FRTB – white paper

Impact of the FRTB consultative paper on IMA and NMRF capitalization

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1. Introduction

Since the publication of the FRTB final standard in January 2016 [1] for the minimum market risk capital requirements, the banking industry has frequently expressed concerns about certain key aspects of the FRTB rules. These concerns often focus on the subtle nuances of the standardized approach (SA), trading desk eligibility for the internal model approach (IMA) through the P&L attribution (PLA) test, the risk factor eligibility test's (RFET) definition of observable prices as well as dealing with seasonally traded instrument, and the proxy selection and capitalization of non-modellable risk factors (NMRFs). The BCBS' FRTB consultative paper (hereafter, CP) of March 2018 [2] attempts to address these issues, among a host of others.

In two separate publications, we examine the impact of new FRTB revisions proposed for the standardized approach [3], and the newly proposed PLA test design [4]. In the present paper, we focus on the impact of the revised guidance on the internal models usage, specifically on RFET and the capital charge add-on related to NMRFs. Ever since the publication of the original FRTB rule [1], the NMRF, especially concerning its RFET, and PLA-test discussions have occupied the center stage.

The original FRTB standard requires a risk factor (RF) to pass the RFET in order for a desk to be able to use the IMA expected shortfall for that risk factor. The RFET requires –

— [**RPO constraint**] A minimum of 24 real price observations (RPO) over the last 12-month period, and

— [**Gap constraint**] No more than a 1-month gap between any two consecutive observations.

If a specific risk factor does not pass the RFET, it is considered a 'non-modellable' factor. As such it is excluded from the IMA expected shortfall (ES) model based capital calculations, and is subject to a separate capital add-on that is estimated based on a stress scenario. In return, banks have often raised concerns over the RFET's inherent design flaw (discussed in Section 4.1), which often results in a significantly higher capital impact for certain risk factors declared as NMRFs. A few industry studies in the past ascribed 30% and more IMA capital charge to the NMRF related capitalization.

The CP attempts to address some of the concerns related to the rules and definitions associated with NMRF requirements that were not properly articulated in [1], and led to a misinterpretation, and potentially inconsistent application across various banks. The NMRF related guidelines in the revised BCBS proposal focus on the following aspects

— Risk factor modellability,

— Model calibrations,

— Impact of seasonality on RF modellability,

— Idiosyncratic equity risk,

— Data governance standards related to IMA.

We address these aspects in detail in Section 2. The CP also introduces a set of seven principles for the purpose of evaluating risk factor data in terms of qualification, accuracy, and sufficiency, including analysis examples that regulators may request from banks in support of high quality data standards. These points are discussed and interpreted in Section 3. Finally in Section 4, we provide further insights and comments on the efficacy of RFET, and how PLA tests interfere with NMRF capital charge.

2. Key observations for modellability criteria

The focus of the proposed revisions linked to IMA and RF modellability has been to provide explanations related to ongoing monitoring, controls, eligibility and capitalization of risk factors. The risk factor specific sections of the CP address the clarification of the terminology and requirements of risk factor modellability, and define additional requirements for sufficiency and accuracy of data used in the expected shortfall models.

2.1 RFET and model calibrations

In the CP, the committee provides further clarity on several topics dealing with the RFET and model calibrations –

1. **Representative RPOs**: The FRTB standards [1] required that RPOs be representative of the risk factors which are subject to the RFET. The RFET was originally proposed without a clear definition of representative-ness, which the CP has addressed. The CP recommends that banks establish their process, along with policies & procedures to explicitly define their approach to map RPOs to the associated risk factors. As such, this recommendation does not impact the capital charge, but makes the modellability criteria crisper.

2. **RF bucketing**: The CP proposes two alternatives to assess how similar a risk factor is to the RPO in order to count as an eligible observation for the purpose of RFET:

   – The first alternative is to let banks define the risk factor buckets, subject to certain limitations and supervisory approval.

   – The second alternative is to have regulators prescribe the risk factor buckets.

The qualitative nature of the NMRF makes it difficult to provide a quantitative evaluation of the impact of bucketing proposal on NMRF capital charges. However, bucketing of risk factors reduces the effective number of NMRFs and thus, is expected to lead to a smaller NMRF capital charge.

3. **Committed quotes and data pooling**: The CP also clarifies conditions under which committed quotes may be used as RPOs and that data pooling mechanisms can be used to satisfy RFET. It is obvious that the proposed expansion in range of applicability of committed quotes for RFET, and the role of third party vendors in providing RPOs can potentially increase the number of modellable risk factors and thus reduce the NMRF capital charge. New requirements for using committed quotes and third party vendors' participation in the process as detailed in the CP add new hurdles and complexity to the implementation of the RFET.

4. **Model calibration**: For MRFs driven models, the BCBS provides banks flexibility in the choice of data to be used to calibrate internal models. However, banks are responsible to use appropriate data to ensure that the model provides a commensurate measure of risk. To ensure the data quality for model calibration, the Committee has proposed a number of principles for selecting the data to calibrate the models (see Section 3), and requirements for the quality of expected shortfall model outputs.

The risk factor modellability related guidance in the CP may have significant impact on:

- The data management framework through procedure & policy documentation recommendations,
- The modellability framework due to bucketing, committed quotes, and data pooling clarifications providing further enhanced RPO process,
- Third-party vendor solutions due to their regulatory requirements when participating in the data pooling process.

In some cases, it is non-trivial to assess the capital impact because of the trade-off embedded in the RF structure proposal. A low level of RF granularity negatively impacts PLA-test outcome, however, it enhances the modellability profile of risk factors.

2.2. Seasonality effect

There was no accommodation for the seasonality effect in the risk factor eligibility framework in the original FRTB standards (1). Since the publication of the rules in 2016, banks have provided several examples of "seasonal" illiquidity in certain market risk factors, including those of European bond markets due to a variety of reasons, including holidays, traders' vacation timing, etc.

The CP downplays banks' concerns about the treatment of seasonal aberrations related illiquidity in market risk factors. In the Committee's view, this is not sufficiently justified as a permanent liquidity impairment, and consequently resulting NMRF-level capitalization. However, the Committee remains open to data evidence and qualitative arguments to assess the validity and materiality of "seasonality" concerns related to risk factors that are sufficiently liquid in normal periods, but turn to be NMRF due to "seasonality" effects based on the current requirements.

The BCBS remains open to alternative proposals from the industry, however the following considerations are key to make a convincing case for the Committee to buy into "seasonality" driven non-modellability, and relax the RFET criteria in those situations.

- Banks need to prove based on risk factor time-series that certain markets are "normally liquid" in periods other than certain recurring periods every year, and a significantly negative impact may be caused on those markets due to the present consideration.
- In addition, banks may need to assess the portfolio of normal trading activities to quantify the materiality of the seasonal impact.

2.3. NMRFs' impact on idiosyncratic equity risk

The capital requirements for NMRFs are calculated using a stress scenario and the resulting stress losses are aggregated without any diversification benefits, with an exception for idiosyncratic credit spread risk related NMRFs. Some banks have requested a similar exceptional treatment for the capital charge aggregation for NMRFs associated with idiosyncratic equities risk factors. Due to lack of sufficient evidence of zero correlation, and/or on the potential materiality of this issue, the Committee did not propose to change the treatment of idiosyncratic equity risk at this time. However, in case of a compelling evidence presented by the industry, the Committee is willing to consider a credit equivalent treatment for equity idiosyncratic risk factors to address this issue (see updated paragraph 190 on pg. 11 of the CP).

2.4. Data governance standards – Increased burden to support model data quality

The revised BCBS proposal lays out the details of supervisory expectations related to the data quality, and data sufficiency for the IMA related models including ES as well as NMRF capital charge using stressed expected shortfall (SES). Section 3 lays out the principles that encapsulate regulatory expectations in regards to the eligibility of risk factors that are used in the IMA ES calculations. The CP also details specific examples of the type of evidence that the banks may be required to provide to their supervisors in support of maintaining minimal data quality standards (as part of overall model governance) related to the risk factors and their respective sources.

Example evidence includes –

- **Recovery of price from risk factors** – A test to demonstrate that risk factors from the ES model can re-produce FO prices. In case of material deviation from the FO prices, supervisors may deem the risk factor(s) to be non-modellable.
- **RF backtesting** – This procedure tests validity of the RF distribution forecasting methodology. It tests both distributions of individual risk factors as well as their correlations. Such a procedure will improve understanding of the dynamics of the RF distributions that underlie the capital charge calculations and will help to understand limits of the calculation's accuracy.
- **Implied RF control** – The BCBS proposes a tighter control over the "implied" risk factors that generate from parameterized models, such as an implied volatility surface. These parameters must be updated and re-calibrated periodically as new data/trades become available, with a NMRF style basis overlay for significant deviation.

3. Further guidance on evaluation of RF data sufficiency and accuracy

The Basel Committee in their CP further defines data governance standards in the form of seven key principles that banks must adhere to in order to ensure accuracy of price observations in addition to sufficiency of RPOs to satisfy risk factor modellability test. These common sense guidelines are to be followed irrespective of the IMA's ES capital charge calculations or the NMRF based capitalizations.

The proposed principles for supervisory assessment of data for expected shortfall models effectively introduce additional risk factor modellability criteria in the RFET to satisfy the sufficiency of observations and data accuracy. The compliance with these principles may lead to an increase in the NMRF capital charge as the proposed guidelines may limit the number of eligible modellable risk factors. They also introduce more operational complexity to the implementation and maintenance of IMA, in addition to some aspects that need further clarifications, such as principle 2.

Paragraph Reference in BCBS revisions [2]	Issue	KPMG Summary	Potential Impact on market risk capital charge
Annex D, Principle 1	**Interpolation & extrapolation of risk factors**	BCBS allows – — Interpolation and extrapolation of MRFs. The RF extrapolation is allowed to "a reasonable distance" provided it is supported by documentation. — Creating new MRF from combinations of other MRFs, and — Compression of MRFs into lower dimension of orthogonal RFs, — Derivation of parameters from MRF observations, such as stochastic volatility models like SABR, without the parameters being directly observable in the market. Such a combination of RFs should be consistent with mappings used for PLA-test.	NMRF capitalization may decline as this principle may increase number of eligible MRFs
Annex D, Principle 2	**Idiosyncratic & systematic risk**	Calculations must be based on comprehensive input that reflect all risks of the position. Splitting of NMRF into general risk and idiosyncratic risk components will be allowed to apply potentially smaller stress scenarios to idiosyncratic part.	This may potentially increase the number of NMRFs
Annex D, Principle 3	**Volatility and correlations**	ES calculations should reflect the volatility and correlations observed in real positions. A specific selection of input data should not misrepresent real risks of the positions.	This adds to operational burden for the banks.
Annex D, Principle 4	**MRF data reconciliation with FO/BO**	The RF data must be reflective of prices observed and/or quoted in the market. This introduces a new requirement for testing input data by periodically reconciling data between FO, BO, and risk in instances where data is not derived from RPO.	The impact on capital charge is inconclusive, as Principle 4 may increase or decrease the number of MRFs
Annex D, Principle 5	**Frequency of the data updates**	This principle establishes a limit on minimum frequency (preferably daily) of updates of data used in ES calculations. The regression coefficients in models should be updated at least bi-weekly, and the models calibrations frequency should not be less than for FO/BO models. In addition, all data gap-filling procedures for the ES models must be documented.	This adds to operational burden for the banks.
Annex D, Principle 6	**Stressed expected shortfall (SES) data**	The data used to determine SES must be reflective of stress period prices This addresses the issue of insufficiency of data observations or data time series corresponding to periods of financial stress in calculation of stressed expected shortfall. For instance, if stressed data are not available, the banks are required to justify why and how actually used data are reflective of the stressed conditions. Also, if some of RF did not exist at the time of the stress, the corresponding time series should not be included in the "reduced" time series used in stressed ES calculations	This adds to operational burden for the banks.
Annex D, Principle 7	**Data proxies**	The use of proxies must be limited, and proxies must accurately represent corresponding transactions. To qualify for MRF treatment, a RF proxy should represent a combination of MRFs and should accurately represent analyzed transactions. Banks should provide the proxy analysis to confirm the proxy has significant explanatory power, their residuals are uncorrelated, and their contribution is small. In addition, proxies, must be used for PLA tests.	NMRF capital charge may increase as principle 7 may increase number of NMRFs. When using a proxy, banks must run PLA-test daily to align risk with the desk, else capitalize the [actual-proxy] basis for NMRFs

Table 1. Guiding principles for evaluation of sufficiency and accuracy of risk factors

4. Comments and concluding remarks

We few subtleties associated with RF modellability, interplay of PLA-test revisions with NMRF capitalization, and impact on liquidity of exotic instruments.

4.1 Issues with RFET in current form

As mentioned earlier, the Committee has rejected industry's concerns about seasonality of certain risk factors, and requires more evidence in the form of data, and conclusive qualitative reasoning, prior to conceding any accommodations to the RFET for the products affected by seasonality. There are a few recent studies [5, 6] that point to intrinsic design flaws within the RFET framework, including the gap constraint being too restrictive for the given RPO constraint, and seasonally-traded instruments not explicitly addressed. This indicates a potential amendment of the RFET may be warranted by the Committee.

For the RF modellability, much of the industry focus remains centered on the minimum arrival rate (i.e., RPO constraint) of 24 observations per annum. The RFET gap constraint of maximum gap of one month between consecutive observations, i.e. twice the gap expected in a uniform arrival pattern, appears reasonably too generous though. If one assumes random trade executions, the risk factors with an arrival rate of 24 RPOs/year have a very small probability to be modellable based on the RFET gap constraint.

Obitz [5] convincingly makes a case that the RFET gap constraint is the key binding constraint. Obitz [5] asserts, by assuming a doubly stochastic Poisson process, with a constant arrival rate of 24 observations/annum for a trade event, that less than 2.5% of risk factors would pass RFET (in current form).

Figure 1. Probability of passing the RFET given the annual arrival rate of the Poisson Process (sourced from [5])

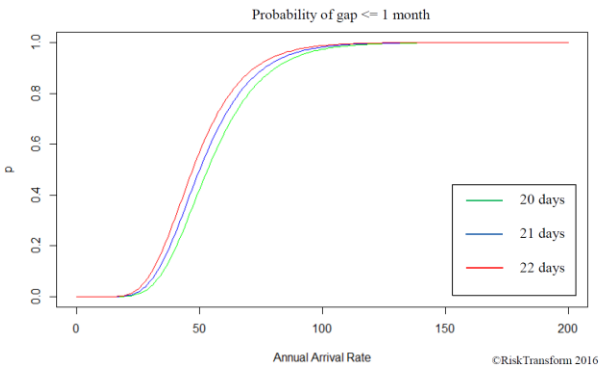
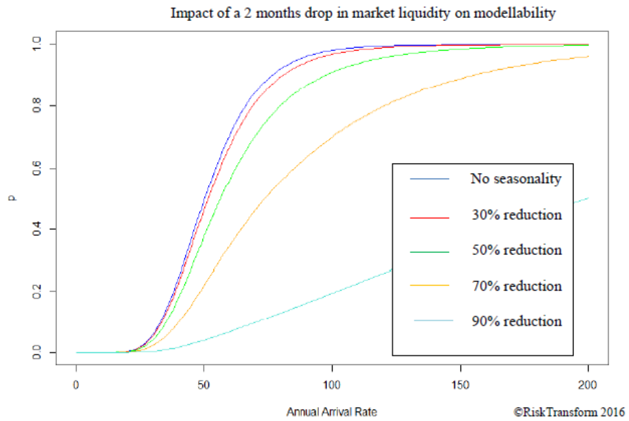


Figure 1 shows the probability of the largest gap between RPOs within a 1 month trading window, (where 1 month designates [20-22] trading days) as a function of the RPO-constraint (i.e., annual arrival rate). Thus, it shows the probability a risk factor passes the gap constraint given the annual arrival rate of its real prices (i.e. expected observations per year). Obitz [5] shows, for a risk factor with an average of 24 observations/year, there is less than 1% probability of being modellable due to the gap constraint. More than 50 observations per year as a target are required to achieve a 50% probability for a risk factor to be modellable after factoring in the gap constraint. If a risk factor has 24 observations of "real" prices in a year, then passing the RFET at 95% confidence would require the gap constraint to exceed 66 trading days (3+ months), and 99.99% confidence interval would require the gap constraint to exceed 133 trading days (7+ months). This presents a strong evidence that the design of gap constraint of RFET is flawed given the other constraint (at least 24 observable "real" prices per year) of the RFET is far more likely to be passed for a given product.

For a product showing seasonality, which is modelled by reduction in the arrival rate parameter of the Poisson process during the seasonal period, a moderate decrease in the probability of passing the RFET is observed when compared with a non-seasonal product with the same arrival rate assuming a Poisson process. The decrease primarily depends on the specific liquidity drop during the seasonal period as shown in **Figure 2**.

Figure 2. Probability of passing the RFET given the annual arrival rate of the Poisson Process and reduction in liquidity for a 2-month period (sourced from [5])



In addition to RFET design, and seasonality, banks may face transitions between MRFs and NMRFs. A bank that observes 100 RFs with (say) 50 RPOs/year, may see only 40 of them as MRFs on average, with an additional 24 of them being replaced by other risk factors over any one year period.

To project the CDF [**Figures 1** and **2**], Obitz deploys a Poisson arrival rate model, which implicitly assumes that the mean and the variance are equal to the arrival rate. In a more realistic framework, there will be a variance of number of trades that will be much higher than the average count of trades if the market displays limited liquidity/activity. For instance, two markets can exhibit the similar number of trades on average, however, they can (and most likely it will be the case) show very different variances of trades arrivals data.

If, for instance, we assume a Negative Binomial distribution, an extension of the Poisson distribution by allowing for over-dispersion and/or larger variance than the mean rate, one can show that the probability to pass the RFET criteria is much smaller than the one of Obitz assuming variance equal to arrival rate. Alternatively, one can also show that the implied gap for a given confidence level of passing the same criteria is much bigger than the one Obitz obtains using a Poisson distribution which forces a moderate dispersion rate of the arrivals data. In other words, we can show that the picture might be much worse and the implied weakness in the BCBS design is much greater if we recognize the variability of liquidity/trades activity from one market to another.

Another research paper by Jones [6] performed an analysis on different currency's interest rate risk factors passing the RFET by month. It shows a clear seasonality effect in certain currencies during holidays and summer months. Thus, this empirical and theoretical evidence of the seasonality effect show flaws in the RFET, where industry will need to provide more concrete examples on how seasonality impacts non-modellable vs. modellable to persuade the BCBS to change the RFET, as the BCBS has not been so far persuaded by examples provided by the industry.

4.2. PLA test revisions vs. NMRF capitalizations

The PLA-test related revisions suggest that a trading desk might be more likely to qualify for IMA due to the introduction of the Amber region, and also the different tests for desk-level qualifications (see, for example, [3]). However, there is a trade-off among how granular the risk factors need to be in IMA to pass the PLA-test, and the total number of NMRFs: With more granular risk factors, the probability of passing the PLA-test increases since there will a be a higher degree of explanation in the "risk theoretical" P&L of the hypothetical P&L, but the number of NMRFs is more likely to increase as more risk factors are included. With less granular risk factors, the probability of passing the PLA-test decreases since there will a be a lower degree of explanation in the "risk theoretical" P&L of the hypothetical P&L, but the number of NMRFs is less likely to increase as more risk factors are included.

Thus, the revisions introduced to the PLA-test impact this trade-off positively as the granularity of risk factors can be further reduced (within constraints) without the consequence of a failing the PLA-test, thus leading to a reduced NMRF set.

4.3. NMRFs in exotic and non-linear instruments

Additionally, since the release of the FRTB standards [1], a negative impact to the liquidity and thus the modellability of certain exotics and non-linear products has been expected due to smaller players exiting these complex business areas (for example, correlation trading. Such a reaction from small market players was anticipated due to exotics and non-linear products making it harder to pass the PLA-test, thus making it difficult for such banks to keep exotics in desks looking to be IMA-eligible. On the other hand, in a SBA desk, exotics would incur punitive capital charges due to conservative stress factors, and the residual risk add-on (RRAO), and thus it was imperative for such banks to exit these products due to costly IMA infrastructure, and potentially dismal returns on incremental regulatory capital.

With the proposed revisions to the PLA-test, a few small banks may reconsider IMA desks treatment for the exotics and non-linear products. This may ultimately increase the number of "real" prices for these products, and reduce the number of NMRFs associated with these products.

4.4. The definition of RPOs

On closer inspection of Annex D of [2], the interpretation of RPO definitions for model approval remains non-trivial. For example, as per revised guidance, a real price is representative for a risk factor of a bank where the bank is able to extract the value of the risk factor from the value of the real price. This works in general, but somewhat vague in a few circumstances.

References

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