FIXED INCOME CLEARING CORPORATION GOVERNMENT SECURITIES DIVISION

OVERVIEW OF THE CLEARING FUND METHODOLOGY

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Overview of the Clearing Fund Methodology for GSD

DTCC Risk Management

October 2023

This document is not legally binding and is only for information purposes. This document should not be regarded as a substitute for the FICC/GSD Rulebook. In all cases, reference should be made to the FICC/GSD Rulebook for a complete statement of FICC/GSD's rules, procedures, obligations, and requirements. Nothing in this document shall be deemed to impose any obligations on FICC that are not set forth in the FICC/GSD Rulebook, and in the case of any discrepancy between this document and the FICC/GSD Rulebook, the FICC/GSD Rulebook shall govern. The FICC/GSD Rulebook is available at http://www.dtcc.com/legal/rules-and-procedures.aspx.

1   Executive Summary

The Government Securities Division ("GSD"), a division of the Fixed Income Clearing Corporation ("FICC")[1], is the leading provider of trade comparison, netting and settlement for the U.S. Government securities marketplace.A key tool that FICC uses to manage market risk is the daily calculation and collection of Required Fund Deposits from Netting Members.[2] The Required Fund Deposit serves as each Netting Member's margin. The aggregate of all Netting Members' Required Fund Deposits, and all other deposits, including Cross- Guaranty Repayment Deposits, constitutes the Clearing Fund of GSD, which FICC would access should adefaulting Netting Member's own Required Fund Deposit be insufficient to satisfy losses to FICC caused by the liquidation of that Netting Member's portfolio. In addition, GSD calculates a mark-to-market which isintended to reflect the realized profit and loss of the Netting Member's positions resulting from actual changes in market prices. The mark-to-market calculation is part of the Funds-Only Settlement Amount ("FOS") and will only be addressed in this document with respect to required times for payment.

The purpose of this document is to provide an overview of the components that comprise a Netting Member's Required Fund Deposit. The Required Fund Deposit is collected to cover potential changes in the value of each Netting Member's position over the assumed liquidation/hedging period in the event that such Netting Member defaults.[3]

2   THE GOVERNMENT SECURITIES DIVISION

GSD provides trade comparison, netting and settlement for the U.S. Government securities marketplace. GSD clears the following securities and transaction types:

- Buy-sell transactions in eligible U.S. Treasury and agency securities.

- Delivery versus Payment ("DVP") repurchase agreement ("Repo") transactions whereby the underlying collateral must be U.S. Treasury or agency securities.

- GCF Repo® Transactions whereby the underlying collateral may be U.S. Treasury securities, agency securities or eligible mortgage-backed securities ("MBS"). Unlike DVP Repo transactions, the underlying collateral for GCF Repo Transactions is not specified until the end-of-day[4] which is when the actual individual securities are allocated.

- Sponsored GC Trades, in connection with the Sponsored GC Service, are Sponsored Member Trades that are Repo Transactions between a Sponsored Member and its Sponsoring Member whereby the underlying collateral may be U.S. Treasury securities, agency securities or eligible MBS.

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[1] FICC is a subsidiary of The Depository Trust and Clearing Corporation ("DTCC").

[2] Capitalized terms used herein and not defined shall have the meaning assigned to such terms in the GSD Rulebook ("GSD Rules") available at www.dtcc.com/legal/rules-and-procedures.

[3] The three-day liquidation period is sometimes referred to as the "margin period of risk" or "closeout-period." This period reflects the time between the most recent collection of the Required Fund Deposit from a defaulting Netting Member and the liquidation of such Netting Member's portfolio. FICC currently assumes that it would take three days to liquidate or hedge a portfolio in normal market conditions.

[4] See SCHEDULE OF GCF TIMEFRAMES in GSD Rules for specific deadlines.

3 OVERVIEW – THE REQUIRED FUND DEPOSIT AND CLEARING FUND CALCULATIONS

The Required Fund Deposit is calculated and collected to cover the risk associated with liquidation of a Netting Member's portfolio in the event of such Member's default. GSD calculates Required Fund Deposits and FOS twice each business day based on a Netting Member's 12:00p.m. and end-of-day positions. Required Fund Deposit deficits are collected at 2:45p.m. on the current day and 9:30a.m. on the next business day, respectively.[5] Separately, FOS is collected and passed through directly to Netting Members twice each business day (i.e., at 4:30p.m. based on a Netting Member's noon positions and 10:00a.m. the next business day based on a Netting Member's prior end-of-day positions).

Through a number of risk-based charges, the Required Fund Deposit addresses a Netting Member's potential market risk exposure. Of these components, the VaR Charge generally comprises the largest portion of a Netting Member's Required Fund Deposit amount. Market risk is measured based on positions and market volatilities. Positions, as input into the risk calculation, are collected into portfolios for the Clearing Fund calculations. Market volatilities are captured by statistics based on historical market conditions.

3.1 Portfolio Based Risk Calculation

Each Netting Member has one or more GSD Accounts used for settlement purposes. With respect to margin calculations, Netting Members are allowed to group Accounts under the same legal entity and Permitted Margin Affiliates[6] into one or more Margin Portfolios, in each case, subject to certain restrictions and limitations.[7] Required Fund Deposit amounts are calculated based on the positions in each Margin Portfolio. This can potentially reduce the Required Fund Deposit due to netting effect and diversification across positions held in a Netting Member's and it's Permitted Margin Affiliates' different Accounts when combined in a Margin Portfolio.

Unless otherwise noted, the Required Fund Deposit and Clearing Fund calculations in this document are based on Margin Portfolios.

3.2 Components of the Required Fund Deposit

GSD calculates and collects two margin requirements - one is based on a Netting Member's intraday 12:00p.m. positions and the other is based on such Netting Member's end-of-day positions. The following table summarizes the components of the Required Fund Deposit calculation based on a Netting Member's intraday and end-of-day positions.

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[5] All times referenced herein refer to New York City time.

[6] The term "Permitted Margin Affiliate" means an affiliate of a Netting Member that is also a member of GSD and that directly or indirectly controls such particular Member, or that is directly or indirectly controlled by or under common control with such particular Member. Ownership of more than 50% of the common stock of the relevant entity (or equivalent equity interests in the case of a form of entity that does not issue common stock) will be conclusively deemed prima facie control of such entity for purposes of this definition. GSD Rule 1, Definitions.

[7] For example, a Dealer Account and a Broker Account cannot be grouped into the same portfolio, even if both Accounts belong to the same Netting Member or a Permitted Margin Affiliate. GSD Rule 4, Section 1a, Margin Portfolio.

Component	Risk Addressed	GSD Portfolio Margin Method
VaR Charge	Market risk of the observed positions.	The VaR Charge is calculated using a risk based margin methodology that is intended to capture the market price risk associated with the securities in a Netting Member's Margin Portfolio over a designated time-period. VaR Charge is calibrated to cover the projected liquidation losses at a 99% confidence level, assuming a 3-day liquidation/hedging period.[8] FICC uses historical simulation to estimate the impact of market volatilities on the Netting Member's Margin Portfolio(s). Simulated returns are based on risk sensitivities obtained from a third party and relevant risk factor time series ("sensitivity based approach"). A ten-year historical look-back is used if it includes sufficient stressed market scenarios. If, however, FICC determines that the historical look-back period does not contain adequate shocks, additional period(s) of stressed market conditions may be added to the ten-year historical data. A haircut method is applied to securities with insufficient requisite data used to employ the sensitivity approach. The total VaR Charge of a Netting Member's Margin Portfolio is the sum of the volatility model calculation and haircuts, subject to minimum amount, referred to as the "VaR Floor." VaR Floor is determined by multiplying the absolute value of the sum of Net Long Positions and Net Short Positions of Eligible Securities, grouped by product and remaining maturity, by a percentage designated by FICC from time to time for such group. The VaR Floor is reviewed from time to time, generally, at least annually, and updated in accordance with FICC's internal model governance process.

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[8] The three-day liquidation period is sometimes referred to as the "margin period of risk" or "closeout-period." This period reflects the time between the most recent collection of the Required Fund Deposit from a defaulting Netting Member and the liquidation of such Netting Member's portfolio. FICC currently assumes that it would take three days to liquidate or hedge a portfolio in normal market conditions.

Component	Risk Addressed	GSD Portfolio Margin Method
Bid-Ask Spread Charge	Market risk of the observed positions.	The Bid-Ask Spread Charge is included in the VaR Charge to cover the transaction cost to liquidate a portfolio. The charge is segmented into six classes by product type and/or maturity and a specific haircut rate is applied to each class. (1) TSY maturing in less than 5 years (including Treasury bonds with remaining maturities less than 5 years, excluding TIPS); (2) TSY maturing in 5 years or more, but less than-10 years (including Treasury bonds with remaining maturities between 5 years or more, but less than 10 years, excluding TIPS); (3) TSY maturing in 10 years or more (including Treasury bonds with remaining maturities 10 years or more, excluding TIPS); (4) Agency (including all Agency bonds); (5) TIPS (including all TIPS bonds); (6) All mortgage-backed securities.
Portfolio Differential	Portfolio Variability Risk	The PD Charge is designed to capture variability in the VaR Charge collected from the Member over the look back period. The PD Charge is calculated twice each Business Day as the exponentially weighted moving average ("EWMA") of the historical increases in the Member's VaR Charge that occur between collections of Required Fund Deposits over a lookback period of no less than 100 days with a decay factor of no greater than 1, times a multiplier that is no less than 1 and no greater than 3, as determined by the Corporation from time to time based on backtesting results.
Margin Liquidity Adjustment Charge	Concentration Risk	The Margin Liquidity Adjustment Charge is only assessed when the Member's Margin Portfolio exceeds a threshold in comparison to the available market liquidity of the market segment. GSD segments the relevant markets into four asset groups: 1) U.S. Treasury securities (excluding TIPS), 2) TIPS, 3) U.S. agency bonds, and 4) mortgage pools transactions. The asset group of Treasury security is further divided into five tenor buckets: i) securities with remaining maturities less than one year; ii) securities with remaining maturities equal to or more than one year and less than two years; iii) securities with remaining maturities equal to or more than two years and less than five years; iv) securities with remaining maturities equal to or more than five years and less than ten years; v) securities with remaining maturities equal to or more than ten

Component	Risk Addressed	GSD Portfolio Margin Method
		years. The TIPS asset group is further divided into four tenor buckets: i) TIPS with remaining maturities less than two years; ii) TIPS with remaining maturities equal to or more than two years and less than six years; iii) TIPS with remaining maturities equal to or more than six years and less than eleven years; iv) TIPS with maturities equal to or more than eleven years.
Cross-Margining Reductions	Systemic Risk	This amount is only applicable to Cross-MarginingParticipants.[9] Pursuant to the CME Cross-Margining Arrangement between FICC and the Chicago Mercantile Exchange ("CME"), each of FICC and CME hold and manage its own positions and collateral, and independently determines the amount of margin that it will make available for cross-margining (such margin is referred to as the "residual margin amount") that remains after FICC and the CME, respectively, conduct their own internal offset. FICC then computes an amount by which the Required Fund Deposit of a Cross-Margining Participant can be reduced by comparing the Netting Member's positions and the related residual margin requirements at FICC/GSD as against those at the CME.
Blackout Period Exposure Adjustment	Market risk	This charge is only applicable to transactions collateralized with MBS. An additional charge or reduction that may be added to applicable Members' VaR Charge to mitigate exposures to FICC that may arise due to potential overvaluation of transactions collateralized with MBS during the Blackout Period.
Backtesting Charge	Model risk	An additional charge that may be added to a Netting Member's VaR Charge to mitigate exposures to FICC causedby settlement risks that may not be adequately captured by FICC's portfolio volatility model. FICC may assess this charge on a Netting Member's start of day Margin Portfolios (the "Regular Backtesting Charge") and/or its intraday MarginPortfolios (the "Intraday Backtesting Charge").

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[9] Currently, Cross-Margining Participants are Netting Members that participate in the Cross-Margining Arrangement between FICC and the Chicago Mercantile Exchange (the "CME"). See GSD Rule 1, Definition.

Component	Risk Addressed	GSD Portfolio Margin Method
Holiday Charge	Risk related to trading activity on a Holiday.	An additional charge that may be added to Netting Members' VaR Charge on the Business Day prior to a Holiday.
Clearing Fund Premiums and Special Charges	To address compliance issues or mitigate perceived risks in excess of those systematically addressed via components referenced above.	**Collateral Premiums:** the greater of $1 million or 25% of the Netting Member's Required Fund Deposit. **Excess Capital Premium:** equal to the Netting Member's Excess Capital Differential multiplied by its Excess Capital Ratio. **Special Charges:** additional deposit to mitigate specific risks that may arise from time to time.

For the Intraday Supplemental Fund Deposit, the VaR Charge is computed from the simulated profit and loss (P&L) scenarios that are calculated with the relevant intraday position.The entire Required Fund Deposit will be the greater of the sum of these charges, or the Minimum Charge,which varies depending on membership type. The "Minimum Charge" is a floor applicable for the unadjusted Required Fund Deposit (which is the calculated requirement minus any premiums or special charges). This floor is equivalent to $1 million for most membership types and applied to each Margin Portfolio. Pursuantto the GSD Rules, Repo Brokers are subject to a higher absolute floor of $5,000,000.[10]

4 VAR METHODOLOGY

GSD uses a value-at-risk ("VaR") historical simulation approach to calculate the price volatility within its Required Fund Deposit. VaR is a widely used risk management concept in the financial industry. In its simplest form, VaR provides an estimate of the possible losses for a given portfolio based on a given confidence level over a particular time horizon. It is intended to cover the uncertainty of market volatility for any given portfolio. For example, if a 3-day VaR calibrated to a 99% confidence level is $10,000,000, it means that there is a 99% chance that the 3-day liquidation loss won't exceed $10,000,000.The total VaR Charge of a Netting Member's Margin Portfolio is the sum of the VaR model calculation andhaircuts, subject to minimum amount, referred to as the "VaR Floor."Summarized below is an overview of the methodology that GSD uses to compute the VaR Charge.

4.1 Historical Simulation

To measure the risk of a Margin Portfolio, it is necessary to project the potential value changes of the portfolio. Various techniques are available to project value changes in a portfolio and GSD has chosen a historical simulation approach.

As mentioned above, GSD's VaR Charge is generally computed based on the confidence level of 99% and the assumption of 3-day liquidation/hedge period. For a fixed end of day or intraday Margin Portfolio, this requires a sample of the possible P&Ls in 3-day periods. A general technique is to use the 3-day returns of selected instruments over a predetermined time interval, for example, ten years, thus producing 2500 returns for each instrument. The historical returns can then be applied to the Margin Portfolio containing these instruments to calculate a P&L for each of the 2500 historical days. In effect, it applies the historical market conditions of each of the past 2500 days to the current Margin Portfolio to simulate 2500 Margin Portfolio P&Ls. The 2500 P&Ls are then sorted and a VaR with a 99% confidence level is the 1st percentile of the losses. Historical simulation is appealing because it uses actual and observable historical data. Also, it does not make any specific assumption on the underlying P&L distribution. However, all models carry

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[10] GSD Rule 4, Section 1b, Unadjusted GSD Margin Portfolio Amount.

certain assumptions behind them. The basic assumption that GSD makes is that the past ten years of market movement is sufficient to adequately measure the worst 99th percentile movement over the next three business days.

If, however, GSD determines that the historical look-back period does not contain adequate shocks, additional period(s) of stressed market conditions can be added to the ten years of historical data. GSD would utilize its standard model governance process to determine whether to apply the stressed historical VaR for margining purposes and the appropriate historical stressed period to incorporate. The historical stressed period chosen for the historical stressed VaR would be consistent with the historical stress scenarios applied to GSD in DTCC's stress test.[11]

As an example, consider the following example Margin Portfolio that contains three securities in July 2017:[12]

Security	Market Price	Par	Description
912828XW5	99.629	$2,000,000	5 year U.S. Treasury note with 1.750% coupon maturing in June 2022
912828XX3	98.668	-$1,000,000	7 year U.S. Treasury note with 2.000% coupon maturing in June 2024
01F040677 (3138WFH66)	106.4	$1,000,000	30-year Fannie Mae Single Family with 4% coupon

GSD computes 2500 days of simulated P&L returns using vendor supplied data and the positions in the Margin Portfolio.[13] The last column is the total simulated P&L for the Margin Portfolio, which is the sum of simulated P&Ls of the three CUSIPs. The following table gives simulated results.

Simulation Day	Simulated P&L			Margin Portfolio P&L
	912828XW5	912828XX3	01F040677	
1	1,000.31	(647.70)	103.01	455.62
2	566.63	(1,604.25)	20.50	(1,017.12)
3	(2,003.14)	1,391.35	(1,025.60)	(1,637.39)
…	…	…		…
2498	(3,160.33)	976.54	(200.00)	(2,383.79)
2499	(3,012.69)	572.73	(68.25)	(2,508.21)
2500	824.00	(2,597.78)	(58.85)	(1,832.63)

The next step is to sort the "Margin Portfolio P&L" column and find the first percentile of the simulated losses(100% minus 99%, for a 99% confidence level). The sorted results are show below.

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[11] At the time of implementation, the 10-year look-back period included the 2008/2009 financial crisis scenario. To the extent that an equally or more stressed market period does not occur when the 2008/2009 financial crisis period is phased out from the 10-year look-back period (i.e., from September 2018 onward), FICC would continue to include the 2008/2009 financial crisis scenario in its historical scenarios. However, if an equally or more stressed market period emerges in the future, FICC may choose not to augment its 10-year historical scenarios with those from the 2008/2009 financial crisis. The stressed period, if added to the look-back period, shall be no shorter than 6 months and no longer than 36 months, and comprised of either one continuous period specified by a start date and an end date or comprised of more than one non-continuous period. It is currently set at 18 months covering a period from January 2008 through June 2009.

[12] This example is for illustrative purposes only.

[13] See section 4.2 for further discussion the calculation of returns.

Sorted Order	Simulation Day	Simulated P&L			Margin Portfolio P&L
		912828XW5	912828XX3	01F040677	
2500	131	(7,456.00)	1,317.00	(1,139.00)	(7,278)
...	...	...	...	...	...
2476	980	(6,010.00)	143.00	(501.00)	(6,368)
2475	2220	(2,545.00)	(2,400.00)	(991.00)	(5,936)
...	...	...	...	...	...
1	1890	473.00	5,257.00	50.00	5,780

The 99% VaR based on the 2500 returns summarized in the table above is then calculated through interpolation.

Denote N = 2500 for the sample size and α = 99 for the confidence level.

Let $k = floor\,(0.01(N + 1)\,\alpha) = 2{,}475$, and $d = 0.01(N + 1)\,\alpha - k = 0.99$.

We have $r_k = r_{2475} = -5{,}936$, and $r_{k+1} = r_{2476} = -6{,}368$

Then, $VaR = -\left(r_k + d(r_{k+1} - r_k)\right) = -\left(-5{,}936 + 0.99 * \left(-6{,}368 - (-5{,}936)\right)\right) = 6{,}363.68$

The VaR Charge for the Margin Portfolio is $6,363.68.

a)   Risk P&L Model

In order to obtain the simulated returns used in the VaR model calculation, GSD uses a sensitivity approach, where the risk profile of a Netting Member's Margin Portfolio is decomposed and represented by the behaviors of key market risk drivers ("factors"), such as changes in interest rates.

A Netting Member's Margin Portfolio will consist of U.S. Treasury/agency securities and/or MBS thus the risk factors selected by GSD to explain the price changes are slightly different for each product. For U.S. Treasury and agency securities, the following risk factors have been incorporated: key rates, convexity, agency spread, implied inflation, volatility, and time. For MBS,[14] GSD uses risk exposure analytics of to-be-announced ("TBA") securities as a proxy for the MBS risk exposure analytics. Therefore, MBS are mapped to TBAs and the risk factors are the same as those used by FICC's Mortgage-Backed Securities Division ("MBSD") VaR model, but with an additional risk factor to account for the basis risk between the MBS and the mapped TBA proxy.

The value change of a Margin Portfolio is approximated by multiplying the change of the selected risk factors under various scenarios by the magnitude of the Margin Portfolio's reaction (i.e., the sensitivity) to the change.

More specifically, a position's P&L is estimated by the sum-product of the risk exposures and the corresponding risk factor returns.

Risk exposure measures the change of a Margin Portfolio's value to the change of a risk factor. The exposure of a position in security j of the Margin Portfolio to the i-th risk factor can be shown as:

$E_{ij} = MV_j * S_{ij} * multiplier_i$ Here, we assume a Margin Portfolio has N number of securities, and one of

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[14] As noted above, MBS enter a Netting Member's Margin Portfolio as collateral of GCF Repo Transactions.

them is the security j, which has a market value of MV_j, and the sensitivity of security j to the i-th risk factor is S_{ij}. The multiplier is static and driven by how the risk sensitivity is quoted and how the risk factor change affects the P&L.

Margin Portfolio level exposures are calculated by aggregating position level risk exposures. Assuming N securities in a Margin Portfolio, the exposure of the portfolio to the i-th risk factors will be

$EE_{ii}^{PP} = \sum_{j=1}^{N}(MV_{jj} * S_{ij} * multiplier_i)$ EE_{ii}^{PP} constitutes the exposure vector of the Margin Portfolio P, which contains the exposure of the portfolio to each risk factor.

For example, consider the Margin Portfolio in the prior section with three positions: 5 year U.S. Treasury note maturing in June 2022 (912828WS5), 7 year U.S. Treasury note maturing in June 2024 (912828XX3), and a GCF Repo Transaction collateralized with a MBS.

		(MV)	(S)	(M)	E=(S*MV*M)
CUSIP	Factor Name	Market Value	Sensitivity	Multiplier	EXPOSURE
912828XW5	Key Rate (5yr)	2,000,000	0.4147	-1	-829,400
912828XX3	Key Rate (5yr)	-1,000,000	0.27339	-1	273,390
01F040677	Key Rate (5yr)	1,000,000	0.22000	-1	-220,000

Each product's sensitivity to a change in the 5yr rate, and the multiplier (which is based on the way the sensitivity is quoted and the impact it has on the value change) are shown above. The risk exposure provides an estimate of how the Margin Portfolio's market value will change as a result of a change to the 5yr rate.

Using the risk exposure calculated above, the simulated P&L, ΔMV_p, is calculated at the Margin Portfolio level as:

$$\Delta MV = \sum_{i=1}^{M} E_i^P \times FR_i \text{ Where}$$

To continue the example of the sample Margin Portfolio above, if the factor for the 5yr rate is changed as shown below, the market value change attributable to the move in the 5yr would be $6,176.66:

		(E)	(FR)	Scenario Date SPnL=E*FR
TBA CUSIP	Factor Name	EXPOSURE	Factor return	Simulated P&L
912828XW5	Key Rate (5yr)	-829,400	-0.0187427	15,545.20
912828XX3	Key Rate (5yr)	273,390	-0.0187427	-5,124.07
01F040677	Key Rate (5yr)	-220,000	-0.0187427	4,123.40
				14,544.53

Additional risk factors give a more complete picture of the simulated market environment and its influence on the value of the Margin Portfolio. The Margin Portfolio market value change is simulated by multiplying observed historical shocks of the selected risk factors over three days against the sensitivity of the current Margin Portfolio to each risk factor.

As noted above, for U.S. Treasury securities and agency securities, FICC would select the following risk factors: key rates, convexity, agency spread, implied inflation rates, volatility, and time. For MBS, each security would be mapped to a corresponding TBA forward contract and FICC would use the risk exposure analytics for the TBA as an estimate for the MBS's risk exposure analytics. FICC would use the following

risk factors to model a TBA security: key rates, convexity, MBS spread, volatility, mortgage basis, and time. To account for differences between MBS and their corresponding TBA, FICC would apply an additional basis risk adjustment.

4.2   Haircuts

Occasionally, Margin Portfolios contain classes of securities that reflect market price changes not consistently related to historical risk factors. In order to help ensure that all positions are accounted for in measuring the portfolio's risk, GSD will apply a haircut method to calculate the risk exposure for classes of securities that have market price changes that are not consistently related to historical risk factors due to varying market volumes.

The haircut charge for each GSD Margin Portfolio consists of the four components explained in each of the following sub-sections. The total haircut is the sum of the following four components.

a)   U.S. Treasury and Agency bonds without sensitivity analytics data

U.S. Treasury or agency securities[15] that have insufficient data to be incorporated into the sensitivities approach are each mapped to a benchmark U.S. fixed income index, based on the security's asset class and remaining maturity, and then all securities within each benchmark wouldbe aggregated into a net exposure. FICC then applies an applicable haircut to the net exposure per benchmark to determine the net price risk for each benchmark. The haircut assessed for this portion of the Netting Member's Margin Portfolio is then calculated from a joint correlation matrix and the net price risk of each benchmark. The correlation matrix is applied to provide risk diversification across tenor buckets that were historically observed.

The haircut rates and correlation parameter are calibrated using historical 3-day returns of the indices during the 10 years of look-back period.

The correlation adjustment is based on 3-day returns during a 10-year look-back. It reflects the average amount that the 3-day returns of each benchmark moves in relation to one another. The correlation adjustment would only be applied for U.S. Treasury and agency indices with maturitiesgreater than 1 year.

b)   MBS without sensitivity analytics data

MBS with insufficient information to be incorporated into the sensitivity approach are mapped into the TBA benchmarks and the haircut charge for this MBS portion of the Netting Member's Margin Portfolio is assessed as described below.

Risk factors are calculated using historical market prices of benchmark TBA securities and (ii) eachNetting Member's Margin Portfolio exposure would be calculated on a net position across all MBSproducts and for each securitization program (i.e., Federal National Mortgage Association ("FannieMae") and Federal Home Loan Mortgage Corporation ("Freddie Mac") conventional 30-year MBS,Government National Mortgage Association ("Ginnie Mae") 30-year MBS, Fannie Mae and FreddieMac conventional 15-year MBS, and Ginnie Mae 15-year MBS). The haircut for the MBS portionof the Netting Member's Margin Portfolio is then calculated by multiplying the risk factor for the Fannie Mae and Freddie Mac conventional 30-year MBS ("base risk factor"), which is the dominant and most liquid portion of the products cleared by FICC, by the absolute value of the Netting Member's net position across all MBS products, plus the sum of each risk factor spread for the other MBS programs to the base risk factor multiplied by the absolute value of its corresponding position

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[15] This haircut does not apply to (x) floating rate notes ("FRN") and (y) term repo rate volatility for term repo transactions and forward-starting repo transactions, which are subject to separate approaches described below.

c)   U.S. Treasury FRN Haircut Charge

For FRN securities, FICC adopted a haircut approach that uses a constant discount margin movement scenario. This discount margin movement amount is based on the current market condition of the FRN price movements. This amount, combined with the calculated discount margin sensitivity of each FRN issue's market price and the US Treasury provided formula, determines the haircut charge of the FRN portion of the Netting Member's Margin Portfolio.

d)   Repo Interest Volatility Charge

FICC/GSD guarantees that the borrower in a repo trade receives their repo collateral back at the close of the repo transaction while the lender receives the start amount paid on the repo inception date plus interest. Market risk of the underlying collateral is assessed with one of the methods in the above sections, depending on the type of collateral. The remaining risk component is that the interest on a repo is subject to the risk of movements of the market repo interest rates. This makes repo interest the relevant risk factor.

The two DTCC GCF repo interest rate indices that track the average daily interest rate paid for the most traded GCF repo contracts for Treasury and MBS securities are not granular enough to capture transaction-specific details of the repo trades in GSD clearing portfolio. If the two indices were used in the same manner as the risk factor time-series for priceable products, a large volume of long and short exposures with different terms, and different collateral sub-types would be netted out. As such, GSD repo contracts are classified into larger collection of buckets. The buckets differentiate special repos with underlying collateral consisting of certain "special" U.S. Treasury securities, and general repos referencing all other types of eligible collateral. The buckets are also differentiated according to time to settlement.

Repo interest volatility risk is handled with a haircut based approach. The repo volatility charge is calculated based on the following steps: 1) apply the corresponding haircut rate to each repo interest position based on whether it is long or short; 2) sum up the amounts derived from step 1 for position within each risk bucket, then take the absolute value thereof to obtain the charge for that risk bucket; 3) sum up the charges from all repo interest risk buckets to obtain the repo interest volatility charge for the portfolio.

4.3   VaR Floor

The VaR Floor is a calculated amount that would be used as the VaR Charge when the sum of the amounts calculated by the sensitivity approach and haircut method is less than the VaR Floor.

FICC's VaR Floor seeks to address the risk that the VaR model calculates a VaR Charge that is erroneously low where the gross market value of unsettled positions in the Netting Member's Margin Portfolio is high and the cost of liquidation in the event of a Member default could also be high. This would be likely to occur when the proposed VaR model applies substantial risk offsets among long and short positions in different classesof securities that have a high degree of historical price correlation. Because this high degree of historical price correlation may not apply in future changing market conditions[16], FICC believes that it is prudent to apply a VaR Floor that is based upon the market value of the gross unsettled positions in the Netting Member's Margin Portfolio in order to protect FICC against such risk in the event that FICC is required to liquidatea large Netting Member's portfolio in stressed market conditions.

The VaR Floor is calculated as the sum of the following two components: (1) a U.S. Treasury/Agency bond margin floor and (2) a mortgage-backed securities margin floor. The U.S. Treasury/Agency bond margin floor is calculated by mapping each U.S. Treasury/Agency security to a tenor bucket, then multiplying the

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[16] For example, and without limitation, certain securities may have highly correlated historical price returns, but if future market conditions were to substantially change, these historical correlations could break down, leadingto model-generated offsets that would not adequately capture a portfolio's risk.

gross positions of each tenor bucket by its bond floor rate[17], and summing the results. The mortgage-backed securities margin floor would be calculated by multiplying the gross market value of the total value of mortgage-backed securities in a Netting Member's portfolio by a designated amount, referred to as the pool floor rate[18].

4.4   Bid-Ask Spread

For each GSD Margin Portfolio, the positions are segmented into asset-groups and sub asset-groups and the bid-ask charge is calculate as following:

Asset Group	Sub Asset Group
Treasury	Remaining maturity less than 5 years
	Remaining maturity between 5 and less than 10 years
	Remaining maturity 10 years or more
TIPS	All TIPS
MBS	Pools
Agency	All Agency Bonds

$$\text{Bid-ask Charge} = \sum_{g \in Sub \text{ Asset-groups}} GMV_g \cdot HC_g \; GMV_g$$

5 PORTFOLIO DIFFERENTIAL CHARGE

PD Charge is calculated as the front-weighted average of the historical cycle-over-cycle increase in the observed VaR Charges multiplied by the PD factor. For calculation of the charge at each margin cycle, first the calcualtion is done of the VaR Charge increase from that cycle to the next cycle at both the Legal Entity (LE) level and the Margin Portfolio level each day. Then EWMA is applied to the historical data of VaR increase to arrive at the PD Charge amount at both the LE level and the Margin Portfolio level. For the final PD Charge amount, the PD Charge amount at the LE level is allocated to each of its Margin Portfolios pro-rata to the PD Charge amounts of those Margin Portfolios.

5.1. Cycle-over-cycle VaR Increase

For each business day T, and margin cycle which is either SOD or Noon, the cycle-over-cycle VaR increase is calculated for each GSD member and their Margin Portfolios as:

$$VaR \; Increase_{T,SOD} = \max(VaR_{T,Noon} - VaR_{T,SOD}, 0)$$

and

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[17] For U.S. Treasury and agency securities, such percentage shall be a fraction, no less than 10%, of the historical minimum volatility of a benchmark fixed income index for such group by product and remaining maturity.

[18] For mortgage-backed securities, such percentage shall be a fixed percentage that is no less than 0.05%.

$$VaR\ Increase_{T,Noon} = \max(VaR_{T,EOD} - VaR_{T,Noon,collected}, 0)$$

Note that the intention of this calculation is to capture the increase from the VaR Charge actually collected to the VaR Charge calculated on liquidation positions. Note that the GSD Rules provide that for purposes of calculating the Unadjusted GSD Margin Portfolio Amount applicable to a Sponsoring Member Omnibus Account, FICC shall apply the higher of the Required Fund Deposit calculation as of the beginning of the current Business Day and intraday on the current Business Day. Therefore, in practice, for any Sponsoring Member Omnibus Account, if its Noon VaR calculated is lower than its SOD VaR, GSD would keep its SOD VaR Charge for the Noon collection. In other words, for these omnibus portfolios

$$VaR_{T,Noon,collected} = \max(VaR_{T,SOD}, VaR_{T,Noon})$$

Noon collected VaR Charge amount for the members with omnibus portfolios are adjusted accordingly when aggregated from the portfolio level.

5.2 PD Calculation

On each business day, we calculate PD Charge for each GSD member that is subject to margin requirement and each of their Margin Portfolios for margin cycle t (either SOD or Noon) with the formula below.

$$PD_{T,t} = \frac{\sum_{i=1}^{N} \theta^{(i-1)} * VaR\ Increase_{T-i,t}}{\sum_{i=1}^{N} \theta^{(i-1)}}$$

Here N is the lookback window model parameter, θ is the decay factor.

5.3 PD Charge Allocation

While the PD Charge is calculated at the member level, GSD applies VaR and other charges at the Margin Portfolio level. We allocate the member level PD Charge to its Margin Portfolios proportional to PD Charge calculated for those Margin Portfolios. For each Margin Portfolio i within a GSD legal entity (LE), its PD Charge is calculated as:

$$PD\ Charge_i = \frac{PD_{LE} * PD_i}{\sum_{j=1}^{M} PD_j} * PD\ factor$$

where PD factor is a model parameter.

6   MARGIN LIQUIDITY ADJUSTMENT

The GSD MLA charge applies to concentrated positions of Treasury securities (excluding TIPS), TIPS, Agency Bonds, Agency MBS pools, and Agency MBS TBAs. The charge depends on the level of the concentration relative to the market depth and the market volatilities. GSD's MLA methodology divides a closeout portfolio into asset-groups ("market liquidity segments") across similar market risk characteristics, trading venues and market microstructures, participants and investor bases. Securities within each of those market liquidity segments exhibit similar trading and liquidity profiles. Their liquidities are fungible. Their price changes are highly correlated, often can be used to hedge each other.

GSD segments the relevant markets into four asset groups: 1) Treasury securities (excluding TIPS), 2) TIPS, 3) Agency bonds, and 4) Agency MBS (pools and TBAs). The asset group of Treasury security is further divided into five tenor buckets: i) securities with remaining maturities less than one year, ii) securities with remaining maturities between one and less than two years, iii) securities with remaining maturities between two and five years, iv) securities with remaining maturities between five and less than ten years and v) securities with remaining maturities ten years or more. The TIPS asset group is further divided into four tenor buckets: i) TIPS with remaining maturities less than two years, ii) TIPS with remaining maturities

between two and less than six years, iii) TIPS with remaining maturities between six and less than eleven years, and iv) TIPS with maturities eleven years or more.

The MLA is assessed at the asset class level and summed up to the member level. The assessment of MLA charge involves calculating the liquidation impact cost of securities in each asset group and comparing the impact cost to the core charge allocated to the asset group. When the ratio of the impact cost to the allocated core charge exceeds the threshold, MLA charge will be assessed for that asset group. The amount of the MLA charge is approximately linearly proportional to the exceedance of the threshold and linearly proportional to the allocated core charge. For the applied MLA Charge GSD may apply a downward adjusting scaling factor based on the ratio of the calculated market impact cost to a portion of the VaR Charge, where a higher ratio would trigger a larger downward adjustment of the MLA Charge and a lower ratio would trigger no downward adjustment of the MLA Charge.

The calculation of the impact cost has two components : (1) the directional market impact cost and (2) the basis cost, which is based on the net unsettled positions' gross market value (not applicable for TIPS <1yr maturity in GSD). The first component is a function of the directional market value, market depth parameter, and volatility parameter. The directional market value is defined as the absolute value of the net market value of securities in an asset group/tenor bucket. The second component is basis cost that is a function of the gross market value, market depth parameter, and basis volatility parameters.

BLACKOUT PERIOD EXPOSURE ADJUSTMENTThe Blackout Period Exposure Adjustment is only be imposed during the Blackout Period which, with respect to the Blackout Period Exposure Charge, is the period between the last business day of the prior month and the date during the current month upon which a government-sponsored entity that issues mortgage-backed securities publishes its updated Pool Factors.

The Blackout Period Exposure Adjustment is calculated by (1) projecting an average pay-down rate for the government sponsored enterprises (Fannie Mae and Freddie Mac) and the Government National Mortgage Association (Ginnie Mae), respectively, then (2) multiplying the projected pay-down rate[19] by the net positions of MBS in the related program, and (3) summing the results from each program.

7   BACKTESTING CHARGE

The objective of the Backtesting Charge is to increase the Required Fund Deposit for Netting Members that are likely to experience backtesting deficiencies by an amount sufficient to maintain such Netting Member's backtesting coverage above the 99% confidence threshold. FICC may assess this charge on a Netting Member's start of the day Margin Portfolio (the "Regular Backtesting Charge") and/or its intraday Margin Portfolio (the "Intraday Backtesting Charge"), as needed, to enable FICC to achieve its backtesting coverage target.

FICC employs daily backtesting to determine the adequacy of each Netting Member's Required Fund Deposit. FICC compares the Required Fund Deposit for each Netting Member with the simulated liquidation gains/losses using a snapshot of the actual positions in the Netting Member's Margin Portfolio, and the actual historical security returns. Regular Backtesting compares the Required Fund Deposit to a snapshot of the Netting Member's Margin Portfolio at end-of-day, while Intraday Backtesting compares the Required Fund Deposit to a snapshot of the Netting Member's Margin Portfolio at noon. FICC investigates the cause(s) of any backtesting deficiencies. As a part of this investigation, FICC pays particular attention to Netting Members with backtesting deficiencies that bring the results for that Netting Member below the 99% confidence target (i.e., greater than two backtesting deficiency days in a rolling twelve-month period) to determine if there is an identifiable cause of repeat backtesting deficiencies. FICC also evaluates whether

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[19] GSD calculates the projected average pay-down rates each month using historical pool factor pay-down rates that are weighted by historical positions during each of the prior three months. Specifically, the projected pay-down rate for a current Blackout Period is an average of the weighted averages of pay-down rates for all active mortgage pools of the related program during the three most recent preceding months.

multiple Netting Members may experience backtesting deficiencies for the same underlying reason.

Because the settlement activity and size of the backtesting deficiencies varies among impacted Netting Members, FICC must assess a Regular Backtesting Charge and/or Intraday Backtesting Charge that is specific to each impacted Netting Member.

To do so, FICC examines each impacted Netting Member's historical backtesting deficiencies observed over the prior 12-month period to identify the three largest backtesting deficiencies that have occurred during that time. The Regular Backtesting Charge and the Intraday Backtesting Charge amount generally equals that Netting Member's third largest historical backtesting deficiency that have occurred during the previous 12 months[20], subject to adjustment as further described below.

This charge is only applicable to those Netting Members whose overall 12-month trailing backtesting coverage falls below the 99% coverage target. Although the third largest historical backtesting deficiency that have occurred during the previous 12 months for a Netting Member is used as the Regulars Backtesting Chargeor Intraday Backtesting Charge in most cases, FICC retains discretion to adjust the charge amount basedon other circumstances that may be relevant for assessing whether an impacted Netting Member is likely to experience future backtesting deficiencies and the estimated size of such deficiencies.

8   HOLIDAY CHARGE

The Holiday Charge approximates the exposure that a Netting Member's trading activity on the applicable Holiday could pose to FICC. Since the FICC cannot collect margin on the Holiday, the Holiday Charge is due on the Business Day prior to the applicable Holiday.

Netting Members would be notified of a Holiday Charge and the applicable methodology by an Important Notice issued no later than 10 Business Days prior to the application the Holiday Charge. The charge is collected on the Business Day prior to the applicable Holiday and removed from the Required Fund Deposit on the Business Day following the Holiday.

9   OTHER CHARGES

GSD applies a premium charge to Netting Members in instances where the calculated VaR exceeds its specified regulatory capital figure. This premium charge is known as the "Excess Capital Premium." It is similar to a premium charge applied to Clearing Members of the MBSD of FICC.

Additional compliance charges may also apply to a particular Netting Member. For example, the failure to submit certain required reports and other information as set forth in the GSD rules will subject a Netting Member to the greater of either the sum of the normal calculation of its Required Fund Deposit plus

$1,000,000, or 125% of the normal calculation of its Required Fund Deposit, until the required information is submitted to GSD.

Similarly, failure to comply with the GSD's minimum financial requirements will subject the Netting Member to the greater of either the sum of the normal calculation of the Netting Member's Required Fund Deposit plus $1,000,000, or 125% of the normal calculation of the Required Fund Deposit. This chargewill remain until the 90th calendar day after the later of the date on which the Netting Member returned to compliance with such standard or the GSD's receipt of notice of the applicable violation.

Pursuant to the GSD Rules, GSD also has the authority to collect charges above the systemically generated

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[20] Any backtesting deficiencies that are attributed to GCF Repo Transactions collateralized with MBS during the Blackout Period would only be considered in calculation of the Regular Backtesting Charge or Intraday Backtesting Charge during the Blackout Period.

Required Fund Deposit when deemed appropriate in order to protect GSD and its Netting Members.

10 INTRADAY MARGIN

FICC will calculate margin requirements, including mark to market for cash positions and repo interests, twice daily based on 12:00p.m. position and end-of-day position, and collect them at 2:45p.m. and 9:30a.m. in the morning of the next business day, respectively. All the charges in the above sub-sections will be calculated with the updated positions for both end-of-the-day and intraday in the similar fashion.

In addition, the GSD Rules give FICC the authority to collect Intraday Supplemental Fund Deposits from Netting Members, as further described in the Appendix below.

Appendix 1: Intraday Supplemental Fund Deposit

Intraday Supplemental Fund Deposits is determined based on GSD's observations of a Netting Member's simulated VaR Charge as it is re-calculated throughout the trading day based on the open positions of such Member's Margin Portfolio at designated times (the "Intraday VaR Charge").[21]

The Intraday Supplemental Fund Deposit is designed to mitigate exposure to GSD that results from large fluctuations in a Netting Member's Margin Portfolio due to new and unsettled trade activities that are not otherwise covered by a Netting Member's recently collected Required Fund Deposit. Currently, FICC determines whether to assess an Intraday Supplemental Fund Deposit by tracking three criteria (each, a "Parameter Break") for each Netting Member. The first Parameter Break evaluates whether a Netting Member's Intraday VaR Charge equals or exceeds a set dollar amount (as determined by FICC from time to time) when compared to the VaR Charge that was included in the most recently collected Required Fund Deposit including, any subsequently collected Intraday Supplemental Fund Deposit (the "Dollar Threshold"). The second Parameter Break evaluates whether the Intraday VaR Charge equals or exceeds a percentage increase (as determined by FICC from time to time) of the VaR Charge that was included in the most recently collected Required Fund Deposit including, if applicable, any subsequently collected Intraday Supplemental Fund Deposit (the "Percentage Threshold"). The third Parameter Break evaluates whether a Netting Member is experiencing backtesting results below a set confidence level (as determined by FICC from time to time) (the "Coverage Target"). If a Netting Member breaches established intraday monitoring thresholds, FICC determines whether to assess a Intraday Supplemental Fund Deposit which will be adjusted by the Portfolio Differential ("PD") charge collected during that margin cycle as the PD charge already accounts for the Netting Member's Margin Portfolio variability.

Appendix 2: Sponsoring Members and Sponsored Members Considerations

In addition to all calculations applicable to Netting Members as described above, Sponsoring Members[22] and Sponsored Members[23] are subject to following Clearing Fund requirements:

VaR Charge

VaR Charge for Sponsoring Member is calculated as the sum of the VaR Charges for all of the Sponsored Members whose activity is represented in the Sponsoring Member Omnibus Account.

Margin Liquidity Adjustment Charge Applicable to Sponsored Members that Clear Through Multiple Accounts

If applicable, GSD calculates the MLA Charge for Sponsored Members that clear through multiple accounts sponsored by multiple Sponsoring Members to better align with the market impact cost arising from position concentration of the Sponsored Member's respective Sponsored accounts. Those Sponsored Members' accounts with higher relative market impact cost and a lower relative VaR Charge would be apportioned a higher amount of the additional market impact cost than those Sponsored Member's accounts with lower relative market impact cost and a higher relative VaR Charge.

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[21] See GSD Rule 4, Section 2a (Intraday Calculation of VaR Amounts – Intraday Supplemental Fund Deposit)

[22] As defined in GSD Rule 1 (Definitions), the term "Sponsoring Member" means a Netting Member whose application to become a Category 1 Sponsoring Member or a Category 2 Sponsoring Member has been approved by the FICC Board of Directors pursuant to GSD Rule 3A.

[23] As defined in GSD Rule 1 (Definitions), the term "Sponsored Member" means any Person that has been approved by FICC to be sponsored into membership by a Sponsoring Member pursuant to GSD Rule 3A.