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Should only geeks care about IM calculation?

Why the consequences of inadequate IM calculation should not be underestimated

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Achieving compliance with Uncleared Margin Rules requires a substantial effort. There are many elements to address, from document negotiation to setting up segregated custody accounts, to putting in place a system for Initial Margin (IM) calculation and collateral management. As a result, often the issues of risk sensitivity and SIMM calculation are not given enough attention. It is a great mistake that must be avoided. A firm may end up paying a dear price for it.

IM calculation is not an academic issue that is of interest only to those in a technical function; it is a business issue that deserves the attention of senior management.

Current development and challenges

It is fair to say that phase 5 and 6 firms are under no illusion about the potential challenges of processing their portfolios even if they are not as huge as large global banks. Although ISDA SIMM does a brilliant job of standardising a part of the IM calculation process, it still leaves the task of computing the risk sensitivities of in-scope positions to the discretion of each firm. In other words, risk sensitivity calculation is not standardised and there can be material differences between different firms' calculations. In addition, although the majority of phase 5 and 6 firms will outsource this task to a third-party provider, outsourcing IM calculation does not guarantee a desirable outcome.

IM calculation may be highly technical in nature and therefore, it is often left to the most technically minded teams within the organisation. But the consequences arising from issues with IM calculation directly affect the business. IM calculation is not an academic issue that is of interest only to those in a technical function; it is a business issue that deserves the attention of senior management.

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Collateral exchange

Collateral exchange is a bilateral process where agreeing the amount of collateral to move is at the heart of the process. If the pledgor party does not agree on the called amount, the pledgor normally posts the amount in agreement and the difference is left in dispute. Reconciling IM differences can be a time-consuming exercise, even with a tool to analyse the sources of differences. Typically, in addition to the collateral management team, the risk management team needs to get involved to review issues related to models and methodologies. If the disputed amount is large or the dispute persists for a long period, the issue needs to be escalated to senior management and in certain cases also to the regulators. While appropriate escalation is a necessary element of a sound risk management process, it inevitably creates additional workload resulting in the utilisation of precious internal resources. In addition, if issues are reported externally, potential damage to the firm's reputation could become a point of concern.

Why there are differences in calculated margin amounts

Generally, differences in the calculated margin amount occur for several reasons. The most common cause is disagreement on the portfolio composition or which trades are to be included in the calculation. This can be resolved by improving the process of portfolio reconciliation. Another common and important cause is the differences in the risk sensitivities of the trades in the portfolio. Although each instance of risk sensitivity calculation issue may be different, fundamentally, the issue can only be systematically resolved by improving the quality and reliability of IM calculation. Therefore, **the quality of IM calculation is an important factor for minimising IM collateral disputes (if using SIMM).** However, it requires years of investment to develop comprehensive and sophisticated derivatives modelling capability and acquire a rich set of market data, which underpin accurate IM calculation. Not all providers are in equally strong positions. Therefore, divergent competencies are seen amongst them.

How IM calculation quality impacts calculated IM amount

A few examples are given to illustrate how IM calculation quality can impact the calculated IM amount.

Swaption

Take swaptions, for example. They are a widely-used product, and pricing them is typically not seen as a challenge. But accurate pricing is hard to come by because of the so-called volatility skew. Accurately establishing the right volatility levels for out-of-the-money (OTM) and in-the-money (ITM) positions is genuinely difficult. While the large global banks actively making market in swaptions will know the volatility levels (however, even this may be limited to the liquid regions), the same level of insight and knowledge is beyond the reach of most market participants, including IM calculation service providers.

It is not uncommon for a buy-side firm to have a portfolio containing swaptions that are nearly all deeply OTM or ITM. In fact, OTM positions occur very naturally because:

1. certain trading strategies call for the trading of OTM positions (e.g., long put to guarantee a minimum return, selling of a high strike call in a covered call); and
2. At-the-money (ATM) or near-the-money long-dated positions will become ITM or OTM as the market regime (e.g., interest rate level, equity valuation, FX level) shifts.

Take a 100M USD 10yr-into-10yr payer swaption with a strike that is 300 basis points above the forward level (i.e., ATMF+300). The risk metrics are as follows: [1]

	PV	SIMM	Delta	Vega	Implied Vol
Original valuation	$1,166,910	$1,175,113	$9,291	$48,980	80.7bps

However, since this is a deeply OTM position, the implied volatility level can easily be mis-marked by the calculation provider who does not have reliable data sources. Consider the following two scenarios:

- Scenario 1: Implied vol is marked 10bps higher
- Scenario 2: Implied vol is marked 10bps lower

	PV	SIMM	Delta	Vega	Implied Vol
Original	$1,166,910	$1,175,113	$9,291	$48,980	80.7bps
Scenario 1	$1,694,264	$1,489,847	$11,446	$56,537	90.7bps
Scenario 2	$721,961	$855,688	$6,964	$39,743	70.7bps

This shows that the SIMM amount swings by roughly +/-30% under these implied volatility scenarios. When the high-strike implied volatility is marked 10bps too high, the IM amount is overestimated by circa 30%. Conversely, when it is marked too low by 10bps, the IM amount is underestimated by 30%.

Although this hypothetical example is created for a demonstration purpose, similar situations are encountered in reality, where different parties (including calculation service providers) use materially different input volatility levels. Since Phase 5 and 6 firms' portfolios can be concentrated in terms of risk profile, the phenomenon considered here for a single trade is likely to be observed with a similar effect on the portfolio level.

1. Valuation date 28/May/2021, the amount calculated is the post amount (pledgor party)

CDS indices

The calculation of IM amounts for positions involving CDS indices (e.g., CDX High Yield, iTraxx Crossover) can also pose challenges. Under ISDA SIMM, the calculation of risk sensitivities must be performed at the constituent level. The so-called look-through approach is mandatory. From the perspective of margin saving, look-through is a good approach as SIMM amounts are reduced due to the diversification effect of the basket. However, this calculation is not straightforward to implement accurately.

Clearly, the main challenge is that of sourcing accurate reference data. All constituent names must be allocated to the correct sector and the credit quality must be determined before they can be allocated to the correct bucket under ISDA SIMM. Additionally, if there are exposures to aged (or off-the-run) indices, all the corporate actions (e.g., mergers and splits) to date must also be captured accurately and comprehensively to correctly define the current state of the basket and have risk sensitivities allocated to the right entities.

This issue may occur for any trades that reference a CDS index, including CDS index options (or credit default swaptions) and synthetic CDO tranches. The miscalculation may result in material breaks in SIMM amounts and collateral disputes.

Exotics

Finally, the most obvious product types with which IM calculation issues arise are exotics, which loosely refer to complex and structured trades. Complexity may arise in the form of complex risk, or in the form of complex payoffs and features. Examples of the former include CMS spread options and mid-curve swaptions, while the latter includes yield-enhancing structures such as auto-callables and range accruals. The former category of trades may be traded by professional risk takers such as hedge funds. The latter may be traded by private banking investors looking for a higher return for some additional risk. From a modelling perspective, the challenge associated with the former is modelling the complex risk dynamics, while the latter category of trades with complex payoffs and features requires sophisticated and flexible models to capture every detail of the complex trade economics to value positions.

So, the challenges associated with exotic trades largely depend on their types. For example, CMS spread options may not have a very complex payoff. But to price them accurately, a sophisticated model is required to determine the constituent

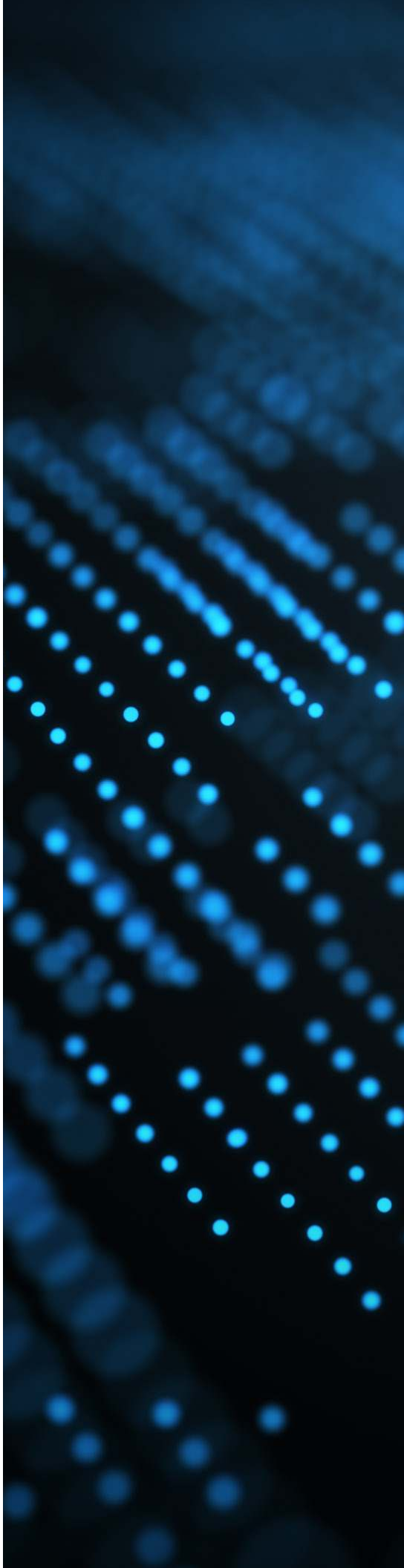
CMS rate distributions and join the marginal distributions with a (term-structure of) correlation to form suitable bivariate CMS rate distributions. As with the inherent difficulty of sourcing high-quality volatility skew data for swaptions, high-quality rate-rate correlation data are crucial to accurately value CMS spread options. However, the availability of such correlation data (or CMS spread option price data) is very limited, even more so than high-quality swaption volatility skew data.

On the other hand, exotics with complex payoffs such as auto-callables typically require computationally intensive Monte Carlo models. Consequently, calculation performance is an important issue. It may not be feasible for a large portfolio to calculate the risk sensitivities with the finite difference method (aka bump-and-revalue) with a short calculation time. Instead, a more efficient alternative technique such as adjoint algorithmic differentiation (AAD) may be used to calculate the full set of sensitivities with a fixed time (relative to the base calculation time of the trades in question) regardless of the number of points for which sensitivities are calculated.

The growing popularity of ADD over the past decade began with a small number of progressive global banks with a burning desire to obtain, with a reasonable calculation time, risk sensitivities of large and complex portfolios such as their XVA portfolios. While AAD proved to be ground-breaking in quantitative finance, its implementation is often challenging and fraught with pitfalls. Apart from general issues such as excessive memory usage, which may arise if the implementation is not optimal, the use of AAD requires utmost care when handling discontinuous payoffs such as binary payoffs and knock-in/ knock-out conditions. In particular, discontinuity must be converted into a Lipschitz-continuous equivalent for risk to be calculated correctly (for example, converting a pure digital call payoff into a call spread). However, the devil is in the detail – suboptimal conversion could result in unstable risk calculation or spikes in risk under certain market conditions.

In general, exotics call for all-around experience in derivatives pricing to achieve accurate results – so that the results are in line with the bank counterparties and there will be no surprises.

In addition to improving model performance, parallel computing is essential to make the IM calculation scalable for portfolios containing a large number of exotics. This requires investment in building the right system architecture.



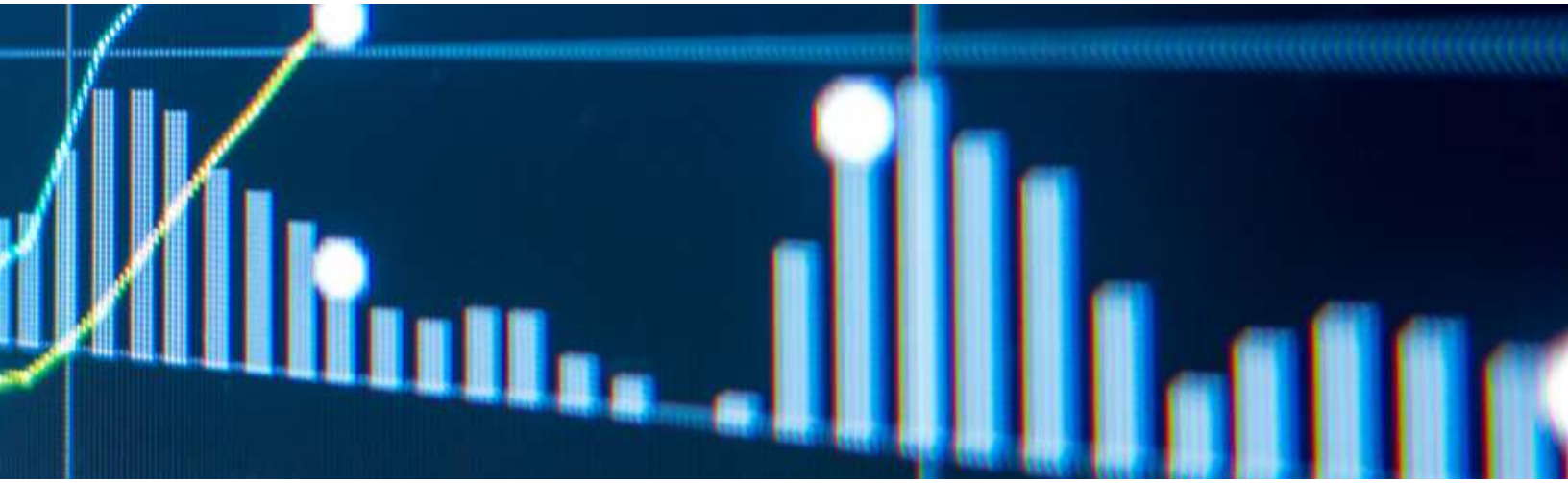
Broader benefits

A firm will benefit greatly if collateral disputes are avoided or minimised. But the benefits of high-quality IM calculation (and risk sensitivities) are not limited to just reducing collateral disputes. As high-quality IM calculation goes hand in hand with the overall prowess in derivatives modelling capability, a provider that can offer an accurate and reliable calculation of risk sensitivities and IM amounts is likely to excel in various aspects of derivatives pricing.

The service provider's capability will have an overarching impact on the outsourcing firm's business outcome. For example, if the outsourcing firm wished to introduce a new product (e.g., a new exotic product) to its portfolio, would the service provider facilitate or hinder it? Alternatively, if the firm's business expanded rapidly and its portfolio size increased manyfold, would the service provider be able to continue to offer its service at scale without disruption? Positive answers to these important questions require tangible and continuous investment in capability development – not only of a comprehensive suite of models, but also of advanced computational techniques such as AAD and cloud computing for scalability. The development and acquisition of ever-so-important market data cannot be underestimated either. In light of that, it can be said that scrutinising a service provider from the perspective of IM calculation capability will reveal its ability to enable the outsourcing firms' business without hindrance, or it will become an obstacle for their business ambitions.

In addition, a provider with strong derivatives valuation capability that excels in IM calculation is likely to be best positioned to adapt to alternative and new ways of calculation. The industry continuously evolves and new methodologies regularly emerge. Some of them will improve IM efficiency, meaning the IM amounts will be reduced if the new methodology is adopted. One such example is applying the look-through approach to equity index trades (e.g., TRS, option, etc.). The look-through approach in question is of the same type as that used for CDS indices. The only difference is that while it is mandatory for CDS index trades (e.g., CDX High Yield, iTraxx Main, etc.), the look-through approach is not mandatory for trades referencing equity indices. A firm may opt to use it if it wishes.

Using a look-through approach for equity index exposures is common amongst large banks with material exposure to equity risk, as it greatly reduces IM exposure. The desire to apply a look-through approach has been compounded by the fact that the risk weights are large for equity under ISDA SIMM (in other words, IM amounts are large for equity trades relative to the risk size).



The mechanics of IM reduction by way of a look-through approach is as follows. Take a simple equity TRS referencing S&P 500 as an example. Considering that the bulk of the risk of the trade comes from the equity leg, the IM amount can be estimated simply by multiplying the equity delta (i.e., circa 1% of the notional) by the SIMM risk weights for equity indices, which is 15 (Bucket 11: Indexes, Funds, ETFs). So, the SIMM amount for equity TRS is circa 15% of the notional if the underlying index is viewed as a standalone asset without looking through the basket. On the other hand, if the index is looked through at the constituent level, the index TRS in question will become a TRS that references a basket of 500 single stocks. Interestingly, the risk weights of the underlying single stocks are all higher than 15. For example, the risk weights range from 20 to 29 for large cap stocks. But the SIMM amount for the basket is much smaller than 15% because of diversification. The significant diversification effect is realised because the levels of correlation between pairs of single stocks are low, at mostly below 30%.

The following example illustrates the effect of applying a look-through approach.

	With look-through	No look-through	IM reduction
$100M swap	$8,539,065	$15,082,298	43.4%
$100M 1Y Put, Collect[2]	$4,697,510	$6,039,168	22.2%
$100M 1Y Put, Post	$3,382,522	$4,723,877	28.4%

However, using the look-through approach in practice can pose challenges due to a lack of basket constituent weight data for an index of interest, or its data is restricted by usage licence.

2. Long position with a 1-year expiry; strike at 80% of spot

Conclusion

Some of the intricacies of IM calculation have been illustrated with a few numerical examples. There are many elements – some of which may not be immediately obvious – that matter to the calculated IM amount. Achieving high-quality, accurate results requires commitment and investment in derivatives valuation. The capability must also include access to high-quality data sets, including hard-to-observe data. Very few providers can cover all aspects.

Achieving high-quality, accurate results requires commitment and investment in derivatives valuation.

Moreover, even seemingly very simple vanilla trades can cause calculation issues. Mistakes have been commonly made in calculating IM amounts where the fine print in the regulatory rule is somewhat subtle. For example, correct treatment of the resetting principals of mark-to-market (MTM) cross-currency swaps is not necessarily straightforward.

As stated at the outset, all these issues relating to IM calculation would only be of academic interest if poor IM calculation did not have any business consequences. But they do have a direct impact on the daily collateral operation of a firm exchanging IM. Mismatched IM amounts result in collateral disputes, which can lead to serious consequences involving external parties. In addition, the process of reconciling IM disputes is inherently labour intensive and typically requires the involvement of skilled risk management staff. Therefore, frequent occurrence of collateral breaks that require IM reconciliation will result in unnecessary utilisation of skilled resources.

Considering the consequences, IM calculation is not a mere technical issue that should be left simply to the quants who can decipher the IM models. It is an issue that warrants the attention of senior management from both an operational and reputational perspective.

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