



MONTRÉAL EXCHANGE

February 2022

Switch Risk in Futures: A Refresher

Following several years of low rates and flat bond yield curves, many investors may have forgotten the impact that a cheapest-to-deliver (CTD) switch can have on positions in physical delivery bond futures. For such investors, 2022 may be a good time to brush up on some of the basics of the embedded quality option, a more formal term for switch risk, as the September expiry of the Ten-Year Government of Canada Bond Futures (CGB™), the CGBU22 contract, appears to have significant switch potential under expected market conditions.

Quality Option/Switch Risk Basics

Short positions in physical delivery futures contracts own several types of options¹ but we focus here on the quality option which is sometimes referred to as the delivery option. This option exists because holders of short futures positions have a choice of which bond in the basket of qualifying bonds they will deliver to fulfill their contract obligations. As most professional investors are aware, each bond that meets the requirements of the contract has a conversion factor that is calculated by the exchange, which attempts to make different bonds with different maturities and coupons roughly equally valuable. The fact that the conversion factor calculation does not perfectly equate the value of different bonds in the basket at all levels of interest rates means that, under various market conditions, the bond that is most attractive (i.e. cheapest) for a short position to deliver to the long position can change.

The conversion factor calculation favors the shortest duration bond in the basket when yields are below 6%² so higher coupons and shorter maturities have tended to be the bond that is cheapest-to-deliver recently. Under higher yield regimes, CTD switches become much more likely; the same is true for steeper curves. Since yields have recently been very low and curves very flat, switch risk has been almost nonexistent and the embedded quality option has been worthless or almost worthless for several years in all Canadian physical delivery fixed income futures contracts.

CGBU22

Since yields have now risen moderately and curves have steepened at the same time, switch risk would be expected to become more likely but, even at today's yields, the quality option would normally not be valuable. However, a coupon anomaly has been created by the plunge in interest rates in the early days of the pandemic such that the 10-year bond that was created in 2020 has a much lower coupon than the next-in-maturity 10-year bond in the basket. The delivery basket for CGBU22³ is shown in Figure 1.

FIGURE 1

COUPON	MATURITY	YIELD	CONVERSION FACTOR	MACAULEY DURATION
0.50%	1-Dec-30	1.680%	0.6462	8.2
1.50%	1-Jun-31	1.717%	0.6971	8.3
1.50%	1-Dec-31	1.771%	0.6841	8.8

Source: Montréal Exchange, BMO Capital Markets' Fixed Income Sapphire database

¹ We refer interested readers to "Embedded Options in CGF and CGB Futures" published by Montréal Exchange in 2018.

² 6% represents the notional coupon of all MX's Government of Canada bond futures.

³ Delivery baskets may change based on upcoming Government of Canada bond issuances. While all these bonds will certainly qualify for delivery into CGBU22, additional bonds may also qualify by the delivery date.

The switch risk for CGBU22 will likely be elevated for two reasons:

1. There will be a very large difference in coupon between the 0.5% Dec 2030 and 1.5% Jun 2031.
2. The maturity difference between the shortest and next-to-shortest maturity will be just six months rather than a full year as was normal with past contracts, due to increased bond issuance and a change at the Bank of Canada from creating a new 10-year bond once per year to creating a new bond twice per year, starting in 2020.

The combination of the two factors noted above means that the duration of the Dec 2030, at current yields but recalculated for May 27th, the day the CGBU22 contract is likely to become the active contract, would be 8.2 while the Jun 2031 bond would be just 8.3, as seen in the final column of Figure 1. Unlike in past quarters, the two durations are unusually close in magnitude and switch risk will result in a quality option with value.

We have calculated a table of yields and bond slopes that result in Dec 2030 and Jun 2031 being CTD at the delivery date, which is shown in Figure 2. As one can see in that figure, it takes only a slight steepening of the 10-year segment of the curve to achieve a switch; at the time of writing, the yield curve between Dec 2030 and Jun 2031 is 3.7 basis points and a 0.8 basis point steepening would cause a switch of CTD from the Dec 2030 to the Jun 2031. Alternatively, a selloff of 44 basis points with no change in slope, would also achieve a CTD switch.

FIGURE 2

		Dec30 Yield															
SLOPE		1.52%	1.56%	1.60%	1.64%	1.68%	1.72%	1.76%	1.80%	1.84%	1.88%	1.92%	1.96%	2.00%	2.04%	2.08%	2.12%
2.0	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30
2.3	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30
2.7	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30
3.0	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30
3.4	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30
3.7	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Jun31
4.0	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Jun31	Jun31	Jun31	Jun31	Jun31
4.2	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Dec30	Jun31	Jun31	Jun31	Jun31	Jun31	Jun31	Jun31	Jun31
4.5	Dec30	Dec30	Dec30	Dec30	Dec30	Jun31	Jun31	Jun31	Jun31	Jun31	Jun31	Jun31	Jun31	Jun31	Jun31	Jun31	Jun31
4.7	Dec30	Jun31	Jun31	Jun31	Jun31	Jun31	Jun31	Jun31	Jun31	Jun31	Jun31	Jun31	Jun31	Jun31	Jun31	Jun31	Jun31
5.0	Jun31	Jun31	Jun31	Jun31	Jun31	Jun31	Jun31	Jun31	Jun31	Jun31	Jun31	Jun31	Jun31	Jun31	Jun31	Jun31	Jun31

The above switch potential contrasts strongly with the CGBZ21 contract which, when we wrote about the contract in mid-August 2021 needed an implausibly large 160 basis point selloff combined with a 24 basis point steepening between 10-year bonds to cause a change in the CTD. Beginning soon, the days of ignoring switch potential are over for the CGB contract.

Case Study of an Instantaneous CTD Switch

The P(L) effects of a cheapest-to-deliver switch can be demonstrated with a simplified example. In summary, a long futures position or a short futures basis position⁴ will have unexpected losses since this position is intrinsically short the quality option which has, by definition when we talk about the effects of a CTD switch, gone in-the-money and will be exercised. Similarly, short futures positions and long futures basis positions will generate profits.

To demonstrate the direction and magnitude of the P(L) effects on different positions, we can construct an instantaneous steepening of the yield curve on some date in the life of the contract; we used July 5th 2022 in our example. In Figure 3, we show the delivery basket for CGBU22 with the same yields⁵ as these bonds had in early January when the yield of the Dec 2030 bond, which would be the cheapest-to-deliver for the September contact under normal conditions, was 1.68% and there was 3.7 basis points of curve steepness between the Dec 2030 and the Jun 2031. Assuming the implied repo rate⁶ for the CTD is 0.75% for the contract on July 5th, we have calculated the fair value for the CGBU22 contract which is also shown in the figure.

⁴ A long futures basis position is a type of cash-and-carry arbitrage where an investor is long the bond and short the futures contract in amounts that make the interest rate sensitivity sum to zero. A short futures basis position is the opposite.

⁵ The yield is not important to the example as long as it is not hundreds of basis points higher.

⁶ Also not important unless it is hundreds of basis points higher. We assume a modest tightening of Bank of Canada policy rate from 0.25% to 0.75%.

FIGURE 3**Starting Scenario: 3.7 bps Steep, Futures Fair Value to CTD**

CONTRACT	PRICE
CGBU22	140.56

BOND	COUPON	MATURITY	YIELD	CONVERSION FACTOR	GROSS BASIS	IMPLIED REPO _{LAST}	DV01 NEUTRAL (100 CTS)
Dec 2030	0.50%	1-Dec-30	1.680%	0.6462	-4.2	0.75%	15.475 MM
Jun 2031	1.50%	1-Jun-31	1.717%	0.6971	22.9	0.53%	14.345 MM
Dec 2031	1.50%	1-Dec-31	1.771%	0.6841	150.2	-5.06%	14.618 MM

Under these conditions, the highest implied repo rate for any bond deliverable into the CGBU22 contract is 0.75% for the Dec 2030 and that bond is the CTD for the contract which is trading at a gross basis of -4.2 cents⁷.

Now imagine that, by midday on July 5th, a steepening of the curve has occurred in the 10-year segment and the Dec 2030 – Jun 2031 is now two basis points steeper at 5.7 basis points in total. At this new yield level, the Jun 2031 becomes the CTD and, importantly, the price of the contract would also change to reflect this. The new price of the futures contract⁸, to preserve our assumption of fair value between contracts and the (new) CTD bond, would reflect a 0.75% implied repo on the Jun 2031 bond to ensure no arbitrage opportunities between the futures contract and the new CTD. The new, steeper, yield curve scenario is shown in Figure 4, where the Jun 2031 is now CTD with the highest implied repo.

The net effect of the changed bond and futures prices is that the gross basis on the Dec 2030 has risen to 6.1 cents.

FIGURE 4**Midday Scenario: 5.7 bps Steep, Futures Fair Value to CTD**

CONTRACT	PRICE
CGBU22	140.40

BOND	COUPON	MATURITY	YIELD	CONVERSION FACTOR	GROSS BASIS	IMPLIED REPO _{LAST}	DV01 NEUTRAL (100 CTS)
Dec 2030	0.50%	1-Dec-30	1.680%	0.6462	6.1	0.26%	15.475 MM
Jun 2031	1.50%	1-Jun-31	1.737%	0.6971	17.8	0.75%	14.345 MM
Dec 2031	1.50%	1-Dec-31	1.791%	0.6841	144.2	-4.81%	14.618 MM

The net effect for various positions in this instantaneous shift would be:

- A 100 contract long position in CGBU22 loses about \$16,000 or the 16 cents per contract that the price of CGBU22 has fallen between the Starting scenario and the Midday scenario. The opposite is true (a gain) for short positions.
- A 100 contract position in long basis gains \$10,300, which can be thought of as the payoff for exercising the option because those portfolios had a long position in futures basis at -4.2 cents that has now moved higher to +6.1 cents. This position can (and should) be reset to reflect the new CTD by selling the Dec 2030 bonds and buying Jun 2031 bonds, effectively closing the long basis position in Dec 2030 and entering a new long basis position in Jun 2031. A short basis position experiences the opposite P(L) effect, of course.

While we use an option metaphor to describe the CTD switch in futures, there is one important difference which is that the holder of a long basis position can exercise this option as many times as the market provides opportunities. Unlike a traditional option, the delivery option does not disappear when it is exercised since the manager simply adjusts their hedge from one CTD to another. The simplest way to show this is to imagine that the manager with a long basis position has, after the curve steepening, reset their position to reflect the new CTD as described in the second bullet point above. After doing this, the manager sees the slope of the yield curve revert to 3.7 basis points by the end of the day. Even though the portfolio manager “exercised” the quality option at midday by converting their long basis position to the new CTD, s/he can do so again at the end of the day with the new flatter curve by reverting to their original position (selling Jun 2031 and buying Dec 2030) and keep the profits they earned by exercising the option. Doing so would generate an additional \$5,095 in profits as the Jun 2031 futures basis moves from 17.8 in Figure 4 back to 22.9 in Figure 3. The manager can continue switching their bond hedge as many times as they can profitably do so until delivery is made, or the position is closed.

⁷ A complicating factor here is that, if the Dec 2030 is CTD, there may be early delivery as carry during the delivery period is negative but only if this bond is the CTD. Here, we are ignoring the possibility of early delivery, which is an exercise of the timing option, not the quality option, to focus on the switch risk.

⁸ As the switch point gets closer, prices would actually change slowly to reflect this but we assume an instantaneous shift here to isolate the switch effect on various positions.

Conclusions for Portfolio Managers

Managers of portfolios that contemplate using the September 2022 10-year bond futures (CGBU22) contract⁹ may consider the following:

Know Your Risk

As noted above, a switch of CTD will benefit short CGB positions at the expense of long positions. Similarly, switch risk that is priced in when a switch fails to materialize would benefit long CGB positions at the expense of short positions. Fluctuations in the probability of a CTD switch can cause unexpected volatility in the futures price; typically welcomed by speculative traders but unwelcome in portfolios that use futures as a hedge instrument or substitute for bonds.

Calculate Value of Embedded Options

Unlike in past quarters, assuming the value of the quality option is zero due to the implausible market moves necessary to create a CTD switch will no longer be viable. Managers have several months from the publication of this paper in which to remember or re-learn how to value the embedded options in futures contracts.

Effect on Trading Liquidity

Liquidity in contracts will probably not be affected but there may be some shift away from contracts for more conservative portfolios. Speculators, normally drawn to volatility, may enter the market in greater numbers with strategies that aim to profit from the embedded option(s) present in the contracts. Futures positions may need greater maintenance given the potential for additional volatility and new opportunities to nimbly move between bonds and contracts for duration needs may arise. A more volatile contract can often lead to more mispricing or a greater difference in the relative pricing of contracts and bonds which creates profitable opportunities for more sophisticated speculators.

⁹ And potentially further CGB contract expiries.



Kevin Dribnenki writes about fixed income derivatives and opportunities in Canadian markets. He spent over 10 years managing fixed income relative value portfolios as a Portfolio Manager first at Ontario Teachers' Pension Plan and then BlueCrest Capital Management. During that time he managed domestic cash bond portfolios as well as international leveraged alpha portfolios and has presented at several fixed income and derivatives conferences. He received a BA in Economics from the University of Victoria, an MBA from the Richard Ivey School of Business, and holds the Chartered Financial Analyst designation.

For more information

irderivatives@tmx.com

[Read more](#) about Institutional Content

m-x.ca/futures

ⁱ BMO Capital Markets is a trade name used by BMO Financial Group for the wholesale banking business of Bank of Montreal, BMO Harris Bank N.A. (member FDIC), Bank of Montreal Ireland plc., and Bank of Montreal (China) Co. Ltd and the institutional broker dealer businesses of BMO Capital Markets Corp. (Member SIPC) in the U.S., BMO Nesbitt Burns Inc. (Member Canadian Investor Protection Fund) in Canada and Asia and BMO Capital Markets Limited (authorized and regulated by the Financial Conduct Authority) in Europe and Australia. "BMO Capital Markets" is a trademark of Bank of Montreal, and is used with permission.

Copyright © 2022 Bourse de Montréal Inc. All rights reserved. Do not copy, distribute, sell or modify this document without Bourse de Montréal Inc.'s prior written consent. This information is provided for information purposes only. The views, opinions and advice provided in this publication reflect those of the individual author. Neither TMX Group Limited nor any of its affiliated companies guarantees the completeness of the information contained in this publication, and we are not responsible for any errors or omissions in or your use of, or reliance on, the information. This publication is not intended to provide legal, accounting, tax, investment, financial or other advice and should not be relied upon for such advice. The information provided is not an invitation to purchase securities or derivatives listed on Montreal Exchange, Toronto Stock Exchange and/or TSX Venture Exchange. TMX Group and its affiliated companies do not endorse or recommend any securities referenced in this publication. CGB, Montréal Exchange and MX are the trademarks of Bourse de Montréal Inc. TMX, the TMX design, The Future is Yours to See., and Voir le futur. Réaliser l'avenir. are the trademarks of TSX Inc. and are used under license.