NOTICE TO MEMBERS

No. 2016 – 102
August 16, 2016

REQUEST FOR COMMENTS

AMENDMENTS TO THE RISK MANUAL OF CDCC FOR THE NEW PRICING MODEL ON OPTIONS ON FUTURES

Summary

On July 28, 2016, the Board of Directors of Canadian Derivatives Clearing Corporation (CDCC) approved amendments to the Risk Manual of CDCC. The purpose of the proposed amendments is to allow CDCC to change its pricing model in SPAN® for Options on Futures.

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 is 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 Rules and Operations Manual of CDCC. Amendments are submitted to the AMF in accordance with the self-certification process and the Ontario Securities Commission in accordance with the process provided in its Recognition Order.

Comments on the proposed amendments must be submitted within 30 days following the date of publication of the present notice. 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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For any question or clarification, Clearing Members may contact CDCC's Corporate Operations.

Glenn Goucher
President and Chief Clearing Officer

AMENDMENTS TO THE RISK MANUAL OF THE CANADIAN DERIVATIVES CLEARING CORPORATION FOR THE NEW PRICING MODEL ON OPTIONS ON FUTURES

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I. SUMMARY

The Canadian Derivatives Clearing Corporation (CDCC) proposes to change its pricing model in SPAN® for Options on Futures (OOF). Thereby, for all OOF, the current Adesi-Whaley model is replaced by the Black model, which is the baseline model for pricing OOF. In addition, this change will have several benefits such as a more appropriate portfolio risk assessment for OOF positions, more efficient calculation of the margin requirement and more accurate backtesting results.

Consequently, in order to implement this new option pricing model in SPAN®, changes to the CDCC's systems (Sola® Clearing) are required. In addition, minor changes to the Risk manual are also required.

II. ANALYSIS

a. Background

Options on Futures pricing models

Black[1] model is the baseline model for pricing OOF and is a special case of the generalized Merton model. This model is more optimal for OOF pricing since it takes into consideration the fact that there are no financing costs (or cost of carry) related to a futures contract compared to a standard equity underlying.

Risk management

<u>Outright margin calculation:</u>

In order to calculate the margin requirement for all option contracts, SPAN® uses option pricing models to determine how each contract will perform over a number of market scenarios[2].

In addition, SPAN® also provides a method to integrate both futures and related OOF contracts into the same risk group to assess the portfolio's risk. This is, for example, the case for cleared contracts at CDCC, such as the BAX futures and the Options on BAX (OBX[3]) or the CGB futures and the Options on CGB (OGB), which are grouped in SPAN® under the same risk group (or combined commodity). More specifically, for a same risk group and for each market scenario, SPAN® firstly computes the theoretical stressed value of each contract of the portfolio and computes gain or loss (P&L). Subsequently, the P&Ls of all futures and options positions of the portfolio (under the same risk group) are aggregated; and the largest portfolio loss, amongst scenarios, becomes the outright margin requirement for that portfolio.

[1] Black, Fischer (1976). The pricing of commodity contracts, Journal of Financial Economics, 3, 167-179.

[2] CDCC currently only uses 8 scenarios since it only stresses the underlying price. 16 scenarios are however available if the volatility of the options is also stressed.

[3] Options on Three-Month Canadian Bankers' Acceptance Futures include OBW, OBX, OBY, OBZ but are broadly identified as OBX in this document.

Strategy-based charges:

SPAN® also uses deltas to compute an equivalent future strategy-based charge (or Intermonth Spread Charge). The strategy-based charges, for each identified spread or butterfly combination in the portfolio, are added to the outright margin calculation detailed above. More specifically, for each option contract, a delta equivalent position (ranging from -1.0 to +1.0[4]) is calculated in order to combine together related options and futures contracts under the same risk group.

b. Description and Analysis of Impacts

For OOF, CDCC proposes to change the current Adesi-Whaley[5] model in SPAN® by the Black model (a special case of the Merton model). The Black model is selected in SPAN® by setting the cost of carry to zero. By doing so, the Merton model becomes mathematically equivalent to the Black model.

Thereby, for a portfolio which incorporates OOF positions, an improvement in the option pricing models will lead to a more precise calculation of the P&Ls (for the outright margin calculations) and a more precise deltas calculations to determine equivalent future strategy-based charges. These changes will consequently lead to a more efficient margin requirement calculation.

c. Proposed Amendments

The proposed amendments are presented in Appendix 1.

d. Benchmarking

As shown in the following table, this model choice is similar to other international CCP, which are currently using the Black model (or an equivalent Merton model) for comparable OOF contracts.

CCP	Products	Model in SPAN®
CME Clearing	Option on Eurodollar futures, Options on US T-Note Futures	Merton with carry set at zero
ASX Clear	Options on 90 day bank bill futures	Merton with carry set at zero
Japan Securities Clearing Corporation	Options on JGB	Black

Source: ftp://ftp.cmegroup.com/pub/span/data/

[4] Note that a long futures position has a delta of +1.0 and a short futures position has a delta of -1.0.

[5] The Adesi-Whaley model, referred to CDCC's risk manual as Barone-Adesi and Whaley (BAW), is currently applied for all listed options contracts.

III. PRIMARY MOTIVATION

The proposed amendments are motivated by the CDCC's decision to improve the pricing model for OOF in SPAN®, which demands amendments to the Rules (Risk Manual) of the CDCC.

IV. IMPACTS ON TECHNOLOGICAL SYSTEMS

The proposed solution will be implemented in Sola® Clearing. In order to minimize the potential for operational risk, the new solution will be properly tested with a complete user acceptance test (UAT) prior to its implementation in the production system.

V. OBJECTIVES OF THE PROPOSED MODIFICATIONS

The objectives of the proposed modifications are to give CDCC more flexibility in the choice of the option pricing models it can select in SPAN® through the SOLA® Clearing system. This change will have several benefits such as a more appropriate portfolio risk assessment for OOF positions, more efficient calculation of the margin requirement and more accurate backtesting results.

VI. PUBLIC INTEREST

The modifications to the Risk manual of CDCC are proposed in order to give CDCC more flexibility in the choice of the option pricing models it can select (subject to the internal model review process). In CDCC's opinion, the proposed amendments are not contrary to the public interest.

VII. MARKET IMPACTS

The impact analysis conducted over a one-year period (from April 1, 2015 to March 31, 2016), demonstrated that, given the current low outstanding level of OOF positions cleared at CDCC, this model change would have very little impact on CDCC's global margin fund level and on individual Clearing Member's margin requirement. However, for highly concentrated OOF positions at the sub-account level, mainly for strategy-based positions on BAX futures and Options on BAX (OBX), this impact could be significant.

VIII. PROCESS

The proposed amendment is submitted for approval by the CDCC Board. After the approval has been obtained, the proposed amendment, including this analysis, will be transmitted to the Autorité des marchés financiers in accordance with the self-certification process, and to the Ontario Securities Commission in accordance with the "Rule Change Requiring Approval in Ontario" process. The proposed amendment and analysis will also be submitted for approval to the Bank of Canada in accordance with the Regulatory Oversight Agreement.

IX. EFFECTIVE DATE

CDCC would like to implement the amendments in the third quarter of 2016.

X. ATTACHED DOCUMENTS

Appendix 1: Amended Risk Manual

TMX | CDCC

Risk Manual

Initial Margin for Options Contracts

This section describes how the Initial Margin is calculated for the Options contracts, which include the equity options, index options, currency options, exchange-traded-fund options and options on futures.

The Risk Arrays are obtained by varying the Underlying Interest (eight scenarios) and the option's implied volatility (eight scenarios). The term PSR for Options contracts is calculated through the following formula:

PSR = Underlying Interest Price x MI x Contract Size

For equity options contracts, the contract size is usually equal to 100.

Risk Arrays

Each Risk Array scenario represents losses or gains due to hypothetical market conditions:

- The (underlying) price movement: upward (+) and downward (-) with corresponding scan range fraction (0, 1/3, 2/3, 3/3 or 2)
- The (underlying) volatility movement: upward (+) and downward (-) with corresponding scan range fraction (0 or 1).

Since some scenarios consider large movements on the Underlying Interest price, the whole difference (gain and loss) between the new (simulated) theoretical option price and the actual option price will not be considered. For scenarios 15 and 16, since their probability of occurrence is low, only a fraction of 35% of the difference is considered. The purpose of these two additional extreme scenarios is to reduce the problem of short option positions that are highly out of the money near expiration. If the Underlying Interest price varies sharply, these positions could then be in the money.

A scan range is a fluctuation range of the Underlying Interest price and volatility defined for each Combined Commodity.

The Risk Engine calculates 16 Risk Array scenarios as follows:

Risk Scenarios	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Underlying Price Variation *	0	0	1/3	1/3	-1/3	-1/3	2/3	2/3	-2/3	-2/3	1	1	-1	-1	2	-2
Volatility Variation *	1	-1	1	-1	1	-1	1	-1	1	-1	1	-1	1	-1	0	0
Weight Fraction Considered	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	35%	35%

* Expressed in scan range

Each Risk Array value is calculated as the current contract price less the theoretical (simulated) contract price obtained for the corresponding scenario by using the valuation model. (The Risk Engine uses different valuation models including Black 76, Black-Scholes, Generic Merton, Barone-Adesi-Whaley (BAW) and others).

However, it should be noted that for the intra-day margin processes, CDCC relies on the previous day's closing prices for those Option contracts for which it has open interest.

However, since the Initial Margin driven by Option contracts is relatively small with respect to the total Initial Margin that includes all cleared products, the Corporation does not consider the Volatility Scan Range (VSR) in its risk model. This means that the Corporation does not vary the option implied volatility up and down (+1 and -1) eight times, but varies only the Underlying Interest price in order to simulate the potential losses for each position. Therefore, the Risk Engine produces eight different scenarios as shown in the table below.

Risk Scenarios	1	2	3	4	5	6	7	8
Underlying Price Variation*	1/3	-1/3	2/3	-2/3	1	-1	2	-2
Weight Fraction Considered	100%	100%	100%	100%	100%	100%	35%	35%

* Expressed in scan range

For Options contracts belonging to the same Combined Commodity, the Risk Engine first calculates the Risk Arrays for each Option contract and for each one of the eight risk scenarios. The Risk Engine then adds up the Risk Arrays results of all Options contracts under the same risk scenario. For example, for two Options contracts O1 and O2 on the Underlying Interest XX, the same scenarios are performed for each Option contract, and then, they are added up. Therefore, the Risk Array value for O1 under the risk scenario 1 is added up to the Risk Array value for O2 under the risk scenario 1, likewise the Risk Array value for O1 under the risk scenario 2 is added up to the Risk Array value for O2 under the risk scenario 2, and so on. The largest total Risk Array value amongst the eight values is the Scanning Risk of this Combined Commodity. The details of this method are described in the section on Risk Arrays.

For a better explanation of the Risk Engine methodology used by the Corporation, here are the steps to calculate the Initial Margin for an Option contract using the Risk Array:

Example 1:

Let's assume that the price of an Option contract is X_0, its Underlying Interest price is P_0 and its Margin Interval is MI. Using the formula described above, we can calculate the Price Scan Range (PSR) of the option which represents the fluctuation range of the Underlying Interest as follows:

$$PSR = MI \times P_0 \times \text{Contract Size.}$$

Since the contract size of an Option contract is generally 100, the formula becomes:

$$PSR = MI \times P_0 \times 100$$

For the clarity of the table below, please note that the PSR used in the following steps does not include the contract size, i.e. PSR = MI x P_0.

Scenario 1:

Step 1: calculate the Underlying Interest price variation. To accomplish this, the Risk Engine varies the Underlying Interest price by 33% (or 1/3) to the upper range of its MI. If for example the MI is 30%, the Underlying Interest price moves to the upper range by 33% of the 30% which leads to a 10% increase. Therefore, the Underlying Interest price variation is +33% of the PSR.

Step 2: calculate the new (simulated) Underlying Interest price by adding the Underlying Interest price variation calculated in the last step to the original Underlying Interest price.

Step 3: calculate the new (simulated) theoretical option price with the selected ~~Barone-Adesi & Whaley (1987)~~ model[1] using the new (simulated) Underlying Interest price.

Step 4: calculate the option's gain or loss by subtracting the new (simulated) theoretical option price from the original option price.

Step 5: multiply the gain or loss by the considered weight fraction (the last row of the above table) to get the Risk Array amount associated to the scenario 1.

After repeating the above steps for the remaining seven scenarios, the Risk Engine chooses the largest amount of (the weighted) gain or loss as the most unfavourable projected liquidation value (worst case) of the option. This amount is called the Scanning Risk.

Here is the same table as before but with the formulas of each step:

Risk Scenarios	1	2	3	4	5	6	7	8
Underlying Price Variation	1/3 * PSR	-1/3 * PSR	2/3 * PSR	-2/3 * PSR	PSR	-1 * PSR	2 * PSR	-2 * PSR
New Underlying Price	P_1 = P_0 + 1/3 * PSR	P_2 = P_0 - 1/3 * PSR	P_3 = P_0 + 2/3 * PSR	P_4 = P_0 - 2/3 * PSR	P_5 = P_0 + PSR	P_6 = P_0 - PSR	P_7 = P_0 + 2 * PSR	P_8 = P_0 -2 * PSR
New Option Price (~~BAW~~)	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8
Gain / Loss	$P\&L_1$ = $X_0 - X_1$	$P\&L_2$ = $X_0 - X_2$	$P\&L_3$ = $X_0 - X_3$	$P\&L_4$ = $X_0 - X_4$	$P\&L_5$ = $X_0 - X_5$	$P\&L_6$ = $X_0 - X_6$	$P\&L_7$ = $X_0 - X_7$	$P\&L_8$ = $X_0 - X_8$
Weight Fraction Considered	100%	100%	100%	100%	100%	100%	35%	35%
Risk Arrays Results	RA_1 = 100%*$P\&L_1$	RA_2 = 100%*$P\&L_2$	RA_3 = 100%*$P\&L_3$	RA_4 = 100%*$P\&L_4$	RA_5 = 100%*$P\&L_5$	RA_6 = 100%*$P\&L_6$	RA_7 = 35%*$P\&L_7$	RA_8 = 35%*$P\&L_8$

~~[1] The Corporation uses BAW (1987) model since most of the listed equity options that are cleared are American style.~~

The table above shows all details about the Risk Engine method used by the Corporation to calculate the worst potential loss of an Option contract. The last row has the eight Risk Arrays outcomes. The largest amount (positive amount) amongst the eight amounts is the Scanning Risk which will be, in most cases, the Initial Margin of this position.

It is important to note that the above calculations are performed at the Combined Commodity level, implying that when there is more than a single contract with the same Underlying Interest, the Risk Engine method calculates the Risk Arrays for all contracts belonging to the same Combined Commodity and then sums up the Risk Arrays results thus calculated for all contracts for the same scenario. In other words, the RA_1 of the first contract is added up to the RA_1 of the second contract and to the RA_1 of the n^{th} contract that belong to the same Combined Commodity in order to get the Total RA_1 for the same Combined Commodity. Then, the RA_2 of the first contract is added up to the RA_2 of the second contract and to the RA_2 of the n^{th} contract that belong to the same Combined Commodity in order to get the total RA_2 for the Combined Commodity. Likewise we obtain the total RA_3, RA_4, RA_5, RA_6, RA_7 and RA_8. Finally, the Risk Engine considers the largest amount of the eight total Risk Arrays as the Scanning Risk.

Example 2:

Let's assume a portfolio with three different positions: a short position in ten (10) Futures contracts on the S&P/TSX 60 Index, a long position in six (6) call Options contracts on the same index and a short position in three (3) put Options contracts on the same Underlying Interest (the expiry date for these three Options contracts might be the same or different).

In addition, the contract size and the price of the Futures contract are respectively 200 and F_0 and its Margin Interval is MI_F. The price of the call option is X_0, the price of the put option is Y_0 and the contract size of these two Option contracts is 100, whereas the price of the Underlying Interest S&P/TSX 60 Index is P_0 and its Margin Interval is MI_I. The MI_F and the MI_I values are almost the same but not exactly equal since the first is calculated using the historical volatility of the Future's returns, whereas the second is calculated using the historical volatility of the index's returns. However, since the index and the Futures contracts are strongly correlated, both Margin Interval values must be almost similar. Using the calculated Margin Intervals, we can calculate the Price Scan Range (PSR_F) of the Future contract, which represents the fluctuation range of the Futures contract and the index Price Scan Range (PSR_I) which represents the fluctuation range of the underlying index as follows:

$$PSR_F = MI_F \ x \ F_0 \ x \ Contract \ Size$$

and,

$$PSR_I = MI_I \ x \ P_0 \ x \ Contract \ Size$$

Thus, since this Futures contract size is 200 and the contract size of the index option is 100, the previous formulas become:

$$PSR_F = MI_F \times F_0 \times 200$$

and,

$$PSR_I = MI_I \times P_0 \times 100$$

For the clarity of the table below, please note that the PSR_F and the PSR_I do not include the contract size, i.e. $PSR_F = MI_F \times F_0$ and $PSR_I = MI_I \times P_0$.

This is the Risk Arrays table of this example:

Risk Scenario	1	2	3	4	5	6	7	8
10 Index Futures Contracts								
Futures Price Variation	10 x 200 x 1/3 x PSR_F	-10 x 200 x 1/3 x PSR_F	10 x 200 x 2/3 x PSR_F	-10 x 200 x 2/3 x PSR_F	10 x 200 x PSR_F	-10 x 200 x PSR_F	10 x 200 x 2 x PSR_F	-10 x 200 x 2 x PSR_F
Weight Fraction Considered	100%	100%	100%	100%	100%	100%	35%	35%
Total Weighted Profit and Loss	$P\&L_{F1}$ = 2000 / 3 x PSR_F	$P\&L_{F2}$ = -2000 / 3 x PSR_F	$P\&L_{F3}$ = 4000 / 3 x PSR_F	$P\&L_{F4}$ = -4000 / 3 x PSR_F	$P\&L_{F5}$ = 2000 x PSR_F	$P\&L_{F6}$ = -2000 x PSR_F	$P\&L_{F7}$ = 1400 x PSR_F	$P\&L_{F8}$ = -1400 x PSR_F
6 Index Call Option Contracts								
Index Price Variation	1/3 x PSR_I	-1/3 x PSR_I	2/3 x PSR_I	-2/3 x PSR_I	PSR_I	-PSR_I	2 x PSR_I	-2 x PSR_I
New Index Price	P_1 = P_0 + 1/3 * PSR_I	P_2 = P_0 - 1/3 * PSR_I	P_3 = P_0 + 2/3 * PSR_I	P_4 = P_0 - 2/3 * PSR_I	P_5 = P_0 + PSR_I	P_6 = P_0 - PSR_I	P_7 = P_0 + 2 * PSR_I	P_8 = P_0 - 2 * PSR_I
New Call Option Price (~~BAW~~)	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8
Weight Fraction Considered	100%	100%	100%	100%	100%	100%	35%	35%
Total (6 x 100) Weighted Profit and Loss	$P\&L_{X1}$ = 600 x (X_0 - X_1)	$P\&L_{X2}$ = 600 x (X_0 - X_2)	$P\&L_{X3}$ = 600 x (X_0 - X_3)	$P\&L_{X4}$ = 600 x (X_0 - X_4)	$P\&L_{X5}$ = 600 x (X_0 - X_5)	$P\&L_{X6}$ = 600 x (X_0 - X_6)	$P\&L_{X7}$ = 210 x (X_0 - X_7)	$P\&L_{X8}$ = 210 x (X_0 - X_8)
3 Index Put Option Contracts								
New put Option Price (~~BAW~~)	Y_1	Y_2	Y_3	Y_4	Y_5	Y_6	Y_7	Y_8
Weight Fraction Considered	100%	100%	100%	100%	100%	100%	35%	35%
Total (-3 x 100) Weighted Profit and Loss	$P\&L_{Y1}$= -300 x (Y_0 - Y_1)	$P\&L_{Y2}$= -300 x (Y_0 - Y_2)	$P\&L_{Y3}$= -300 x (Y_0 - Y_3)	$P\&L_{Y4}$= -300 x (Y_0 - Y_4)	$P\&L_{Y5}$ = -300 x (Y_0 - Y_5)	$P\&L_{Y6}$= -300 x (Y_0 - Y_6)	$P\&L_{Y7}$ = -105 x (Y_0 - Y_7)	$P\&L_{Y8}$= -105 x (Y_0 - Y_8)
Combined Commodity Risk Arrays Results	RA_1 = $P\&L_{F1}$ + $P\&L_{X1}$ + $P\&L_{Y1}$	RA_2 = $P\&L_{F2}$ + $P\&L_{X2}$ + $P\&L_{Y2}$	RA_3 = $P\&L_{F3}$ + $P\&L_{X3}$ + $P\&L_{Y3}$	RA_4 = $P\&L_{F4}$ + $P\&L_{X4}$ + $P\&L_{Y4}$	RA_5 = $P\&L_{F5}$ + $P\&L_{X5}$ + $P\&L_{Y5}$	RA_6 = $P\&L_{F6}$ + $P\&L_{X6}$ + $P\&L_{Y6}$	RA_7 = $P\&L_{F7}$ + $P\&L_{X7}$ + $P\&L_{Y7}$	RA_8 = $P\&L_{F8}$ + $P\&L_{X8}$ + $P\&L_{Y8}$

The largest amount (positive number) of the eight Risk Arrays results is the Scanning Risk which will be the Initial Margin of a portfolio with these three positions.

By convention, Risk Array values are given for a single long position. For a short position (as for the short Put option of the previous example), the calculated profit and loss is multiplied by the negative sign (-1). Losses for long positions are expressed as positive numbers and gains as negative numbers.

In the case of all the eight Risk Arrays values being negative (i.e. all corresponding to a gain) or zero (no risk), the Scanning Risk amount is set to zero.

The number of the Risk Arrays scenario that gives the largest amount (worst case scenario) for the option is called the Active Scenario. If two scenarios have the same figure, the one with the lowest scenario number is the Active Scenario. For example, if scenarios 5 and 7 give the largest and similar results, scenario 5 will be defined as the Active Scenario.

The Risk Engine calculates the Initial Margin for each Combined Commodity, for each member's account and sub-account. Thus, the Initial Margins calculated for each Combined Commodity account and sub-account are then sent to CDCS in order to be aggregated at the Clearing Member level.

Risk Arrays values are denominated in the same currency as the specific contract.

The Corporation's Risk Arrays file is published every day on the Chicago Mercantile Exchange (CME) website.

Short Option Minimum

In the event of a sharp variation of the Underlying Interest price, short option positions can lead to significant losses. Therefore, the Risk Engine calculates a minimum amount called Short Option Minimum (SOM) for short positions in each Combined Commodity. This amount will be called if it is higher than the result of the Risk Arrays.

In order to determine the appropriate SOM for every group of products, CDCC considers Out of The Money (OTM) call and put Options for every Underlying Interest.

After shocking the Underlying Interest price by its appropriate stress scenario, as set forth in the relevant notice to members, CDCC re-calculates the price of all OTM call and put Options using the new Underlying Interest price and the same other parameters of the Options. The difference between the actual Option price and the new Option price represents the potential loss of the Option. Then, the average of all Options' losses is calculated to determine the potential loss for every Underlying Interest. Finally, the average of the potential losses for all Underlying Interests of the same group of products is calculated to determine the potential loss of the Combined Commodity, which represents its SOM. The latter is then translated in a percentage of the Price Scan Range (PSR).

This SOM calculation is reviewed on a regular basis, at least annually, and communicated to Clearing Members by written notice.

OTCI TRANSACTIONS FOR WHICH THE UNDERLYING INTEREST IS A SECURITY

The Initial Margin calculation process for OTCI Transactions for which the Underlying Interest is a Security is the same as for listed options, except that the Corporation uses a theoretical price calculated using an in-house program, instead of the contractual option price.

Theoretical Price Calculation

The Corporation uses the Barone-Adesi and Whaley (BAW) model to evaluate the Options that have an American style and the Black and Scholes (BS) model to evaluate the Options that have a European style. In order to evaluate the Option price, we need to determine the implied volatility to be used. For this, two different methodologies are used depending whether the Option is an Exchange traded Option.

If the Option contract is an Exchange traded Option, the Corporation uses the Option's data (the entire Option series for one expiry month) available at the Exchange and builds a Smile Volatility Curve using a Cubic Spline function. After building the Smile Curve, the Corporation determines the implied volatility that corresponds exactly to the strike price of the Option to be assessed. If the expiry date of the Option does not correspond to the ones of the listed series, the Corporation builds two Smile Volatility Curves, one using the Option series with an expiry date that is right after the one of the assessed Option and one using the series of Options with an expiry date that is right before the one of the assessed Option to be evaluated.

Then, the volatility that corresponds to the strike price of the Option to be evaluated is determined on each curve. Finally, a linear interpolation is done to determine the volatility that corresponds to the strike and to the expiry date of the Option to be evaluated. However, if the expiry date of the Option to be evaluated is before (after) the first (last) expiry date of the listed Options series, the Corporation uses the volatilities of the Smile Volatility Curve of the first (last) expiry date of the listed Option series.

If the Option is not listed and no data is available for it, the Corporation uses the yearly historical volatility of the Option's Underlying Interest price as a proxy for the implied volatility.

Liquidity Interval

To calculate the Margin Interval for OTCI transactions for which the Underlying Interest is a Security, the Corporation may apply a different number of liquidation days. In addition, for OTCI with Physical Settlement/Delivery, the Corporation calculates an additional Liquidity Interval and adds it to the Margin Interval.

The assumptions under which the Liquidity Interval is calculated are similar to the assumptions the Corporation uses to calculate the Margin Interval, i.e., the confidence interval over 99% is obtained by using 3 standard deviations (based on the normal distribution's assumptions). The Liquidity Interval is calculated based on the historical bid-ask price spread of the Underlying Interest according to the same formula for Margin Interval.

UNSETTLED ITEMS

Options contracts with physical delivery that have been exercised or expired in the money without being settled (i.e. the Underlying Interest is not delivered yet) are considered as Unsettled Items and the Corporation has to manage the settlement risk associated with these products until the whole quantity of the Underlying Interest is completely delivered/settled. For instance, when such Option contract expires in the money, the Underlying Interest is delivered three days after the expiry date consistent with current market settlement conventions. The Corporation has to charge a Margin requirement to cover the Replacement Cost (RC) of the Option contract and its Potential Future Exposure (PFE) as well. The procedure is as follows:

To cover the Replacement Cost of the Option contract, the Corporation requests a Margin requirement equal to the intrinsic value of the Option times the position (quantity of Options). However, when the writer of a put Option has deposited a Put Escrow Receipt to cover the total amount of the strike price in accordance with Section A-708 of the Rules, the Corporation will not require Margin on the relevant put Option. In the same manner, when the writer of a call Option has deposited a Call Underlying Interest Deposit to cover the total quantity of the Underlying Interest deliverable thereunder in accordance with Section A-708 of the Rules, the Corporation will not require Margin on the relevant call Option.

To cover the Potential Future Exposure of the Option contract, the Corporation requests a margin requirement amount to cover any potential Underlying Interest price movement over two days and within three standard deviations (under the normal distribution's assumption).

SPECIFIC WRONG-WAY RISK

The Specific Wrong-Way Risk arises where an exposure to a counterpary is highly likely to increase when the credit worthiness of that counterparty is deteriorating.

CDCC had identified two particular situations where the Specific Wrong-Way Risk exists and it addresses them as follows:

Put Options: When a Clearing Member takes a Short Put Option position on the shares of its own company or affiliates, the full strike value amount is charged as margin requirement.

Unsettled Items: For an Unsettled Item that is related to the Specific Wrong-Way Risk, the full strike value amount is charged as margin requirement. In such case, the margin requirement is collected in the Difference Fund.