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Fundamental Review of The Trading Book – The road to IMA

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Agenda

- NMRF
- PL attribution

Non-Modellable Risk Factors (NMRF)

NMRF is a capital add-on based on non the modellability of risk factors

- NMRF was designed to formalize the existing "Risks not in VaR" (RniV) framework originally developed by the UK PRA

- For Nomura, about 65 % of the risk factor population can be classified as non-modellable, with an average liquidity horizon (LH) of ~130/140 days. Below is a breakdown per main risk classes.

Spot risk factors				
Risk class	**% NMRF**	**Mean NMRF LH (in days)**	**Std Dev NMRF LH (in days)**	**IMA LH range**
Equity	61%	82	53	10-20
Rates	38%	139	90	10-20
FX	7%	113	110	10-20
Credit	67%	149	85	20-60

Volatility risk factors				
Risk class	**% NMRF**	**Mean NMRF LH (in days)**	**Std Dev NMRF LH (in days)**	**IMA LH range**
Equity ATM Vol	95%	142	69	20-60
Rates ATM Vol	78%	147	79	60
FX ATM Vol	82%	129	74	40

- Nomura supports the industry pooling of data, but the data outcome is still uncertain

There are certain key features/assumptions that affect the value of NRMF

- Nomura has developed a tool to test the sensitivity of NMRF to these key features/assumptions

Features	Description
One year Stress Period	To be defined either at risk factor level or based on IMA classification.
Liquidity Horizon (LH)	To be defined either at risk factor level or based on IMA classification
Max time rule	The maximum gap between two observations. To be defined as either one month or longer
Idiosyncratic risk correlation	FRTB allows non-modellable risk factors to be decomposed into a proxy (modellable) and an idiosyncratic non-modellable risk factor. The credit idiosyncratic risk factors can be aggregated with a zero correlation at risk type level. We consider extending the zero correlation assumption to other risk factors (e.g. equity)

By varying the assumptions we observe enormous variability in the capital impact

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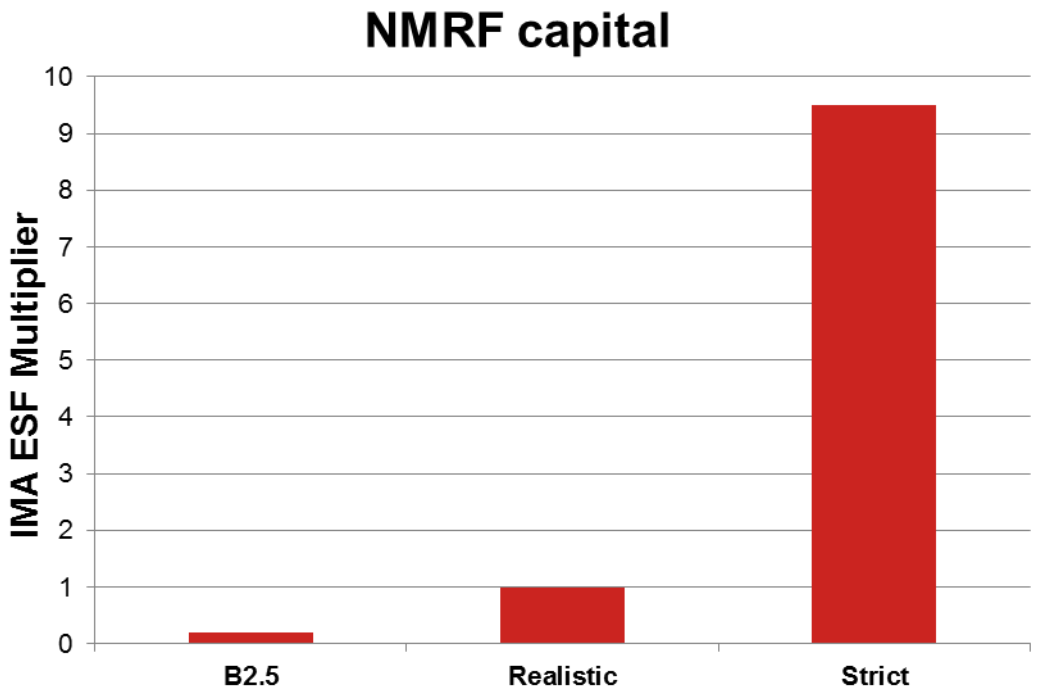
- Nomura analysed two NMRF capital scenarios

Assumptions	Strict rule interpretation	More Realistic
Liquidity Horizon	Risk factor specific	IMA based
Stress Period	Risk factor specific	IMA based
Zero Correlation Aggregation	Credit	Credit
Transaction Data	Internal only	Internal + partially external*
Observability Rule	Min 24 per year and max 1M gap	Min 24 per year only

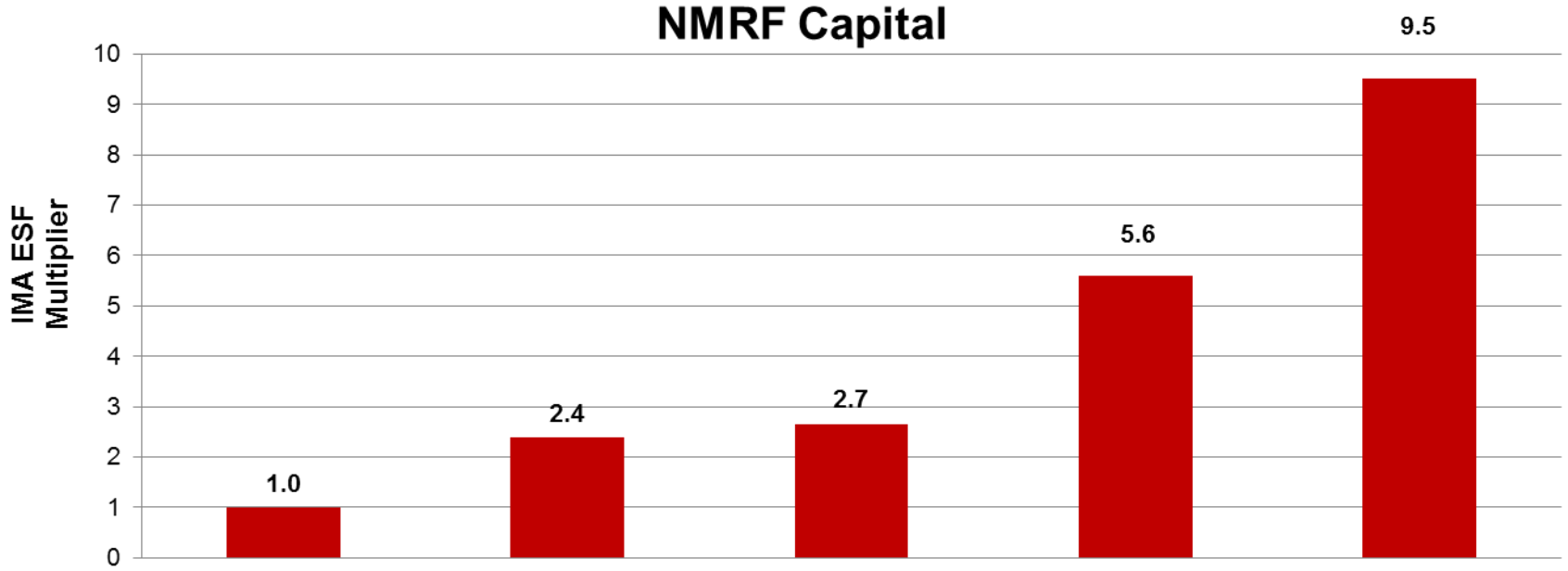


- In Basel 2.5, RniV capital is much smaller than NMRF capital. RniV ~ 0.15 x IMA ESF.
- For the FRTB QIS Nomura submitted the more realistic scenario. Even so, the resultant NMRF capital ~ IMA ESF capital.
  - *Do we really think that we have a 100% uncertainty in the VaR engine, let alone 1000%?*

** All Equity, FX, G10 Rates are assumed modellable, the NMRF liquidity horizon is assumed to be aligned to IMA liquidity horizon, the 1 month modellability criteria was relaxed*

NMRF: Assumption sensitivity analysis

- A breakdown of these two scenario provide some information on most sensitive parameters.



Scenario / Definitions	Realistic	Scenario 1	Scenario 2	Scenario 3	NMRF Strict
Observability Test	# Trades Count Only	# Trades Count Only	# Trades Count Only	# Trades Count Only	# Trades Count + 1M Max Gap
Liquidity Horizon	IMA LH	IMA LH	IMA LH	NMRF LH	NMRF LH
Stress Period	Fixed	Fixed	Rolling	Rolling	Rolling
Zero correlation for specific risk	credit spread	credit spread	credit spread	credit spread	credit spread
Modellable RF Data	Equity/FX/G10 Rate Spot modellable + Nomura trades	Nomura trades	Nomura trades	Nomura trades	Nomura trades

Let us now consider five key recommendations to improve the reliability of NMRF

Given the uncertainty on external data solution, we should consider complementary solutions	
Recommendation 1	Define less granular risk bucket for observability only.
Recommendation 2	Relax the one month maximum criteria between two observations.
Recommendation 3	Redefine NMRF liquidity horizon.
Recommendation 4	Use CSA reconciliation as real price for observability.
Recommendation 5	Zero correlation assumption for specific risk

NMRF Recommendation 1: Define less granular risk buckets for observability only

❑ Industry recognize that risk factor granularity has contradictive requirement between NMRF and P&L attribution (PLA).

Higher granularity – prerequisite for internal model usage

PLA

Test is designed to ensure appropriate risk factor coverage.

Defining not enough risk factors can lead to PLA failures and hence IMA ineligibility

Lower granularity – prerequisite for reasonable NMRF

NMRF

Only modellable risk factors can be capitalized in IMA ESF model

All others are capitalized via NMRF

Defining too many risk factors can lead to unreasonable NMRF

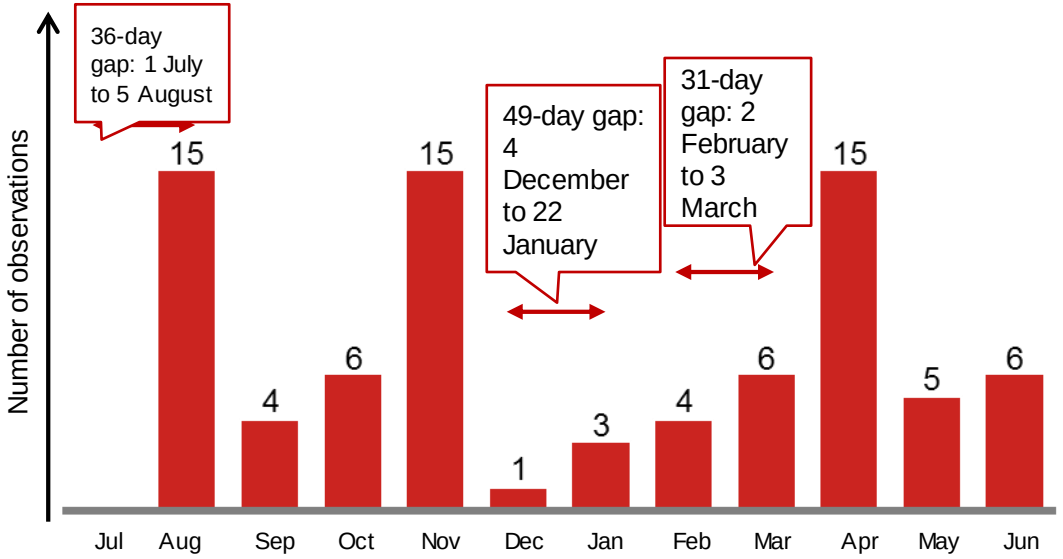
❑ Risk factor definition/cannot be generally aligned across firms/vendors, with consequent bucketing.

Recommendation 1: Introduce risk factor buckets for the observability assessment only. A reasonable starting point could be the SBA risk factors.

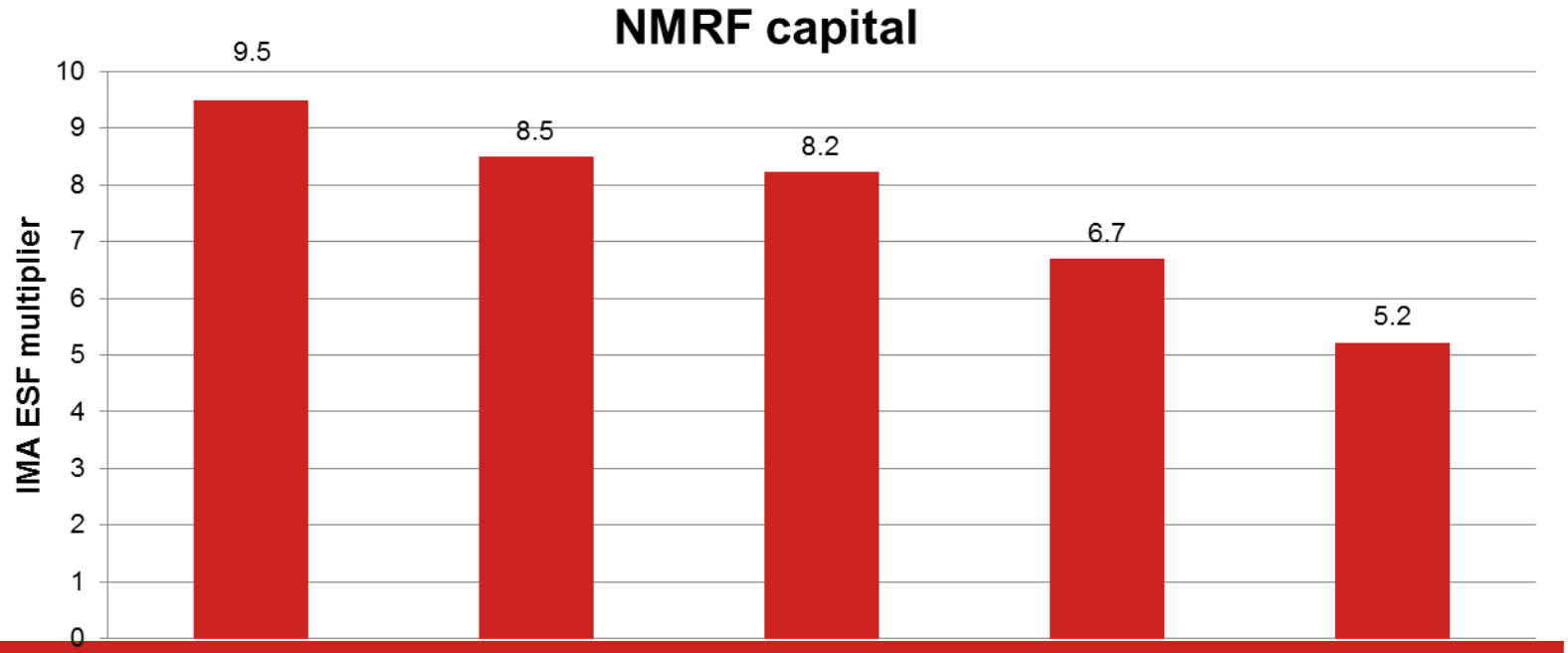
NMRF Recommendation 2: Relax the max one month gap between two observations

- The one month maximum gap requirement can lead to a significant number of risk factors becoming non modellable
  - MarkIT research illustrates this issue over **holidays period**
    - Philippine Peso over Holy Week with a week long national holiday,
    - Christmas season or winter holidays affecting Swiss Franc and Hong Kong dollars.
  - FRTB utility initiative illustrate this issue over **seasonality** on a CDS example with 3 data gaps larger than 30 days

Number of observations submitted by 5 banks over one year for CDS



NMRF Recommendation 2: Relax the one month gap between two observations



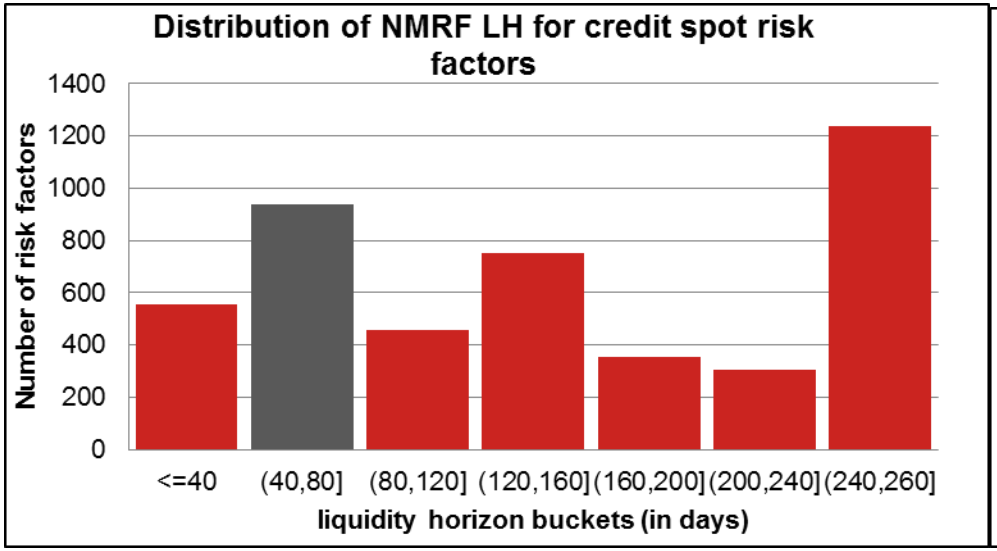
Scenario Definitions	NMRF Strict	Scenario 2	Scenario 3	Scenario 4	Scenario 5
Observability Test	# Trades Count + 1M Max Gap	# Trades Count + 2M Max Gap	# Trades Count + 3M Max Gap	# Trades Count + 6M Max Gap	# Trades Count Only
Liquidity Horizon	NMRF LH	NMRF LH	NMRF LH	NMRF LH	NMRF LH
Stress Period	Rolling Period	Rolling Period	Rolling Period	Rolling Period	Rolling Period
Zero correlation for specific risk	credit spread	credit spread	credit spread	credit spread	credit spread
NMRF Data	Use only Nomura trades	Use only Nomura trades	Use only Nomura trades	Use only Nomura trades	Use only Nomura trades

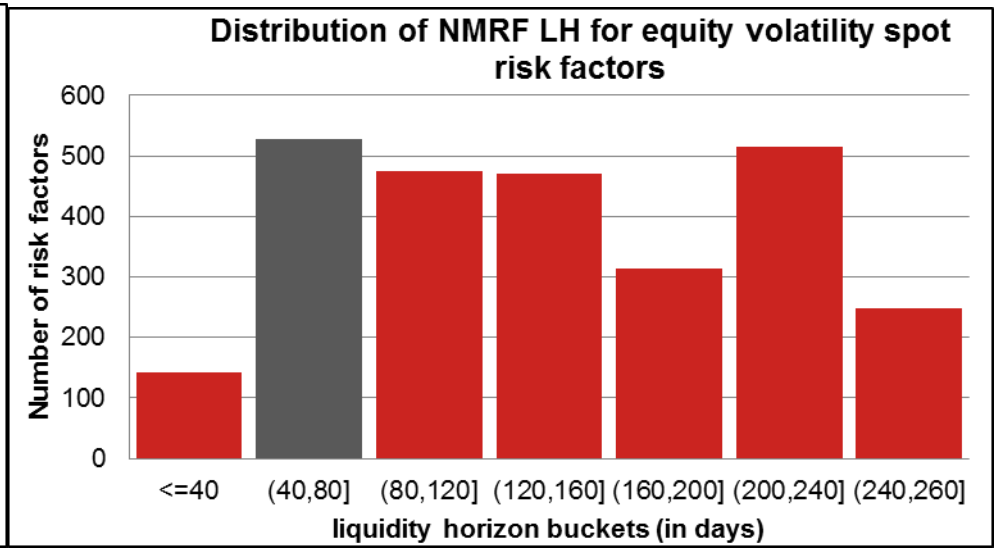
<u>Recommendation 2</u>: NMRF capital reduction is significant when Max Gap is larger than 6 months.

- **An approach may be to adopt 3 months and relax other assumptions.**

NMRF Recommendation 3: Redefine NMRF liquidity horizon

- The NMRF liquidity horizon can be extremely punitive for certain risk factors with horizon going up to 1year.
- The below graph corresponds to two NMRF liquidity horizon distributions for credit spot and equity volatility. The grey column corresponds to the IMA ESF liquidity horizon level.





- Observations/conclusions
  - In 60-70% of cases, NMRF liquidity horizons are higher than IMA liquidity horizon.
  - In 40% of cases, NMRF liquidity horizons are more than twice IMA liquidity horizon.

- **<u>Recommendation 3</u>: Redefine NMRF liquidity horizon. A reasonable starting point would be to align liquidity horizon to IMA ESF.**

NMRF Recommendation 4: Use of CSA reconciliation for real-price source

Background

- Reconciliation of collateral levels for bi-laterally cleared derivatives is an established operational process
- Such process is required by existing regulation covering the mitigation of operational and counterparty credit risk (for example, Article 11 of EMIR)
- Results in tangible economic consequences – i.e. the exchange of collateral
- Data at the trade level is readily available from existing vendor products. Contract details are well-defined to facilitate the mapping to risk factors
- When reconciliation is achieved, it effectively means that 2 parties with opposite economic interests are aligned on price

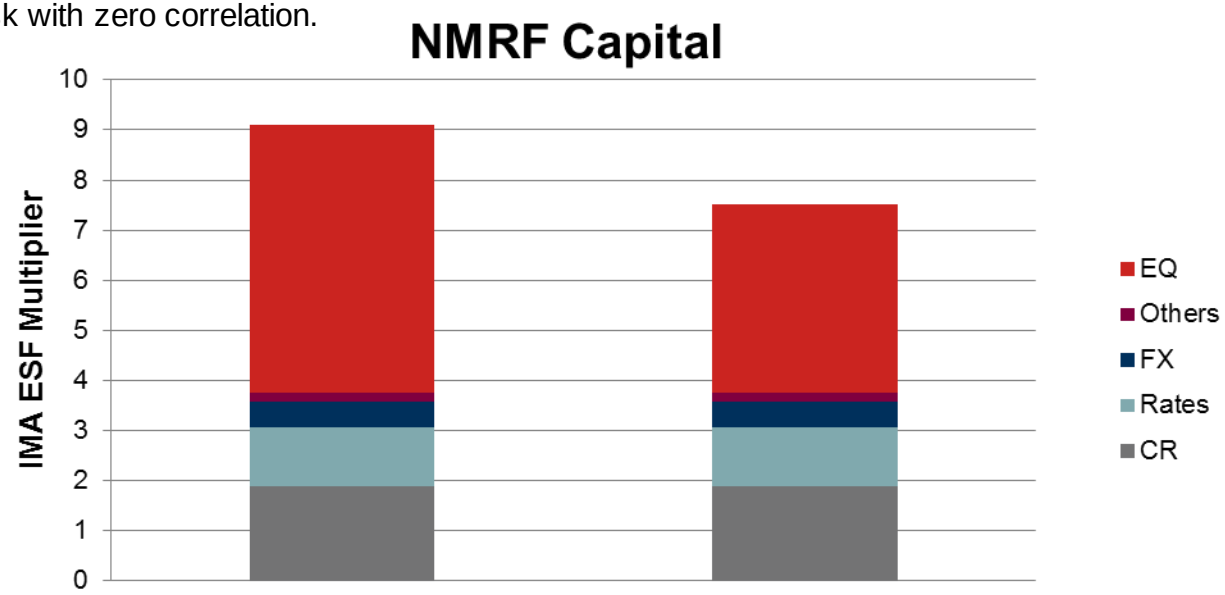
Recommendation

The recommendation is that – subject to certain standards – the prices used in CSA reconciliation should be permissible as a source of real-price observations in the risk factor modellability test. Those standards are:

- Visibility of prices at the trade level
- Agreement between counterparties on the terms of each trade
- Independent submission of trade-level prices by each counterparty
- Agreement on price between counterparties to within specified thresholds.

NMRF Recommendation 5: Zero correlation on residual risk

- Assuming all NMRF equity are decomposed as proxy + residual, the graph below shows the NMRF capital impact of aggregating equity residual risk with zero correlation.



Scenario Definitions	NMRF Strict	Scenario 1
Observability Test	# Trades Count + 1M Max Gap	# Trades Count + 1M Max Gap
Liquidity Horizon	NMRF LH	NMRF LH
Stress Period	Rolling Period	Rolling Period
Zero correlation for specific risk	credit spread	credit spread + equity spot/vol
NMRF Data	Use only Nomura trades	Use only Nomura trades

Recommendation 5: Review NMRF aggregation. Consider zero correlation for residual risk aggregation.

PL attribution (PLA)

Background

P&L Attribution (PLA) is a new concept for Internal Model Approach (IMA) approval, introduced under FRTB

- We must compare two quantities:
  - **Hypothetical P&L (HPL)**: The P&L produced by revaluing the positions held at the end of the previous day using the market data at the end of the current day – a familiar concept from backtesting
  - **Risk Theoretical P&L (RTPL)**: the ex-ante P&L 'from the risk model' – a new concept
  - To compute the **Unexplained P&L (UPL)**, defined as the difference of the two.

- Given these two quantities, we measure two statistics:

$$MR = \frac{|Mean[UPL]|}{StdDev[HPL]} < 10\% \qquad VR = \frac{Var[UPL]}{Var[HPL]} < 20\%$$

- The Mean Ratio (MR) and Variance Ratio (VR) are computed every month, and reported to the regulator
  - If a desk violates the threshold on either metric more than 3 months out of 12, model approval is lost.

PLA is the number one industry concern on the final FRTB rule

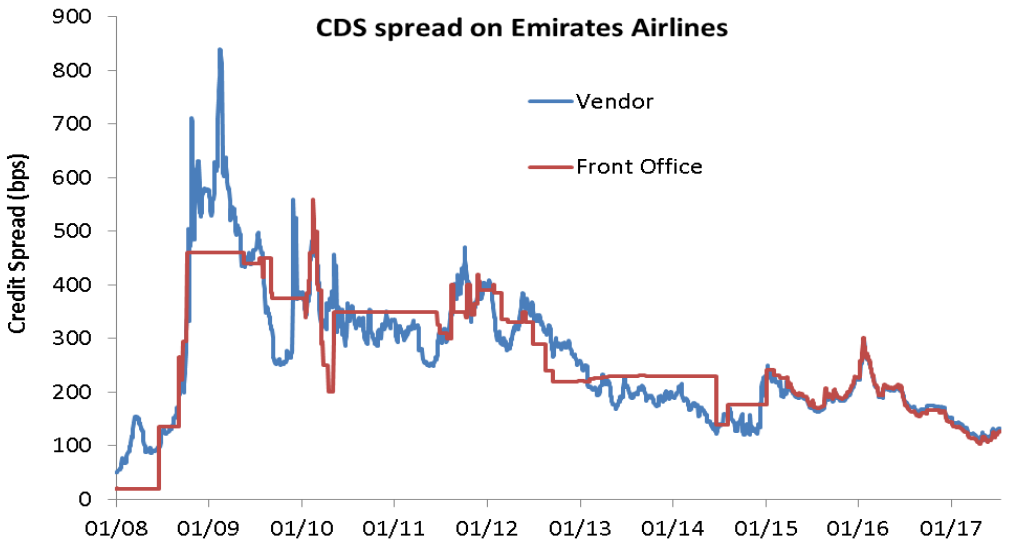
- This is driven by the high number of desks failing in test exercises, and the associated capital penalty

***What are the key issues, and how might they be fixed*?**

P&L Attribution

1) Lack of data alignment between RTPL and HPL

- Parts of the FRTB text imply that data sourcing are in scope for the test, i.e. that RTPL must be based on risk model market data, while HPL is based on the marks used by the Trading Desk
- While apparently reasonable, this creates a serious issue in testing for correlation between HPL & RTPL
  - A small difference in data source – e.g. use of a different close of business time or data vendor - can dramatically reduce one-day correlation
  - Moreover, industry argues that it is sometimes desirable for the risk model to use calibration data independent of the Front Office, to ensure proper coverage of the stress period, for example
- **Proposal** – industry strongly recommends to permit alignment of market data sourcing in the PLA test, while continuing to test risk factor coverage and risk model pricing accuracy
- *Potential Outcome: Likely to be accepted by MRG, with some constraints on how proxies and transformations (e.g. conversion from zero rates to par rates) should be handled*



Comparison of vendor market data with CDS dealer marks

Vendor: greater frequency of marks, as multiple CDS dealers are included

Front Office (one CDS dealer): daily marks when position is held, but infrequently marked when no position is held.

P&L Attribution

2) Penalty function for failing P&L Attribution

- A desk which fails the PLA test – defined as either ratio falling above the threshold for more than 3 months out of 12 – immediately moves on to the standardised approach, with potentially huge jump in capital:

	SBM§ to ES*
Interest rate risk	3.7
Credit spread risk	1.6
Equity risk	3.8
Commodity risk	3.3
Foreign exchange risk	5.3

§The Sensitivities Based Method (SBM) is the Standardised Approach (SA) less the Default Risk Charge and Residual Risk Add-on, and is reflected in relation to Expected Shortfall (Internal Models Approach).

*including regulatory multiplier of 1.5

*Results based on data contributed by 30 banks

Source: ISDA/GFMA/IIF FRTB QIS analysis, July 2017

- Considering the novel form and hence unpredictable of PLA, imposing such a severe penalty seems risky .
  - Having such a binary outcome can lead to instability in regulatory capital, complicating capital planning for firms, and for supervisors via ICAAP, CCAR, etc
- **Proposal:** industry recommends to have a smooth capital penalty as the PLA pass rates deteriorates, for example by making a linear interpolation of SBA and IMA for the bank as a whole.
  - And to allow a temporary 'Amber zone' for failing desks, where the issues can be diagnosed, before capital penalty is applied
- *Potential Outcome: MRG seems inclined to use a traffic light test, introducing an Amber Zone for moderately poor PLA performance. Desks in this zone would see a capital add-on, but less punitive than full SBA*

3) The metric used to test PLA – especially the variance ratio – can be unstable

$$Mean\ Ratio\ (MR) = \frac{|Mean[UPL]|}{StdDev[HPL]} < 10\% \qquad Variance\ Ratio(VR) = \frac{Var[UPL]}{Var[HPL]} < 20\%$$

- The use of *Var[HPL]* in the denominator of the Variance Ratio can lead to a very high ratio where HPL is small in absolute terms, such as for a well hedged Trading Desk.
- Also, it can be shown that the VR moderately favours desks where *Var [RTPL] < Var [HPL],* i.e. where the Risk model underestimates the true volatility of P&L
- A further issue is that the use of monthly data (i.e. ~22 one day samples) can lead to sampling error in the results
- **Proposal**: maintain the spirit of the test by measuring the similarity and correlation of RTPL and HPL, but using better understood statistical metrics.
  - For example, the Kolmogorov-Smirnov test to compare the shape of the distributions, and a non-parametric measure like Spearman's rho to measure correlation
  - Use rolling annual data in the test, to minimise sample noise
- *Potential Outcome: likely to been accepted by MRG, except that Chi-squared test may be used rather than Kolmogorov-Smirnov*

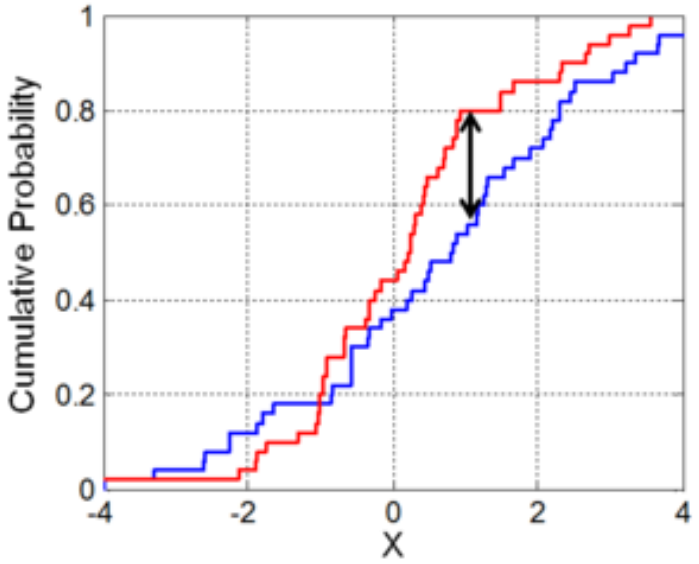


Illustration of KS test, which measures the size of the highlighted area

4) Calibration of the test is very difficulty, until firms can provide reliable input data

- Regardless of the specific statistics chosen, the regulators need to calibrate the thresholds for failing the test
- The obvious solution is to gather data via the QIS process, but this is difficult for firms to provide,
  - In particular, the system and process changes to develop RTPL are very significant, and firms have been reluctant to invest in this while the PLA rules remain uncertain
- **Proposal**: the industry has tried to tackle this issue via the construction of hypothetical datasets, with stylized representations of what real HPL and RTPL may look like. But it is very difficult to be sure that any hypothetical data are truly representative
  - Instead the industry proposes to have a temporary calibration period post FRTB go-live, where firms must submit RTPL and HPL data and explain results to regulators, but without a binding test.
- *Likely Outcome: a non-binding calibration phase is not likely to be accepted. Instead the FRTB go-live is being pushed back by national regulators – see for example recent draft European Council report proposing a three or four year delay following the entry into force of the FRTB regulations*

Potential EU FRTB timeline