

March 2020

# Wildcard Option Simulation

The CDCC delivery reports for the CGFZ19 and CGBZ19 contracts indicate that a short position in CGF may have attempted<sup>1</sup> a small Wildcard option play while no one attempted such a trade in CGB. Figure 1 gives a summary of the early days of the delivery period for CGFZ19 where a few thousand contracts were delivered on days when bond prices increased after 3pm. No contracts were delivered into the CGB contract last quarter, save for a handful very near the end of the delivery period.

**FIGURE 1**

## CGF Delivery Report Summary

Date	CTD 3pm-5pm Change	Delivered Contracts
2-Dec-19	+5.9¢	1000
4-Dec-19	+2.5¢	2085

Source: [CDCC Delivery Reports](#)

A Wildcard exercise for CGFH20 seems odd since the Wildcard option embedded in the CGB contract, in the current environment, should be worth at least double that of the same option embedded in the CGF contract. Further, a hedged position in CGB carried positively during the delivery period so a short position in the contract was paid to wait for his/her payoff while the CGF carried negatively by a small amount every day.

We have prepared a simulation model to estimate the value of the Wildcard option in CGBH20 and CGFH20 in order to clarify why this activity is unusual.

## Wildcard Option

As a reminder to physical delivery futures participants, there are several options embedded in these contracts and all are “owned” by the short position. We will not discuss all of the embedded options here as, for the most part, current yield and yield curve slope levels render the other options worthless<sup>2</sup>. For a review of all the different types of options, please refer to [Embedded Options in CGF and CGB Futures](#) published by Montréal Exchange in November 2018.

1. The delivery reports don't indicate the time that delivery notice was made, only the date, so it is impossible to infer with certainty from public information what the intent was of the delivered position.

2. Except the timing option which allows the short futures position to avoid negative carry by delivering early. In the absence of surprise Bank of Canada rate changes, this “option” is very predictable and fully priced by the market.

In this paper, we address only the Wildcard option, which arises because of a timing mismatch between the settlement calculation for the futures contract at 3pm<sup>3</sup> and the 5:30pm time at which a short position must decide whether he/she will give notice to deliver at the settlement price for the contract.

If bond prices increase<sup>4</sup> after the futures settlement price is determined but before delivery notice must be made, a short futures position can profit from this late-day price movement by choosing to deliver at the futures price set several hours earlier. For a full description of a successful Wildcard option exercise, please refer to [CGB Case Study: Wildcard Option Exercise](#) published by Montréal Exchange in July 2019.

## Simulation Method

For this valuation exercise we chose to use a simulation method to determine, over thousands of iterations, how much profit can be extracted from holding a long basis position during the delivery period for the CGF and CGB contracts. A long basis position is a long position in the cheapest-to-deliver (CTD) bond paired with a short position in the futures contract; both positions have identical DV01 risk.

We devise a decision function where the holder of the Wildcard option makes a decision at 5pm<sup>5</sup> to deliver or to do nothing and wait for another opportunity the next day. The option exists only on trading days between (and including) First Notice and the day before<sup>6</sup> the Last Trading Day; in the case of H20 futures, the 16 business days between February 27<sup>th</sup> and March 19<sup>th</sup> inclusively.

## Decision Function

At 5pm, the long basis holder may decide to deliver early at the settlement price for his/her contracts calculated by the Exchange at 3pm. Any change in bond prices between 3pm and 5pm will influence his/her decision and we assume here that the basis holder will choose to exercise if more profit can be captured by delivering early than by waiting until Final Delivery on the last business day of the Delivery Month.

Technically, since the remaining value of the Wildcard option is destroyed by exercising (i.e. an option can only be exercised once), one should take into account the value of the remaining option as a hurdle. We choose not to since 1) the option, however valuable, is very difficult to sell given that the liquid roll period has already passed and 2) we suspect that most Portfolio Managers would take certain profits today over uncertain (or zero) profits before the expiry of this very short option. Perhaps some managers could forego profits today for potential profits tomorrow but much of behavioral economics suggests otherwise.

## Distribution, Calculation, & Simulation

We measured the actual change of the cheapest-to-deliver bond price between 3pm and 5pm for 3.5 years (for CGF) and 4.5 years (for CGB) and created a histogram of those changes. From this data sample, we extracted the price change *during the delivery period* for the past 14 contracts since there is a good argument that the CTD should be less volatile during the futures delivery period because Wildcard holders will exert selling pressure on the CTD as the price rises after 3pm as they are selling their delivery tail in anticipation of exercising the option<sup>7</sup>. We then calculated the four parameters of best fit for a JohnsonS<sub>U</sub> distribution<sup>8</sup> which was used to run the random draws for the simulation. A histogram of actual observations overlaid with the fitted JohnsonS<sub>U</sub> distribution is shown in Figure 2.

3. Except for early close trading days where the settlement calculation is done at 1pm.

4. For all contracts right now, a short futures position benefits if bond prices RISE after the futures settlement. If conversion factors are greater than 1, which is unlikely to occur in the foreseeable future, the opposite will be true.

5. We chose 5pm because it is the accurate data we have access to but also because it leaves 30 minutes for the futures short to arrange delivery notice and to execute a transaction on the delivery tail.

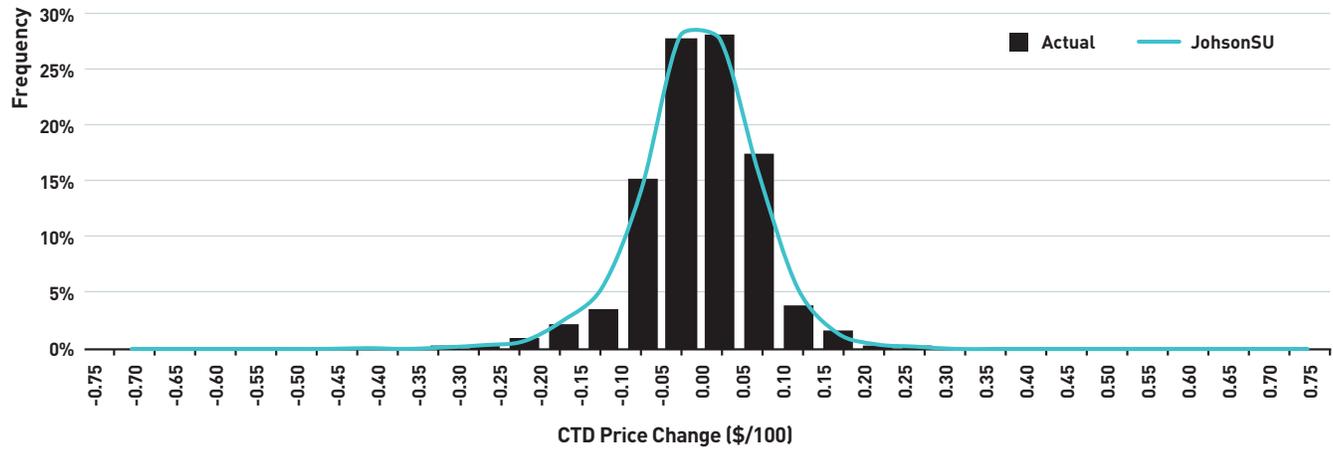
6. There is no Wildcard option on the Last Trading day as remaining positions will be delivered with certainty.

7. We found zero evidence of this in the data. Delivery period volatility between 3pm and 5pm was nearly identical to CTD volatility between 3pm and 5pm outside the delivery period.

8. A transformation of the normal distribution sometimes used to model asset returns which can account for extreme values a little better than a normal distribution.

FIGURE 2

## 3pm-5pm CTD Price Changes; Observed & Simulated



Source: BMO Capital Markets Fixed Income Sapphire database

On each of the 16 days between February 27<sup>th</sup> and March 19<sup>th</sup> that the Wildcard option exists, we used the distribution function calibrated above to simulate a value for the 3pm to 5pm price movement of the CTD bond and, if the profit obtained by exercising the Wildcard option exceeded the remaining carry in the position<sup>9</sup>, the bond was delivered into the contract that day and the delivery tail, which generates a profit for the Wildcard holder, was sold at the 5pm price. The profit is therefore:

$$\Pi_t = (B_{t5pm} - B_{t3pm}) * (1-CF)/CF - \max(C_R, 0)$$

Where:

$\Pi_t$  = Profit on day t (per \$100 nominal value)

$B_{t5pm}$  = CTD bond price at 5pm on day t

$B_{t3pm}$  = CTD bond price at 3pm on day t

CF = Conversion factor for the CTD bond

$C_R$  = Remaining carry (per \$100 nominal value) in a long basis position until the Final Delivery date

Of course, after the first date when exercise is profitable, the simulation ends as the Wildcard option can only be exercised once. We simulated 25,000 delivery periods for CGFH20 and CGBH20 using the above criteria to generate the results presented in the next section.

## Valuation Results

The simulation results are shown in Figure 3 where the CGFH20 Wildcard option can be expected to generate 0.6 cents on average during the Delivery Period. For CGBH20, the value that can be extracted from the Wildcard converges to about 1.3 cents in the simulation. Recall that the values in Figure 3 are the option values without regard to the positive or negative carry. The Portfolio Manager can earn (or must pay) the carry in addition to the value extracted from the option.

FIGURE 3

## Simulation Delivery Period Profit (per \$100 nominal value)

Contract	Simulation Profit	Carry (Feb27 to Mar31)	Wildcard Value
CGFH20	0.006	0.000	0.006
CGBH20	0.030	0.017	0.013

9. CGFH20 carries negatively so the threshold to exercise was any increase in price after 3pm.

# Conclusions

Given that conditions were similar, although not identical, during the Z19 contract delivery period, it appears that an attempt to monetize a CGF Wildcard option is, indeed, unusual since no attempt was made to do so for the CGB contract. At this time, based on the above results, we think this activity is unlikely to have been the result of a Wildcard option exercise, or may have been a one-off experiment that is unlikely to be repeated.

## Possible Explanations

Although unusual, there are potential explanations for this type of behavior.

First, it is always possible that what appears to be a Wildcard exercise in the data is actually just a normal delivery by a short position anxious to avoid the negative carry of holding the position to the end of the delivery period. We don't know from public data that notice to deliver wasn't given to the Exchange at noon, for example, prior to the 3pm-5pm volatility that developed that day.

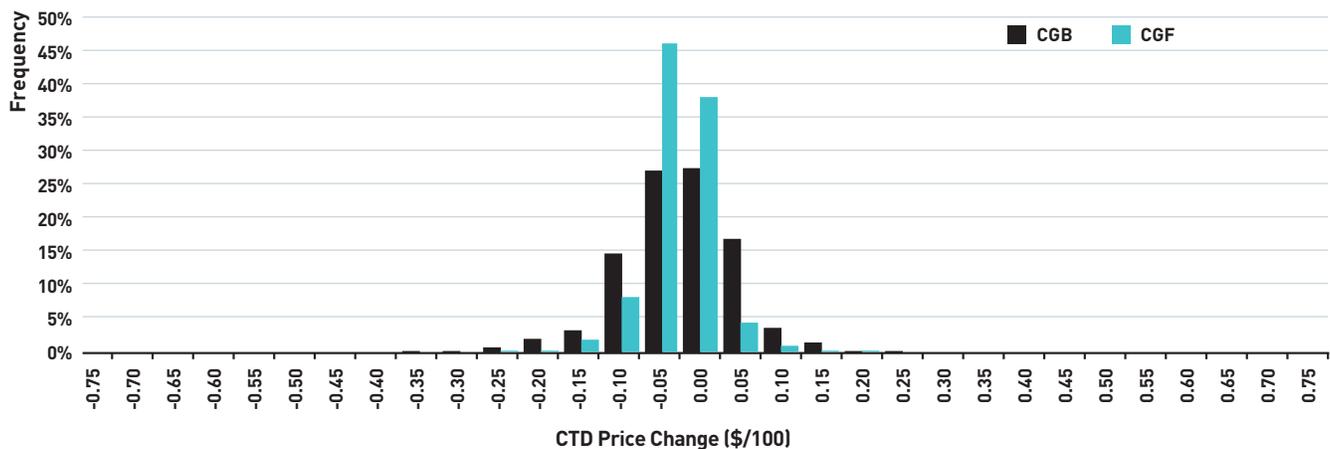
Second, it is possible that the long basis position was established at such an attractive level that the option was acquired for nothing, or even that the acquirer was paid to establish the option position. This is more possible than some observers think given that the option is an embedded option where the price is reflected only in the (lower) price of the futures contract. There have been periods in the past where long basis positions were established at prices that implied negative values for the options being purchased.

## CGF versus CGB

As a final comment, we can use the price data to help demonstrate why the CGF Wildcard results in less profit than the same option embedded in CGB. In Figure 4, we plot the distribution of actual 3pm to 5pm price changes for the respective CTD bonds for previous contracts. The CGF distribution is much more concentrated in the center, with fewer large price changes in both the left and right "tails." This observation should also be intuitive to market watchers since curves have been flat for some time and large slope changes between 3pm and 5pm should be rare. Given this state of markets, a 1 basis point move in yield for a 10-year bond should result in about an 8 cent change in price while a similar 1 basis point move in yield for a 5-year bond (i.e. a parallel curve shift based on new information after 3pm) should result in about a 4.5 cent change in price. Since the option is valuable for an increase in price, the CGF option should be less valuable in a yield curve environment where the slope between 5-10 year bonds is flat and reacts to new information with parallel shifts.

FIGURE 4

### 3pm-5pm CTD Price Changes; Observed



Source: BMO Capital Markets' Fixed Income Sapphire database

Additionally, the hedge tail<sup>10</sup>, which scales the profits to be achieved by exercising a Wildcard option, is larger for CGB than for CGF. Specifically for the H20 contracts, the hedge tail for CGB is \$34,662 per contract while for CGF it is only \$21,242 per contract.

The two factors of less price volatility and lower hedge tails combine to make the CGF contract Wildcard option essentially worthless while the holder pays negative carry to hold it. The CGB Wildcard is worth a far more significant 1.3 cents per contract while the holder is paid to wait for favorable conditions to exercise.



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10. The excess notional of the bond needed to be interest rate neutral due to the CTD conversion factor. The hedge tail is sold on exercising the Wildcard option since it is not needed to satisfy the requirements of delivering into the contract.