Portfolio diversification in the fundamental review of the trading book

Analyzing differences in diversification behavior between standard and internal model approach

White Paper | Trading book

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Introduction

The global financial crisis exposed the shortcomings of market risk management practices of the trading book. In January 2016, the Basel Committee for Banking Supervision (BCBS) overhauled the approach to assess capital requirements with the Fundamental Review of the Trading Book (FRTB). With a 2019 deadline, FRTB is expected to have significant impact on financial institutions and financial markets in terms of infrastructure, capital requirements and operational controls.

Banks must adhere to the rules of the fundamental review of the trading book to avoid higher capital requirements. The FRTB defines two separate approaches for quantifying capital requirements for market risk – Internal Model Approach (IMA) and Standardised Approach (SA). FRTB affects many areas including front office, product control, data and technology.

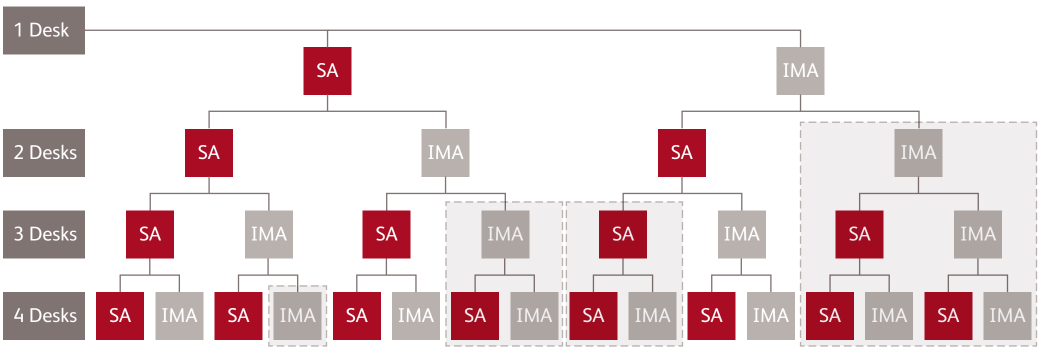
SA vs. IMA

FRTB is a major change to the banking industry's current market risk management practices, including a stricter boundary between the trading and banking book to a more stringent approval process for the use of an internal model.

The option to use the internal model approach (IMA) as opposed to a standardised approach (SA) is not new. The criteria however for gaining regulatory approval for the more capital-efficient IMA as part of the revised FRTB standard are more rigorous and require firms to demonstrate robustness in the models themselves. IMA can only be obtained (and lost) at the desk level. The requirements to receive approval have been intensified and make it a more challenging task.

By specifying that IMA is given at desk level opens up a debate about which approach, IMA or SA, to use for each desk. The decision cannot be based on looking at all the combinations, since these grow exponentially with the number of desks as depicted in figure 1 (for 10 desks there are already 1024 combinations).

FIGURE 1: NUMBER OF POSSIBLE DESK ALLOCATIONS TO SA AND/OR IMA



Many factors come into play when deciding on the right mix. Financial institutions need to consider the pro and cons for their own trading desk, taking into account the capital charge itself under each approach, the likelihood of obtaining approval for the IMA, the added cost of an IMA approach and the associated operational and IT implementation costs. Finally, since no diversification is allowed between the two approaches, the benefit this provides to each desk needs to be carefully analyzed and this is the focus of this white paper.

The FRTB SA is mandatory irrespective of IMA eligibility.
The capital charge under this approach has three components:

1. A **sensitivity-based** component: various delta, vega, and curvature sensitivities to a number of risk factors (grouped in risk classes) are calculated and aggregated, without any diversification allowed between them
2. A **default risk charge**: to capture the jump to default risk of bond and equity instruments
3. A **residual risk add-on** (calculated as percentage of the notional value) for those products which have an exotic underlying or bear other residual risks

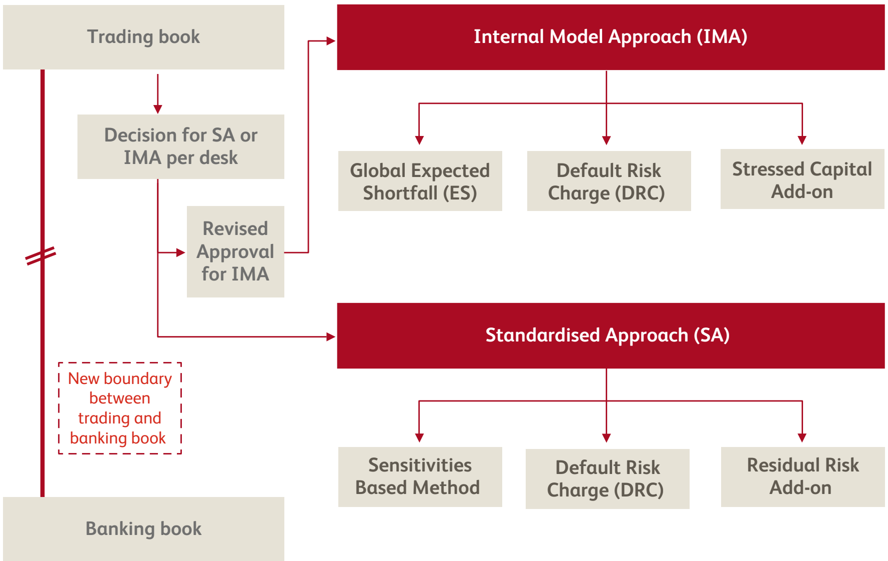
One advantage of SA is its relatively simple implementation, although the calculation of sensitivities for some instruments is not trivial. Secondly, it does not require regulatory approval and is available to all trading desks. It is worth noting that quantitative impact studies have shown, SA reports significantly higher figures than IMA which consequently impact capital planning and costs.

IMA can be used at the bank´s discretion, provided approval of relevant regulators is obtained for selected desks. The capital charge under this approach will also have three components.

1. An **expected shortfall (ES)** component: replaces the old Value at Risk (VAR) with the aim of better capturing the behaviour of losses in the tail. Financial institutions can choose how they calculate this figure, e.g. through Monte Carlo (MC) or historical simulation.
2. A **default risk charge**: to capture the jump to default risk of bond and equity instruments. Compared to the default risk charge within SA, for IMA financial institutions have some degree of freedom in deciding which specific model they adopt.
3. Financial institutions need to identify those risk factors which are deemed non-modellable (i.e. not enough [and/or not good enough quality] data available) and capitalise them separately. Each non-modellable risk factor is to be capitalised using a stress scenario that is calibrated to be as prudent as the ES calibration used for modelled risks

The general structure of the two approaches is exemplified in figure 2.

FIGURE 2: FRTB IN A NUTSHELL – GENERAL STRUCTURE OF DETERMINING THE CAPITAL CHARGE FOR MARKET RISK



The main advantages of IMA is that the resulting charge is generally lower than under SA and that financial institutions have more flexibility in their specific modelling choices. Estimates from several industry-led and regulatory-driven studies show that the capital impact under IMA will have an increase of up to 150 percent compared to current values. The application of SA yields an average increase of 240 percent with peaks exceeding 600 percent in specific cases e.g. FX portfolios.

On the other hand, the disadvantages of IMA are:

- The approval process is cumbersome: it is granted at the individual trading desk level and involves several eligibility tests.
- Irrespective of IMA approval, SA based capital calculations are mandatory for all trading desks. The use of IMA represents an additional cost not only at inception, but on an ongoing basis. This is to ensure continue model eligibility for the model-based approach.

The need for analyzing diversification

This next section outlines the need for analyzing diversification and its effects. Diversification is 'The process of constructing a portfolio of long or short positions in different instruments that are relatively uncorrelated with one another, in order to minimise exposure to individual risks, such as issuers or risk classes.' (BCBS, Minimum Capital Requirements for Market Risk, January 2016)

Charge optimization through diversification

Considering the potential capital impact of FRTB it is no surprise that financial institutions are examining ways in which to optimise their capital.

One option is to optimally use both IMA and SA for each single desk. Each approach has some general tendencies which are favourable to specific types of products/asset classes. Whilst IMA approval is given on a desk-by-desk basis, the valuation of market risk is computed on a superordinate portfolio level, separately for IMA- and SA-portfolios. Thus, to reduce the capital charge, we should also consider the diversification effects of single desk positions within the overall valuation portfolio, as well as the consequences of moving them from the IMA to the SA portfolio or vice versa.

Analyzing diversification effects will increase transparency in terms of:

1. **Which approach leverages diversification the most.** Benefits can stem from both, first, diversification between products where long and short positions lead to netting effects in risk factor positions and second correlation between the risk factors of single products. The latter is exemplified in figure 3 in which a product, subject to only IR and FX risk factors, is depicted.

   FIGURE 3: POTENTIAL NETTING EFFECT OF A PRODUCT'S SENSITIVITY TO RISK FACTORS

	Product A	Sensitivity ^2	√ Sensitivity ^2
Sensitivity to+1bp (IR)	+10	+100	+10
Sensitivity to 1 % (FX)	-10	+100	+10
Total Sensitivity	0	200	20

   In this specific example, the risk factor positions of product A are perfectly diversified i.e. the IR and FX risk factor have an equal and perfectly compensating effect in the total sensitivity as shown in column "Product A".

   As we will show later, the degree to which such effects are actually taken into account for the capital charge varies significantly depending on the specifics of the approach used. This is partially due to the absolute value operations used in the SA which eliminates diversification between risk factors as shown in the last two columns of figure 3. This illustrates that depending on how the approach is constructed, makes a significant difference in terms of how much the existing diversification, between risk factors or across products, diminishes the capital charge.

2. **How to control no diversification between the desks capitalized by SA and ones by IMA.** The total capital charge is in fact:

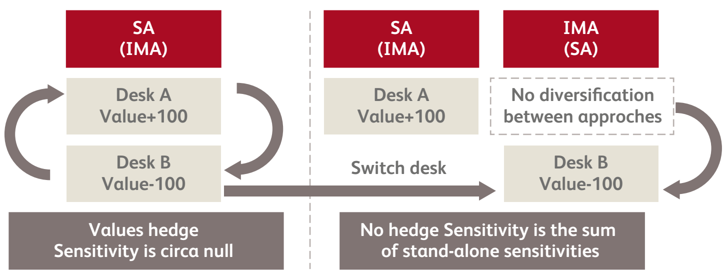
   Total Capital Charge = SA Charge + IMA Charge

   This implies that if two perfectly diversified desks are capitalised by the two different approaches, the diversification effect is completely lost. This can cause a so-called 'cliff effect'.

The cliff effect

The option to allocate every single trading desk to an approach, makes it hard to find an optimal allocation especially for large institutions. There are in fact a lot of possible combinations growing exponentially with the number of desks. In theory, all possible combinations should be looked at. But that implies an investment in time and effort of the financial institution which might not even be impossible, if at all convenient. There is an incentive to keep desks small to minimize cliff effects in that if a desk loses IMA approval the overall impact on the financial institution may not be as substantial.

FIGURE 4: POTENTIAL NETTING EFFECTS OF DESKS DEPENDING ON THEIR ALLOCATION TO APPROACHES



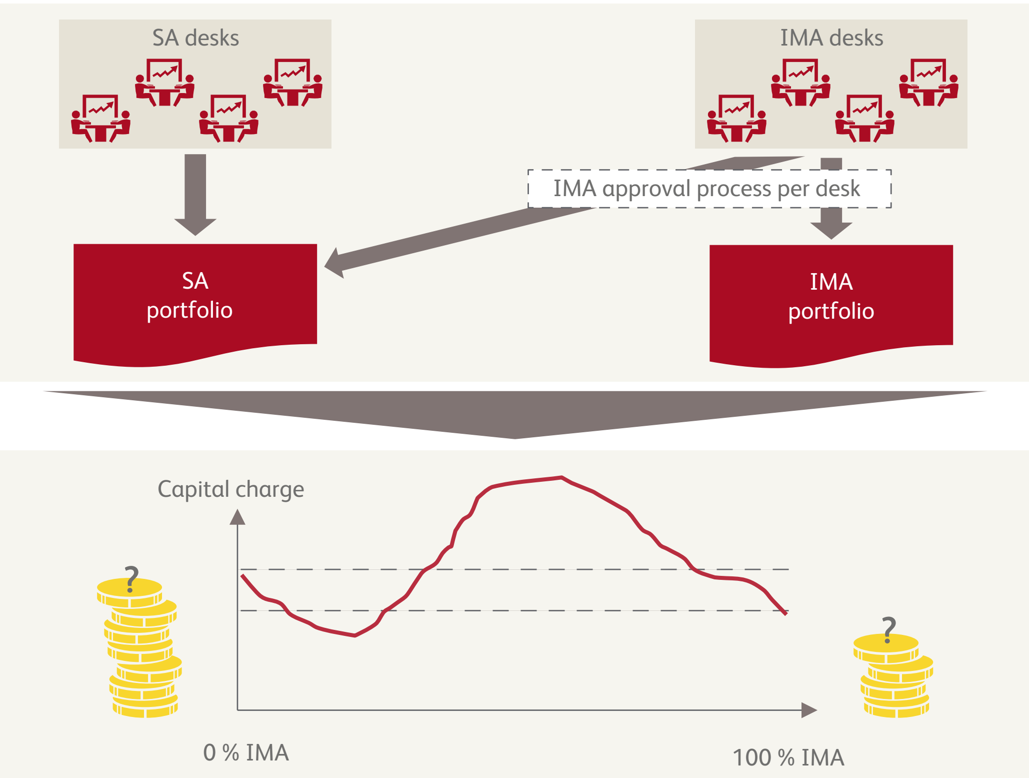
As described in the previous section, the lack of diversification between the approaches further complicates the process of identifying the right combination. As shown in figure 4, two desks with perfectly offsetting PVs are likely have a very small net sensitivity to risk factors. If they are however capitalised by the two approaches, the netting disappears which can create an unwanted increase in capital charges.

A scenario where capital charge is calculated with all desks using SA (likely to be higher) versus all desks using IMA (likely to be lower) creates multiple combinations whose exact value is difficult to predict ex-ante.

The cliff effect refers to the possibility that by changing the approach by which one single desk is capitalised (to benefit a reduced capital charge for this desk) could result in an even higher total value due to a loss of diversification.

For financial institutions' that have discretion to decide, one could argue that this problem is easily solved by carefully selecting and analyzing the optimal approach by which desks are capitalised. However, sometimes it is out of the margins of predictability and control of a financial institution as to which desks gain or lose approval for IMA. Considering the stringent requirements for approval, and the high probability of failing one or more of the required tests, analyzing the diversification characteristics of a financial institutions is crucial to understand the magnitude of potential cliff effects.

FIGURE 5: ILLUSTRATES HOW CLIFF EFFECTS OCCUR WHEN DESK PORTFOLIOS ARE SHIFTED FROM SA TO IMA.



In order to assess the diversification behaviour of portfolios under both approaches, we constructed an example portfolio and ran several tests. The specifics of the portfolio, the methodology (and simplifications) adopted, and the tests run are detailed in the next section. We also provide the results and conclusion of our analysis.

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Example portfolio

To investigate the effect of portfolio diversification on SA and IMA capital charges, we ran calculations for a small portfolio of Interest Rates (IR) and Foreign Exchange (FX) trades. We considered three IR swaps, three Cross-Currency Swaps (CCY) and three Swaptions.

To achieve the balancing-off effect, one of the trades in each swap group has twice the larger notional and the opposite sign compared to the two others. So, for IR swaps we considered two 50mm EUR receivers with 8 and 10 years maturity, and one 9-year 100mm EUR payer, all of them at-the-money (ATM). The reason why we considered trades with different maturity is because of when we added together they do not completely cancel each other out.

For CCY trades we considered three EUR/USD basis swaps: 9-year swap with notional 100mm EUR which pays EUR and receives USD and two swaps with notional 50mm EUR which receive EUR and pay USD and have maturities of 8 and 10 years. We assumed that the spread on all three swaps is 0 and that all CCY swaps are at-the-money.

Finally, for the swaption portfolio we considered three EUR 20mm receiver swaptions, all with ATM strike: one-into-three, three-into-five, and five-into-five. To balance them off we take long position in 1*3 and 3*5 and short position in 5*5.

The data for tests, i.e. EUR and USD IR curves, FX spot rate and swaption volatilities, were taken from March 31st 2017. FX curve was assumed to have 0 basis.

Charge calculation

Sensitivity Based Approach (SBA)

Following instructions of BS 352, the capital charge under SA is the sum of three components:
a) delta sensitivities; b) vega sensitivities; c) curvature sensitivities. All three are relevant for our portfolio.

For each of the three, we needed to calculate sensitivities to risk factors and then aggregate them. The risk classes relevant for our sample portfolio are generalised interest rate risk (GIRR) and FX risk.

The risk factors for GIRR delta sensitivities calculations are defined along two dimensions: a risk-free yield curve for each currency, and the following vertices: 0.25 years, 0.5 years, 1 year, 2 years, 3 years, 5 years, 10 years, 15 years, 20 years, 30 years. In our case there are two IR curves – EUR and USD (we assume that projection and discounting curves for each are the same) and seven relevant maturities. Thus the total number of IR sensitivities is 14, and each rate bucket had a matrix with 49 correlated and weighted sensitivities. There was one FX risk factor – EURUSD curve, and Vega and Curvature sensitivities needed to be calculated for all three interest rate swaptions.

Calculation with IMA

In general, the IMA itself consists of three components:

- Stressed ES (with a confidence interval of 97.5 percent), one-tailed confidence level is to be used
- Default Risk Charge
- Non Modellable Risk Factor Charge

Since our portfolio doesn't have Equity and Credit instruments and we assume that all risk factors are modellable, we only calculated ES Capital Charge. Then the formula for IMA Capital Charge is:

$$C_{IMA} = max\ [ES_{t-1};\ (m_c+\delta) * ES_{avg}]$$

C_{IMA} is the capital requirement

ES is the ES for the trading desk based on the modellable risk factors

ES_{t-1} represents the previous day's ES for the trading desk

ES_{avg} represents the average ES for the trading desk over previous 60 days

m_c represents a multiplication factor which is set at 1.5

δ is a factor to be set by regulators which can range between 0 and 0.5 depending upon financial institution's risk management system and backtesting performance of the internal model to calculate VAR at 99 percentile on the full set of risk factors. We assumed that in our case it is 0.

We also made a simplified assumption that $ES_{avg} = ES_{t-1} = ES$, thus arriving at the formula

$$C_{IMA} = 1.5 * E$$

In general, aggregated capital charge for the modellable risk factors (ES) is calculated as the weighted average of the constrained and unconstrained ES charges:

$$ES = \rho * ES_{Diversified} + (1\text{-}\rho) * (ES_{GIRR} + ES_{FX} + ES_{Equity} + ES_{Credit})$$

where ρ is set at 0.5 and is defined as the relative weight to the financial institution's internal model. Thus, for our portfolio

$$ES = 0.5 * (ES_{Diversified} + ES_{GIRR} + ES_{FX})$$

The ESs for a liquidity horizon must be calculated from an ES at a base liquidity horizon T of 10 days with scaling applied to this base horizon. For our case:

$$ES_{Diversified} = \sqrt{(ES_{Diver,10})^2 + (ES_{Diver,\,60})^2 * \frac{60\text{-}10}{10}}$$

- $ES_{Diver,10}$ is the ES with respect to shocks to all Interest Rates, Volatilities of the Interest Rates, and FX rate
- $ES_{Diver,60}$ is the ES with respect to shock to Volatilities of Interest Rates and keeping the other risk factor constant

$$ES_{GIRR} = \sqrt{(ES_{IR,10})^2 + (ES_{IR,\,60})^2 * \frac{60\text{-}10}{10}}$$

- $ES_{IR,10}$ is the ES with respect to shock to all Interest Rates and Volatilities of Interest Rates, and keeping the other risk factor constant
- $ES_{IR,60}$ is the ES shocking only Volatilities of the Interest Rates, i.e. is the same as $ES_{Diver,60}$

$$ES_{FX} = ES_{FX,10}$$

- $ES_{FX,10}$ is the ES with respect to shock to FX rate and keeping the other risk factor constant

To calculate ES, as is stipulated in BS 352, "[...] no particular type of model is prescribed. So long as each model used captures all the material risks run by the financial institution, as confirmed through P&L attribution and backtesting, [...] supervisors may permit financial institutions to use models based on either historical simulation, MC simulation, or other appropriate analytical methods".

In our calculations we used the MC approach, where for each path we simulated risk factors at 10 business day (14 calendar day) horizon and priced PV of different portfolios of trades based on distribution of PV's calculated at 97.5 percent ES of the portfolio. We calibrated MC to today's market quotes, i.e. used "Current" ES.

Note that in general each of $ES_{Diversified}$, ES_{GIRR}, ES_{FX} should be calibrated to a combination of a period of stress and current data:

$$ES_i = ES_{R,S,i} * \frac{ES_{F,C,i}}{ES_{R,C,i}} \text{ for } i = Diversified, GIRR, FX \text{ where}$$

"Reduced Stressed" $ES_{R,S,i}$ refers to stressed period and an approved reduced set of risk factors for the class i; "Full Current" $ES_{F,C,i}$ is based on the current data and a full set of risk factors; "Reduced Current" $ES_{R,C,i}$ is calculated for the reduced set of risk factors on a current data.

Since in our portfolio's full and reduced sets of risk factors are the same the formula significantly simplifies:

$$ES_i = ES_{S,i} \text{ for } i = Diversified, GIRR, FX$$

i.e. ESs are calculated based on the stressed data. To account for this we assumed that during the stressed period the volatility doubled and since ES is relatively proportional to volatility, we assumed that $ES_i = 2 * ES_{C,i}$. To get "Current" ESs we calibrated MC to today's market quotes, more precisely to the market quotes as of March 31st 2017.

Combining all this into one formula, we get

$$C_{IMA} = 1.5 * \left(\sqrt{(ES_{IR,10})^2 + 5 * (ES_{IR,60})^2} + \sqrt{(ES_{Diver,10})^2 + 5 * (ES_{IR,60})^2} + ES_{FX,10} \right)$$

Thus, the total number of different ESs for this Portfolio is 4. In our MC simulated risk factors were EUR and USD rates and EUR/USD FX rate. To get the effect of shocks for just Interest Rates we set FX volatility to 0, and to get shocks for just FX rate we set IR volatility to 0.

Since our MC was not using the stochastic volatility model, simulating shocks to volatility was more difficult. To get $ES_{IR,60}$ for portfolio with swaptions, we used an analytical approximation, based on a formula for ES for normal distribution for a random variable with 0 drift and standard deviation σ:

$$ES_\alpha (N(0,\sigma)) = \sigma * \frac{\varphi(\Phi^{-1}(\alpha))}{1-\alpha}$$

Where $\varphi()$ and $\Phi()$ are probability density and cumulative probability for normal distribution, resp. Assuming that swaption implied volatility is log-normally distributed with 0 drift and standard deviation σ_{vol}, we get for each swaption:

$$ES_{IR,60} \approx Vega * \sigma_{Imp} * ES_\alpha (N(0,\sigma_{vol})) = Vega * \sigma_{Imp} * \sigma_{vol} * \frac{(\varphi(\Phi^{-1}(0.975))}{0.025}$$

In our calculations we assumed that the annualized volatility of the swaption volatility is 10 percent, thus $\sigma_{vol} = 10\ \% * sqrt(\frac{10}{252}) = 2.0\ \%$. Assuming perfect correlation between stochastic volatilities we can simply combine shortfalls for individual swaptions to get a shortfall for a portfolio of swaptions.

It should be noted, that to be absolutely correct one has to include volatility shifts into $ES_{IR,10}$ and $ES_{Diver,10}$ as well but comparing their contribution to other terms like results of IR and FX shifts, we decided that they can be ignored.

Diversification effects

Findings

Whilst only run on a small and specifically designed portfolio, our tests demonstrated some interesting results, which we believe can be translated to larger, more complex portfolios:

- First, we observe a **significant difference in the capital charge amount** between SA and IMA. While this finding is well-known, it is worth noting that the SA-charge is almost 50 percent higher than the charge under IMA. Despite the simplifications we applied to the testing environment, we expect percentage the order of the magnitude of the difference to stay the same.
- **Products without optionality** (IR Swaps and CCYs) both SA and IMA benefit significantly from the diversification of products which are highly negatively correlated. When we analyzed the difference between a product capitalised on stand-alone basis to its capitali sation with a negatively correlated product, we found that for both SA and IMA the percentage difference increases with the correlation coefficient. For IR Swaps, the diversification benefit seems slightly higher but the result measured in absolute values is not significant. However, we should not forget that the difference in the approaches itself is way more significant.
- For **CCYs**, if taken undiversified, the vast majority of the charge is due to the Delta FX under both approaches. When diversified across products concerning the FX risk factor, this charge can be annulled – this applies to both approaches. In the IMA, however, a further degree of diversification can be achieved if the IR and FX risk factors are correlated. Since the two delta charges are capitalised separately by SA, there is no additional benefit granted.
    a.) To investigate this behaviour, we analyzed a portfolio of two products: 9-year 100mm IR Payer and 10-year 50mm CCS (pay USD, receive EUR). Figure 6 shows the capital charges for SA and IMA (the latter calculated by the ES for products individually and for different combinations of SA and IMA desks). It shows that when both products represent an IMA desk, one can achieve significant diversification effects from the correlation between the EUR interest rate and the USD/EUR FX rate.

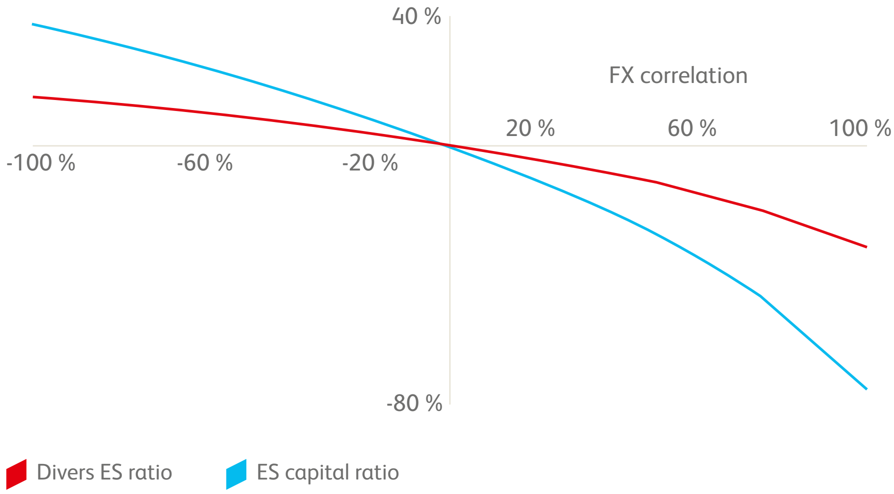
FIGURE 6: RESULTS TABLE – CAPITAL CHARGE UNDER VARIOUS PRODUCT ALLOCATIONS AND CORRELATION SCENARIOS

			Capital charge (component)		
Calculation	Approach	Product combinations	SA (in mm EUR)	ES (in mm EUR)	Total (in mm EUR)
Product-by product	SA	9-year Swap	9.3	0	9.3
		10-year CCY	10.9	0	10.9
	IMA	9-year Swap	0	6.5	6.5
		10-year CCY	0	8.3	8.3
Product portfolios	SA		19.9	0	19.9
	Mixed Approach	Swap SA, CCY IMA	9.3	8.3	17.6
		Swap IMA, CCY SA	10.9	6.5	17.4
	IMA	IR/FX Correl = -0.5	0	13.6	13.6
		IR/FX Correl = 0	0	12.5	12.5
		IR/FX Correl = 0.5	0	11.1	11.1

b.) The explanation for this result is that ES describes a characteristic of the portfolio's PV distribution in two weeks. This particular distribution mainly depends on two random factors – the EUR rate and the USD/EUR FX rate. Moreover, because the CCY pays USD, it is the difference between the EUR rate and the FX rate which defines the distribution. As a result, when there is a perfect negative correlation ES Diversified is the highest and very close to the sum of ES Diversified for each trade. In the opposite case, when the correlation coefficient equals 1, ES Diversified reduces significantly. As expected, all other ESs are almost unaffected by correlation.

c.) In figure 7 below, the blue line shows how ES Diversified changes with correlation relatively to its value at a correlation of 0. The same ratio is graphed for ES Capital (red line). One can see that for ES Diversified the sensitivity to changing correlations can be very dramatic ranging from 38 percent at a coefficient of 1 to -75 percent for perfect positive correlation.

FIGURE 7: DIVERSIFICATION EFFECT IN DEPENDENCE OF THE CORRELATION BETWEEN FX AND IR



- Products with optionality (swaptions in our portfolio) are different as the effect of combining negatively correlated products has a less reducing impact as for other cases. This is owed to the fact that diversification is not permitted between vega and delta sensitivities under SA (even though we see a general charge reduction in a diversified portfolio compared to an undiversified one). We also find that the IR delta sensitivity factor is only mildly effected by diversification. This is possibly due to the fact that the portfolio was not perfectly diversified at inception. The final delta IR charge is as high for the diversified portfolio as the lowest charge of the separately charged instruments. For vega, it is even higher than for the lowest vega of the instruments valued by themselves.
- The curvature charge is also a significant contributor, representing on average a third of the capital charge. While the IR delta and vega factors are somehow linearly growing with overall maturities (i.e. the maturity of the swaption plus the maturity of its underlying), the curvature charge presents an unpredictable behaviour.
- In terms of the approaches, we can observe some effects of the three correlation scenarios on the final SA values. We noticed a certain tendency of the low correlation scenarios to

prevail, however given the nature of our portfolio we do not have statistical reference to validate this. In the IMA, the introduction of different liquidity horizons and separation of constrained and unconstrained ES appeared to have an insignificant impact (i.e. the final ES as per FRTB regulation was always very much aligned with a simple ES). It is to be noted, however, that our portfolio consisted of a limited number of risk factors, whereby only a few liquidity horizons were relevant.

a.) Here it is interesting to observe how correlations scenarios in SA affect the diversification effect for a swaption portfolio. We previously mentioned that this diversification is not very pronounced in a final SA capital charge. This is because the final charge in our example was always defined by lower correlation. Figure 8 shows that for medium and high correlation scenarios, the effect of having all three swaptions (of which two are held in a long position and one in a short position) in one portfolio is much more pronounced. Looking at the components of the SA capital charge one can see, that this diversification effect for medium and high correlations stems not only from the delta but also from the vega component.

FIGURE 8: RESULTS TABLE – CAPITAL CHARGE IN DEPENDENCE OF CORRELATION BETWEEN FX AND IR

	Low Correl	Medium Correl	High Correl
Swaption 1*3, long	1,024,759	1,011,677	993,175
Swaption 3*5, long	1,087,121	969,092	951,307
Swaption 5*5, short	1,757,581	1,561,747	1,532,285
Combined	1,147,753	681,139	549,906

Finally, we can appreciate the cliff effect if we consider each product as a desk. Within the IR Swaps, the one with a maturity of 9 years is the one which balances out the other two (in terms of both Mark to Market (MtM) at inception and sensitivities). The standalone swaps would each report, for the 8, 9 and 10 year maturities, a charge of 4.9 and 5m EUR respectively under SA. However, considering that the 9-year swap position has a negative sign, the overall charge of all swaps charged as one portfolio is only about 10,000 EUR. If we however switch the 9-year swap to the IMA, under the hypothesis that this will decrease the charge due to IMA being generally more favourable, the final capital charge will be 15.8mm EUR, so higher than any other approach. The following table 4 resumes these results.

FIGURE 9: RESULTS TABLE – CAPITAL CHARGE UNDER VARIOUS PRODUCT ALLOCATIONS

			Capital charge (component)		
Calculation	Approach	Product combinations	SA (in mm EUR)	ES (in mm EUR)	Total (in mm EUR)
Product-by-product	SA	8-year swap	4.2	-	4.2
		9-year swap	9.3	-	9.3
		10-year swap	5.1		5.1
	IMA	8-year swap	-	2.7	2.7
		9-year swap	-	6.5	6.5
		10-year swap	-	3.6	3.6
Product portfolios	SA	8-9-10-year swaps	0.01	-	0.01
	IMA	8-9-10-year swaps	-	0.003	0.003
Mixed approach		8- & 10-year swaps SA, 9-year swap IMA	9.3	6.5	15.8
		8- & 10-year swaps IMA, 9-year swap SA	6.3	9.3	15.6

A similar effect can be achieved when all three swaps are capitalised by IMA (resulting in 9k EUR) and one of the products (i.e. the 9-year swaps which provides the highest diversification) loses the approval for IMA. This increases the final charge of swaps in the IMA portfolio to 6.3mm (for 8- and 9-year swaps) and to 9.3 for the 9-year swap under SA, for a total of 15.6mm EUR. A very similar result is obtained when the 8- and 10-year swaps lose approval and need to be capitalised by SA, while the 9-year swap remains in the IMA portfolio.

Take-aways

The analysis shows that certain patterns emerge when taking into account diversification across components, products and approaches. The analyzed portfolio was small and only included a small amount of risk factors and asset classes. However, it allows us to draw some conclusions and principles for optimizing the charge:

- Desks/portfolios should be kept well diversified within one approach as reflected in the final charge. For a well-diversified desk, it is less relevant which approach is used (in our example for swaps the difference was between 10k for SA and 9k for IMA which in absolute terms and relative to the size of the book is irrelevant).
- The observable way to decrease the final charge for undiversified portfolios is to capitalise the portfolio by IMA as this seems to produce significantly lower charges.
- It is paramount to have control of which desks/products are providing the highest diversification benefit, since a change in approach for those products can have overwhelming effects. If a financial institution chooses to change the approach for a desk, a thorough analysis should be carried out beforehand. In addition, for IMA desks, financial institutions must be mindful of the risk of losing approval, since this can have a detrimental impact if that particular provides a high diversification effect to the overall IMA portfolio.
- Products with sensitivities to several asset classes (e.g. CCY which are delta sensitive to IR and FX risk factors) for which there is a negative correlation are better capitalised by IMA.
- For products with optionality the use of IMA is much more favourable. Yet, if these products enter into exotic territory, there are other effects to be analyzed e.g. the RRAO in SA and the NMRFs in IMA).

The impact on firm processes, capital, operations

The impact of FRTB will be felt way beyond risk, with front-office, finance, treasury, IT operations all heavily affected. This is due to the substantial changes to models, data, technology and processes needed for FRTB. The changes are so fundamental that they may cause some financial institutions to reconsider their business strategy. The new approach to the capital charge for market risk could lead to decreased profitability of some products, which raises the question as to how feasible it is to continue trading these products.

The effects of diversification, which in certain cases are unpredictable, will directly impact the implementation of FRTB:

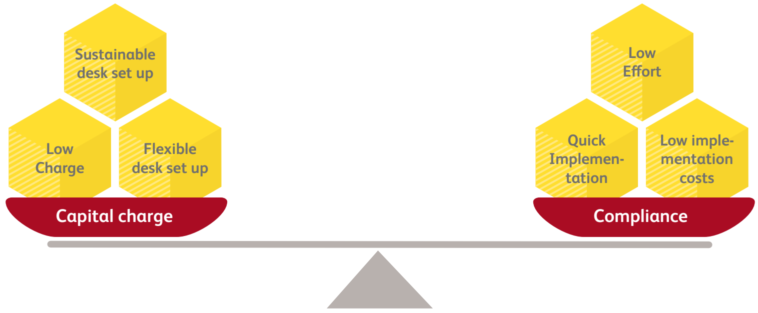
- As highlighted earlier, some of the benefits, or consequences, of (mis-)management of diversification effects can significantly impact the final capital charge which consequently has implications for capital planning and related costs. An increase in capital charge, in particular acute ones as presented in this paper, can have a major impact on the cost of capital of a financial institution. A well-managed diversification can reduce the charge to near zero, however, a sudden switch of one desk from one approach to the other, whether intentional or not, can cause the capital requirements to jump to significant levels. For this type of scenario though where a trading book is completely diversified and the capital charge is at "normal" levels, these jumps can have dislocating effects by suddenly increasing the capital needed.
- From a process and operations point of view financial institutions will need to establish new processes designed to monitor and control these events.

  a.) At inception, the tendencies of the various approaches and asset classes need to be studied in order to identify the trends which can deliver a lower charge.

  b.) The studies will have to be repeated periodically, to ensure desks continue to reflect the same composition of products and exposure to risk factors that drove the initial decision on which approach to adopt. For those desks that have received IMA approval, a financial institution needs to introduce a process to assess the diversification effect provided by each desk. For those desks that provide a high diversification benefit, an ongoing estimate of compliance with IMA requirements needs to be carried out. Desk that fear losing their IMA approval must take corrective actions or set up plans to handle consequences of a change in capital charge.

- Lastly, given the multitude of new activities that result from adopting both the SA and IMA, financial institutions should consider the business case for IMA. Whilst IMA can deliver a lower and more appropriate capital charge, executing on IMA presents increased imple mentation and running costs, as pictured in figure 10.

FIGURE 10: POSSIBLE PRIORITIES OF INSTITUTIONS FOR THE IMPLEMENTATION OF FRTB



Conclusion

In a recent Quantifi survey* 60 percent of respondents stated that FRTB is a key business priority. Despite the operational challenges involved in implementing FRTB, we have observed many global financial institutions making significant strides with regards to implementation programmes and creating awareness across their firm with plans to meet the Basel deadline of 2019.

Although the FRTB standards were finalised in January 2016 there are a number of grey areas that are creating a degree of uncertainty across the industry. A number of these uncertainties still require clarification or interpretation. One area of uncertainty regard the specifics of IMA (namely the P&L attribution test and non-modellable risk factors requirements). Most financial institutions aim to have a fully operational SA the end of 2018. Even though SA is associated with complications of its own, as highlighted in this paper, it is a more straightforward approach and similar to current market practices. Furthermore, SA will have to be calculated for all desks, even those which will be reporting under IMA.

The analysis of this paper, even if limited to a simplified portfolio, highlights some tendencies in the behaviour of the charge which can help financial institutions select the right approach or mix. Additionally, diversification effects between products can have a strong influence on decreasing or increasing the charge if poorly managed (i.e. the cliff-effect).

In our analysis, we confirmed that the SA-charge can be as up to 50 percent higher than IMA. However, for a well-diversified portfolio, both approaches benefit in principle from diversification, making the choice between the two approaches less relevant. We also saw that products which are sensitive to different asset classes, or have optionality, benefit from an additional diversification of these components under IMA. For an undiversified portfolio, a decrease in capital charge can arise from the application of IMA, as this approach generates lower charges.

Adopting a mixed approach could be the optimal route, whereby some desks are capitalised under SA and others under IMA. Although a sudden or unexpected change of approach can generate a so-called cliff effect and may result in an even higher total value due to a loss of diversification. Banks that adopt the IMA approach should closely monitor all those desks, as losing approval also means losing the diversification effect they were providing to other desks.

FRTB impacts financial institutions across all functions as it poses operational, methodology and technology challenges. To meet the requirements financial institutions will need to rethink their business and technology strategies with a view to streamlining their processes and architecture. FRTB program design structure will be influenced by how firms are set up internally. If executed correctly, financial institutions can benefit from operational and capital efficiency gains, and enhance the way it manages risk. Financial institutions that adopt a more disciplined and cohesive approach in executing it strategy for front office and IT operations will help shape its prospects in the post FRTB world.

* 106 financial institution practitioners that took part in Quantifi's webinar 'FRTB: Are Banks Prepared?' were surveyed

List of figures

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