

Fundamental Review of the Trading Book (FRTB) 2017

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Special report



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FRTB

A Sisyphean labour

Greek mythology tells the unhappy tale of Sisyphus, doomed for all eternity to push a boulder up a hill – only to watch it roll back down and flatten him each time he completes the task. It's a feeling banks in the throes of implementing the Basel Committee on Banking Supervision's new market risk rules – the *Fundamental Review of the Trading Book* (FRTB) – will be able to relate to.

The clock is ticking: almost 18 months since the framework was finalised, banks have used up roughly half the time available to them for implementation before the rules are phased in from 2019.

However, several major challenges must be brooked before banks can declare themselves ready. Many of them relate to banks' freedom to continue calculating market risk capital requirements for a given desk or product by using their own models. Failure to win supervisory approval for this approach will force a desk to shift to the regulator-set standardised approach, which will carry a capital hit of anywhere between double and six times the numbers achieved using an internal model, according to one study.

Top of the list of concerns over achieving own-model approval is the profit-and-loss (P&L) attribution test, which compares the hypothetical P&L generated by a bank's front-office pricing model for a desk with its risk-theoretical P&L. Both approaches are designed to reflect the P&L generated by revaluing yesterday's portfolio using today's end-of-day prices. To pass the test, there can only be a small variance between the two measures.

Basel's final FRTB framework sets out two apparently conflicting ways of generating a desk's risk-theoretical P&L, however – and one version is significantly more difficult than the other. Astonishingly, more than a year after the issue first came to light, banks are still unsure which version of the test they will be required to use.

Basel's long-awaited FAQ document conspicuously failed to acknowledge the issue when it finally materialised in January – forcing banks to assume the worst and prepare to apply the more complex version of the test.

As a number of the contributors to our special report outline, banks are already allocating tens of millions of dollars in tech spending to the tasks that will enable them to gain own-models approval, such as sourcing the data required to generate the requisite sensitivities to model a particular product – a costly undertaking for exotic products, or those with non-linear payoffs.

For regional lenders, the hurdles to implementation look higher still: many complain local market liquidity – even for benchmark products such as longer-dated government bonds – is too patchy, with trading heavy around key events and then non-existent on all but the most liquid tenors for weeks on end.

This is a facet many have learned to live with when pricing trades using their own trusted models – but under Basel's non-modellable risk factor framework, which penalises illiquid risk factors, it is a sure-fire route to a hefty capital add-on when modelling a product with highly variable liquidity.

Many will be hoping other supervisors take a leaf out of the European Commission's approach in calling for a further three-year phase-in for the rules to take effect. But the risk of global regulators' approaches diverging is already growing: fears are being raised that the US may deliberately dally while other jurisdictions roll ahead with implementation.

With US banks dominating trading in many key global markets, a fragmented roll-out would render other houses at a crippling disadvantage. Already, say market watchers, many banks have begun to focus their implementation efforts on those portions of the rules that have the highest value-add for their business lines, in a bid to ensure that something positive comes from the Sisyphean task of implementing FRTB.

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Fast and accurate KVA using AAD
AAD works where market practice approximations fail

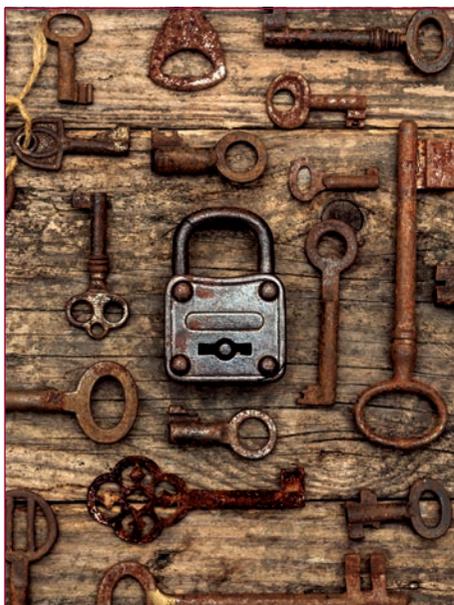
Traders do not need to resort to crude and unreliable approximations in their capital valuation adjustment calculations



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Fast and accurate KVA using AAD

AAD works where market practice approximations fail

Traders do not need to resort to crude and unreliable approximations in their capital valuation adjustment (KVA) calculations. Adjoint algorithmic differentiation (AAD) for KVA is rapid, accurate and requires no extra computational power, writes Alexander Sokol, head of quant research at [Compatibl](#)

Calculating the valuation adjustment reflecting the cost of future capital (KVA) is now a key part of evaluating a prospective trade. Recently, several competing views of defining and computing KVA have emerged, some based on the hurdle rate or target return on capital, and others on assessing the effect of the trade on the entire balance sheet of the firm.

Irrespective of which KVA framework is used, calculating future capital for each path and time step of the Monte Carlo simulation is always required. For 5,000 paths and 400 time steps, this means performing capital calculation two million times.

Calculating capital under FRTB is perceived to be difficult and slow, and practitioners are often quick to conclude that performing the same calculation two million times is impossible. Instead, they resort to crude approximations that ignore all but a few leading contributions to capital, and capture even those in a highly stylised and imprecise way. These crude approximations are then superficially 'improved' by rescaling the capital requirement by a constant multiplier to match today's capital.

For realistic portfolios, a comparison with the exact first-principles calculation of capital shows such approximations are so unreliable as to make them practically useless. In fact, the sensitivities to key risk drivers these approximations most often use as proxies for the market risk capital are the very same sensitivities that are well hedged in a realistic portfolio. As a result, even the approximations that seem to work reasonably well for a few swaps in a research paper fail completely for a diversified and well-hedged portfolio encountered in a practical setting. The extent of their failure would be plain were it not concealed by the rescaling to match today's capital requirement.

There is a much better way of calculating the future capital requirement for KVA. Instead of trying to crudely approximate capital as a function of market risk factors, capital can be calculated from first principles for each path and time step using its complete set of inputs, with fast approximations only employed for simple, atomic inputs to the capital calculation, such as individual trade sensitivities.

A key computational technique that makes this work in practice is adjoint algorithmic differentiation (AAD). With AAD, the calculation of an unlimited number of sensitivities of trade price is around five times slower than the calculation of the trade price itself. As we will see, this makes it possible to compute KVA for sensitivity-based contributions to capital at a computational effort only five times greater than the effort of computing CVA.



Alexander Sokol

Here is a rough outline of the method. We first consider the standardised approach to market risk capital for the trading book (SA-TB). The SA-TB capital requirement consists of components based on delta, vega and curvature, plus the default risk charge and the residual risk add-on (RRAO). We will tackle them in order of increasing complexity. The RRAO is based only on trade notional and is easy to compute. The default risk charge is based on both notional and mark-to-market, and also references the credit rating that may change along the path; its contribution to KVA can also be computed at a fraction of the effort of computing CVA. Thanks to AAD, both delta and vega contributions to KVA can be computed together at a fixed multiple of around five compared with the effort to compute CVA. Finally, the curvature-based charge can be computed by interpolation with computational effort comparable with that of CVA.

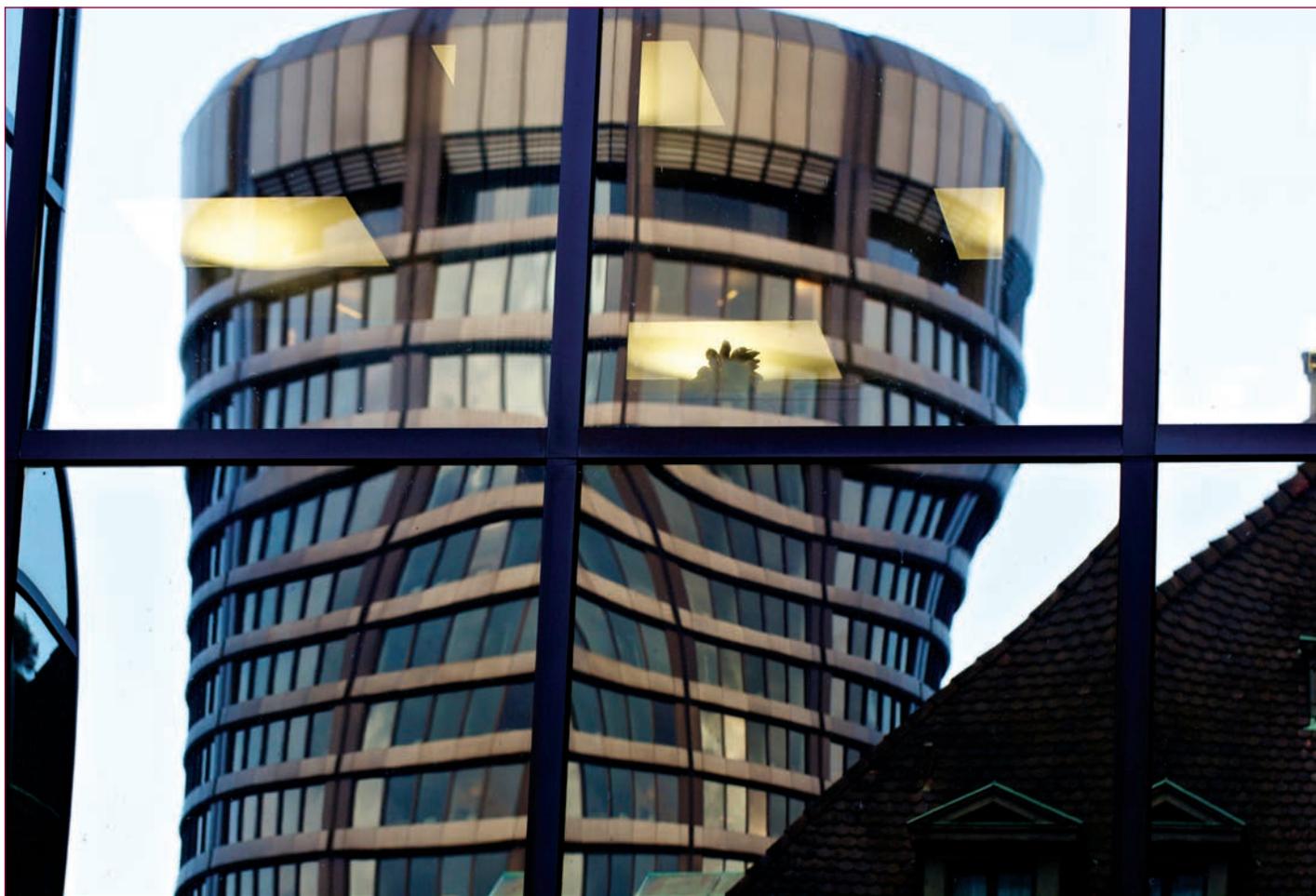
Even the internal models approach (IMA) in FRTB is not too complex for first-principles simulation. While IMA requires considerably more complex calculations than SA-TB, a bank able to compute today's IMA capital has all the computational tools in its possession to implement the same logic for first-principles calculation of IMA KVA. Because of the need to compute expected shortfall (ES) for each path and time step, this calculation would be too slow for practical use without further optimisations. Once again, AAD comes to the rescue. If portfolio P&L is calculated using sensitivities on those dates of the historical stress period when the change in market risk factors is small, and full revaluation is performed only where significant market shocks have occurred, the resulting estimate of ES will be relatively fast to compute and still be far more accurate than the type of crude approximations to the capital requirement that are part of today's market practice.

A complete set of examples for this calculation can be downloaded from www.modval.org

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Shake-up in Basel has banks hoping for FRTB changes



The establishment of the Basel Committee's new market risk group, headed by the Bank of England's Derek Nesbitt, is encouraging banks to call for a fresh look at the P&L attribution test, writes [Duncan Wood](#)

Banks are hoping to get a fresh hearing for their complaints about new market risk standards, after a change of leadership at the regulatory group that drew up the regime.

Top of the industry's wish list for the new rules – FRTB – is a review of the P&L attribution test that acts as a gateway to the use of internal models. Banks spent much of last year arguing the test was badly designed and would prove almost impossible to pass, leaving many trading desks stuck on the tougher standardised approach to regulatory capital.

A long-awaited FAQ document published by regulators in January addressed few of the industry's concerns – but dealers hope the change of leadership on

Basel's market risk policy body could see them reappraised.

"The change of leadership has created a slight wind of optimism that maybe we will have an opportunity to discuss the practical issues with the rules and hopefully lead to us being able to find a better place for them – somewhere where we're clearer on what the rules are and where they can actually be implemented," says a source at one European bank, who has been involved in negotiations with regulators over the regime.

Four industry sources confirm the Basel Committee on Banking Supervision's trading book group, which drafted the rules, has been merged with its sub-group, which focused on implementation. The new chair is Derek Nesbitt, head

of market and counterparty risk policy at the Bank of England (BoE). He replaces co-chairs Norah Barger of the Federal Reserve and Philippe Durand of the Banque de France. The merged group is called the market risk group (MRG).

The Basel Committee and BoE declined to comment. The Banque de France's Durand did not respond to an email requesting comment.

Banks have welcomed Nesbitt's appointment: "The lead is now the BoE, which should be positive in terms of openness to negotiate with the Street," says a market risk specialist at a second European bank.

A risk policy source at a third bank describes Nesbitt as "a pragmatist", adding: "In our discussions with him, he's been less dogmatic, less set in his views. I hope the MRG will be more open-minded under his chairmanship and will try to find a solution that works."

A first meeting between banks and the MRG was scheduled for late March, sources say.

For banks, the stakes are high. Industry studies have found FRTB's standardised approach would produce a 2.4-times jump in capital, relative to current numbers – with the increase far higher for certain asset classes, such as foreign exchange, where standardised capital would leap 6.2 times. Under the internal models approach (IMA), capital would be 1.5 times higher than current levels.

Concerns over P&L attribution test

Criticisms of the P&L attribution test were a feature of discussions between regulators and banks after FRTB was finalised in January last year. Any trading desk that wants to use the IMA to calculate its capital has to pass the two-part test, as well as a daily backtesting regime. The aim is to ensure a bank's risk models closely track the actual performance of its trading business, and can therefore be trusted as the basis for regulatory capital numbers.

"Any small operational differences that have been OK in the past are likely to cause you to fail, just because it is so sensitive to small deviations"

A source at a European bank

The P&L attribution test does this by asking banks to compare two measures of a desk's daily performance – the hypothetical P&L and the risk-theoretical P&L (RTPL), with the former generated by a bank's front-office pricing models and the latter generated by its risk models.

Even at this level, the test has caused some confusion. While the glossary to the final rules describes the test as the comparison between the outputs of these two different models, the appendix – where the test is described in full – defines RTPL as the product of a bank's front-office models if they used the more limited set of risk factors found in the risk model. In other words, two different sets of inputs are fed into a single model, and the outputs compared.

Big banks believe this would be easier to pass, and have come to know the appendix definition as the 'risk factor coverage' approach. One of the industry's hopes last year was that this approach would be officially endorsed in the FAQ document. In the end, the FAQs were silent on the point, and the European Commission's draft version of the FRTB text, published in late November, went the opposite way – telling banks to produce RTPL with their risk models.

Understandably, the industry's hopes of Basel-level backing for the easier approach have subsequently dwindled: "It would be challenging to go back to risk factor coverage now. I think that's lost," says the third bank's risk source.

Some are hopeful that more technical concerns around the workings of the tougher of the two forms of P&L attribution test could now be reviewed,

however. The second test takes the variance of the so-called unexplained P&L – the difference between hypothetical and risk-theoretical measures – and divides it by the variance of the hypothetical P&L. If the ratio of the two exceeds 20%, the desk suffers a breach; four breaches in a 12-month period will cause the bank to lose IMA approval.

In practice, banks say, this means a desk will only pass the test if its front-office and risk estimates of desk-level P&L are very close.

Over-sensitivity

Exactly how close is shown in recent analysis by the market risk team at Intesa Sanpaolo, which simulated a 1,000-year time series of the two P&L numbers in order to find the implied level of correlation required for a desk to pass the variance test. The analysis found that a desk's chances of success are practically zero at less than 90% correlation. Once it reaches 90%, a desk would suffer 8.9 breaches a year, on average, but might suffer as few as one. It was only at a correlation of 97% that the average number of breaches dropped below the failure threshold of four.

The work is referenced by the first European bank source: "The 97% correlation level isn't actually the test metric, but everyone knows what it means – it's an easier way to convey just how hard it is to pass the test."

Because of the test's sensitivity, banks have argued they might fail because of differences in the time at which the two P&L numbers are calculated – risk figures tend to be calculated globally once per day, while front-office P&L is calculated at the end of each region's trading day.

Another worry is that differences in the underlying data used by the two separate models could also cause a desk to fail – alignment in terms of data and systems between front-office and risk is rare, banks claim, and the consequence of the P&L attribution test is that the industry will have to spend a lot of time and money trying to make these things match up.

"To get to that level of correlation, it's less a question of how well risk is being measured and managed, and simply becomes a huge alignment exercise, because you need to have the exact same data, the same sources of data, the same timings. Everything has to be perfectly aligned and any small operational differences that have been OK in the past are likely to cause you to fail, just because it is so sensitive to small deviations," says the first European bank source.

The design of the test means it is also more difficult to pass if a desk's portfolio consists of offsetting positions – as would be typical for a market-maker. Variation in the P&L on each side of the hedge is captured and magnified by the variance test, producing ratios far in excess of 20%. In one simplified industry test, shared with regulators last year, a portfolio made up of bought and sold call options produced variance ratios of up to 1,025.4%.

The third bank's risk policy source says these problems are recognised by the MRG, and claims the industry has been told a review will take place. The regulators' options, though, are limited.

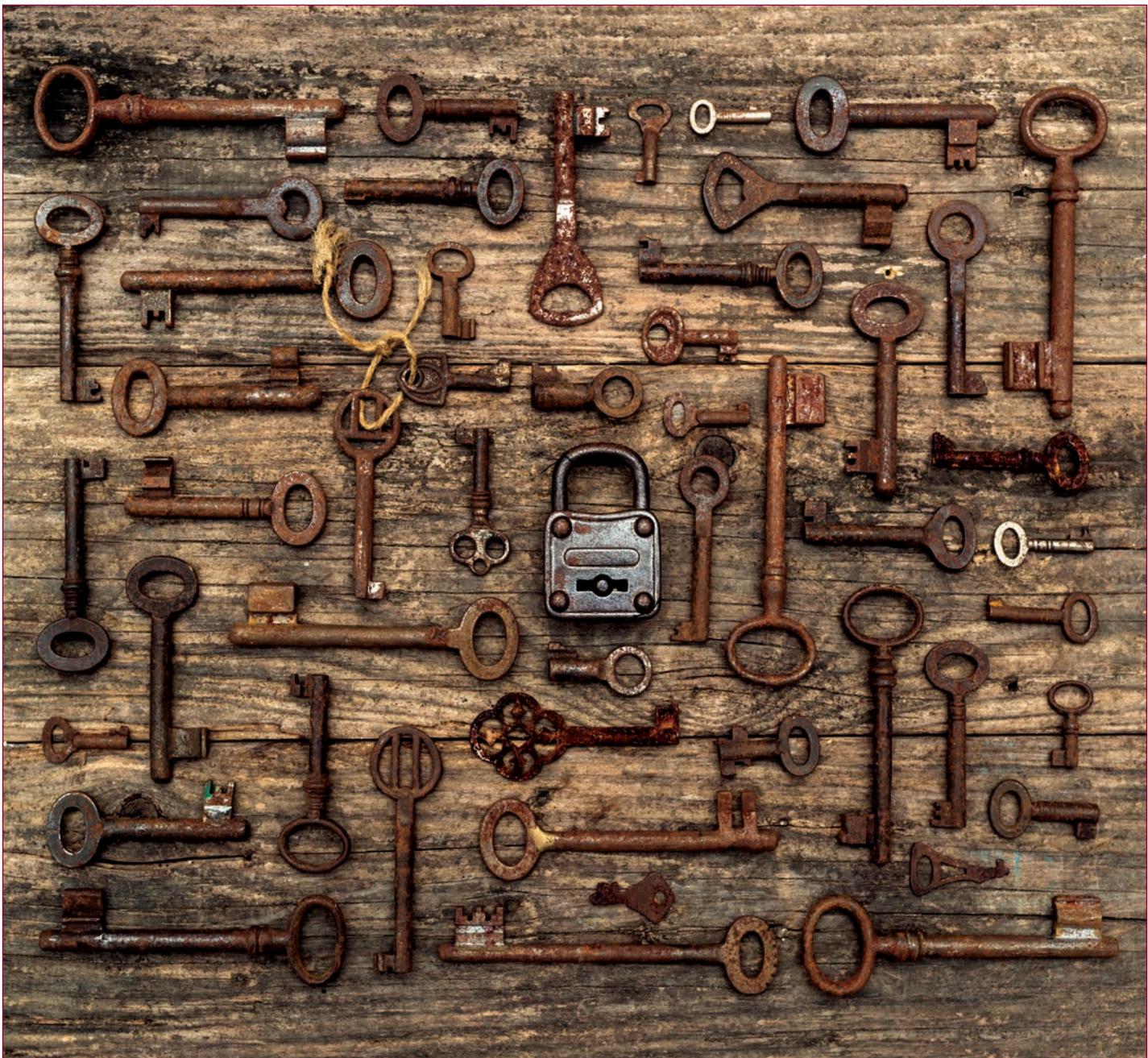
"They are trying to get a closer match between risk models and front-office numbers. Intuitively, that makes a whole lot of sense – it is laudable – I think everyone agrees on that. But how much can they change in the confines of a rule that is written in black and white? We hope they throw away the variance test or put new ratios in there. They could go back to basics, but that kind of fundamental change would be embarrassing for them. I'm just hopeful we will see more flexibility introduced into the test," says the source.

The Intesa Sanpaolo analysis suggests one option that would preserve the mechanics of the test. Switching to annual sampling of the variance ratio, rather than monthly, produces a higher chance of success, the bank found – a 70% success rate could be achieved with correlation in the low-90s, rather than the high-90s. ■

Previously published on Risk.net

Basel guidance on backtesting vexes dealers

Dealers blast the Basel Committee's "illogical" carve-outs for backtesting exceptions, and insist they face overcapitalising their non-modellable risk factors or limiting exposure to illiquid trades, reports [Louie Woodall](#)



Dealers have been left frustrated by the Basel Committee on Banking Supervision's response to questions on model backtesting under the revised market risk framework. One dealer complains the provisions – which seek to clarify the circumstances in which trading desks can ignore backtesting breaches that are attributable to illiquid risk factors – “make no sense”, while others interpret them as likely to load unjustified capital charges on to banks.

The committee's FAQ document, published on January 26, addressing questions on the implementation of FRTB, includes a response to industry concerns on backtesting desk-level internal models.

FRTB permits a limited number of backtesting breaches before a desk is disqualified from using an internal model to calculate its market risk capital. The FAQ states breaches attributable to a non-modellable risk factor (NMRF) can be disregarded from this tally, but only if they are fully covered from a capital perspective by the charge assigned to this factor.

Dealers say such an approach is counterintuitive, however. “It is illogical to say a backtesting exception shown to relate to a specific NMRF can only be removed if the NMRF capital charge exceeds the entire desk's P&L. Banks should be permitted to demonstrate to supervisors where backtesting exceptions were driven by NMRFs, and permitted to disregard them where the NMRF can be demonstrated to be adequately capitalised already,” says a senior FRTB expert for a large European bank.

“This doesn't make sense. There is nothing in the maths to justify it,” agrees a senior market risk specialist at a large North American bank.

Each trading desk is eligible for the internal models approach (IMA) provided it clears a Basel-prescribed P&L attribution test and model backtesting hurdles.

For the latter, each day a desk must compare its one-day static value-at-risk measure to one-day P&L over the past 12 months. If actual losses exceed the value-at-risk measure more than a dozen times at the 99% confidence level – or 30 at the 97.5% level – within the space of a year, the desk is booted off the IMA and on to the more punitive standardised approach.

Only modellable risk factors are incorporated in the VAR measure, but if a desk can evidence a limit break was driven by an NMRF, then it can be disregarded. The FAQs clarify this exception only applies if the NMRF charge assigned to the offending risk factor is greater than the total loss reported for that breach, however – even if the factor is only partially responsible for the loss.

The Basel Committee provides the following example: “If the P&L for a desk is –€1.5 million and the VAR measure is €1 million, a desk-level NMRF charge for the risk factor of €0.8 million would be insufficient to disregard the exception. The charge for that risk factor would have to be greater than €1.5 million for the backtest breach to be disregarded.”

The committee's conditions put dealers in a bind: to retain the IMA, they could either overcapitalise NMRFs to ensure each desk-level charge exceeds a potential VAR breach, or cull instruments referencing NMRFs from their portfolios.

The first solution would drag on a desk's performance and magnify the capital impact of NMRFs. An industry survey reports that NMRFs are likely to account for 30% of IMA banks' total capital charge already.

The second would limit the variety of instruments a dealer would be willing to trade, encouraging crowded trading in liquid underlyings, an outcome experts already fear likely under the framework.

One dealer points to the difficulty of modelling non-linear products such as swaptions, where dealers must take into account a trade's sensitivity to different risk factors across a multitude of expiries, strikes and underlying maturities. A desk can have numerous such NMRFs if they are diligently identifying and capitalising them in their model, he points out.

“Due to their large number, there is often at least one [factor] that might make even a small move enough to tip a desk [into a] breach. Then the materiality of each NMRF doesn't matter; that risk factor could contribute 1% of

“Those acting conservatively are going to get killed if they have lots of NMRFs in their models, as there is no way those are going to be capitalised [sufficiently] to cover their entire desk's VAR at all times”

A senior market risk specialist

the breach, and you'd have to capitalise as if it contributed 100%. That's not in line with the concept of adding capital from each risk measure to capitalise the potential loss from each group,” says the senior market risk specialist.

Dong Qu, FRTB project lead for the front office at UniCredit in London, doubts banks will trip their exception limits as the rules provide every incentive for desks to handle their NMRFs with care.

“If you fail too many backtests because of NMRF it will be a nightmare, as you'll have to add more capital – which makes the IMA uneconomical – or leave the IMA entirely. However, I doubt there is a high probability of this happening; banks are already experienced with VAR backtesting process and practice, and they tend to mark illiquid factors conservatively,” says Qu.

Others dispute this. The senior FRTB expert at the large European bank says a desk-level model incorporating many risk factors on the edge of modellability may find lots of them dumped into the NMRF bucket in a sleepy market, when there is insufficient trading to provide the requisite observations. In such cases, the model would appear to perform poorly relative to P&L, making backtesting exceptions more likely.

Consultants say the Basel Committee should not compare desk-level sensitivities to modellable and non-modellable risk factors in a single backtest.

“The right thing for Basel to do is remind us that the eligibility test is checking for risk coverage and predictability. That suggests we keep the comparison between liquid [factors] and NMRF separate. The NMRFs are isolated from the modellable risk factors when it comes to capitalisation – so they should be isolated for backtesting too. Instead, regulators are now forcing the banks to over-capitalise their NMRFs,” says David Kelly, London-based partner in the UK financial services practice at consultancy Parker Fitzgerald.

“On the one hand, you have your VAR based on sensitivities to liquid risk factors. On the other, you have NMRFs capitalised using a stress scenario. The sensitivities to the liquid risk factors change frequently, the NMRFs much less so. It's fine to compare your P&L based on liquid risk factors to the VAR, and it's fine to compare your P&L from re-marking a NMRF to its stress scenario. You can't mix the two measures together – you are not comparing like for like,” he adds.

Increased susceptibility

Dealers that manage their market risk at low levels of VAR are statistically more susceptible to breaches, some point out, making the backtesting rule especially onerous.

“Those acting conservatively are going to get killed if they have lots of NMRFs in their models, as there is no way those are going to be capitalised [sufficiently] to cover their entire desk's VAR at all times. It will push dealers to do things they otherwise wouldn't have, like getting rid of certain risk factors from their models. I can't imagine the regulators want that,” says the senior market risk specialist.

More damningly, by emphasising NMRFs, Basel's approach could also dissuade dealers from rigorously inspecting their models for additional flaws, others argue.

“This FAQ is concerning, because it seems to restrict the ability of banks to precisely explain their backtesting exceptions and seek approval to disregard the ones caused by risk factors already punitively capitalised under NMRF,” says the senior FRTB expert for a large European bank. ■ *Previously published on Risk.net*

Crowd trouble

The war on basis risk



New market risk capital rules are tough on mismatching positions, so trading will congregate around liquid products, say academics, banks, hedgers and other critics. Their fear is an increase in crowding, herding and a more fragile market. **Louie Woodall** reports

Flexibility is the foundation of the market-making business. A dealer's ability to hedge single-stock positions with indexes, Eonia with Euribor, or a nine-and-a-half-year-swap with a 10-year swap, is how it manages risk while making money. But under new trading book capital rules, this flexibility comes with an increased cost – and there are growing concerns about the second-order effects.

FRTB punishes with extra capital anything that does not offset perfectly. This could affect the price of less liquid trades and push end-users towards more standardised products, some fear; the result would be less diversity, more crowding and potentially a more fragile market.

"FRTB's standardised approach is basically central planning of risk pricing, and it will produce Gosplan-like results," says Craig Pirrong, professor of finance at the University of Houston, referring to the state economic planning unit of the Soviet Union.

It's not just the regulator-set standardised capital formula, though: banks argue tighter constraints on internal modelling will produce similar effects.

"The revised standard rules are intended to be calculated and executed uniformly across the industry, and you've also got a much more constrained internal modelling framework where the expectation is that models will become more similar in their treatment of risk. That has the potential to increase herd behaviour," says Ed Duncan, a London-based director in the risk function at Barclays.

These worries are now starting to get more attention – not just among banks, but also academics, corporate hedgers, and even some regulators. According to two consultants, a number of European banks have been encouraged by their supervisors to stick with the internal models approach (IMA) on the grounds that it will allow more diversity.

Risk.net spoke to 10 dealers for this article; all agreed, to varying degrees, that FRTB was a recipe for more homogeneous trading. That view holds for both capital methods: the standardised sensitivities-based approach (SBA) and the IMA.

"Both approaches encourage banks to trade only standardised instruments and converge on the same types of risk and underlyings. We've raised this point with the European Central Bank and other supervisors, as well as Basel's trading book group," says Arie Boleslawski, deputy head of trading at Societe Generale Corporate & Investment Banking (SG CIB) in Paris.

A source at the European Commission pushes back, saying FRTB will not increase systemic risk. The Basel Committee did not respond for comment by press time.

So, what happens if the critics are right? At times of market stress, liquidity already drains from

exotic products and often gaps even in more vanilla products – an effect that would be accentuated by FRTB, stoking procyclicality. This may lead dealers to pre-emptively cut off certain hedging relationships with end-users and drive business into less well-regulated corners of the financial system.

“Liquidity, or its absence, certainly becomes more likely to be self-reinforcing,” says Mark Penney, head of capital management at HSBC in London. “If [FRTB is] not softened, the volatility of non-vanilla products would be likely to increase materially. Banks may possibly look to offload this into shadow banks,” he adds, meaning buy-siders looking for bespoke trades would have to go off the beaten track for willing counterparties.

In addition, concentration in certain products would make banks’ portfolios more closely correlated and liable to move in unison under market stress. Max Verheijen, managing director at pension fund asset manager Cardano in Rotterdam, says banks may push buy-side firms into more cleared and standardised trades. The result? “The system gets more fragile. If it collapses now, you will have collateral damage,” he warns.

Liquidity bias

The SBA and IMA implementations incentivise uniform trading in slightly different ways: the former by the calibration of the standardised formula used to generate the market risk charge, and the latter by the constraints loaded on to dealers’ use of their own models.

“Ultimately the impact of FRTB on the market, whether banks use the standardised or internal models approach, is to reduce liquidity. The less liquid an instrument is to start with, the less likely banks will want to keep trading it, which is where the herd mentality kicks in. Sure, it will be viable to maintain a US Treasury trading book – but what about sub-investment grade, non-G7 currency eurobonds?” says Moorad Choudhry, professor at Kent Business School.

The SBA was designed as a more risk-sensitive update to Basel 2.5’s standardised approach. Its purpose is to act as a credible fallback for – and potentially a floor to – the internal models approach, with dealers using their own pricing models to assess the sensitivities of instruments in their trading book to myriad prescribed risk factors (see box: *How the SBA works*).

Dealers say the structure of the SBA is biased against banks running basis risk on behalf of clients, and hence will discourage the warehousing of these positions.

Specifically, idiosyncratic risks hedged by vanilla

instruments are vulnerable. A combination of high risk weights for specific factors and the mechanics of the correlation formulas are to blame. Take the example of the equity risk charge. SBA delta and curvature equity risk factors are spot prices, and vega factors the implied volatilities of options that reference these prices.

No benefit

Charges apply to net sensitivities, so long and short positions on specific equity names are offset – but the SBA denies this benefit where a long position in single stocks is hedged by a short position on an index, or vice versa.

Why? Because the rules demand dealers break down index positions into their individual underlyings and calculate a separate notional position for each of the constituents, equal to the market value of the index multiplied by the percentage of the index the constituent represents. This formula means the long position in each single stock in the above example will only partially be offset by the short position in the relevant index constituents.

This will seriously hamper popular equity strategies such as dispersion trades, says SG CIB’s Boleslawski, in which investors play off the price of an equity index against its constituents.

“Say you are short a basket of single-name variance swaps including automotive stocks and are long variance swap on an index. If you look historically at these positions, in terms of correlation their mark-to-market moves inversely, and our P&L reflects that. Under the SBA, you will shock the automotive stocks by 30%, with a strong impact on single-name variance swaps, but when you shock the hedging index swap, after looking through, the shock to the automotive constituents may only result in a risk weight of, say, 2%. On top of this the correlation formula that recognises hedging and diversification within buckets assumes low correlation. This is very, very penalising for positions where you have single names hedged by indexes,” he says.

A dealer must submit their portfolios for each risk class to three different stresses assuming high, medium and low correlations. The scenario that generates the largest capital requirement is selected as the ultimate risk class charge. The compounded effect of the equity risk weights and correlation formula is what threatens to wreck these basis positions.

A similar problem faces rates desks. The delta risk factors for this asset class correspond to specific vertex points on a risk-free yield curve for each

currency: for example, for the euro this could be the Eonia swap curve. Instruments with delta sensitivity to interest rates in the same currency – priced with a curve other than Eonia – are captured through prescribed correlation formulas.

The problem is the combined effect of the correlation formulas – coupled with the overarching correlation scenarios – will punish any basis positions a dealer has on its books. For instance, if a trader is long Eonia at the one-year point and short three-month Euribor at the one-year point, they would consider themselves economically hedged – but the SBA applies a 99.9% correlation factor for such a position. This results in a capital charge equivalent to 4.5% of what it would be had the long position been entirely unhedged. The charge is also punitive for positions referencing separate points on separate curves, and separate vertices on the same curve.

The 4.5% charge sounds manageable – but the ultimate charge for each risk class is determined by the correlation scenarios.

Basis mismatches within a portfolio are magnified by the low correlation stress, almost guaranteeing it will produce the highest charge – even where economic correlations within a risk class are high.

One dealer agreed to run the numbers for a five-year euro fixed-for-floating rate swap referencing six-month Libor. The trade has a per-basis point sensitivity of €100,000 and would require €10.6 million in capital under the SBA. Imperfectly hedging with another five-year euro swap of the same maturity, but referencing one month instead of six month Libor, would cut only €3 million from the unhedged charge assuming the low correlation scenario applies – far exceeding the risk implied by the P&L volatility of the position.

“This means a bank hedging a client exposure – for example interest rate risk to a specific curve, using a different, more liquid benchmark curve such as Libor – would have to calculate net sensitivities for each curve without the benefit of offsetting or netting, regardless of how closely they are correlated,” explains Thomas Ehmer, London-based senior manager at consultancy Baringa Partners.

Mind the gap

Regulators are aware of the industry’s gripes. In a paper published by the European Banking Authority in November last year, it noted the low scenario assumes basis positions are correlated at a shade under 75%, resulting in “highly inflated charges for highly correlated positions”, and explained the industry was seeking “clarification” on whether basis positions should be exempt. No such

clarification was forthcoming in Basel's long-awaited FAQ paper published on January 26, however. Faced with this threat to warehousing basis risk, banks have few escape routes. They could seek to avoid such positions, or pass the cost of running them on to clients. Either option would be bad news for end-users.

The Association of Corporate Treasurers is concerned FRTB "will affect real economy enterprises that may find the cost of hedging becoming so expensive as to become prohibitive", says Steve Baseby, associate policy and technical director in London.

Alternatively, dealers could encourage clients to migrate to standardised products and wear the basis themselves. However, not only would this leave complex risks with institutions less capable of managing them, it could build up systemic risk within the banking system.

"Dealers will, of course, focus on businesses where they are not exposed to idiosyncratic risk. This means a concentration on standardised trades referencing liquid risk factors," says SG CIB's Boleslawski. "For equities, this means increased activity around indexes. Yet if this happens at a time of market stress, everyone will be holding the same position. Right now, positions in single stocks differ from one dealer to another, depending in particular on its client base, but if everyone comes to indexes we will always be trading the Euro Stoxx 50."

The dangers of regulatory-induced crowding among banks were illustrated in a Bank of England working paper released in January. The BoE found that Basel II, which, like FRTB, included both a standardised and internal models approach, concentrated high loan-to-value mortgage risk in lenders using the standardised approach – those by nature less likely to have sophisticated risk management tools at their disposal.

Other dealers say end-users will simply shake up their businesses to accommodate this herding. "Corporates will start restructuring their own transactions so their hedging needs become standardised. Certain contracts will change and the market can accommodate this. It'll be inconvenient, but not all negative," says a risk model head at a North American bank.

As an example of where banks' behaviour may change, one risk management consultant cites the inflation swaps market.

"A dealer may use an interest rate as a proxy hedge to inflation because he is not able to effectively hedge inflation risk directly for that country. If a corporate takes out an inflation swap and the facing dealer hedges with an interest rate

swap, that becomes prohibitively expensive and the corporate will be encouraged to buy the interest rate as a hedge rather than inflation," he explains.

Yet crowding around certain benchmarks comes with both costs and benefits – and the size of the latter cannot be discounted.

"With Libor, because of the agglomeration of liquidity around this benchmark, we have deep and liquid markets connecting a wide range of related instruments. But there is indeed a cost: it is now difficult for an even better benchmark to emerge, given that liquidity will strongly remain with Libor until some regulatory change or another bad event of manipulation. Moreover, Libor is not as sound a benchmark as it should be, given the paucity of underlying term unsecured bank

borrowing transactions. We should not rely so heavily on a benchmark unless it is extremely robust," says Darrell Duffie, professor of finance at Stanford University.

Own model bias

The SBA is conservative by design – in part, to drive banks to use internal models. An industry survey reported in June last year that the standardised approach would increase capital requirements by 240%. Internal models, in contrast, would generate a 150% increase.

Policymakers charged with implementing the rules say they do not want firms taking on these sorts of increased costs, suggesting a preference for the less capital-intensive IMA.

"After we have materially strengthened the quality and quantity of bank capital in previous reforms of the Capital Requirements Regulation, a further significant increase of capital requirements across banks and types of risk should be avoided," says a European Commission official.

Dealers have also been lobbying the Basel Committee to tweak the IMA to further incentivise banks to migrate to this system of calculating their regulatory capital. "Initiatives are underway [at Basel] to give some incentive for the banks to move from the SBA to the IMA," says a source close to the discussions. January's FAQ paper addressed some of the concerns dealers had in this regard, several say.

"The majority of banks will push to be on internal models. If for whatever reason large numbers of banks end up with the SBA, there will be a substantial capital increase across the industry which is not what the regulators wish to see," says Dong Qu, FRTB project lead for the front office at UniCredit in London.

Those dealers pursuing the IMA may be forgiven for believing the calibration of the SBA is of no consequence to them. Yet there are two ways in which it could still influence their capital planning.

First of all, policy watchers say Basel is still debating whether IMA capital should be floored at an amount calculated by the standardised approach. If a high floor is set – at anything above 50–55% of standard rules, say dealers – the standardised approach rather than the modelled approach will have the potential to drive capital allocation. The question of floors was absent from the FAQ paper.

Second, a trading desk that fails the FRTB's byzantine P&L attribution test will fall back on to the SBA and its more punitive capital calculation. In an example of regulatory cognitive dissonance, a well-hedged desk appears more likely to fail this test than an unhedged one. What is sensible practice

HOW THE SBA WORKS

The FRTB's standardised market risk charge is the sum of three components: the SBA, a default risk charge and a residual risk add-on.

The SBA asks banks to map the sensitivities of all instruments in their trading books to a host of prescribed risk factors designed to capture their cumulative delta, vega and curvature exposures.

- **Risk factors** are bucketed according to common characteristics, and these buckets are in turn assigned to one of seven risk classes: general interest rate risk, foreign exchange risk, equity risk, commodity risk, and three classes of credit spread risk (non-securitisation, securitisation and correlation trading portfolio).
- For the **delta** and **vega** components of the risk charge, the net sensitivity to each factor across instruments is multiplied by a set risk weight to define a total risk position. For example delta equity risk factors are equity spot prices, vega equity risk factors the implied volatilities of options that reference these spot prices.
- **Correlation formulas** are applied at the risk bucket and risk class level to generate the cumulative delta and vega risk charge.
- The **curvature charge**, meanwhile, applies to all instruments embedding optionality: equity options and interest rate swaptions being two obvious examples. Its rationale is to capture risks peculiar to instruments with convex payoffs which the delta risk component may miss out. To find the curvature charge, the risk factor is subjected to two stress scenarios involving an upward shock and downward shock, with the worst loss of the two providing the total risk position.

under the IMA is not seen in the same light under the SBA.

At face value, the IMA affords much greater freedom to banks to generate their own capital charge. Those internal models that pass muster with regulators can be used to define additional risk factors to those specified under the SBA, allowing a wider range of sensitivities to be modelled. In addition, banks can use empirical correlations within risk factor classes instead of Basel's own correlation formulas.

However two aspects of the IMA regime could give rise to crowding. First of all, Basel requires IMA banks to assign their risk factors to set liquidity horizons, ranging from 10 to 120 days, to account for the length of time policymakers expect it would take firms to hedge or exit a position in stressed market conditions.

These liquidity horizons adjust the expected shortfall calculations banks use to capitalise each risk position. The longer the liquidity horizon, the greater the total risk charge. These act like multipliers on dealers' capital, says Barclays' Duncan. "For example, if you have credit risk in the high-yield space, whether it be corporate high yield or sovereign high yield, you end up with a multiplier against the capital that you are applying today – perhaps between as much as four to six times over what a 10-day VAR may produce today. Even when you factor in a removal of the double-counting of VAR and stressed VAR and a reduction in the multiplier, FRTB could still result in an increase in IMA capital. The scaling up of capital in the longer liquidity horizon buckets is going to make them less appealing to hold," he says.

Second, dealers' freedom to use their own risk factors as model inputs is subject to conditions. Those factors that cannot be evidenced by a sufficient number and frequency of verifiable quotes are disqualified. These non-modellable risk factors (NMRFs) are subject to stressed capital add-ons that exceed the charges assigned to their modellable cousins. IMA dealer participants in an industry survey say NMRFs will contribute a whopping 30% of their total market risk capital.

Given the size of this capital punch, dealers will want to minimise trading positions that reference prohibited risk factors. This will concentrate activity on instruments linked to risk factors underpinned by rich market data. UniCredit's Qu says this will incentivise crowding in the same manner as the SBA.

Others agree: "The issue of NMRFs is of very high concern, because when evaluating the regulatory requirements banks may find out there are many



"Dealers will, of course, focus on businesses where they are not exposed to idiosyncratic risk. This means a concentration on standardised trades referencing liquid risk factors"

Arie Boleslawski, SG CIB

risk factors that would be non-modellable. This risks banks having just a few liquid factors to include in the model. If this is the case, everyone will be concentrated on a few liquid risk factors, so liquidity will dry up on others," says Rita Gnutti, head of internal model market and counterparty risk at Intesa Sanpaolo in Milan.

Dealers will also be discouraged from incorporating risk factors that lie on the border of modellability: those that qualify for IMA one day, but could fall into the NMRF bucket the next. A risk factor's modellability must be assessed on a monthly basis. For a factor to avoid the NMRF sin bin, a bank must provide at least 24 observable real prices within a 12-month period, with no more than one month between two consecutive transactions. What constitutes a "real price" is an ongoing subject of debate.

"You're not going to want to be on the borders of modellable treatment around reporting periods, particularly around quarter-end and year-end, because there is the potential for your capital measures to become volatile. Products without the requisite frequency of trading will become more expensive to maintain, and perhaps more expensive to trade. That means anything long-dated, anything a little more bespoke," says Barclays' Duncan.

For risk factors on the edge of modellability, the consideration for the dealer is whether they can

make enough profit acting as liquidity providers to cover their cost of capital.

Alternatively, consultants say they could add a spread to instruments vulnerable to these factors, perhaps as a constituent to the capital valuation adjustment (KVA).

"A bank may decide they have to push the costs of the potential loss of modelled capital to the end-user," says David Milne, national leader, quantitative advisory services for Canada at EY in Toronto.

The haves and have-nots

Any instrument that is infrequently traded will be targeted for scrutiny. Corporate bonds that trade infrequently are at risk as they may lack the requisite number and frequency of price observations to qualify as modellable.

This may prove the final straw for bit-part players in the bond market. Increasing trading velocity on these illiquid names to ensure their modellability is a non-starter for these dealers, who may already be struggling to generate sufficient return on capital to keep the business running.

"I'll give you an example," says Ryan Ferguson, head of credit derivatives and XVA at Scotiabank in Toronto. "Say we trade a particular bond once a week but another bank trades it once a day. They don't need as big a bid/offer to cover their capital cost as us since they've got a high trading velocity where they make enough on each trade to justify that capital – whereas we're only doing a fifth of their flow to support the same amount of capital. If you don't have scale you will have to shut down, and that further concentrates activity among those who already have that scale."

The same is true for over-the-counter derivatives referencing illiquid risk factors: banks face a trade-off between the cost of quoting instruments to ensure modellability and simply accepting the NMRF charge. Some may decide to exit certain markets altogether.

Dealers are working together on pooling data through various utilities in a bid to classify more risk factors as modellable – though some argue this could further the concentration of certain trading activity.

"Internal model banks could buy modellability from external vendors if they do not have the necessary data to hand. This could create another divide among IMA banks that can afford to invest in this market data, and trade across many risk factors, and further reduce trades in some illiquid market segments," says Intesa's Gnutti. ■

Previously published on Risk.net

Banks bemoan FRTB model guidance

Risk models pulled in opposite directions by P&L attribution test and non-modellable risk factors, writes [Louie Woodall](#)

Conflicting demands contained within the Basel Committee on Banking Supervision's revised market risk capital framework have left dealers confused over how best to calibrate their internal models.

The regulatory shake-up, known as FRTB, allows banks to use an internal models approach, or IMA, to calculate a trading desk's market risk capital requirements – as long as they pass a series of supervisory checks.

One of these checks – the P&L attribution test – incentivises firms to make their models as granular as possible. But another – the regime's risk factor framework, which assesses the modellability of inputs – seems to push in the opposite direction, argue market participants.

"It's lunacy. Why set up rules that demand very granular risk models in one place and penalise you for that in another? That's not good thinking on the part of the regulators," says a senior FRTB expert for a large European bank.

The P&L attribution test compares the hypothetical P&L generated by a bank's front-office pricing model to its risk-theoretical P&L (RTPL). Both approaches are designed to reflect the profit or loss generated by revaluing yesterday's portfolio using today's end-of-day prices. To pass the test, there can only be a small variance between these two P&L measures.

Basel's final FRTB framework sets out two conflicting ways of generating a desk's RTPL, however. One version tells a bank to use its back-office risk models; the other requires the bank to use its front-office model, but applying only the more limited set of factors that exist in the risk models.

Which approach regulators intended banks to use has been a subject of hot debate – but dealers are working on the assumption they will be required to use the latter approach. Basel's long-awaited FAQ document on FRTB implementation, issued in January, failed to address the problem.

Banks' front-office models are generally more risk sensitive, incorporating thousands of risk factors to accurately price trading positions. For the RTPL to be a close match, a similar number of risk factors



The contradictory nature of certain elements of FRTB is leaving banks lost

would therefore have to be incorporated into the risk model, making it more granular.

But in order for risk factors to be capitalised under the IMA, they have to meet strict observability criteria. Those that fall short are categorised as non-modellable risk factors (NMRFs) and are capitalised separately, and more punitively, than their modellable cousins. Banks could therefore be incentivised to incorporate only modellable risk factors to avoid these charges, many argue – pushing their models to be less granular.

"One of the biggest issues the banks are assessing right now is what balance to strike between the risk factors they use to pass the P&L attribution test and those they use for the risk factor modellability test. For the P&L attribution test, banks seek to use the most granular set of risk factors in their risk models, because that matches with their front-office pricing models and helps determine the true risk associated with that position," says Chris Casey, global head of regulatory and reference data at Bloomberg in New York.

"However, for the risk factor modellability test, it would be more desirable to include just those risk factors where you have the required observations

to minimise NMRFs. The more granular your model, the harder it is to get the necessary observations for each risk factor," he adds.

Four large dealers *Risk.net* spoke to for this article did not say whether they were leaning towards favouring more or less granular models.

A market risk specialist at a US bank suggests trading desks will likely be driven towards incorporating "risk factors that are easier to prove modellability for" into their models; the risk chief at an Asian bank says banks will "modify" their internal models for FRTB – but not to the extent that they risk mispricing or incorrectly hedging their portfolio just to qualify for IMA.

A regulatory capital manager at another large US bank, on the other hand, emphasises the risks of a detailed risk model: "A more granular risk representation increases the prevalence of NMRF, as it will be more challenging to achieve the required transaction observations to prove modellability. Moreover, the resulting NMRF charges can result in disproportionate capital due to the required straight sum aggregation," he says.

The first senior FRTB expert at the European bank says regulators urgently need to "fix" the dilemma that the push-pull of the two tests poses for internal models.

Dealers will likely weigh up the merits of an own-models approach when deciding whether to submit for IMA approval on a desk-by-desk basis. A desk that does not qualify or apply for internal model treatment will be capitalised under the standardised approach instead.

"If you have some very particular products that use a particular group of risk factors, you can make a decision at desk level as to whether you want to make the model granular so that single desk can pass the P&L attribution test or say, 'the cost is too high, let's just make it less granular' – even though it may mean that desk goes on to the standardised approach instead of the internal model," says the market risk specialist at the US bank. ■

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Risk 30

The logo features the word 'Risk' in a bold, dark grey sans-serif font above the number '30' in the same font. A stylized globe with a green and blue gradient is positioned behind the '30', with a bright sunburst effect emanating from the top of the '0'.

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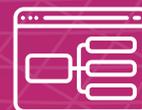
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With a final implementation date of end-2019 on the horizon, banks are looking to respond swiftly and effectively to the challenges posed by the new FRTB framework. In a forum sponsored by [CompatibL](#), [Murex](#) and [Numerix](#), a panel of market risk practitioners explores the revolution in data, advances in technology and rethinking governance, trading structures and hedging strategies





Frank Heanue
Head of Presales for ERM, Murex
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What are the greatest challenges being faced by banks on the path to implementation?

Frank Heanue, Murex: In many cases the legacy systems of banks are either not up to the task of supporting the calculations required – for example, producing risk theoretical profit-and-loss (RTPL) attribution or lacking risk factor depth – or they cannot provide the data in a timely manner. Such systems often struggle to attain the required accuracy, at least for a subset of instruments, and to consistently align risk and trading results. In some instances, an overhaul of the current risk systems is sufficient to bring them closer to the front office. In many others, a new front-to-risk architecture is preferred, resulting in a broader project and potentially reducing the actual FRTB compliance window. Importantly, it is often difficult for the bank to make such decisions without an initial investigation involving a considerable amount of resourcing and investment. It is no small task to understand the impact of non-modellable risk factors (NMRFs) on the overall capital requirement or to assess the optimal granularity of risk factors needed to pass the P&L attribution test.

Even for banks using the standardised approach (SA) only, older methods required inputs based on balance-sheet items, such as mark-to-market and notional, whereas FRTB-SA dictates a whole new set of additional reference data, risk and pricing capabilities. In terms of calculations, sensitivities need to be generated and hold consistency across multiple desks, and vega is now needed for product types other than options. Stress-test scenarios need to be defined and managed for curvature risk and the SA-default risk charge requires offsetting of weighted positions that can prove tricky to implement. Thus, the target solution needs to display the required levels of calculation and aggregation capabilities.

Furthermore, structural considerations such as potential desk reassignment or alignment of models and/or market data can only be addressed once conclusions are drawn from this analysis phase. These outcomes feed operational decisions and human resource elements of the project that can be time-consuming to address.

Banks must overcome a multitude of hurdles under FRTB: in data sourcing and management, in assessing current systems, in considering internal organisational and business challenges, and in terms of where to build and where to use existing vendor solutions. Many banks have, to date, been focused on other aspects of regulation, but now is the time to seriously examine the potential impacts of FRTB.

Andy McClelland, Numerix: Banks face a host of major challenges. Many are obvious, such as the challenge of setting a clear strategy to prepare for FRTB. But I would like to highlight two less obvious challenges. One is ensuring the bank's personnel is prepared for FRTB. The scope of the new regulatory dynamic is massive and requires organising a strong and committed team of leaders who can make the tough decisions and be held accountable for them – and

who have the capability to make the transformation meaningful, powerful and successful. A project team must also be mobilised, including representatives from trading desks, IT, risk and finance.

The other challenge is that bank management will need to make three separate worlds co-exist. To help ensure a smooth and successful transition, it will be necessary to pull together the trading, risk and finance departments. These three functions must be closely aligned during the implementation process, as key issues and decisions will impact all three from both a workflow and technology set-up perspective.

Nick Haining, Compatibl: Other than the wide array of technical challenges imposed by FRTB, the key business challenge is the lack of certainty and finality in key aspects of FRTB, even as the current implementation schedule demands that FRTB projects get under way. The most significant provisions still to be finalised are the internal models approach (IMA) capital floor, the P&L attribution challenge for a well-hedged portfolio, widespread NMRF challenges in all but the most liquid markets, and of course the delay in publication of the final FRTB credit valuation adjustment (CVA) regulation. Until these provisions are finalised, banks will not be able to engage in confident FRTB project planning and address technological and organisational challenges.

Hany Farag: The biggest challenge is the uncertainty we have at this stage. The P&L attribution test, as we understood it from the trading book group of the Basel Committee on Banking Supervision, is fairly difficult to pass. To achieve the required standard, we have to rebuild the risk systems across the industry to become essentially full revaluation, have matching models in front office and risk, and align the market data and risk factors between those functions. This sounds great in principle, but is very expensive to achieve. If the test is diluted or the definition in the glossary is not required in its strict form, the cost is suddenly an order of magnitude smaller. This uncertainty is not at all helpful. More uncertainty comes from the noises we are hearing from the US regarding regulations and the pushback that may ensue. Not having a level playing field is harmful to the global financial system and can ultimately lead to some jurisdictions walking away from the regulations if they feel it is a one-way street.

Another challenge arising from P&L attribution is the need to study the behaviour of different products in the test. If the test itself is not yet finalised, this remains a very challenging issue. We cannot determine if certain products, or even desks, are better off on the SA or the IMA. Furthermore, you cannot price your clients properly for long-dated trades – those that mature post-FRTB – if you cannot estimate your capital impact accurately. Nor can you decide which businesses to keep and which to exit if you cannot assess the capital cost to maintain them.

Richard O'Connell, Credit Suisse: Every bank has its own unique challenges; however, some issues seem to be universal for banks seeking to pass the RTPL alignment.

A bottleneck at the moment is around technical issues with the statement of the tests, which result in model failure for 'unintended' reasons. These issues will need to be resolved with FAQs and technical changes to the rules by the Basel Committee on Banking Supervision. For example, a recent FAQ clarified that local closes can be compared with local P&L for banks that operate across time zones – there are many other issues that will hopefully be resolved in a similar fashion.

Once these technical problems are addressed, banks will be able to address three common issues that, as intended, cause models to fail RTPL:

- Data lineage: ensuring every market data input is traced back to an arm's-length transaction or quote.
- Proxies: insufficient granularity of market indexes to match position-level P&L – for example, mapping all stocks onto Standard & Poor's 500.
- Model imperfection: generating accurate RTPL for large portfolios of offsetting trades – for example, a swap book – requires far greater precision than for individual trades, such as a single swap.

The issues involved in addressing data lineage should not be underestimated; however, it is relatively simple to explain and a well-defined problem. Additionally, for many banks it is a new requirement, so there are no legacy systems to fix.

Proxies and model imperfection, on the other hand, are not so well defined. It is not clear how many indexes must be expanded into sub-indexes, or how many second- and third-order effects must be incorporated, before the RTPL test can be passed. These changes must also be made to legacy systems currently in use for day-to-day risk management and capital adequacy calculations.



Andy McClelland
Director of Quantitative Research, Numerix
numerix.com

How will banks' tech strategy and spending need to change as they implement FRTB?

Andy McClelland: To meet FRTB's requirements, banks will need to rethink – and probably completely overhaul – their technology strategies and can expect to spend at least tens of millions doing so. This will likely require a change in a bank's technology philosophy. Firms will be pushed to re-evaluate the legacy software and analytics in their arsenals and explore new, more powerful hybrid technologies and methodological approaches that are open-ended, agile and transparent. The demands will include technologies that can meet the massive increase in data integration, data storage, data validation and computational power requirements, as well as open-source ecosystems that bring the data and compute environments together.

Given this, I see banks' technology strategies changing in three ways:

- Banks will conduct more comprehensive analyses to identify gaps in existing infrastructure. It is important to be aware of the two core elements within the technology infrastructure: computational requirements and data management requirements, and the options for each are diverse.
- New kinds of delivery model for the new architecture will be explored. Banks can use software-as-a-service, they can have delivery on premises or they can have it in a cloud. Solutions deployed as a hosted service in a private cloud can facilitate rapid installations, streamline updates, enable high operational efficiency and lower total cost of ownership (TCO) compared with on-premises software.

- Banks will change their perceptions around 'build versus buy', letting go of the belief that building all technology in-house is the only option. That time is gone; the decision now is which elements of the architecture should be built in-house and which can be better met by best-of-breed technology vendors. The regulatory climate has been moving banks away from building technology in-house to rely more on third-party providers. These vendors specialise in developing highly customisable technology, which can serve as a competitive advantage for a bank.

Nick Haining: For the banks' IT functions, FRTB poses a unique set of challenges to the traditional way of delivering risk software. Of these new challenges, the most dramatic is the need to reconcile risk models with front-office models to such a degree of precision that the best and sometimes the only way to achieve it is to call the front-office pricing model from risk software. While this seems easy in theory, the practical challenge of adopting a front-office model for the use within risk software is enormous. This is why banks and software vendors that can provide risk models accurately matching front-office P&L will enjoy a considerable head start as FRTB implementation projects get under way. With regard to spending, the change from firm-wide approval to desk-level approval for IMA both lowers the plank for gaining IMA approval and dramatically reduces its cost, if pursued for a specific trading desk or line of business. This has the effect of moving the spend on IMA approval from being part of the overall strategy of the bank to being part of the strategy of a business or even a single desk.

Frank Heanue: It could be argued FRTB has a greater impact on banks' IT decisions than any other regulation. As for most new regulation, data availability, data quality and volumes handling are a huge concern – especially where the inability to source, manage or validate such datasets can lead to penalties of large capital requirement increases. Accuracy and timeliness of calculations are also primary factors, as well as the ability to drill down results to understand and reconcile any discrepancies and misalignments. Solutions must be performant, scalable, robust and have the flexibility and openness to adapt to changes. Take performance, for example; it is not as simple as throwing hardware at the problem: the key factor to any solution is software optimisation designed with FRTB in mind and, in particular, eliminating redundancy in calculations by performing 'never twice' calculations.

In addition to software solutions, banks will also look for help from hardware and infrastructure changes. For example, many banks are leveraging grid solutions – using graphics processing units and central processing units (CPUs) – and exploring how cloud and other outsourcing can provide all or part of the FRTB solution where regulatory constraints do not exist. Of course, all these IT decisions need to be made while considering overall costs, benefit to the FRTB project, timeliness of solution delivery, synergies that can be realised with other projects and the long-term strategy of the organisation.

Etienne Varloot, Natixis: One of the novelties of FRTB is the willingness by the regulator to merge the front-office and the risk-pricing models, which are clearly captured by the P&L attribution test. In its current wording, the test is so stringent and the risk of failing from a data standpoint already so material, most banks are unwilling to risk a major models gap between risk and front office. This front-to-risk integration is new and has some significant tech implications.

First, the cost of computing risk metrics is skyrocketing – generating an

expected shortfall (ES) or value-at-risk (VAR) computation through an elaborate autocall, target redemption forward or Bermudan swaption pricer is prohibitively expensive. Second, risk and front-office IT departments were very independent under Basel 2.5, but the new framework is pushing them towards greater integration; a similar pattern can be observed in effective expected positive exposure or derivatives valuation adjustment computation. One should expect some governance or organisational chart changes as well as a new approach to IT budget management.



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Does FRTB present an opportunity for transformational change?

Nick Haining: We believe that FRTB presents a unique opportunity to improve the quality of the models and processes in risk management to a greater degree than previous iterations of the Basel accords required. One of the key drivers of this change will be the need to meet P&L attribution and NMRF requirements. Even if, as widely expected, the P&L attribution and NMRF criteria are relaxed or amended, the need to reconcile front-office P&L with the risk model and carefully document the origins of the market data inputs will drive systemic improvements to the quality of risk management models, processes and data.

Etienne Varloot: Considering the budget and the amount of governance and workflow changes required by FRTB, it would be a missed opportunity not to leverage this mandatory change into something transformational, especially if you consider a similar drive from parallel regulation – the US Federal Reserve Board's *Supervisory guidance on model risk management* (SR11-7), the Volcker rule and the Markets in Financial Instruments Directive (Mifid) II. The major impact could be in product and model governance integration, as the model will be shared more by front office and risk, P&L explanation integration between risk and independent price verification, or model validation between risk and pricer.

Frank Heanue: Certainly. FRTB provides a unique opportunity for banks to critically analyse their infrastructures with a view to streamlining their architecture, as well as meeting the shorter-term regulatory requirements.

Requirements around static data have not only grown in terms of volume and type of data required, but the bank must ensure consistency of data across systems while being conscious of the overlap and potential synergies with other regulatory requirements, in particular initial margin and Mifid II data transparency.

FRTB may force organisational change as some desks become too expensive to run as a viable enterprise. Others may be merged to reduce capital burden or to boost the chances of passing the P&L attribution tests. Additionally, new lines of business and relationships may need to be developed to address client needs and to prevent non-diversification or over-concentration of business activities. FRTB transformation also offers the opportunity to make communication

channels within and across business lines more efficient, and to provide transversal management structures for such processes across the front office, risk, finance and IT. Similarly, it forces the bank to consider alignment of different close-of-business criteria across geographically dispersed entities.

In IT infrastructure, the new regulation provides – and, in some cases, dictates – the opportunity to review and enhance front-office and risk systems. In fact, many banks are already using the opportunity of FRTB to replace legacy systems and to more closely align risk and trading. Other customers are looking at how FRTB fits into the new regulatory framework and how synergies can be realised across regulations such as the standard initial margin model (SIMM), SA-counterparty credit risk (SA-CCR) and SA-CVA, among others.

Hany Farag: Yes, it is an opportunity for the risk function to upgrade its skill set and up its game. It is an opportunity for the bank to align models between the front office and risk for better measurement and faster time-to-market for various products. It is an opportunity for finance, risk and the front office to align their processes, automate them and cut costs – eventually, though with a steep climb at first. It is an opportunity for capital market executives to re-examine their businesses, assess profitability, risk-reward trade-offs in the new framework and capital costs, and re-strategise for the next five to 10 years. Most banks are expected to do this, as redefining desks and their strategies at this point in light of FRTB and other regulations is a must. Return on equity (ROE) will be heavily impacted by FRTB, and one cannot miss the opportunity to use this lever to optimise ROE for the next decade.



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Richard O'Connell: If a firm invests in the system changes to bring risk calculations to a level that passes RTPL alignment requirements, it will find considerably more ways to use this information. For example, if you can attribute P&L moves at a granular level daily, you can sum up daily moves over a quarter, and discuss secular drivers of P&L with confidence and accuracy.

Andy McClelland: With disruption comes opportunity. I believe a comprehensive and successful implementation of FRTB will, in several ways, result in positive transformational change for banks. One outcome is a diminution of risks to a bank's reputation. Making the investment in the technology will help ensure financial stability and bank solvency. In addition, having the best risk management technology in place sends the message that the firm is dedicated to protecting the clients it serves.

Another positive outcome is a gain in cost benefits and efficiencies. The use of the cloud, for example, can enable quick deployment, enhanced speed, faster model performance and a lower overall TCO. The more rapid computation of the incremental capital impact or margin impact of trading decisions may enable firms to eventually achieve greater efficiency. With more capital at their disposal

and not tied up in capital charges, and lower aggregate margin requirements, banks can put these resources to work and focus again on profitability.

What are the challenges and potential systemic risks posed by the SA?

Nick Haining: The main challenge of the SA, in FRTB as well as in earlier iterations of the Basel framework, is the lack of precision in risk sensitivity. This drives the requirement of conservative calibration, in turn causing higher capital levels for firms unable or unwilling to undergo the arduous process of obtaining IMA approval. The use of the SA by most market participants may also lead to concentration in certain thinly traded hedge instruments, increasing the potential of a liquidity crunch. A different challenge unique to the SA is that, unlike the SIMM, it lacks provisions for recalibration. The regulatory risk weights and correlations will increasingly fall out of sync with the relevant historical periods. If the markets pass through periods of stress in the future, the lack of global recalibration provision in the SA may cause some of the country supervisors to unilaterally impose additional capital multipliers, destroying the level playing field the Basel capital accords aim for.



Hany Farag
Senior Director at a large
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Hany Farag's responses to our questionnaire are in a personal capacity, and the views expressed herein do not necessarily reflect or represent the views of his employing institution

Hany Farag: When you have a crude capital measure that is punitive, it is natural for traders to look for the highest-efficiency products. These are likely to have higher risk than the ones they trade today, but are more capital-efficient in FRTB. Given the SA itself is a simplistic model, it is likely traders will find themselves trading products that have risk-to-capital ratios that are higher than we would like. In other words, the SA will be too crude for these products and may not capitalise them properly.

There are other ambiguities and anomalies with the SA. For example, it uses maturity of instruments to allocate the sensitivities on the term structure – yet a swap can mature in 10 years. Should all its sensitivities be summed up and allocated to a 10-year point? That makes no sense, and would lead to all kinds of bizarre anomalies and incorrect risk measurements. We also have asymmetries in foreign exchange risk, where the SA seems to favour USD-reporting banks. This seems unintentional but we found extremely problematic examples that demonstrate anomalies of up to 400% for some portfolios. This is not a level playing field at all. I hope these and other inconsistencies will be addressed with an open mind by the regulators.

What operational changes will result from FRTB implementation around desk structure and internal risk transfer (IRT) practices?

Etienne Varloot: Implementing FRTB desk structure creates many challenges because it is a multi-layered problem and a company-wide endeavour. Constraints such as 'one trader per desk', 'one budget per desk' or 'IRT back-to-back risk reversal for non-IR with external firms' are not current market

practice(s) and require changing the organisation and responsibilities across the firm. In the special case of a banking mutual group, the IRT issue needs extra care to handle the group's overall asset-liability management. The new IRT rule also seems to be pushing banks to move into their trading book some functions traditionally handled by their treasury in a banking book, such as Euro Medium-Term Note issuance.

Other considerations are compatibility with the Volcker desk structure and its key information ratios, the domestic banking law desk structure and homologation rationale: are the risk axes homogeneous? Is this an NMRF-prone desk? How different are the front-office and risk models? What is the CPU cost of ES computation? Do we even bother adopting the IMA?

A key concern is the homologation strategy: which desk is due to be IMA-homologated and when? Keeping a desk under the sensitivity-based approach (SBA) would burden it with extra capital, but the cost of going down the IMA road and the likelihood of failing homologation may be so high that the overall net present value (NPV) of the project may be negative. This is all the more true in that the announced phase-in is pushing funding cost gains linked to IMA into the future, whereas investment costs are still current. This desk-by-desk NPV IMA or SBA computation is also difficult as one needs to estimate the SBA-to-IMA floor level and future CPU grid costs reduction.

This raises the final question: if a desk stays with the SBA, will other IMA desks subsidise its capital valuation adjustment charge? The challenge is a mix of extremely technical considerations, some decisions with serious end-of-year desk economic-value-added impact and organisation chart adjustments. The bank's management is therefore solicited to make the required decisions.

Andy McClelland: Viewing the desk structure question from a purely capital perspective, things boil down to which types of desks are most likely to gain and maintain IMA approval. There is an incentive to keep desks small to minimise cliff effects, in that, if a small desk loses IMA approval due to poor P&L attribution performance, the impact on the bank as a whole might be less significant. On the other hand, dedicated desks dealing only in exotic products, which require complicated pricing models, might find the task of achieving adequate P&L attribution performance overwhelming. Indeed, middle-office risk systems have long used simpler pricing models than their front-office counterparts, and such differences will be heavily scrutinised under the new IMA approvals framework. The problem is probably even worse when considering that lower-order risks will likely be hedged by these desks through internal hedging efforts.

Nick Haining: One of the novel aspects of FRTB compared with the current regulations is the stringent set of requirements used to prevent regulatory arbitrage through aggressive IRTs between the trading book and the banking book. Banks that previously relied on risk transfers and hedging across the formal trading desk boundaries will have to restructure the organisational structure of their front office or face a significant increase in their capital requirements.

The P&L attribution test and risk factor modellability criteria under FRTB are pulling banks' risk models in conflicting directions. What are your thoughts on this?

Andy McClelland: In short, there is a trade-off between P&L attribution versus NMRFs. Using more risk factors makes it easier to pass the P&L attribution test, which means a bank can obtain approval for using IMA. However, using more

risk factors also means some are likely to be non-modellable, as there will be less data to support each individual risk factor. NMRFs are penalised with a separate stress-scenario charge, which pushes up IMA capital costs. This may be very frustrating for dealers, leaving them with the difficult task of determining the optimal trade-off between the two competing pressures.

What challenges does FRTB's NMRF framework pose for data sourcing and management?

Hany Farag: There are three components to NMRFs, two of which – data sourcing and governance – go together and are already a big challenge. It also takes a rigorous governance process to keep track of the required information on modellability and more information has to be resourced to satisfy the criteria for modellability. However, from my perspective, an even greater challenge is to efficiently model these risk factors to reduce their capital charges in the spirit of the rules, which takes a fairly sophisticated infrastructure and creative modelling choices. One is compelled to do so in order to achieve high efficiency and compete in the market place – the infrastructure and its maintenance is non-trivial and certainly costly, but ultimately worth it.

Nick Haining: Before FRTB, data providers were able to use advanced interpolation algorithms to work around stale data and lack of liquidity in certain market segments. Previously, banks using the data did not need to document the interpolation algorithms used to obtain, for example, a continuous volatility surface from a limited set of data points. Under FRTB, for the data to be acceptable as input to regulatory capital calculations, it will have to rely on actual trades or executable quotes and the bank will need to have full transparency with respect to the data quotes and interpolation algorithms.

What challenges does FRTB pose for client relationships?

Nick Haining: Under FRTB, some banks may face dramatic increases in capital requirements for the type of trading they historically relied on to win their unique client relationships. As an example, a regional bank may have built valuable client relationships providing liquidity in names traded primarily in their respective home markets. Under FRTB, this service may face NMRF charges that can severely limit their ability to continue providing this important service to their clients.

What governance challenges are there for data pooling and sharing initiatives?

Hany Farag: Data pooling is very promising and may be the wild card that can bring the IMA to capital-neutral in its impact – or possibly capital-reducing. However, there are many moving parts. We need regulatory clarity as to the requirements for data pooling and proper governance. Some banks want to collaborate, yet others – often quite large – prefer to go it alone and not share anything, which can lead to the lack of a level playing field and other problems. It is hoped the regulators can establish a clear guideline that maintains a level playing field without being too onerous. If trade information is out there, I predict it will ultimately become more transparent and traders will opt for capital reduction by disclosing more trade information.

Nick Haining: Because FRTB requires that market data inputs are based on actual trades or executable quotes, a data pooling provider would have to receive and store more information about the trade, including its counterparty, than would

normally be collected by a typical consensus-based data source. The ability to ensure proper stewardship and confidentiality of this highly sensitive data, as well as legal issues surrounding its disclosure to the data pooling service, will have to be addressed for the data pooling to attract the critical mass of contributors.



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What does FRTB mean for enterprise-wide capital optimisation and product choice for clients?

Etienne Varloot: In the current low-yield environment, some popular retail products are relying on structured coupon pick-up. To generate extra spread, these payouts may monetise some illiquidity premium – for example, long-dated out-of-the-money sensibility and its related unobservable risk basis, and Greeks. FRTB is rightly demanding more capital for that type of risk axis through the NMRFs or residual risk add-on (RRAO) capital charges.

To avoid accumulation of these risk and capital charges, it is likely that the risk budget allocated to those products will be more constrained by risk limits. Another avenue may be risk mitigation offered by new solutions-advanced investors not affected by the FRTB framework and able to carry those tail risks on their balance sheets and/or alternative funds.

Nick Haining: By imposing stringent trading-desk definitions and disallowing offsets across trading-desk boundaries, FRTB will force banks to reorganise their front-office hierarchies in a way that benefits enterprise capital optimisation. This will lead to trading desks being organised according to the risks they must hedge, and not the role they play in client relationships. A trading-desk structure created for this purpose may lead to a reduced ability to focus on unique client relationships. As for product choice implications, RRAO and NMRF provisions in FRTB are designed to penalise and discourage risk-taking outside the primary risk classes and outside linear instruments or vanilla options. While this will reduce the likelihood of severe losses due to trading in complex financial instruments, it will considerably limit product choice for the clients.

Richard O'Connell: For enterprise-wide capital optimisation, a typical concern is maintaining a diverse portfolio of businesses that results in a sub-additive VAR calculation for the entire bank. With FRTB's ability to force desks out of the IMA and on to the SBA, things can be both simpler and much harder. For a bank that is entirely on the SBA, there is much less diversification benefit available – a simple sum across desks might be a good estimate. Conversely, for a bank that has a variety of businesses that might be on either the IMA or SBA, a proper optimisation analysis must now consider many different scenarios where individual desks are either on the IMA – and thus potentially increasing diversification – or on the SBA, in which case the diversification benefit for the remaining IMA desks is likely reduced. Accounting for all the possible permutations of IMA/SBA desks will be extremely challenging. ■

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