Montréal Exchange

Reference Manual

ONX – 30-Day Overnight Repo Rate Futures

30-DAY OVERNIGHT REPO RATE FUTURES - ONX
Success factors, Design, Strategies and Pricing

Objective

This paper presents the success factors, design, strategies and pricing of the proposed 30-day Overnight Repo Rate futures contract (ticker symbol: ONX) as well as other relevant comments.

Introduction

An optimal window of opportunity exists for the launch of the 30-day overnight repo rate futures, witnessed in 2001 by the Bank of Canada's aggressive cutting of the overnight repo target rate. A survey among Canadian money market participants has confirmed a need for such a contract because of the next anticipated directional move in rates in 2002. This next directional move in rates will be the triggering event that will establish the initial wave of the liquidity pool for the contract to be a success.

THE 30-DAY OVERNIGHT REPO RATE FUTURES CONTRACT

The ONX futures contract is a futures on the overnight repo rate (CORRA). The current price of the contract will reflect both the average overnight repo rate up to that a point in the month, as well as the market's expectations for the overnight repo rate for the remainder of the month. The price of the 30-day overnight repo rate futures is 100 minus the average overnight repo rate during the contract month. The contract enables professionals to manage interest rate risks ranging from one to 30 days with the nearest contract month, and up to 4 months with deferred contract months.

WHAT IS THE OVERNIGHT REPO RATE?

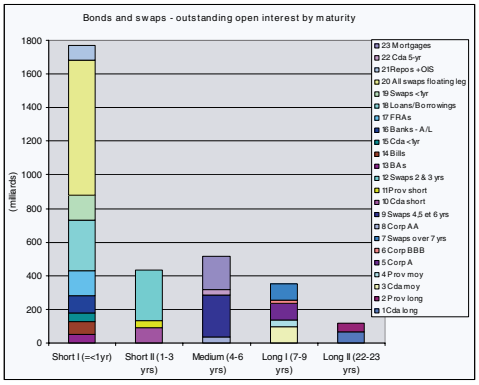
The overnight repo rate or CORRA is a weighted average of the rates to which the typical (i.e. not special) repo transactions are traded by dealers on the screens of the following interdealers brokers: Freedom International Brokers, Prebon Yamane (Canada) Ltd., Shorcan Brokers Ltd. and Tullett & Tokyo Forex (Canada). This rate does reflect the overnight financing rate even if trades that are processed through interdealer brokers represent roughly 20% of the trades (the rest of the trades being made between brokers and clients or directly between clients). Interviews of funding, repo and trading desks confirm that the overnight repo rate collected by the Bank of Canada is a reliable rate[1].

In Canada, the overnight repo rate is the daily overnight rate of reference of the floating leg of the Overnight Indexed Swap, a successful derivative used on the OTC market.

[1] In the United States, the rate of reference of the 30-day Fed Funds futures is the fed effective rate, which is a weighted average of the rates at which fed funds traded during a day, where the weights are the dollar amounts exchanged at each rate. There is no such rate in Canada.

THE CANADIAN MONEY MARKET AND THE USE OF THE 30-DAY OVERNIGHT REPO RATE FUTURES CONTRACT

- The Canadian debt market displays a high concentration in the short-term segment of the yield curve as illustrated in the following graph.



- The money market is the milieu between borrowers and investors in the short-term interest rate segment. For example, banks lend any excess funds to other banks in need of cash. Most of these interbank transactions are overnight borrowings based on the overnight financing rate, the rate at which major participants in the money market borrow and lend one-day funds to each other. The overnight financing rate is highly correlated to the overnight repo rate.
- In managing interest rate risks at the short-end of the term structure, Canadian money market participants use exchange-traded (BAX) and OTC derivative instruments (FRAs, Overnight Indexed Swap).
- However, no exchange-traded futures contract is available for managing overnight loans or short-term borrowings of less than a month. The 30-day overnight repo rate futures contract meets such needs.
- Unanticipated interest rate movements can expose participants in the short-term money markets to unacceptable risks.
- Interest rate risk exposure can increase in the overnight and short-term money markets due to fundamental and technical factors in the cash markets. For example, economic and government reports, unanticipated changes in the Bank of Canada, and concerns about the Canadian dollar can all affect market expectations.
- Money market participants can protect their financial interests by hedging with the 30-day overnight repo rate futures. Futures prices have an inverse relationship with interest rates. If interest rates rise, the price of the futures contract decreases. Thus, participants can protect against rising interest rates by selling 30-day overnight repo rate futures and vice versa.
- A survey among Canadian money market participants has confirmed a need for such a contract. The next anticipated directional move in rates in 2002 would be the triggering event that will establish the initial wave of the liquidity pool for the contract to be a success.

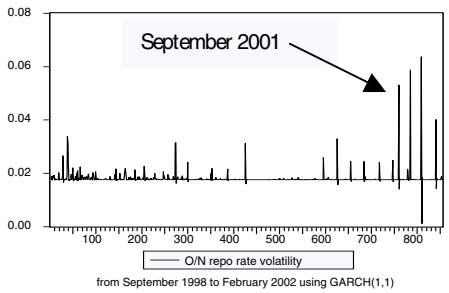
SIX SUCCESS FACTORS

We have identified six factors for launching successfully the 30-day overnight repo rate futures contract.

- Since October 2000, Bank of Canada has made public the dates on which it will announce any changes to the official interest rate it uses to implement monetary policy[2]. The 30-day overnight futures rate will be used as a predictor of the BoC policy and will be an efficient hedging tool for Canadian money market participants.

[2] http://www.bankofcanada.ca
In exceptional circumstances, the Bank of Canada will meet between these dates and will be able to change the Bank rate.

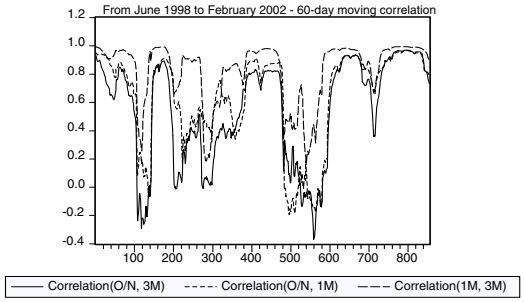
- The increased short-term rate volatility since September 2001.



from September 1998 to February 2002 using GARCH(1,1)

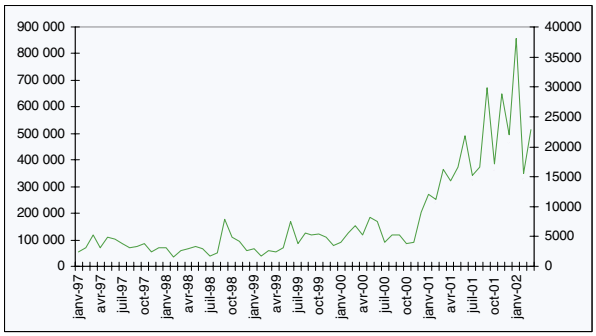
The 30-day overnight repo rate futures will help managing increasing uncertainty.

- The unstable correlation of the front-month BAX rate with very short-term rates, which makes BAXs a less effective hedging tool for very short maturities.



The 1-month and 3-month CDOR rates display overtime a chaotic correlation with the overnight repo rate, with bottoms reaching zero. The ONX futures will be specifically used for maturities less than a month since it is much more correlated to very short-term rates.

- The significant growth of the repo and reverse repo market in recent years in Canada, with an $80 billion daily average. Structural and regulatory changes have played important roles in its development. The 30-day overnight repo rate futures targets especially this market.
- The successful OTC contract OIS (Overnight Indexed Swap) has been widely used by traders of repo and funding desks in Canada in the last two years. However, it can be costly. The ONX futures meets part of the OIS users' needs with the added advantage of bringing price discovery and transparency. Furthermore, the 30-day overnight repo rate futures will help traders to manage their books of swaps.
- The increased success of the CBOT 30-Day Fed Fund futures since December 2000:



Monthly (left scale) and daily (right scale) volumes of the CBOT 30-day Fed Fund futures from Jan.1997 to March 2002.

As the 30-Day Fed funds futures contract has finally been successful in the US after years of shunning, with 18,000 contracts per day on average in 2001, the necessity of a similar Canadian contract makes sense for the Canadian money market. The uptick in volume of the Fed Funds futures for 2001 in part can be attributed to the multiple rate changes by the Federal Reserve Bank and overall volatility increase in fixed income markets. The contract serves as a harbinger to future Fed rate changes. As a result, it garnered increased interest in 2001.

The overnight repo rate level has a 91% correlation to the Fed Funds effective rate. However, looking at the logarithmic changes of the Fed Funds rate and the Canadian overnight repo rate, the correlation reaches only 9%, which means that the 30-day Fed Funds futures is a poor hedging instrument for the Canadian money market. A Canadian based underlying is required such as the overnight repo rate.

SPECIFICATIONS

	30-day Overnight Repo Rate Futures
Trading Unit	Each contract shall be for a nominal value of C$5,000,000.
Contract Months	The four nearest calendar months.
Price Quotation	Index: 100 minus the monthly average overnight repo rate for the contract month.
Last Day of Trading	Last business day of the contract month.
Contract Type	Cash settlement.
Minimum Price Fluctuation	0.01=C$41.10 (1/100 of one percent of C$5,000,000 on a 30-day basis).
Reporting Limit	300 contracts.
Position Limits	Information on position limits can be obtained from the Bourse as they are subject to periodical changes.
Final Settlement Price	The contract is cash settled against the monthly average of the daily overnight repo rate for the contract month. The daily overnight repo rate (CORRA) is calculated and reported by the Bank of Canada. The monthly average is a simple arithmetic average corresponding to the sum of the daily overnight repo rates divided by the number of calendar days in the month. Weekend and holiday rates are considered to be the rate applicable on the previous business day for which a rate was reported. For example, Friday's rate is used for Saturday and Sunday rates. The final settlement price is determined on the first business day following the last day of trading.
Minimum Margin Requirements	Information on minimum margin requirements can be obtained from the Bourse as they are subject to periodical changes.
Daily Price Limits	None.
Trading Hours	8:00 a.m. to 3:00 p.m. (EST/EDT).
Clearing Corporation	Canadian Derivatives Clearing Corporation (CDCC).
Ticker Symbol	ONX.

SPECIFIC USERS AND USES OF THE 30-DAY OVERNIGHT REPO RATE FUTURES

Specific users:

- Corporate treasurers (ALM).
- Bank funding managers.
- Dealer financing managers.
- Repo dealers/traders.
- Swap traders.
- Money market traders.
- Participants in the overnight repo market.
- Proprietary trading desk.
- Options desk.

Specific uses:

- Interbank loans based on the overnight financing rate.
- Repurchase agreements (repos) based on the overnight repo rate.
- Certificate of deposit (CDs).
- Floating-rate portion of a portfolio or interest rate swap agreement.
- Mismatch between assets and liabilities
  - When a treasurer faces a "gap" in terms of time to maturity.
  - When assets and liabilities have different interest rate structures.
  - Whatever the case, the monthly trading cycle of the 30-day overnight repo rate futures contract allows for exact gap coverage without assuming the basis risk inherent in longer-term 3-month Canadian Bankers' Acceptance futures.
- Trading vehicle for spreaders who exploit spreads on 3-month Canadian Bankers' Acceptance futures contracts (BAX) and also for the other money market rates that are closely linked to the overnight rate such as the 1-month bankers' acceptance or the certificate of deposits rates.

EXAMPLES OF STRATEGIES

1. Hedging in the deferred months

Situation

A repo trader borrows daily C$100 million in repo funds. In June, the repo trader expects an increase of the overnight repo rate due to signs of inflation in the economy. He would like to protect his cost of overnight repo funds by using futures so that any rise in interest rates will be offset by gains in the futures position.

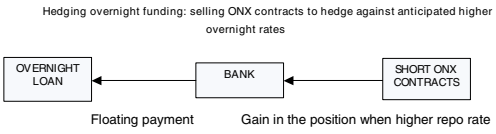
Strategy

The repo trader sells 20 ONX (30-day overnight repo rate futures contracts) and holds them to expiration. The hedge ratio is computed with the following formula:

$$\text{Hedge ratio} = \frac{\text{number of days in the month}}{30} \times \frac{\text{exposure in C\$}}{\text{C\$5 million}} =$$

$$\frac{30}{30} \times \frac{\text{C\$100 million}}{\text{C\$5 million}} = 20 \text{ contracts}$$

The following diagram illustrates the position of the bank:



Result

The following tables illustrate the data, the strategy step by step and the resulting outcome:

Data	June 1	June 30
ONX futures price	98.00	97.80
ONX futures rate	2%	2,2%
Average rate on O/N repo funds borrowed	-	2,2%

Strategy by steps	Formula	Results
On June 1:		
Sell 20 ONX at 98,00		
On June 30:		
Interest rate expense (1)	$100M x 0.022 x30/365	180 822 $
Gain on short position at expiration (2)	20 contracts x 20 ticks x 41.10	16 440 $
Net interest rate expense:	(1) - (2)	164 382 $
Cost of funds:	$164,382 / $100M x 365/30	2,00%

Conclusion

The repo trader paid 2.00% when rates increased to 2.20% due to the gains in the futures position, which offset the interest rate rising 20 basis points.

2. Hedging irregular time spans: stubs and tails

As the time period underlying the 30-day overnight repo rate futures is 1-month, stubs and tails refer to time periods shorter than a month.

- Example of a tail period: the 45-day period from March 1 to April 14 can be divided into a 31-day March period and a 14-day April period; the second period is called a tail period.
- Example of a stub period: the 46-day period from September 15 to October 31 can be divided into a 15-day September period and a 31-day October period; the first period is called a stub period.

Situation

A Canadian bank has a 46-day gap remaining on September 15 on a $75 million fixed-rate loan at 2.15%, with an initial maturity of one year. The bank has issued one-month certificates of deposit (CDs) to fund this loan. But the rates are presently too high to use CDs for financing. The treasurer of the bank

chooses the 30-day overnight repo rate futures and overnight financing.

Strategy

As explained above, this 46-day gap from September 15 to October 31 can be divided into a 15-day September period (stub) and a 31-day October period. The treasurer sells 16 October ONX contracts and holds them to expiration. He computes the hedge ratio with the following formula:

$$\text{Hedge ratio} = \frac{\text{number of days in the month}}{30} \times \frac{\text{exposure in C\$}}{\text{C\$5 million}} =$$

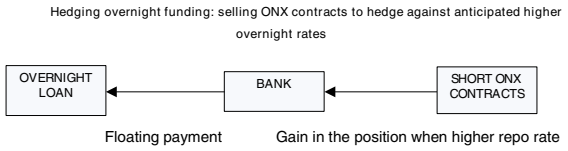
$$\frac{31}{30} \times \frac{\text{C\$75 million}}{\text{C\$5 million}} = 15.50 \cong 16 \text{ contracts.}$$

To hedge the stub period, the treasurer sells 15 September ONX contracts and holds them to expiration. The hedge ratio is computed with the following formula:

$$\text{Hedge ratio} = \frac{30}{30} \times \frac{\$75 \text{ million}}{\$5 \text{ million}} = 15 \text{ contracts.}$$

N.B.: the treasurer uses the ratio 30/30 and not 15/30 since the volatility of the ONX contract on any given day in the month is the same as that of the term rate for the remaining time period. On the contrary, to hedge a tail period, say for the first 15 days of October, he would have used the ratio 15/30 in computing the hedge ratio of the October ONX contracts. This is explained by the fact that a tail period incurs risk for a period that begins on the first day of the contract month and ends before the expiration date (in our example, October 15). The price of the ONX contract on the first day of the month reflects full exposure to movements in one-month interest rates. Thus, the number of contracts used to hedge a tail period is a weighted part of a full month's hedge, adjusted to reflect the risk incurred for only part of the month. This is why the treasurer should have used the ratio 15/30 in the example of a tail period.

The following diagram illustrates the position of the bank:



Result

The following tables illustrate the data, the strategy step by step and the resulting outcome:

Data	September 15	September 30	October 31
SEPT ONX futures price	97,95	97,55	-
SEPT ONX futures rate	2,05%	2,45%	-
OCT ONX futures price	97,85	97,45	97,65
OCT ONX futures rate	2,15%	2,55%	2,35%
Average rate on O/N repo funds	-	2,55%	2,35%

Strategy by steps	Formula	Results
On September 15:		
Sell 15 SEPT ONX contracts at 97,950		
Sell 16 OCT ONX contracts at 97,850		
Bank cost of funds:		
September	$75 million x 0.0255 x 15/365	78 595,89 $
October	$75 million x 0.0235 x 31/365	149 691,78 $
Total cost of funds (1)		228 287,67 $
Gain on short ONX position at expiration		
September	15 contracts x 40 ticks x $41.10	24 660,00 $
October	16 contracts x 20 ticks x $41.10	13 152,00 $
Total gain on futures (2)		37 812,00 $
Net interest expense	(1) - (2)	190 475,67 $
Cost of funds	190,475.67 / $75 million x 365/46	2,02%

N.B.: the average overnight repo rate was 2.55% for the last 15 days of September.

Conclusion

The bank paid 2.02% although rates increased to 2.55% in September and 2.35% in October. The bank

maximized the spread earned between funding costs and the fixed-rate loan at 2.15%. The treasurer has closed the 46-day gap and lowered its costs.

3. Hedging within a contract month

When a hedger takes a position within a contract month without knowing how long the risk period will be, he hedges as if the risk period were up to month-end.

Situation

On March 5, a primary dealer has $50 million in 3-month bankers' acceptances (BAs) in his inventory, as no buyers are available at the moment. The dealer wants to hedge his position against interest rates increase as BAs are marked–to-market daily; he finances himself daily through repos at the overnight repo rate.

Strategy

Anticipating a non-farm payroll announcement, on March 8, which will temporarily drive up interest rates, the dealer sells 10 MAR ONX contracts ($50 million divided by $5 million, the size of the ONX contract). On March 22, the dealer believes that the overnight repo rate has reached its ceiling, therefore that it is time to close its futures position by buying back the 10 MAR ONX contracts.

Result

The following tables illustrate the data, the strategy step by step and the resulting outcome:

Data	March 5	March 22
MAR ONX futures price	97,50	97,45
MAR ONX futures rate	2,50%	2,55%
Average repo rate	2,39%	2,47%

The bankers' acceptances have a 2.57% discount rate for a yield of 2.595% for 90 days. The $50 million face amount is discounted to a principal expense of $49,685,146 [= 50,000,000/(1 + (0.0257 x 90/365))].

The average repo rate was 2.47% for the period of March 5 to March 22.

Strategy by steps	Formula	Results
On March 5:		
Sell 10 MAR ONX contracts at 97,50		
On March 22:		
Gain on short futures (1)	10 contracts x 5 ticks x $41.10	2 055,00 $
Repo financing expense (2)	$49,894,606 x 0.0247 x 17/365	57 399,30 $
Net interest expense	(2) - (1)	55 344,30 $
Cost of funds	(55,344.30/49,894,606) x 365/17	2,38%

Conclusion

The financing cost for the period from March 5 to March 22 was reduced from 2.47% to 2.38%. This represents a saving of 9 basis points below the daily repo rate and allowed the dealer to maintain positive carry despite rising costs, thus neutralizing the mark-to-market loss.

4. Using the 30-day overnight repo rate futures to predict the target rate

The rate implied by the 30-day overnight repo rate futures can be used to measure market expectations of the Bank of Canada policy changes. Therefore, the contract can be seen as an accurate predictor of the Bank of Canada policy.

Situation

On April 16, the Bank of Canada (BoC) will make the next policy announcement. Market consensus calls for a 25 basis points increase by the BoC on April 16.

Strategy

Probability theory can be used to determine the market's assessment of the likelihood of BoC action on April 16.

Result

The following tables illustrate the data and how to compute the probability that the target rate will increase by 25 basis points:

Data	
Days in April	30
Days to BoC meeting	16
Days remaining	14
Target rate	2,00%
Expected target rate	2,25%
APR ONX futures price	97,90
APR implied average O/N repo rate	2,10%

Compute the probability	Formula	Results
On March 31:		
Compute the probability that the target rate will increase from 2.00% to 2.25%	2,10% = 2.00%*16/30+ [Px2.25%+ (1-P)x2.00%]x(14/30)	
Solving the equation, we find P:		0,85
Meaning that the ONX futures price implies that there is a 85% probability that BoC will raise the overnight target repo rate to 2.25%.		

Conclusion

As there is 85% that the BoC raises the target repo rate by 25 basis points, those who agree sell the APR ONX contract expecting its price to go down to 97.50, while those who disagree buy the contract in the expectation of no action of BoC.

THE 30-DAY OVERNIGHT REPO RATE FUTURES IS COST EFFECTIVE

The 30-day overnight repo rate futures contract is cost effective compare to the OIS (Overnight Indexed Swap). The following example illustrates the fact.

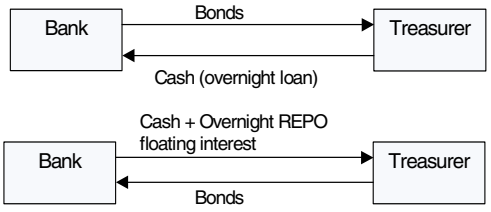
Data	Sept. 1	Sept. 30
OCT ONX futures price	97,12	97,62
OCT ONX futures rate	2,88%	2,38%
Average repo rate from Sept.1 to Sept. 30	-	2,28%

Situation

In September, a treasurer that invests daily excess funds through reverse repo (with a C$100 million daily average) is worried that the Bank of Canada will lower the target repo rate on its next meeting 3 weeks from now. The treasurer wants to hedge its current return on overnight funds lent in October under reverse repo agreements so that any decline in interest rates will be offset by gains in the futures market.

Strategies

The reverse repo is illustrated below:



Bank: engaged in a REPO transaction.

Treasurer: engaged in a reverse REPO transaction.

The treasurer can either use the Overnight Indexed Swap (OIS) or the ONX contract for hedging its current return on overnight funds.

1. Using the 30-day Overnight Repo Rate futures

The treasurer buys 20 OCT ONX contracts and holds

$$\text{Hedge ratio} = \frac{\text{number of days in the month}}{30} \text{x} \frac{\text{exposure in C\$}}{\text{C\$5 million}} =$$

$$\frac{30}{30} \text{x} \frac{\text{C\$100 million}}{\text{C\$5 million}} = 20 \text{ contracts}$$

them to expiration. Since the treasurer lends a daily average of C$100 million, he computes the hedge ratio with the following formula:

Result

The following tables illustrate the data, the strategy step by step and the resulting outcome:

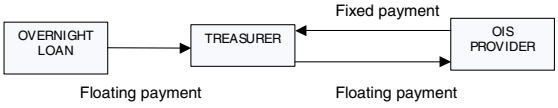
Strategy by steps	Formula	Results
On Sept. 1:		
Buy 20 OCT ONX contracts at 97.12		
Commission fee (buy and sell) (1)	$5 x 20 contracts	-100,00 $
Costs related to the Bid/Ask spread (2)	2 ticks x 20 contracts x 41.10	-1 644,00 $
On September 30: Interest rate revenue (3)	$100 million x 0.0228 x 30/365	187 397,26 $
Gain on long futures at expiration (4)	20 contracts x 50 ticks x $41,10	41 100,00 $
Net interest rate revenue	(1) + (2) + (3) + (4)	226 753,26 $
Return on investment	($226,753.26/$100 million) x 365/30	2,76%

Conclusion

The treasurer earned 2.76% as rates declined to 2.28%, thanks to the gain on long ONX futures.

2. Using the Overnight Indexed Swap (OIS)

As the treasurer receives the overnight floating rate, he sells an Overnight Indexed Swap to pay floating and receives fixed. Thus, the treasurer hedges the risk of lower overnight rates.



Result

The following tables illustrate the data, the strategy step by step and the resulting outcome:

Data	Sept. 1	Sept. 30
O/N repo rate	2,74%	2,24%
O/N indexed swap	2,883 - 2,928	2,383 - 2,428
Average repo rate	-	2,28%

Strategy by steps	Formula	Results
On Sept. 1:		
Sell an OIS - notional amount $100,000,000		
Commission fee (1)	1/8 bpsx $100,000,000	-1 250,00 $
Costs related to the Bid/Ask spread (2)	2 ticks x $100,000,000	-20 000,00 $
Fixed payment to the treasurer (3)	$100 million x 0.02883 x 30/365	236 958,90 $
Net interest rate revenue	(1) + (2) + (3)	215 708,90 $
Return on investment	(215,708.90/$100 million) x 365/30	2,62%

Conclusion

The treasurer earned 2.62% as rates declined to 2.28%, thanks to the gain on OIS. However, it is 14 bps less than the strategy with ONX contracts (2.76%). In this example, the ONX contract is more cost effective than the OIS.

PRICING THE ONX CONTRACT

1. Current month contract pricing

The price feature offers an effective way of managing exposure to changes in interest rates for whatever period remains to month-end.

The price of the current month contract is obtained with the following formula:

$$\text{Current month futures price}_j = 100 - \frac{\sum_{i=1}^{j} \text{Realized}(ON_i)}{\text{Days}_n} + \frac{\sum_{i=j+1}^{j} \text{Expected}(ON_i)}{\text{Days}_n}$$

Example: on June 10, the JUN ONX contract is priced 97.455, indicating a rate of 2.545 (100 – 97.455 = 2.545). The overnight rate-to-date component of this price is an average of the daily overnight repo rate for the first ten days of June. If the average rate-to-date for these 10 days is 2.457%, then the June 10 price of 97.455 implies a term rate of 2.589% for the remaining 20 days in the month based on the pricing formula:

$$0.02545 = \frac{10}{30} x0.02457 + \frac{20}{30} x0.02589.$$

N.B.: Since the number of days to month-end decreases daily, when approaching the end of the month the price in the current month is dominated by the accumulating average of daily overnight repo rates. As a consequence, volatility in the current month normally declines as expiration approaches. It is why Bourse de Montréal Inc. will introduce half tick prices in the upcoming months.

The final settlement price of the 30-day overnight repo rate futures is 100 minus the arithmetic average of the actual daily overnight repo rates experienced each calendar day in the month (please refer to the specifications above).

2. Deferred month contract pricing

The price of each deferred contract tracks the one-month forward rate implied by an uncompounded average of the expected overnight repo rates, given the deferred month's specific position on the yield curve. It is why the forward rates implied by 30-day overnight repo rate futures prices tend to be lower than the comparable term rates, which are typically based on compounded averages.

The following equation illustrates the deferred month pricing formula:

$$\text{Deferred month futures price} = 100 - \sum_{i=1}^{n} \frac{\text{ExpectedON}_i}{\text{Days}_n}$$

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