Cleared and Uncleared Margin Comparison for Interest Rate Swaps

by:

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Abstract:

This paper compares currently reported margins for cleared interest rate swap portfolios against hypothetical uncleared margins, generated with the ISDA SIMM framework on the same exposures. The ten-day holding period of risk for uncleared margin should theoretically induce higher collateral requirements compared to the five-day period for cleared margin, all else being equal. However, the results show that the hypothetical SIMM market risk measures are lower than the cleared market risk measures for a subset of portfolios. This illustrates that larger methodological differences, specifically the historical simulation approach used by the clearinghouses versus the parametric approach of ISDA SIMM, can compensate for the difference in holding period. The treatment of liquidity risk across the two classes of models further complicates the picture. The clearinghouse models calculate market and liquidity costs simultaneously over the holding period, whereas SIMM extends the period to capture liquidity risk. The cleared initial margins are higher than the correspondent SIMM values for more portfolios compared to when only considering the market risk measure.

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I. Introduction

Since passage of the Dodd-Frank Act in 2010, the CFTC has overseen an increase in cleared derivative contracts. The agency passed several requirements for central clearing of certain standardized and well-traded contracts, with the aim of enhancing market stability by means of counterparty risk collateralization and third-party default management. On January 6, 2016 the CFTC published the uncleared margin rule that requires collateral exchange between swap dealers and major swap participants in the uncleared derivatives market. During that same year, the CFTC in conjunction with other prudential regulators as well as the National Futures Association (NFA) approved firm-specific application of the ISDA Standardized Initial Margin Model (SIMM) to calculate the collateral posted between uncleared market participants.

According to the regulation[2], uncleared margin must be calculated at a ten-day liquation period, while cleared margin is set at a five-day period. The respective time horizons represent the estimated number of days it would take to hedge and liquidate a defaulted portfolio. Additionally, uncleared margin must be posted opposite each counterparty for which the margin calculation exceeds $50 million at the consolidated parent company level, without the netting benefits of central clearing. Such a collateralization regime might incentivize a shift of bilateral activity into the cleared market. Clearinghouses have recently started offering additional products for voluntary clearing, such as foreign exchange options and credit default swaptions.

This paper compares hypothetical SIMM-generated uncleared margin with cleared margin for interest rate swap (IRS) portfolios at two clearinghouses (denoted “DCO A” and “DCO B”). The results illustrate key methodological differences between the two classes of margin models, quantify the collateral-based incentives across market segments, and provide guidance for further regulatory study of model performance. Future analysis might extend these results to the other four uncleared asset classes, including foreign exchange, equity, credit, and commodity-based derivative instruments.

II. Cleared IRS Margin Models and SIMM

Both cleared and uncleared margin models are required to cover the number of expected future losses at the 99% confidence level. The market risk measure is generally calculated with either value-at-risk (VaR), which corresponds to a given quantile of the portfolio loss distribution, or expected shortfall (ES), which corresponds to the average of losses beyond a given quantile. CFTC regulation specifies that margin models should be risk-based and pass back-tests and stress tests at the calibrated 99% level.

[2] http://www.cftc.gov/ucm/groups/public/@lrfederalregister/documents/file/2015-32320a.pdf

The cleared margin models are also required to collateralize for any non-market exposures, such as liquidity risk, credit risk, or settlement risk.

The DCO A IRS model calculates five-day 99.7% value-at-risk using historical simulation. The loss distribution is simulated by application of the past five years of historical returns to today's positions. This approach makes no parametric assumptions about the return distribution, but instead builds an empirical distribution using the past five years of returns. Interest rate returns are scaled by a moving average volatility term that normalizes the time series data across different volatility regimes. The model includes a liquidity risk add-on, calculated with a clearing member poll that approximates transaction costs of delta hedges at different notional amounts. This add-on scales with portfolio size due to the increased cost of large-position liquidation.

The DCO B IRS model calculates five-day 99.7% expected shortfall using historical simulation. The overall approach is very similar to the DCO A framework. The model employs a longer historical lookback window of ten years instead of five years. Interest rate returns are similarly scaled by a moving average volatility term. DCO B also uses the more conservative measure of expected shortfall, which considers the average losses beyond the 99.7% quantile, not just the cut-off value. The initial margin is floored at unscaled 99.5% value-at-risk, which acts as an anti-cyclical measure when market conditions are stable. The model includes add-ons for liquidity risk, credit risk, diversification risk, and basis risk.

The SIMM framework calculates ten-day 99% value-at-risk using a set of parametric assumptions. Risk factor returns are assumed to follow the joint normal distribution. This enables a simple summation of scaled risk factor exposures, which follows the formula for the sum of correlated normal random variables (also called the "variance-covariance" method). The framework uses sensitivity-based approximations (delta, gamma, and vega) rather than full revaluation to compute portfolio profit-and-loss. Risk sensitivities are mapped into different "buckets" and "factors" within buckets that vary in definition based on the asset class. In terms of interest rate products, for example, risk sensitivities are bucketed by currency, and then further separated out by tenor and reference curve within a currency.

The SIMM framework provides a quick and simple alternative to historical simulation. The assumption of joint normality enables direct computation of the 99% loss quantile, rather than estimation from a simulated distribution. There are two types of model parameters used in SIMM: risk factor standard deviations and correlation coefficients, the latter defined both within and across buckets. These model parameters are calibrated from three years of historical data and a one year stress period. The risk factor standard deviations are assigned in volatility buckets ("low", "regular", and "high") that group together multiple currencies. The cross-tenor, cross-curve, and cross-currency correlation parameters are assigned the same across all currencies. These model parameters are used to generate margin from risk sensitivities mapped and submitted by market participants. In the context of interest rate instruments, delta, gamma, and vega risk sensitivities are reported at the reference curve and tenor level. The model includes an add-on for concentration risk for large-position portfolios. Members with net delta exposure past a certain threshold at the currency bucket level are subject to a market risk multiplier.

All else being equal, a longer liquidation period should produce a higher market risk measure. However, as discussed above, the two classes of margin models differ across a number of fundamental modelling techniques and inputs. The clearinghouse models use the empirical return distribution to generate potential portfolio losses, while the SIMM framework assumes joint normality across risk factors. The clearinghouse models measure potential loss at the 99.7% confidence level, which goes beyond the regulatory requirement of 99% used in SIMM. The DCO B model adds more conservatism by using expected shortfall in place of value-at-risk, which is employed by both DCO A and the SIMM framework.

The effect of these inputs on relative market risk measures can be examined in a stylized univariate setting. The four figures below illustrate the progressive effects of changing the liquidation period, the quantile and risk measure, and the underlying distribution. The upper-left figure shows the initial ten-day 99% value-at-risk using the normal probability distribution. This ten-day figure is de-scaled to a five-day figure using the "root-time" rule. A risk measure derived from standard deviation can be scaled to different time horizons by multiplying by the square root of the ratio of discrete time steps, under the assumption that the returns process follows a Gaussian random walk[3]. The 99% value-at-risk is then converted to 99.7% expected shortfall by moving the quantile and taking the average beyond the cut-off. Finally, the underlying distribution is changed better reflect the potentially heavy-tailed empirical return data. In this case the scaled Student t-distribution ($\mu = 0$, $\sigma = 1/\sqrt{2}$, $v = 5$) provides a reference point. The exact empirical distribution will depend on the interest rate and tenor in question. The table below shows the different risk measures and scale factors that correspond to the model inputs:

Risk Measure	**IM ($\mu = 0$, $\sigma = 1$)**	**Scale Factor to 10D 99% VaR**
10D Normal 99% VaR	2.33	1
5D Normal 99% VaR	1.65	$\sqrt{2} = 1.41$
5D Normal 99.7% ES	2.16	1.08
5D Heavy-tailed 99.7% ES	4.17	0.56

Table 1 – Relative Market Risk Measures and Scale

[3] The root-time approximation is somewhat inappropriate here, since SIMM standard deviations are calibrated to absolute interest rate moves, while DCO A and DCO B use shifted log-returns.

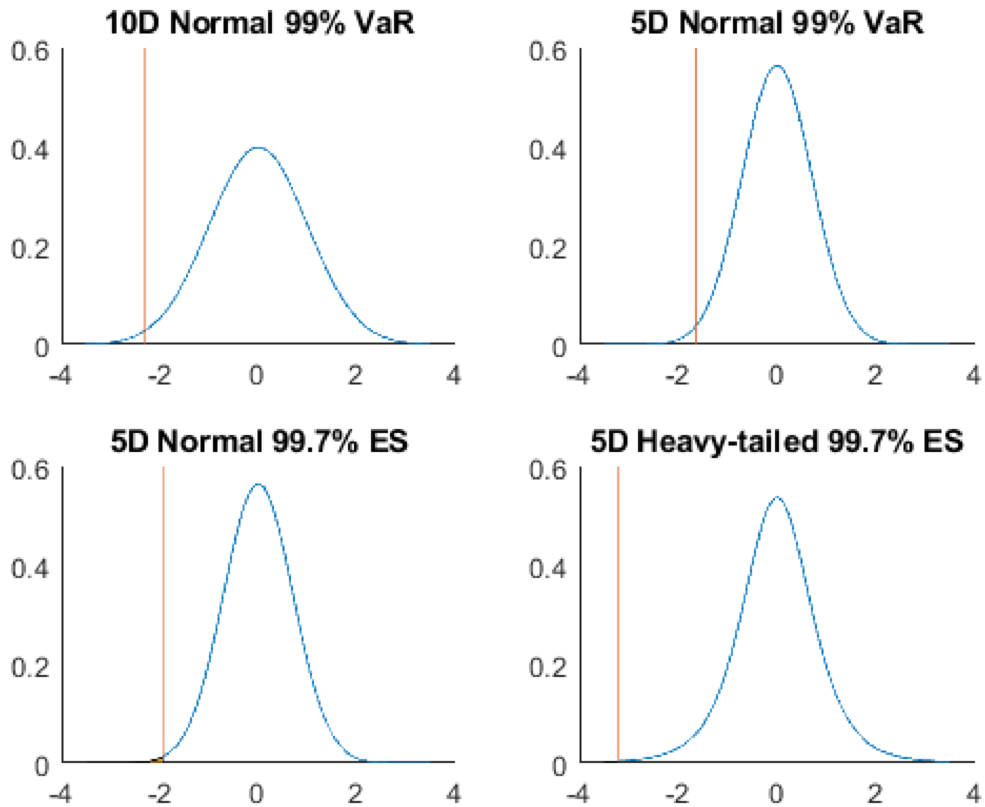

Figure 1 – Relative Market Risk Measures and Distributions

This univariate comparison does not capture all of the major methodological differences across the two model classes, notably the effects of volatility scaling and the treatment of correlation across risk factors. The SIMM approach examines unscaled returns, while the clearinghouse models scale the return distribution by the ratio of today's volatility to historical volatility for each return observation. This will dampen the loss distribution in times of low volatility, and amplify the distribution during highly volatile periods. The correlations across risk factors in SIMM are modeled with a Pearson coefficient calculated as a historical average both within and across currencies, while the clearinghouse models use the actual multivariate return distribution. It would be difficult to illustrate the fixed effect of either input, since volatility scaling depends on current and historical market conditions, and any impact from correlation would be highly sensitive to portfolio composition. These differences will be further discussed in the comparison results section.

III. Margin and Delta Sensitivity Data

This section briefly summarizes the data sources and the margin comparison methodology before presenting the results.

Margins for cleared IRS portfolios are submitted on a daily basis under CFTC Part 39 regulations. The data is separated by house and customer account origin and further split into margin components. Both the overall initial margin and the market risk component of initial margin are reported separately by the clearinghouses, as well as a total collateral figure. The market risk component represents only the value-at-risk or expected shortfall figure as generated by the portfolio loss distribution. Initial margin includes the market risk component as well as any non-market risk add-ons such as liquidity risk, concentration risk, settlement risk, and other risks unique to each derivative asset class. Total collateral includes the previous margin charges subject to collateral haircuts applied by the clearinghouse, as well as clearing member guarantee fund contributions and any excess margin held on deposit.

Delta risk sensitivities for cleared IRS portfolios are also reported to the CFTC by DCO A and DCO B. The delta exposures for each clearing firm are submitted by reference curve and key tenor on a daily basis. The voluntary delta ladder submissions save the extra step of calculating portfolio risk factor sensitivities, which serve as the primary inputs in SIMM margin generation. Note that gamma and vega sensitivities don't apply to the cleared interest rate swap portfolios under consideration, since they contain no option positions. The SIMM framework uses vega sensitivities to approximate the gamma term, and therefore portfolios without option exposures have no second-order price risk under the model.

The house account delta values were inputted into the SIMM framework to calculate a hypothetical uncleared margin figure directly comparable to the reported clearinghouse margin. The SIMM framework was replicated in Matlab, following publicly available ISDA documentation[4]. The Matlab model has been tested and validated against multiple sample portfolios.

IV. Cleared and SIMM Margin Comparison Results

The analysis examines a month's worth of cleared IRS data from 10/2/17 to 10/27/17. This represents a time series of varying exposures that change day-to-day with portfolio composition. The cleared and hypothetical uncleared margins are averaged by account across the time series for the sake of comparison and to smooth changes in composition. The analysis was limited to clearing member house accounts, as customer margins were reported as an aggregate figure for the time period under consideration. In total there were eleven member portfolios considered from DCO A, and ninety from

[4] https://www.isda.org/a/oFiDE/isda-simm-v2.pdf

DCO B. The house account portfolios are generally larger in terms of gross notional but netted across tenor exposures. The first section isolates model performance by examining only the market risk component of margin. The second section will compare overall initial margin requirements by including non-market risk add-ons charged to market participants.

A. Market Risk Measure Comparison

The following tables show a comparison of the SIMM value-at-risk figure to the cleared market risk measures, averaged across the time series for each account and represented by the ratio of each value. The SIMM-generated market risk component for interest rate portfolios cleared at DCO A is 1.72 times higher on average than the clearinghouse figure, and 1.58 times higher for portfolios cleared at DCO B. The portfolios cleared at DCO B notably demonstrate a wider dispersion in terms of relative measure.

Measure	Ratio SIMM / Market Risk
Minimum	1.32
25th Percentile	1.48
Average	**1.72**
75th Percentile	1.84
Maximum	2.58

Table 2A – Market Risk Measure Comparison (DCO A)

Measure	Ratio SIMM / Market Risk
Minimum	0.96
25th Percentile	1.34
Average	**1.58**
75th Percentile	1.74
Maximum	2.88

Table 2B – Market Risk Measure Comparison (DCO B)

The results also show that the SIMM-generated market risk component isn't necessarily higher than the cleared value, even though the holding period of risk is twice as long. Two clearing members at DCO B would be charged a lower market risk measure on their cleared portfolios with the SIMM model (with ratios of 0.96 and 0.97, respectively). Note that this doesn't necessarily indicate poor performance on the part of SIMM. The results simply reinforce the univariate example above, showing that the clearinghouse models can produce higher risk measure due to methodological differences. Generally speaking, SIMM produces a value well above the univariate scaling factor from five-day normal 99.7% expected shortfall to ten-day normal 99% value-at-risk, which suggests an average ratio of 1.08 (see Table 1). The average ratio is roughly the same across clearinghouses, likely because the two cleared IRS margin models are very similar. The DCO B model produces a slightly higher value on average due to the use of expected shortfall in place of value-at-risk, and possibly the longer lookback period of ten years compared to five years.

The discrepancy in the ratio of the SIMM to cleared market risk measure across clearing member accounts may be partially explained by differences in portfolio composition, which in turn point to key differences in the modelling methodologies. Recall that the SIMM framework employs fixed parametric assumptions about interest rate standard deviations and correlations across currency buckets and interest rate curve tenors, whereas the clearinghouse models use empirical distributions. These assumptions might drive the discrepancy across both low- and high-ratio portfolios.

The clearing member accounts with relatively lower SIMM market risk measures are generally concentrated in a wider variety of highly correlated currencies traded in the same direction. The SIMM framework assumes a cross-currency correlation parameter of 0.23 for every currency pair. This value was calibrated by taking the median of each currency pair correlation across tenors, and then taking the median across all currencies. The “average-of-averages” approach might dampen the individual interest rate curve co-movements that have occurred historically. The higher DCO B values are likely driven by simultaneous directional changes across different currency curves that may not follow a simple linear relationship. The attached appendix contains the correlation matrix for three-month reference rates for both the crisis period (4/16/08 – 4/15/09) as well as a single year used in the calibration period (1/1/15 – 12/31/15). The non-stationarity of correlations makes stable parameter estimation a difficult task, and thus can be better captured with an empirical distribution. The correlation coefficients describe the average relationship across return data, and not the individual co-movements.

The clearing member accounts with relatively higher SIMM market risk measures are generally concentrated in Euro-denominated exposures, with some only trading in this single currency. The lower cleared margin is likely driven by individual risk factor standard deviations, rather than correlations. The SIMM standard deviation parameters represent ten-day movements compared to five-day empirical movements used in the clearinghouse models, and in isolation should produce higher margins. The lower clearinghouse margins in this case are likely driven by the shorter liquidation period, which can have a pronounced relative effect on portfolios concentrated in single currencies. The difference in parametric and empirical correlations does not apply to these portfolios.

The broad commentary above does not necessarily mean that all portfolios with the same rough characteristics will show the same relative market risk measures. It would be difficult to forecast the relative collateral levels from two margin models based on broad portfolio attributes, since they can be described in terms of currency, directionality, and tenor concentration. Nevertheless, the common portfolio characteristics at different SIMM-to-cleared ratios show that relative collateral requirements under the uncleared margin regime will be sensitive to patterns in portfolio exposures, and thus market participant behavior.

As mentioned above, both clearinghouse models use volatility-scaled returns for the loss distribution, while SIMM distributional parameters are calibrated on unscaled returns. The volatility scale factor is calculated as an exponentially weighted moving average of today's volatility divided by a moving average of historical volatility from the return date. This dampens historical returns when today's volatility is relatively low, and amplifies historical returns when today's volatility is relatively high, making the model more reactive to current market conditions. Interest rate markets have been relatively stable recently, and therefore the clearinghouse loss distributions are significantly dampened by the volatility scale factor. Clearinghouse market risk measures would likely be closer to the SIMM values if the comparison were conducted during a stress period. This underscores a key difference in risk sensitivity across the two classes of models. The clearinghouse models incorporate daily price changes into the empirical distribution as well as the volatility scale factor. The SIMM model, on the other hand, relies on fixed parameters that are recalibrated on an annual basis[5]. This might then lead to smaller relative demands on uncleared margin compared with cleared margin during a market-wide volatility increase.

B. Initial Margin Comparison

The previous comparison considered only the market risk component of margin, as generated by value-at-risk or expected shortfall on the same set of interest rate swap portfolios. This comparison can be expanded to include the add-ons from both model classes that collateralize non-market exposures such as liquidity risk or credit risk. The following two tables show how the relative collateral requirements change when the overall initial margin figure is used in place of the market risk component:

[5] https://www.isda.org/a/7FiDE/isda-simm-governance-framework-19-september-2017-public.pdf

Measure	Ratio SIMM / Market Risk	Ratio SIMM / Initial Margin
Minimum	1.32	1.28
25th Percentile	1.48	1.34
Average	**1.72**	**1.64**
75th Percentile	1.84	1.74
Maximum	2.58	2.58

Table 3A – Initial Margin Comparison (DCO A)

Measure	Ratio SIMM / Market Risk	Ratio SIMM / Initial Margin
Minimum	0.96	0.54
25th Percentile	1.34	0.92
Average	**1.58**	**1.16**
75th Percentile	1.74	1.37
Maximum	2.88	2.11

Table 3B – Initial Margin Comparison (DCO B)

32% of member firms under consideration have a higher collateral requirement under the clearinghouse models when all initial margin costs are included, compared with 2% when only considering the market risk component. This shows that non-market risk add-ons compose a significant portion of clearinghouse financial resources.

The liquidity risk add-on makes up the majority of this non-market risk margin in the clearinghouse models. For the DCO A model it is the only add-on used in the framework. For the DCO B model it makes up 78% of total non-market add-ons on average across member accounts and dates, compared with the sum of basis risk, diversification risk, and credit risk charges. Certain member accounts at DCO B are charged liquidity risk add-ons that actually exceed the market risk measure, as shown below. The DCO B model demands a relatively higher proportion of non-market risk charges compared with DCO A, likely due to the size of member portfolios, as well as the number of additional charges. DCO B clears the vast majority of the IRS market, and these large portfolios lead to both higher concertation risk and a higher liquidity risk charge. The table below shows summary statistics for portfolio size and the liquidity risk add-on across the two clearinghouses:

Portfolio Size	DCO A	DCO B
Average portfolio net delta	$3,569,493	$9,180,527
Average portfolio gross delta	$49,340,871	$80,526,310

Liquidity Risk Add-on		
% Non-market add-ons		
Average	100%	78%
% Market risk measure		
Average	6%	29%
Maximum	21%	188%

Table 4 – Cleared Portfolio Size and Liquidity Risk Add-on

The SIMM framework also calculates a liquidity risk add-on, assessed only when currency-specific net delta exposure exceeds a threshold value. The threshold parameters are set at the assumed maximum amount that may be liquidated over ten days without any increased cost, and are assigned by four currency volatility buckets. Note that none of the cleared IRS portfolios exceed the SIMM concentration thresholds for any single currency. The ten-day thresholds are shown below for reference, along with the maximum net delta for all clearing member portfolios. These values represent the maximum across currencies within a given currency volatility bucket:

Currency Bucket	Currencies	SIMM Threshold (Net Delta)	Maximum Member Portfolio Concentration (Net Delta)
Low volatility	JPY	$82,000,000	$7,643,908
Regular volatility / well-traded	USD, EUR, GBP	$230,000,000	$41,690,314
Regular volatility / less well-traded	AUD, CAD, CHF, DKK, HKD, KRW, NOK, NZD, SEK, SGD, TWD	$28,000,000	$19,036,806
High volatility	All other currencies	$8,000,000	$1,983,053

Table 5 – Net Delta Concentration by Currency Bucket

The two classes of models are distinguished by their treatment of portfolio liquidation upon default. These assumptions correspond to the operational and structural differences across market segments: centralized default management in the cleared market, and a more uncertain re-hedging process in the bilateral market. The clearinghouse models assume that portfolio liquidation begins the day that the member defaults and apply day-to-day costs from the beginning of the five-day holding period. Hedge costs are calibrated to member price impact estimates at different delta amounts. This leads to a nonlinear or stepwise risk measure that can grow exponentially with portfolio size. The risk-reducing hedges are assumed to incur market impact costs simultaneously with five days of continued market exposure, as required by regulation. The SIMM model, on the other hand, assumes that portfolio liquidation occurs instantly and without cost after a time period that is proportional to portfolio size. Hedge costs therefore approximately scale to the root-time rule that effectively extends the ten-day holding period. Currency-level standard deviation and correlation parameters are increased by the ratio of net currency-specific delta to concentration threshold delta ($\sqrt{\Delta/\Delta_T}$). There is no simultaneous measurement of liquidity and market costs through the holding period, only a further scaling of market risk. This explains the observed increase on the cleared side in the above comparison. The clearinghouse models account for concurrent market and liquidity costs over the holding period, which brings the overall initial margins significantly closer to the SIMM values.

Note also that the concentration thresholds in SIMM are applied to the individual counterparty exposures, whereas the clearinghouse liquidity and concentration charges are sized to the entire member portfolio. The bilateral segmentation of uncleared exposures will likely understate the overall costs of large-position liquidation, which are better modelled on the portfolio as a whole in terms of a market-wide liquidity impact. The SIMM concentration thresholds are applied solely on the basis of net delta exposure across individual currencies. This means that a portfolio of standardized instruments and a portfolio of exotic instruments with same net exposure would be assessed the same liquidation risk.

In practice, swap dealers and major swap participants are required by CFTC rule 23.600 to maintain a risk management program that monitors liquidity risk as well as any other applicable risks. This could include additional collateral requirements on top of the amount modelled by ISDA SIMM. The SIMM-generated initial margin only represents a minimum amount that must be exchanged between counterparties, and the actual firm-specific application of the model might vary on a case-by-case basis. Therefore the results above represent only a tentative and hypothetical reference point, since the implementation of uncleared margin model governance is currently in progress. The analysis suggests that liquidity risk management will be vital for large bilateral market participants, since the SIMM framework as designed doesn’t capture the wider market impact of portfolio liquidation.

Note that the comparison above does not capture the actual initial margin requirements for the same portfolio placed in different market segments. The analysis has ignored the netting effects of central clearing, which can significantly reduce the overall portfolio exposure across counterparties. The previous analysis assumes that the same netted portfolio would be margined with both models, and consequently underestimates overall SIMM margin requirements by a factor that scales with number of counterparty exposures that exceed the $50 million threshold and the relative amount of risk netting across exposures. A market participant with significant activity across a large number of counterparties would face a much higher aggregate SIMM margin than what was shown. The comparisons above are convenient to examine model performance on the same exposures, but don't reflect the structural differences across markets. Along the same lines, the total collateral amount charged by clearinghouses was not included in the comparison. This amount includes initial margin as well as any collateral haircuts, guarantee fund contributions, and any excess margin held on deposit. The purpose of the paper is to compare common risk measures across cleared and uncleared market segments, and therefore any charges outside the initial margin model have been excluded.

V. Conclusion

The analysis shows that a longer liquidation period does not necessarily guarantee a higher margin value. Although this holds only for a subset of cleared interest rate swap portfolios, the result underscores that broader methodological differences can compensate for a difference in the holding period of risk. The cleared and uncleared models are differentiated by a historically simulated distribution compared with a parametric distribution, a higher-than-required confidence level used in the clearinghouse models, and the more conservative measure of expected shortfall used by DCO B in place of value-at-risk. The relative margin levels across the two models are dependent on portfolio composition. In the case of SIMM compared to clearinghouse models for IRS, portfolios with significant exposures across multiple currencies are assessed a relatively lower SIMM margin, and portfolios with single currency exposures are assessed a relatively higher margin. This highlights an important methodological difference assumption in the treatment of correlation and illustrates that margin-based incentives will vary across participant exposures. The analysis does not necessarily show poor performance or any deficiency in the assumptions of SIMM, nor does it establish a benchmark to evaluate the model. Per existing regulation, the model performance is subject to ongoing backtests and stress tests. As mentioned previously, the SIMM-generated margin figure represents only a minimum amount that might be modified in firm-specific application. The initial margin value as modelled with SIMM alone may understate the amount of collateral collected in practice. The results indicate that swap dealer oversight of any large-position liquidity risks in their uncleared derivative positions will be centrally important.

The required liquidation period for margin models should be the subject of further regulatory study. As discussed earlier, the extended holding period shifts liquidity risk measurement to market risk measurement under the SIMM assumptions, and doesn't necessarily produce a higher overall margin requirement. The general exchangeability of liquidity and market risk is questionable given the relative scaling to portfolio size. The ten-day liquidation period was established to reflect the generally higher liquidity risk of uncleared derivatives. However, as shown in the initial margin comparison results, this leads to an assessment of only market risk that doesn't incorporate any measure of portfolio concentration, contract type, or market depth. The clearinghouse models collateralize market and liquidity costs that would occur simultaneously over the holding period. This might be considered an overly punitive "double-counting" of risk: assuming that the portfolio remains fully exposed to price movements over five days, but also assuming that the positions are progressively hedged at an appropriately estimated cost from the start of the period. This double-counting is illustrated most clearly in member accounts that are charged a liquidity risk add-on at least as large as the market risk measure. Several clearinghouses have shown in their liquidity risk models that member interest rate swap or foreign exchange portfolios can be hedged within a single day, as the cleared markets are currently active and well-traded. Ideally both of these models should be calibrated to a market-sensitive holding period, based on a product-specific liquidity profile. A more refined and product-specific approach would better capture the interrelated market and liquidity risks across contracts in both the cleared and uncleared segments. The CFTC margin model staff will continue to assess the relative performance and assumptions of various models in order to monitor the changing derivatives landscape.

Appendix – Correlation Coefficients across SIMM Calibration Periods

	USD	EUR	GBP	JPY	AUD	SEK	CAD	NOK	CZK	HUF	PLN	ZAR	HKD	MXN	CHF
USD	1.00	0.90	0.91	0.87	0.78	0.91	0.88	0.91	0.73	-0.35	0.78	0.73	0.97	0.45	0.87
EUR	0.90	1.00	0.99	0.91	0.93	0.97	0.99	0.98	0.90	-0.35	0.93	0.91	0.83	0.52	0.93
GBP	0.91	0.99	1.00	0.86	0.95	0.99	0.99	0.97	0.84	-0.43	0.86	0.85	0.84	0.41	0.97
JPY	0.87	0.91	0.86	1.00	0.74	0.82	0.86	0.89	0.93	-0.12	0.96	0.90	0.84	0.67	0.74
AUD	0.78	0.93	0.95	0.74	1.00	0.94	0.95	0.89	0.79	-0.59	0.77	0.78	0.65	0.25	0.97
SEK	0.91	0.97	0.99	0.82	0.94	1.00	0.97	0.96	0.81	-0.44	0.83	0.81	0.83	0.35	0.97
CAD	0.88	0.99	0.99	0.86	0.95	0.97	1.00	0.97	0.86	-0.44	0.88	0.86	0.80	0.44	0.96
NOK	0.91	0.98	0.97	0.89	0.89	0.96	0.97	1.00	0.86	-0.31	0.90	0.87	0.86	0.50	0.92
CZK	0.73	0.90	0.84	0.93	0.79	0.81	0.86	0.86	1.00	-0.07	0.96	0.92	0.69	0.56	0.72
HUF	-0.35	-0.35	-0.43	-0.12	-0.59	-0.44	-0.44	-0.31	-0.07	1.00	-0.07	-0.14	-0.16	0.24	-0.62
PLN	0.78	0.93	0.86	0.96	0.77	0.83	0.88	0.90	0.96	-0.07	1.00	0.96	0.76	0.72	0.74
ZAR	0.73	0.91	0.85	0.90	0.78	0.81	0.86	0.87	0.92	-0.14	0.96	1.00	0.70	0.70	0.74
HKD	0.97	0.83	0.84	0.84	0.65	0.83	0.80	0.86	0.69	-0.16	0.76	0.70	1.00	0.51	0.76
MXN	0.45	0.52	0.41	0.67	0.25	0.35	0.44	0.50	0.56	0.24	0.72	0.70	0.51	1.00	0.26
CHF	0.87	0.93	0.97	0.74	0.97	0.97	0.96	0.92	0.72	-0.62	0.74	0.74	0.76	0.26	1.00

Figure 1A – Correlation Table of 3M Interbank Rates over Stress Period (4/16/08 – 4/15/09)

	USD	EUR	GBP	JPY	AUD	SEK	CAD	NOK	CZK	HUF	PLN	ZAR	HKD	MXN	CHF
USD	1.00	-0.86	0.54	-0.70	-0.06	-0.09	-0.43	-0.58	0.70	-0.56	-0.22	0.93	0.06	0.85	0.32
EUR	-0.86	1.00	-0.66	0.85	0.44	0.21	0.65	0.70	-0.85	0.84	0.49	-0.90	-0.05	-0.58	-0.49
GBP	0.54	-0.66	1.00	-0.53	-0.54	-0.04	-0.79	-0.69	0.68	-0.85	-0.39	0.65	0.51	0.45	0.75
JPY	-0.70	0.85	-0.53	1.00	0.30	0.18	0.63	0.76	-0.92	0.68	0.35	-0.81	-0.07	-0.41	-0.34
AUD	-0.06	0.44	-0.54	0.30	1.00	0.48	0.67	0.25	-0.35	0.67	0.81	-0.14	-0.28	0.07	-0.64
SEK	-0.09	0.21	-0.04	0.18	0.48	1.00	0.41	0.03	-0.18	0.09	0.43	-0.02	0.05	0.00	-0.01
CAD	-0.43	0.65	-0.79	0.63	0.67	0.41	1.00	0.72	-0.77	0.75	0.46	-0.60	-0.35	-0.24	-0.63
NOK	-0.58	0.70	-0.69	0.76	0.25	0.03	0.72	1.00	-0.86	0.70	0.09	-0.76	-0.26	-0.33	-0.43
CZK	0.70	-0.85	0.68	-0.92	-0.35	-0.18	-0.77	-0.86	1.00	-0.74	-0.28	0.86	0.19	0.44	0.44
HUF	-0.56	0.84	-0.85	0.68	0.67	0.09	0.75	0.70	-0.74	1.00	0.53	-0.70	-0.27	-0.33	-0.70
PLN	-0.22	0.49	-0.39	0.35	0.81	0.43	0.46	0.09	-0.28	0.53	1.00	-0.20	-0.16	-0.11	-0.54
ZAR	0.93	-0.90	0.65	-0.81	-0.14	-0.02	-0.60	-0.76	0.86	-0.70	-0.20	1.00	0.10	0.70	0.42
HKD	0.06	-0.05	0.51	-0.07	-0.28	0.05	-0.35	-0.26	0.19	-0.27	-0.16	0.10	1.00	0.20	0.52
MXN	0.85	-0.58	0.45	-0.41	0.07	0.00	-0.24	-0.33	0.44	-0.33	-0.11	0.70	0.20	1.00	0.25
CHF	0.32	-0.49	0.75	-0.34	-0.64	-0.01	-0.63	-0.43	0.44	-0.70	-0.54	0.42	0.52	0.25	1.00

Figure 1B – Correlation Table of 3M Interbank Rates over Recent Period (1/1/15 – 12/31/15)