Minimum Capital Requirements for Market Risk: Comments

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<u>**BIS FRTB**</u>

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1 Standardised Approach

There are two issues within the SA framework that perhaps do not capitalise risks as robustly as the risks within a portfolio might demand:

1. SA: Correlations
2. SA: Curvature Risk Calculations (Gamma)

1.1 SA: Correlations

1.1.1 GIRR Delta

Within the same currency, basis swap (tenor and clearing house basis) positions, the correlation of 99.9% seems too high relative to historic correlations.

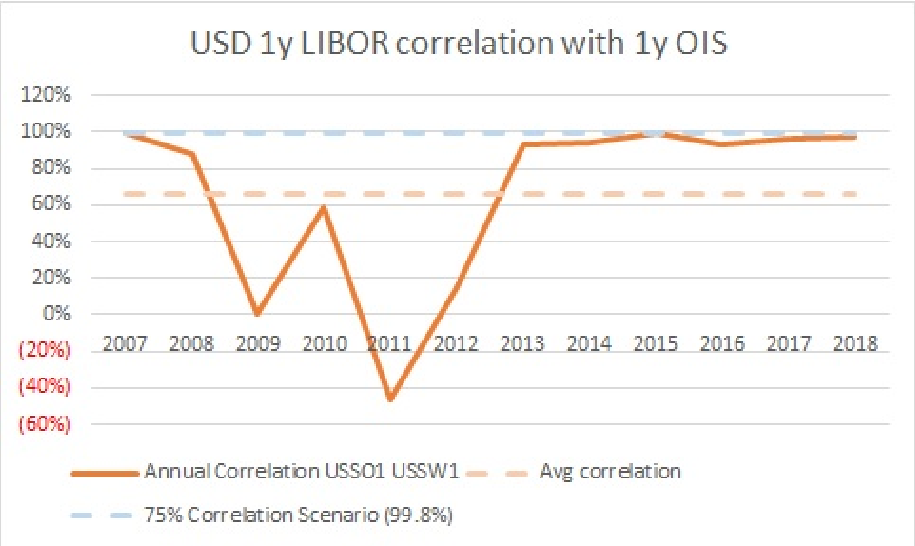

Figure 1: In the 75% correlation scenario, this is only reduced to 99.8% compared to 65% average correlation over the past 10 years for USD 1yr OIS vs USD 1yr Swap.

In any moderately stressed time, Figure 2, these bases display similar volatility to the underlyings. The capitalisation of an outright swap is 16 times that of a tenor basis swap yet the tenor basis displays closer to 63% the volatility of the outright swap (over the past 10 years), as opposed to the 6% which is being proposed. Capitalisation using a 99.8% correlation may lead to significant under-capitalisation of these risks just when it is needed most.

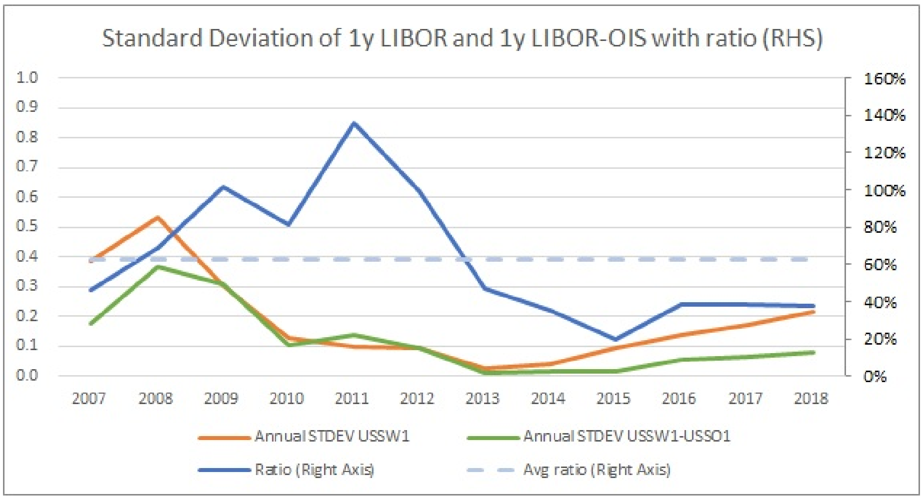

Figure 2: The Basis regularly exhibits volatility that is a significant percentage of the outright swap, which implies a 99% offset is unrealistic

1.1.2 GIRR Vega

Vega correlations as defined by the SA model may also be too high. Two cases highlight this.
For the first case, a 1y1y swaption vs a 1y10y swaption, at the 75% correlation scenario the vol points are correlated at 82.8% but the average over the past 10 years is 68%(Figure 3).

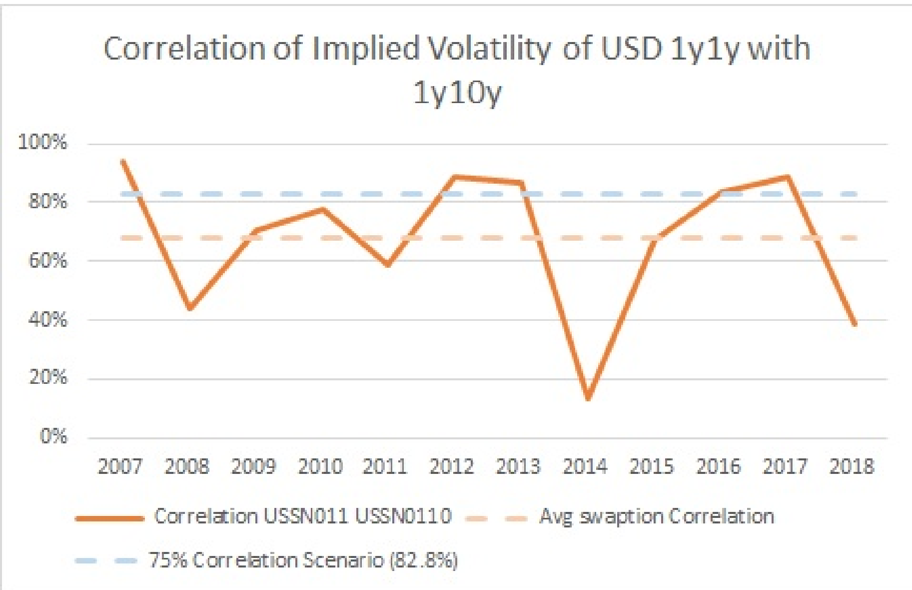

Figure 3: The 10 year historic average correlation of these vol points is significantly lower than the current SA low correlation scenario.

On options of the same underlying but differing optionality, eg 1y1y and 10y1y swaption, the current SA method assumes a correlation of 82.8% in the 75% scenario yet the historic average correlations over the last 10 years is less than 50% (Figure 4).

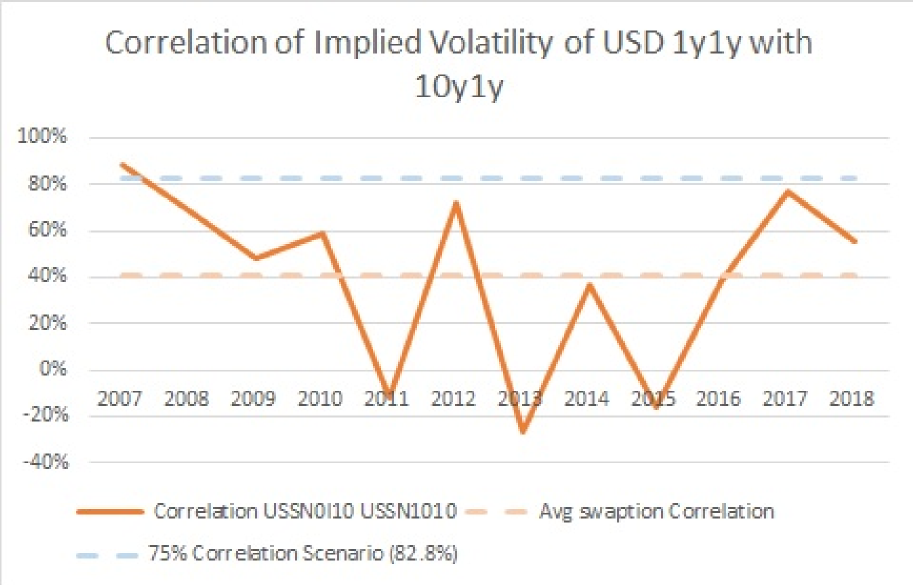

Figure 4: Again, the SA implied correlation is far above both the historic average and the realised correlations during stress times, when SA capital is meant to "kick in".

Decorrelating the options may provide for a more suitable capital buffer in times of stress - moving the alpha (used to determine these correlations) from 1% to 2% would move both these correlations to 67% (on the 75% correlation scenario), but for stress periods, 4% may be more appropriate.

1.2 SA: Curvature Risk Calculations

Within the SA model, curvature risk is calculated by applying a parallel shock to the curve. The assumption of parallel curve moves during stressed scenarios may not pick up all the inherent nonlinear exposures in trading books. The scenarios (Russian financial crisis, sub-prime crisis) referenced in the proposed regulations include some dramatic steepening or flattening of the yield curves. See 3 examples below where the curve shape was as volatile as outright yields.

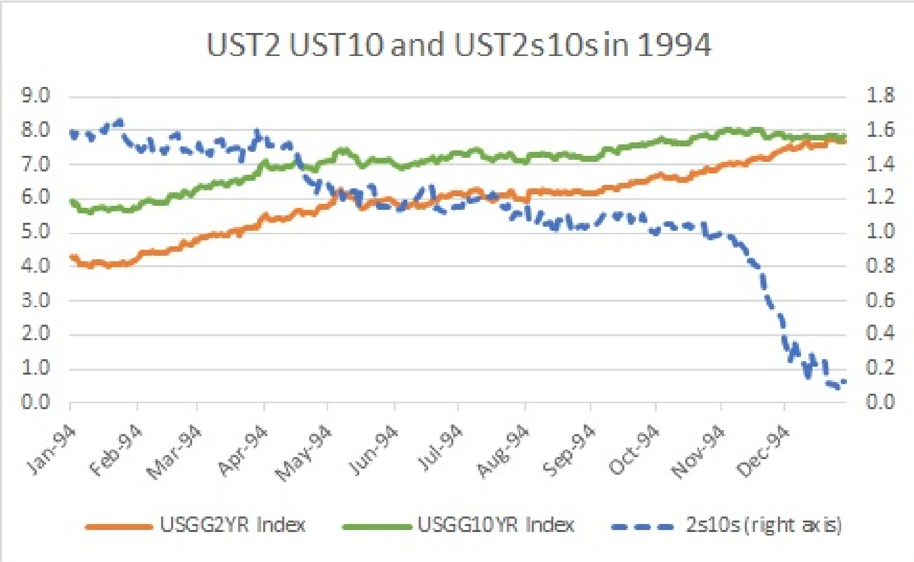

Figure 5: 2y and 10y moved less than the spread during December 1994

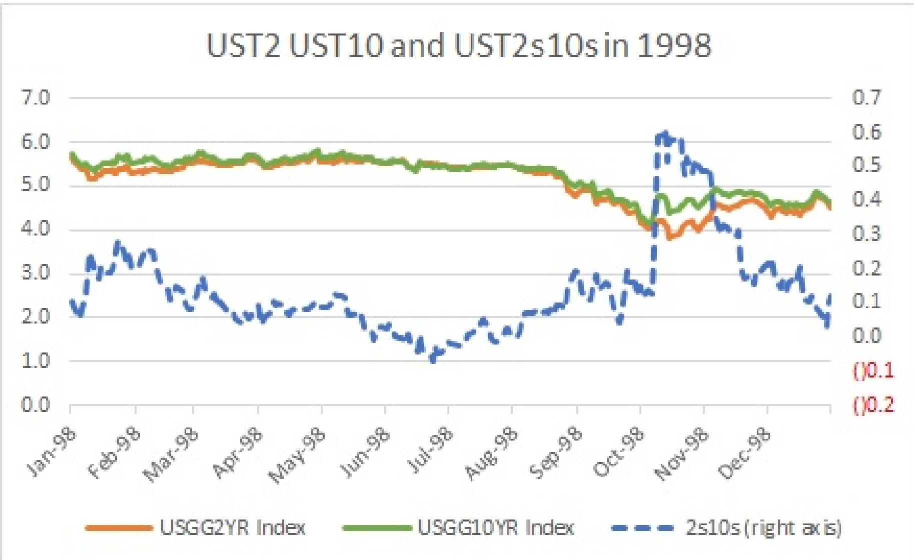

Figure 6: Russian crisis - the yield curve steepness saw periods of extreme volatility

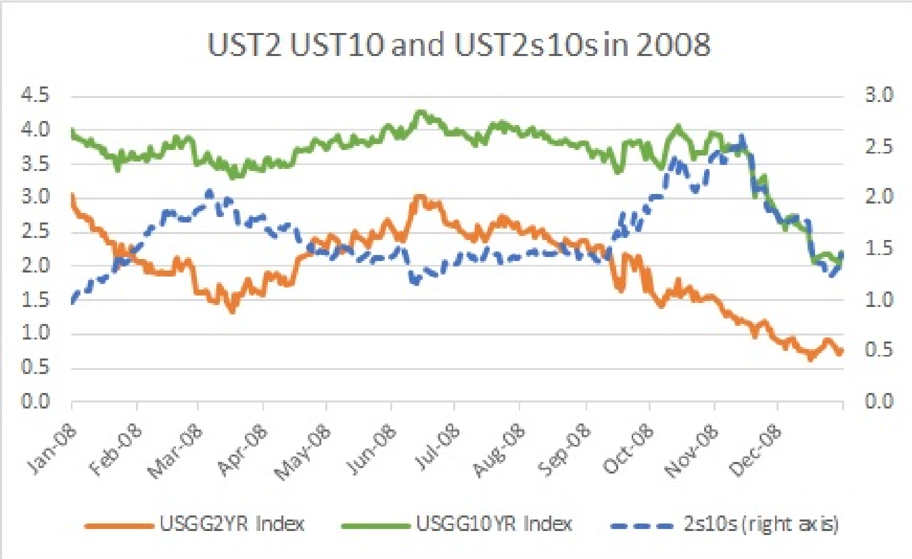

Figure 7: In late 2008, 2s10s steepened and flattened 100bps in a matter of months.

It would be prudent, without being overly cautious, to add 4 more scenarios in addition to the parallel scenarios already proposed:

1. Bear flattening scenario: the shortest tenor is shocked +1.5x the risk weight, the longest tenor +0.5x the risk weight, and a linear interpolation used to calculate the shock to any other point

2. Bear Steepening senario: The shortest tenor is shocked +0.5x the risk weight, the longest tenor +1.5x the risk weight, and interpolation as above

3. Bull Flattening senario: The shortest tenor is shocked -0.5x the risk weight, the longest tenor -1.5x the risk weight, and interpolation as above

4. Bull Steepening senario: The shortest tenor is shocked -1.5x the risk weight, the longest tenor -0.5x the risk weight, and interpolation as above

Either the worst of these 6 scenarios, or some weighted average of the 3 bullish scenarios vs the weighted average of the 3 bearish scenarios compared, to generate the curvature capital. This would more effectively capture all curvature risk within a trading book, especially given the broad range of options that are primarily affected by curve shape.

2 Internal Models Approach

A major concern with the IMA regulations lies with the fact that banks can pass PLAT by adding a delta overlay and still have a model which doesn't correctly attribute risk and PL.

2.1 Traditional Risk Factor Generation

In almost all financial institutions, risks within trading books are calculated on a standard "bump and revalue" model. This holds for delta, theta, vega, and gamma.
Gamma is calculated under a parallel curve shift assumption i.e. the curve is parallel shifted by 1 basis point, the delta ladder recalculated and the difference taken. This method is susceptible to a misattribution of risk within certain classes of non-linear derivatives as the results can be significantly impacted by curve shape.
Most interest rates options books do not monitor or attribute PL to vanna ($\Delta - Vega$ cross, $\frac{d^2V}{drd\sigma}$) or volga (vol gamma, or vomma, $\frac{d^2V}{d\sigma^2}$) or make a very rough approximation which can often prove worse than no estimation at all.

An example trades will be examined and for simplicity 2 assumptions will be made, neither of which materially affect the results

1. the annuity value of a spot starting swap is assumed equal to the tenor of the swap regardless of rate level (this assumption should have little implication at the margin)
2. The trade is initiated such that the delta is 0, net gamma = ± 1

2.1.1 Example Trade: Short 3y1y ATM Straddle

The Gamma ladder traditionally used is below, an example market move, and the predicted delta change due to gamma is given below:

Bucket	Gamma	d rate	Δ Change
1y	0	4	0
2y	0	4	0
3y	3	4	12
4y	-4	3	-12
5y	0	3	0

In this scenario, traditional gamma would result in non-linear PL of +6 ($= 0.5 * \left((3) * 4^2 + (-4) * 3^2\right)$). This is counterintuitive - the model implies that the seller of the option has made money on the gamma risk.
The 3y1y forward in this scenario has not actually moved so the correct gamma PL is zero and although the total delta change above happens to sum to 0, the delta change for every bucket should also be zero, not ± 12.
This failure is only observed on days when the curve does not move in parallel (ie most days). However with a small delta overlay this model could be made to pass PLAT and thus deemed acceptable for IMA capitalisation when clearly it is neither accurately reflecting risk nor PL.
If the model can fail so comprehensively for a simple example in a benign rate

move, it seems difficult to trust the results of the ES calculations for more significant market moves. Vanna risk and volga risk have not been addressed but these are clearly important risks especially in stress scenarios and there are multiple examples of periods of moderate stress or market shifts where these risks dominated trading book PL but the regulations as they stand do not seem to provide a capital buffer against these risks.

2.2 Suggested Solutions

It is proposed that within the IMA framework banks should show the ability to properly attribute risk and PL on a set of very simple portfolios, each portfolio consisting of a single trade of a given risk type and the natural hedges (so a total of about 2-5 trades) limited to those products of equal or lesser complexity.

Broadly applied, this would provide for product level proof of the risk model without the ability to obfuscate incorrectly attributed (or overlooked) risk via a portfolio effect.

For example, one would prove the following trades can pass PLAT sequentially:

1. IRS: a 1y forward, 1y swap, with the risk factor suggested by the model suggests (1y IRS, 2y IRS, and the requisite OIS hedges). This portfolio should be run on market data shocks of a reasonable stress period and show that PL attribution holds.
2. Vanilla European Swaptions: 1y1y 25 basis point OTM option, vega hedged with an at the money option and delta hedged should predict PL well on market data shocks taken from a stress period.
3. For European midcurve options and spread options, show that an at the money midcurve straddle eg 1y option onto 5y5y forward swap, hedged with the vanilla European straddles to vega neutral or gamma neutral (proving both are valid seems reasonable) and delta hedged as model specified, PL attribution holds.

(To mitigate the complexity of aging a portfolio, the proofs would be on a single day of PL with market data shocks taken from stress periods.)

This is an iterative method, so each portfolio steps up in complexity of the tested instrument and uses a subset of simpler instruments to hedge. If there is a failure at any point, it can be assumed that all higher complexity products that require the failed product to hedge would also fail.

Significant improvements could be achieved via these simple test portfolios, highlighting where the risk management model does or does not work and places where it is stable enough to trust for capital calculations.

It should not significantly increase the workload as it should only need to be run once per model/product combination at induction of the product to IMA to confirm risk management efficiency, and possibly updated if a “new” stress scenario comes to pass that is quantitatively and qualitatively different from previous stress periods.

Having tested these portfolios, and even under the recently revised PLAT tests, due to the parallel assumptions outlined above, these would regularly fail. However these portfolios can be made to pass through addition of a delta overlay (portfolio obfuscation) which highlights another significant issue with the current PLAT tests as envisioned.

Below are 2 examples, of vanilla European options (similar to test portfolio 2 from above) and vanilla mid-curve options (test portfolio 3) run through PLAT with SA and IMA capital calculated before and after a delta overlay is added.

The trade notional is 100 million USD per leg, and capital charges (in 1000’s of USD) are calculated for

1. SA
2. IMA using traditional bank metrics
3. IMA where a more complete quantification is made to fully capture the portfolio risk

These are capital risk market charges only, and do not include NMRF capital, correlation add-on, or any other capital charges.

		PLAT			Capital charge		With Delta	PLAT			Capital charge	
Portfolio (vega and delta neutral)		Spearman	Chi	KS	SA	IMA	Overlay	Spearman	Chi	KS	SA	IMA
1y1y ATM Payer vs 1y1y A+25 Payer	Traditional gamma	55.0%	55.0	0.170	153	1	Pay 5mio 6m swap	83.0%	7.0	0.070	152	22
	Complete gamma	98.0%	0.5	0.020		540		99.8%	0.1	0.020		539
Long 1y4y straddle vs 1y1y, 1y opt onto 1y1yfwd , 1y opt onto 2y1yfwd , 1y opt onto 3y1yfwd straddles	Traditional gamma	45.0%	257.0	0.400	13	105	Pay 0.5mio 10y swap	97.0%	8.0	0.090	100	110
	Complete gamma	99.9%	0.3	0.020		346		100.0%	0.0	0.010		347

The key findings are:

1. In all portfolios the base SA capital is significantly less than the expected capital when using a more complete quantification of risks. This incentivises banks to use a less quantitatively complete model for risk management.
2. The IMA model, if achieved, usually provides for significant capital release under traditional metrics which unfortunately have been demonstrated to significantly overlook risk.
3. Traditional risk metrics are poor predictors of non-linear PL, hence failing PLAT, but this can become obfuscated with the addition of small amounts of linear risk (delta or vega).
4. A more complete quantification of the risks in the portfolio show that within the ES model, the linear risk overlay creates no meaningful change in capital charges (as you would expect when the overlay is relatively trivial market risk).

5. A complete quantification of risks shows that the SA capital method can significantly under-capitalise portfolios during stress periods. This is related to both excessively optimistic correlation assumptions, gamma scenarios, and the lack of scenarios to capture the vanna and volga risk run in a portfolio, all addressed in Section 1.

2.3 Updated PLAT Test

Issues with the revised PLAT tests

1. Measures only test relative accuracy rather than absolute accuracy so unable to highlight the risk model shortcomings
2. Can be passed by simply adding a small overlay of linear risk obfuscating risk management shortcomings.

Replacement test Proposal:

1. The PLAT testing should be skewed towards checking PL predict accuracy in stressed periods so that the ES figures can be relied upon
2. The test gives a quantitative measure of the accuracy of the risk model for non-linear PL
3. It is assumed that the Risk management model accurately attributes PL for first order vanilla risks (ie delta and vega)

The simplest test implementation could be:

1. Calculate the HPL and RTPL for the test horizon, daily.
2. Calculate the first order vanilla risks(FOV) for RTPL only for each day.
3. Generate a non-linear HPL (NLHPL) estimate as $HPL - FOV$.
4. Select the top 20 NLHPL by magnitude (the most extreme non-linear days, whether positive or negative).
5. For these days, calculate a percent error for the non-linear estimate as:$Err = ABS\left[\frac{HPL-RTPL}{NLHPL}\right]$
6. Take the average Error.

It is proposed that errors in extreme situations should be no more than 30%.

This section has assumed that risk theoretical PL will be calculated using some form of risk expansion on the trades [1].

[1]For example, a Taylor series expansion with first difference methods to solve for derivatives

3 Conclusion

1. SA correlations are set unrealistically high for basis curves and vega points
2. SA Curvature scenarios could be improved by adding steepening and flattening rather than just parallel shift
3. The revised PLAT tests can be circumvented (and thus IMA capitalisation can still be maintained) through simple delta (or vega) overlays and should be revised to focus on non-linear PL during stressed periods.
4. PLAT tests are only run at the portfolio level, and therefore can allow unwarranted IMA treatment through a portfolio effect. This issue could be corrected by applying PLAT to each stand-alone product before it can qualify for IMA treatment.

These concerns should justify a modification to the regulations and the implementation should not be too onerous.