NOTICE TO MEMBERS

N° 2022 - 018

February 15, 2022

REQUEST FOR COMMENTS

AMENDMENTS TO THE RISK MANUAL OF THE CANADIAN DERIVATIVES CLEARING CORPORATION BASE INITIAL MARGIN MODEL CHANGE FOR FIXED INCOME PRODUCTS

On February 4, 2022, the Board of Directors of Canadian Derivatives Clearing Corporation ("CDCC") approved certain amendments to the Risk Manual of CDCC in connection with the initial margin model change for fixed income products.

Please find enclosed an analysis document as well as the proposed amendments.

Process for Changes to the Rules

CDCC is recognized as a clearing house under section 12 of the *Derivatives Act* (Québec) by the Autorité des marchés financiers ("AMF") and as a recognized clearing agency under section 21.2 of the *Securities Act* (Ontario) by the Ontario Securities Commission ("OSC").

The Board of Directors of CDCC has the power to approve the adoption or amendment of the Risk Manual of CDCC. Amendments are submitted to the AMF in accordance with the self-certification process and to the OSC in accordance with the process provided in the Recognition Order.

Comments on the proposed amendments must be submitted before **March 15, 2022**. Please submit your comments to:

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A copy of these comments shall also be forwarded to the AMF and to the OSC to:

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Executive Director, Legal Affairs
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For any question or clarification, Clearing Members may contact Sophie Brault at 514-268-0591 or at sophie.brault@tmx.com.

George Kormas
President

AMENDMENTS TO THE RISK MANUAL OF THE CANADIAN DERIVATIVES CLEARING CORPORATION REGARDING THE BASE INITIAL MARGIN MODEL CHANGE FOR FIXED INCOME PRODUCTS

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I. DESCRIPTION

As a response to the impacts of the COVID-19 market events on its Base Initial Margin ("**Base IM**"), the Canadian Clearing Derivatives Corporation ("**CDCC**" or "the **Corporation**") proposed rule amendments regarding its Base IM model on Exchange Traded Derivative (ETD) products (Equity and Bond Derivatives). Both rule amendments proposals came into force on October 28, 2021. The Corporation is now disposed to propose a third and last permanent model change on the other line of products it clears, the Fixed Income Transactions.

CDCC proposes amending its Risk Manual with regard to the Base IM calculation for Fixed Income Transactions margined under the VaR methodology, which employs a full repricing approach by shocking the underlying risk factors (i.e. rate curves). The two main methodological changes will be:

- Historical shocks on the risk factors will now be calculated on an absolute basis instead of the current relative variations in the computation of the Historical Filtered Scenarios used for the Expected Shortfall.
- A Stressed Value-at-Risk ("SVaR") component will be integrated to the margin model as an additional measure to mitigate the procyclicality and, in line with the two previous model changes, this one will be integrated alongside the Historical Risk (i.e. Expected Shortfall) using a weighted approach. This will replace the current Margin Buffer Multiplier, which will be decommissioned.

These two changes come as a permanent solution to a series of remediation actions put in place to deal with the aftermath of the Covid-19 crisis where extreme market conditions induced instability in the current margin model.

Unless otherwise defined herein, any defined term used in this analysis will have the meaning described in the CDCC Rules and Manuals (hereinafter the "**Rules**").

II. PROPOSED AMENDMENTS

CDCC proposes amending the Risk Manual by introducing the notion of Historical Risk and Stress Risk in the Base IM calculation of Fixed Income Transactions, as such:

- CDCC intends to change the manner Historical shocks on the risk factors are calculated in section 6.2.1 from relative returns to absolute variations.
- The Corporation will also incorporate additional language regarding the Stressed Value-at-Risk methodology ("SVaR") in section 6.2.4. This proposed model change will integrate the SVaR methodology as a measure to mitigate the procyclicality of margins ("**Anti-Procyclicality**" or "**APC**" measures), which is in accordance with the previous model changes (Equity and Bond derivatives) and in response to the current limitations of the Margin Buffer Multiplier. Following the introduction of the SVaR methodology as the preferred APC measure, the Margin Buffer Multiplier will be permanently decommissioned.
- Additionally, CDCC proposes to modify Section 1.1 of the Risk Manual to align the manual with the proposed modifications.

The proposed amendments are attached hereto.

III. ANALYSIS

a. Background

In light of the Covid-19 crisis, Real Returns Bonds (RRB) issued by the government of Canada experienced negative short-term forward inflation rates, which resulted in unpredictable and incoherent margin dynamics, coupled with deterioration in margin coverage. This proposed model change comes in as a permanent solution to the inadequacy of the current model's framework to the post-Covid-19 interest rate levels, and therefore targets all the Fixed Income Transactions that are margined under the VaR methodology, namely:

- Government of Canada bonds (including RRB)
- Provincial Government bonds (issued by Quebec, Ontario and British Columbia)

In order to deal with the model inadequacy to the low rates environment, two emergency mitigation actions were performed:

1. Data treatments were applied on rate levels in order to mitigate the impact of near-zero and negative values on the current modeling methodology. Daily monitoring and validation/change of rates was also put in place to follow future market events that would further magnify the current model instability.
2. A methodology adjustment on the Margin Buffer Multiplier was performed since its activation was more sensitive to the level of rates themselves rather than their market volatility.

These two emergency remediation actions will no longer be required with the proposed model change since they aimed at mitigating the current model's limitations. The daily monitoring and validation of rates will however be kept in order to actively monitor future market events that could negatively affect the margin model.

However, the Corporation proposes to maintain the data treatments on the provincial spread curves as these ones are improving the accuracy and the quality of the data, while respecting the key economic assumption that provincial spread rates should be strictly positive. They will therefore be considered as a permanent calculation step rather than an emergency remediation action.

b. Risk analysis

The Corporation will be detailing its analysis in two parts i) the change in a key assumption of the VaR methodology and ii) the use of APC measures in the Base IM model. Notably, Section 1 addresses the change from relative to absolute returns in the calculation of daily market variations of the underlying rates, while Section 2 addresses the integration of the SVaR to the VaR methodology

Section 1 - Key assumption of the VaR methodology: Change from relative to absolute shocks

The VaR methodology computes margin by shocking the underlying risk factors (i.e. rate curves) and calculating the profit-and-loss at the portfolio level through a full repricing methodology. The change to the calculation of historical shocks on the risk factors from relative to absolute returns aims at addressing the instability of the VaR methodology in near-zero and negative rate levels. Indeed, using relative returns in such a rate environment generally amplifies the size of historical shocks used in the generation of VaR scenarios, with margin dynamics getting strongly correlated with rates levels rather than market volatility.

Switching to an absolute return yields much more coherent margin dynamics, being widely impacted by market volatility rather than rate level, and is a robust framework to near-zero and negative levels of interest rates. In addition, margin dynamics under the absolute methodology are also much more consistent between different products maturity, risk factors and interest rate derivatives margined under different models.

Section 2 - Use of APC measures: Integration of the SVaR and decommission of the Margin Buffer Multiplier

<u>Calibration of the SVaR under the VaR methodology</u>

The selection of a single fixed stressed period is mandatory under the VaR methodology in order to capture the commonality of the underlying risk factors during stressed market events. In effect, a strong commonality has been observed between the primary risk factor (i.e. the Government of Canada curve) and the secondary risk factors (the forward inflation curve and provincial spread curves) used to compute the Base IM of RRB and Provincial Government bonds), as well as between each tenor of these curves.

However, in line with CDCC's interest rate zoning methodology, which suggests the identification of three distinct levels of interest rates for the Government of Canada curve: low, medium and high (the "**Zoning methodology**"), the calibration of the SVaR of the primary risk factor will have to be adjusted accordingly. More specifically, a conversion factor based on the Zoning methodology will be applied to the historical returns of each tenor of the Government of Canada curve in order to adapt the selected fixed stressed period to evolving interest rates levels.

All other calibrations will be aligned with the calibration that was proposed for the model changes on Equity and Bond Derivatives, taking the 99th percentile on the absolute value of the distribution during a fixed stressed period of 260-days. Additionally, the integration of the SVaR will also be done on a weighted approach, by calculating the Base IM using a combination of 75% of the Historical Risk (i.e. the Expected Shortfall) and 25% of the Stress Risk (i.e. the SVaR).

<u>Decommission of the Margin Buffer Multiplier</u>

The Fixed Income Transaction's Base IM model is subject to the Margin Buffer Multiplier as an APC measure. Its intent is to raise margin levels in periods of low volatility and to be consumed when volatility increases. However, it suffers from a multitude of limitations, notably its

instability shown in a low rate environment, but mostly from limitations in terms of reactivity, progressivity and coherence between tenors and risk factors due to its one-size-fits-all approach.

The SVaR offers a much more dynamic and comprehensive framework, with each tenor and risk factor being taken into account on a daily basis in the calculation of the Base IM. This makes it a much better suited APC measure, leading to the conclusion that the known limitations of the Margin Buffer Multiplier would overcome the benefits of maintaining it.

c. Objectives

The proposed amendments are motivated by CDCC's governance process around the reaction of its Base IM models to the Covid-19 outbreak on financial markets. After proposing a targeted model change for Equity and Bond Derivatives, the Corporation is now addressing Fixed Income Transactions as the last step of its model changes.

d. Comparative Analysis

Absolute returns are known to be the market standard for the fixed income risk modelling in the current rate environment, as it is generally supported by practitioners and by the academic literature. The approach based on relative returns has been widely favored in times when the level of rates was significantly higher, but a consistent switch toward using absolute variations as the level of rates was decreasing has been witnessed since then.

As for anti-procyclicality measures, an analysis of publicly available information from different clearing houses such as ASX Clear, FICC, Eurex Clearing, ICE Clear US and LCH SA was performed by CDCC on the usage of APC measures in the clearing market and found that the inclusion of a stress period in the calibration of the margin model was inline with industry practices.

The addition of the Stressed-Value-at-Risk ("SVaR") in also in alignment with the recommendations of Regulatory bodies[1] to incorporate at least 25% weight to stressed observation in the lookback period as an APC measures and is in-line with CDCC's previous model changes targeting Equity and Bond Derivatives.

[1] https://www.esma.europa.eu/sites/default/files/library/esma70-151-1293_final_report_on_guidelines_on_ccp_apc_margin_measures.pdf

CCP	Margin Model (Fixed Income)	Identified APC Measures			
		STRESS	FLOOR	BUFFER	Details
ASX Clear[2]	Filtered Historical Simulation VaR (HsVaR)	X	X		The pro-cyclicality is addressed by setting floors, where necessary, across a range of risk parameter inputs in CCPs margin models, incorporating stressed market conditions in the sensitivity analysis and using short term volatilities.
DTCC -FICC[3]	HVaR	X	X		FICC addresses the procyclicality of the formula by adopting a 10-year lookback period that incorporates an additional stress period if FICC determines that the historical look-back period does not contain adequate shocks, utilizing a VaR Floor and ongoing Member outreach.
Eurex Clearing[4]	RBM (Risk Based Margining)		X		RBM uses minimum margin parameters to ensure stability. The minimum margin parameters are based on long term histories of respective products or benchmark instruments and are complemented by expert judgement.
ICE Clear US[5]	ICE Risk Model		X		Floor established using 10 years of historical observations of P&L (using the EWMA methodology).
LCH SA[6]	Historical simulation with volatility scaling		X	X	Procyclical margin changes are mitigated through features such as averaging the largest losses, the application of counter-cyclicality buffer and the use of long-term margin floor.

e. Analysis of Impacts

i. Impacts on Market

[2] https://www.asx.com.au/documents/asx-compliance/pfmi-disclosure-framework.pdf

[3] https://www.dtcc.com/-/media/Files/Downloads/legal/policy-and-compliance/FICC_Disclosure_Framework.pdf

[4] https://www.eurex.com/resource/blob/1911986/afa68344defdd2987df43754e3848cb4/data/cpss-iosco-pfmi_assessment_2019_en.pdf

[5] https://www.theice.com/publicdocs/clear_us/ICUS_DisclosureFramework.pdf

[6] https://www.lch.com/system/files/media_root/2019%20PFMI%20Assessment_%20public%20version%20Final.pdf

The change from a relative to an absolute returns framework yields much coherent margins dynamic across products and maturities. The dynamic is more predictable for Clearing Members, being a better fit for market volatility as well as finding a better balance with the effect of the level of interest rates on margins. As for the integration of the Stressed Value-at-Risk ("SVaR"), a strong reduction in procyclicality is observed, which is inline with its intended use as an APC measure. Note that the Margin Buffer Multiplier is currently not activated as it requires a sustained period of low volatility to meet the conditions of its activation (activation by 25% buffer increments). Given the recent volatility in markets, the Corporation does not expect its activation in the near future either, and hence, no impact is anticipated for its decommission.

The overall impact of transitioning from a relative to absolute returns and the integration of the SVaR in replacement of the Margin Buffer Multiplier is a slight overall increase of about 2% in the average margin levels (over a 3 year period). However, from its current level, a decrease of around 25% in Base IM is anticipated. The Clearing Fund observed a slight increase over the lookback period, quantified at about 10 millions as of September 30th 2021. This minimal impact is due to the fact that Fixed Income Transactions are not the main contributor behind the Clearing Fund calibration (i.e. the largest Uncovered Residual Risk is driven by Clearing Members with little exposure to the Repo business). The impact on the Supplemental Liquidity Fund is of the same magnitude.

ii. Impacts on Technology

The implementation of this new model will have material impacts on the CDCC systems. However, this aspect of the project will be addressed at a later stage. The Corporation will provide regulatory notifications accordingly.

A material impact is expected on the Risk system as the Base IM for Fixed Income Transactions is fully computed there:

- With regards to the change of the key assumption of the VaR methodology, the impact is expected to be Medium as the desired calibration is already available in the Risk system. However, a change is still required to maintain the filtering method when using absolute variations.
- With regards to the addition of the SVaR, the impact is expected to be Medium as the SVaR is not currently supported in the Risk system.

An impact is also expected on the end-user-computing-system to support the addition of the SVaR and the decommission of the Margin Buffer Multiplier and emergency remediation actions:

- With regards to the addition of the SVaR, an additional step will be required in the new SVaR calibration process that was introduced with the previous model changes on Equity and Bond Derivatives. This additional step will support the calibration of the conversion factors used to apply the Zoning methodology under the VaR model framework.
- With regards to the decommission of the Margin Buffer Multiplier, the process will be permanently removed.
- With regards to the decommission of the emergency remediation, the data treatments will be permanently removed, except for the provincial spread curves. The daily

monitoring and validation/change of rates will be kept and used as a general validation procedure.

Note that CDCC will not need to work with service vendors, Clearing Members or the Regulatory Division of the Bourse de Montréal In. since this change is internal to CDCC.

iii. Impacts on trading functions

The proposed amendments will have no impact on the Bourse de Montréal trading systems or rules.

iv. Public Interest

CDCC is of the view that the proposed amendments are not contrary to the public interest. In fact, the public and Clearing Members are generally requesting clear rules that are consistent with the best practices of other clearinghouses and are PFMI compliant.

Moreover, CDCC considers these amendments to be in the interest of the public as the Corporation is improving the performance of its IM models without adversely impacting its Clearing Members in times of stress, which should benefit and strengthen the entire marketplace.

IV. PROCESS

The proposed amendments, including this analysis, must be approved by CDCC's board of directors and submitted to the Autorité des marchés financiers, in accordance with the regulatory self-certification process, and to the Ontario Securities Commission in accordance with the rules stated in Appendix "A" of Schedule "C" of CDCC Recognition Order dated April 8, 2014 (as amended from time to time). The proposed amendments and analysis will also be submitted to the Bank of Canada in accordance with the Regulatory Oversight Agreement. The proposed amendments are expected to take effect around the second half of 2022.

V. ATTACHED DOCUMENTS

- Appendix 1: Amended Risk Manual

APPENDIX 1: AMENDED RISK MANUAL
AMENDED VERSION

RISK MANUAL

~~October 28~~, 202~~1~~

Glossary

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~~Margin Buffer Multiplier: Multiplier to the Base Initial Margin for Fixed Income Transaction to prevent and control potential procyclical effects.~~

[…]

Section 1: Margin Deposits

As set out in the Rules, every Clearing Member shall be obligated to deposit Margin with the Corporation, as determined by the Corporation. Deposits must be made in the form of eligible collateral, as specified in Section 2 of this Risk Manual, in an amount sufficient, taking into account the market value and applicable Haircuts.

The Corporation requires Margin Deposits to cover two types of requirements, namely:

- Margin requirement; and
- Clearing Fund Requirement.

1.1 MARGIN REQUIREMENT

The Margin requirement is composed of the Initial Margin and the Variation Margin.

1.1.1 Initial Margin

The Initial Margin is composed of the Base Initial Margin (or Adjusted Base Initial Margin, as the case may be) and the Additional Margins. In order to cover the Initial Margin described below, Clearing Members shall deliver to CDCC an acceptable form of Deposits in accordance with Section 2 of this Risk Manual.

1.1.1.1 Base Initial Margin

The Base Initial Margin requirement covers the potential losses and market risk that may occur as a result of future adverse price and/or Risk Factors across the portfolio of each Clearing Member under normal market conditions.

The risk methodology for the Options, Futures and Unsettled Items incorporates the historical volatility of the daily price returns of the Underlying Interests for Options, Unsettled Items and Share Futures and the daily price returns of the Futures prices for Futures (excluding Share Futures). In addition, as part of the methodology, the Corporation uses a volatility estimator, a confidence level over 99% under the normal distribution or the student's t-distribution assumption and a variable

number of days as the MPOR. The Corporation also considers various measures to mitigate the procyclicality of margins:

- A Stress Risk component, calculated with a Stress Value at Risk (SVaR) and a weighting factor of 25%.
- A volatility floor, calculated as an average of the daily volatility estimator observed over the last 10 years.

The risk methodology for Fixed Income Transactions is the Value at Risk methodology (VaR). This methodology considers a full revaluation method and it is based on Zero Curves. In addition, as part of the methodology, the Corporation uses a volatility estimator~~, a Margin Buffer Multiplier to prevent a large decrease in Margin requirements during periods of low volatility, ,~~ a confidence level over 99% and a variable number of days as the MPOR. The Corporation also considers a Stress Risk component to mitigate the procyclicality of margins, calculated with a Stress Value at Risk (SVaR) and a weighting factor of 25%.

Please refer to Sections 6.1 and 6.2 for additional details on the Base Initial Margin calculation.

With respect to the Limited Clearing Members, the Base Initial Margin is multiplied by the Effective Ratio to calculate the Adjusted Base Initial Margin. Please refer to Section 6.3 for additional details on Effective Ratio Recalibration.

[…]

Section 6: Appendix

6.2 BASE INITIAL MARGIN CALCULATION FOR FIXED INCOME TRANSACTIONS

For greater certainty, this section only applies to Fixed Income Transactions.

To calculate the Base Initial Margin, the VaR methodology is based on Historical Scenarios for all relevant Risk Factors. The Historical Scenarios consist of a set of scenarios for a Risk Factor over a relevant historical period that represents an hypothetical market observation movement (shocked market observation based on market history) reasonably likely to occur, from the current situation to a specific point in time in the future.

For Fixed Income Transactions, the Risk Factors are the Zero Curves. On any given Business Day, the shocks derived from the Historical Scenarios are applied to the initial reference market inputs values. The difference between the initial reference price and the shocked historical price represents an Historical P&L Scenario. The initial reference price and historical shocked price are derived respectively from the initial reference Zero Curves and the shocked Zeros Curve using a full revaluation method.

The Historical P&L Scenarios are calculated at the VaR Risk Group level and are denominated in the same currency as the Fixed Income Transactions. For Fixed Income Transactions belonging to the same VaR Risk Group, the Historical P&L Scenarios results are added up for Fixed Income Transactions.

Lastly, the Historical P&L Scenarios are ranked to derive the Historical P&L Distribution that is used to calculate the average loss of the portfolio using the Expected Shortfall method. ~~A Margin Buffer Multiplier is then applied to the Expected Shortfall value to obtain the Base Initial Margin.~~ The Base Initial Margin is then obtained by combining the Historical Risk component (based on the Expected Shortfall methodology) with a Stress Risk component (based on the Stressed Value at Risk methodology) using a weighted approach.

The main steps to calculate the Base Initial Margin are described in the section below.

6.2.1 Historical Filtered Scenarios

The Historical Filtered Scenarios are generated using the initial reference Risk Factors value and historical observations of different tenors on the Zero Curves.

The shocked Risk Factors are calculated using the following formula:

$$y'_{t,\tau} = y_{T,\tau}\left(1 + R_{t,\tau}c_{t,\tau}\right)$$

$$y'_{t,\tau} = y_{T,\tau} + R_{t,\tau}c_{t,\tau}$$

Where c is the scaling factor for the volatility scaling adjustment and R is the daily ~~relative~~ market variation ~~return~~ over the Margin Period of Risk 'n'. CDCC uses a look-back period of 5 years.

$$R_{t,\tau} = y_{\tau,t} - y_{\tau,t-n}$$

The scaling factor formula at time t and for a given tenors is calculated using the following formula:

$$c_{t,\tau} = Max\left(\frac{\sigma_{T,\tau} + \sigma_{t,\tau}}{2\,\sigma_{t,\tau}}, Min\ SF\right)$$

Where σ is the EWMA volatility forecast and Min SF is the minimal scaling factor.

The implemented formula for the EWMA volatility forecast is:

~~$\sigma^2_{t,\tau} = (1-\lambda)R^2_{t-1,\tau} + \lambda\sigma^2_{t-1,\tau}$,~~

$$\sigma^2_{t,\tau} = (1-\lambda)R^2_{t,\tau} + \lambda\sigma^2_{t-1,\tau},$$

Where R is the daily ~~relative~~ market variation ~~return~~ over the Margin Period of Risk 'n' and λ is the decay factor. CDCC uses λ = 0.99. The Min SF is updated by CDCC from time to time.

6.2.2 Historical P&L Scenario generation

The Historical P&L Scenarios are valued by calculating the difference between the shocked prices of Fixed Income Transactions under an Historical Filtered Scenario and the initial reference prices. The Historical P&L Scenarios results are added up for all Fixed Income Transactions within a VaR Risk Group.

The initial reference prices are calculated using a full revaluation method and the initial reference Risk Factors. The shocked prices are calculated using a full revaluation method and the shocked Risk Factors.

6.2.3 Expected Shortfall

For each VaR Risk Group, the Historical P&L is sorted from largest loss to largest profit to construct the Historical P&L Distribution. Using a confidence value equivalent to 99.62% and the Historical P&L Distribution, the Expected Shortfall is determined by averaging the losses exceeding the confidence value.

6.2.4 Stressed Value at Risk (SVaR) ~~Margin Buffer Multiplier~~

~~The Base Initial Margin for each VaR Risk Group is obtained by applying a Margin Buffer Multiplier to the Expected Shortfall value.~~

~~The Margin Buffer Multiplier is based on the ratio of the average 10 years volatility and the previous month volatility. CDCC will change the Margin Buffer Multiplier level if it is deemed stable for at least 3 consecutive months. The ratio is then rounded to the nearest 0.25. A floor of 1 and a cap value of 1.5 are applied.~~

~~The Margin Buffer Multiplier is updated by CDCC from time to time.~~

In addition, CDCC considers a Stress Risk component based on the Stressed Value at Risk (SVaR) methodology to mitigate the procyclicality of margins:

$$Base\ Initial\ Margin = (1 - w) \times Historical\ Risk + w \times Stress\ Risk$$

Where the Stress Risk component is equal to a confidence level equivalent to a minimum of 99% of the ranked distribution of the absolute stressed P&L over a fixed period of a minimum of 260 days with a high market volatility, a variable number of days as MPOR and a weighting factor of 25% ('w'). The stressed P&L are also calculated using a full revaluation method and the Risk Factors.

The SVaR methodology is applicable to all VaR Risk Groups.

APPENDIX 1: AMENDED RISK MANUAL
CLEAN VERSION

RISK MANUAL

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Section 1: Margin Deposits

As set out in the Rules, every Clearing Member shall be obligated to deposit Margin with the Corporation, as determined by the Corporation. Deposits must be made in the form of eligible collateral, as specified in Section 2 of this Risk Manual, in an amount sufficient, taking into account the market value and applicable Haircuts.

The Corporation requires Margin Deposits to cover two types of requirements, namely:

- Margin requirement; and
- Clearing Fund Requirement.

1.1 MARGIN REQUIREMENT

The Margin requirement is composed of the Initial Margin and the Variation Margin.

1.1.1 Initial Margin

The Initial Margin is composed of the Base Initial Margin (or Adjusted Base Initial Margin, as the case may be) and the Additional Margins. In order to cover the Initial Margin described below, Clearing Members shall deliver to CDCC an acceptable form of Deposits in accordance with Section 2 of this Risk Manual.

1.1.1.1 Base Initial Margin

The Base Initial Margin requirement covers the potential losses and market risk that may occur as a result of future adverse price and/or Risk Factors across the portfolio of each Clearing Member under normal market conditions.

The risk methodology for the Options, Futures and Unsettled Items incorporates the historical volatility of the daily price returns of the Underlying Interests for Options, Unsettled Items and Share Futures and the daily price returns of the Futures prices for Futures (excluding Share Futures). In addition, as part of the methodology, the Corporation uses a volatility estimator, a confidence level over 99% under the normal distribution or the student's t-distribution assumption and a variable number of days as the MPOR. The Corporation also considers various measures to mitigate the procyclicality of margins:

- A Stress Risk component, calculated with a Stress Value at Risk (SVaR) and a weighting factor of 25%.
- A volatility floor, calculated as an average of the daily volatility estimator observed over the last 10 years.

The risk methodology for Fixed Income Transactions is the Value at Risk methodology (VaR). This methodology considers a full revaluation method and it is based on Zero Curves. In addition, as part of the methodology, the Corporation uses a volatility estimator, a confidence level over 99% and a variable number of days as the MPOR. The Corporation also considers a Stress Risk component to mitigate the procyclicality of margins, calculated with a Stress Value at Risk (SVaR) and a weighting factor of 25%.

Please refer to Sections 6.1 and 6.2 for additional details on the Base Initial Margin calculation.

With respect to the Limited Clearing Members, the Base Initial Margin is multiplied by the Effective Ratio to calculate the Adjusted Base Initial Margin. Please refer to Section 6.3 for additional details on Effective Ratio Recalibration.

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Section 6: Appendix

6.2 BASE INITIAL MARGIN CALCULATION FOR FIXED INCOME TRANSACTIONS

For greater certainty, this section only applies to Fixed Income Transactions.

To calculate the Base Initial Margin, the VaR methodology is based on Historical Scenarios for all relevant Risk Factors. The Historical Scenarios consist of a set of scenarios for a Risk Factor over a relevant historical period that represents an hypothetical market observation movement (shocked market observation based on market history) reasonably likely to occur, from the current situation to a specific point in time in the future.

For Fixed Income Transactions, the Risk Factors are the Zero Curves. On any given Business Day, the shocks derived from the Historical Scenarios are applied to the initial reference market inputs values. The difference between the initial reference price and the shocked historical price represents an Historical P&L Scenario. The initial reference price and historical shocked price are derived respectively from the initial reference Zero Curves and the shocked Zeros Curve using a full revaluation method.

The Historical P&L Scenarios are calculated at the VaR Risk Group level and are denominated in the same currency as the Fixed Income Transactions. For Fixed Income Transactions belonging to the same VaR Risk Group, the Historical P&L Scenarios results are added up for Fixed Income Transactions.

Lastly, the Historical P&L Scenarios are ranked to derive the Historical P&L Distribution that is used to calculate the average loss of the portfolio using the Expected Shortfall method. The Base Initial Margin is then obtained by combining the Historical Risk component (based on the Expected Shortfall methodology) with a Stress Risk component (based on the Stressed Value at Risk methodology) using a weighted approach.

The main steps to calculate the Base Initial Margin are described in the section below.

6.2.1 Historical Filtered Scenarios

The Historical Filtered Scenarios are generated using the initial reference Risk Factors value and historical observations of different tenors on the Zero Curves.

The shocked Risk Factors are calculated using the following formula:

$$y'_{t,\tau} = y_{T,\tau} + R_{t,\tau} c_{t,\tau}$$

Where c is the scaling factor for the volatility scaling adjustment and R is the daily market variation over the Margin Period of Risk 'n'. CDCC uses a look-back period of 5 years.

$$R_{t,\tau} = y_{\tau,t} - y_{\tau,t-n}$$

The scaling factor formula at time t and for a given tenors is calculated using the following formula:

$$c_{t,\tau} = Max\left(\frac{\sigma_{T,\tau} + \sigma_{t,\tau}}{2\,\sigma_{t,\tau}}, Min\ SF\right)$$

Where σ is the EWMA volatility forecast and Min SF is the minimal scaling factor.

The implemented formula for the EWMA volatility forecast is:

$$\sigma^2_{t,\tau} = (1-\lambda)R^2_{t,\tau} + \lambda\sigma^2_{t-1,\tau},$$

Where R is the daily market variation over the Margin Period of Risk 'n' and λ is the decay factor. CDCC uses λ = 0.99. The Min SF is updated by CDCC from time to time.

6.2.2 Historical P&L Scenario generation

The Historical P&L Scenarios are valued by calculating the difference between the shocked prices of Fixed Income Transactions under an Historical Filtered Scenario and the initial reference prices. The Historical P&L Scenarios results are added up for all Fixed Income Transactions within a VaR Risk Group.

The initial reference prices are calculated using a full revaluation method and the initial reference Risk Factors. The shocked prices are calculated using a full revaluation method and the shocked Risk Factors.

6.2.3 Expected Shortfall

For each VaR Risk Group, the Historical P&L is sorted from largest loss to largest profit to construct the Historical P&L Distribution. Using a confidence value equivalent to 99.62% and the Historical P&L Distribution, the Expected Shortfall is determined by averaging the losses exceeding the confidence value.

6.2.4 Stressed Value at Risk (SVaR)

In addition, CDCC considers a Stress Risk component based on the Stressed Value at Risk (SVaR) methodology to mitigate the procyclicality of margins:

$$Base\ Initial\ Margin = (1 - w) \times Historical\ Risk + w \times Stress\ Risk$$

Where the Stress Risk component is equal to a confidence level equivalent to a minimum of 99% of the ranked distribution of the absolute stressed P&L over a fixed period of a minimum of 260 days with a high market volatility, a variable number of days as MPOR and a weighting factor of 25% ('w'). The stressed P&L are also calculated using a full revaluation method and the Risk Factors.

The SVaR methodology is applicable to all VaR Risk Groups.