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## The absence of equity diversification in times of stress

Today's evolving global capital regimes require firms to assess the quantity of capital required to survive extreme events. Given the rarity of these events, defining 'stress' scenarios for this purpose turns out to be an inherently very difficult task. The year of 2008 has provided a severe test for financial firms which a number have failed to survive.

For firms that bear risk across a portfolio of equity assets a key lesson is that diversification is absent when markets suffer common global shocks. Dependence between equity markets is strongest during periods of stress. Tellingly, the tools to capture this fundamental feature of equity market behaviour already exist. The challenge for firms and regulators is now to acknowledge the compelling case for this class of models. This recognition of economic reality will have a capital cost.

### How bad was 2008?

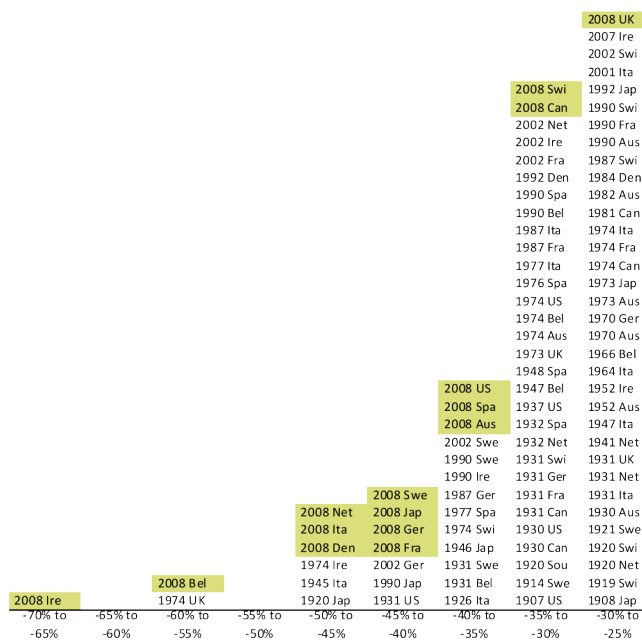
The chart below plots the level of CHF government interest rates for end-2010 and end-September 2011. The interest rates plotted here have been estimated using public data sources and our standard published methodology. You can see that rates have fallen at every maturity with 1-year rates finishing the period close to zero.

2008 will be remembered as an extraordinary period for global equity investors. Many markets suffered price falls in excess of the proposed Solvency II equity stress of -32%.

In figure 1 we show how the equity returns observed during 2008 compare with other years. Whilst the magnitude of the observed returns is certainly unusual, what sets apart 2008 is the fact that so many markets have fallen at the same time. Just when portfolio diversification could have benefited investors most, it simply did not materialise.

Figure 1  
Annual excess returns

*Just when portfolio diversification could have benefited investors most, it simply did not materialise.*



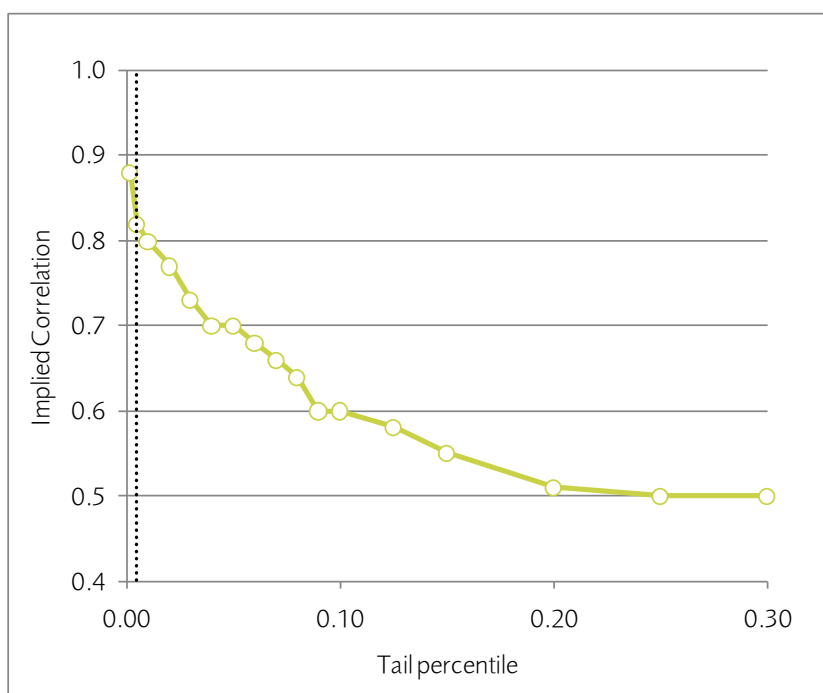
## Could we have predicted this apparently extraordinary dependence?

Although the long-term average level of correlation among large equity markets is of the order of 0.50, this tends to rise at times of market stress. 2008 was no different with a realised 10-day correlation averaged across five major economies as high as 0.79.

Figure 2 plots an 'implied' correlation calculated using an historical analysis of tail dependent events and, while care needs to be taken interpreting these results due to the low number of observations, we can see that dependency seems to increase in the tails. Note that our estimate at the 99.5<sup>th</sup> percentile is uncannily close to the 2008 average.

**Figure 2**

Linear correlation 'implied' by observed tail dependence



As an aside, it is worth noting that the recommended correlation assumption for combining equity stresses under the proposed Solvency II regime (set out in the QIS4 technical documentation<sup>1</sup>) is 0.75.

<sup>1</sup> See, for example, QIS4 Technical Specifications (MARKT/2505/08), Annex to Call for Advice from CEIOPS.

## How can models account for this effect?

Strong tail dependence and the elevated correlation observed at times of stress are the direct result of a rise in the volatility of a shared (i.e. global) common factor. To mimic this effect, model structures which allow for stochastic variation in the volatility of a factor shared by all equity markets are required. This is not a new idea – see for example our 1998 report on this topic and implementations of a stochastic volatility model across multiple equity markets<sup>2</sup>. You might argue that it is just common sense. Indeed, we offer stochastic models for common factor volatility which are driven by a both a continuous time component and a discontinuous 'jump' component<sup>3</sup>.

## So why isn't this standard practice?

If it is so obvious, you might assume that this sort of feature would be widely adopted by firms modelling equity returns for the purposes of product pricing, valuation, capital assessment and capital management. In reality, although some firms have followed this approach, it is certainly not the norm. We can only speculate why this is the case. Certainly, after 2008 there will be pressure on firms and regulators to demonstrate that the stochastic models selected by firms for modelling diversified equity portfolios and the associated calibration choices are capable of capturing the sort of extreme market behaviour observed. Why might a more sophisticated approach be resisted?

Firstly, more complex models will be more difficult for analysts to understand, calibrate and communicate to C-level users of model output. Models should always be kept as simple as possible. One of the most difficult tasks faced by modellers is working out when to introduce additional complexity into a modelling exercise and when it is safe to set it aside in the interests of model 'parsimony'. The answer will vary depending on the question asked of the model.

Secondly, there may be a material impact on a firm's capital costs of adopting more conservative assumptions about the benefits of equity diversification. It should be no surprise that this conservatism has a material cost in terms of additional capital. It seems likely that this cost has acted as a deterrent to firms adopting models and assumptions which embed stronger tail dependence and stress correlation.

*It should be no surprise that this conservatism has a cost in terms of additional capital.*

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<sup>2</sup> Asset Correlations in a World of Abnormal Asset Volatility, Barrie & Hibbert research report #39, November 1998

<sup>3</sup> Stochastic Volatility Jump Diffusion Calibration, Dynamics & Implementation, Barrie & Hibbert technical report November 2008.

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