daily	01/01/1999	
	AU	AS51	Daily	01/01/1999	
Interest	Eurozone	Swap 2yr	Weekly	01/01/1999	Swap Yields 2 Year Spot rate
		Swap 5yr	Weekly	01/01/1999	Swap Yields 5 Year Spot rate
		Swap 10yr	Weekly	01/01/1999	Swap Yields 10 Year Spot rate
	idem for US, UK, CH, JP, AU				
Spreads	Eurozone	ML EMU AAA	Daily	01/01/1999	EMU Merrill lynch Index for spread
		ML EMU AA	Daily	01/01/1999	EMU Merrill lynch Index for spread
		ML EMU A	Daily	01/01/1999	EMU Merrill lynch Index for spread
	idem for US, UK, CH, JP, AU				
Property	France	IPDUFRAR Index	Quarterly	01/01/1999	France IPD Total Return All Property
	Germany	IPDUDEAR Index	Quarterly	01/01/1999	Germany IPD Total Return All Property
	Netherlands		Quarterly	01/01/1999	Netherlands IPD Total Return All Property
	UK	IPDMPROP Index	Monthly	01/01/1999	UK IPD Total Return All Property
	Switzerland	CH IAZI	Quarterly	01/01/1999	CH IAZI index used for the SST
	US	NPPITR	Quarterly	01/01/1999	NCREIF Property Index TR
FX		EURUSD Curncy	Daily	01/01/1999	EUR-USD X-RATE
		EURGBP Curncy	Daily	01/01/1999	EUR-GBP X-RATE
	idem for CHF, JPY, AUD				

Notes:

All the data has been downloaded from Bloomberg. The only exception is for Quarterly return of IPD index for some European market (namely France, Germany, Netherlands)

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