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CGB **Ten-Year Government of Canada Bond Futures**

MONTRÉAL EXCHANGE

CGB as Substitute for 10y Benchmark Bonds

Strategy Comparison: 2011-2020

Summary

In early 2017, we devised a historical model to evaluate the performance of 10-year futures contracts (CGB) relative to cash bonds in a systematic investment process. The approach applied historical prices to a simple all-cash, long-only strategy where a comparison was made between implementing the investment process via CGB contracts or 10-year benchmark bonds[1].

At the end of February 2020, we find that the strategy is still appealing for most portfolios with a caveat that a historically unusual flattening of the entire yield curve in 2017 and 2019 caused sustained periods of underperformance.

2017 Model

In 2017, we concluded that "the historical performance of replicating a cash position in the Canada 10-year benchmark bond using only CGB contracts has been reasonable since 2011, despite a difficult environment and the potential for additional transaction costs incurred by rolling a futures position each quarter."

Next, we examined the sources of variance between the long-only strategy implemented in CGB contracts and the same strategy implemented in cash bonds, and found two which were quantifiable; the term difference between the CGB contract cheapest-to-deliver bond (CTD) and the 10-year benchmark bond, and transaction costs. We quantified the two differences and allotted the remaining difference in P(L) to the Basis, essentially the pricing difference that is almost always present between futures contracts and 10-year bonds. Our 2017 paper found that the negative effect of the flattening curve during the period studied had been overcome by the additional P(L) generated by the Basis as well as the lower transaction costs of the futures contracts.

Finally, we identified a number of situations where Portfolio Managers may wish to utilize futures contracts rather than cash bonds which included minimizing costs, increasing cash available for investment elsewhere without running a time-consuming securities lending program, or even to express a steepening view on the market.

2020 Update & Refinement

While the 2017 model was robust and covered nearly an entire economic cycle[2], several years have passed and the approach merits a refresh. We have made some refinements to the model in 2020 and list them below. The model description from 2017 is included in the Appendix at the end of this paper.

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1   For additional details on the 2017 historical model, refer to "**CGB as Substitute for 10y Benchmark Bonds**" published by the Montréal Exchange.

2   Although notably lacking a long period of rising interest rates.

Model Refinements

Changes made to the 2020 version of this model include:

- **Variant margin.** Due to large up and down moves in interest rates, margin rates on CGB have varied from year to year. For example, per-contract initial margin has varied from a low of $1850 in 2013 and high of $2600 in 2014, to $2330 at the time of writing[3]. Rather than utilize an average margining rate for the entire period studied, we allow contract margin rates to vary, although still only once per year for simplicity.

- **Cash management.** Most of the unused cash in the CGB model will never be used for margining purposes and the 2017 model unnecessarily invested all the excess cash at the overnight rate. The 2020 model for the CGB strategy invests $1 million in the overnight market and invests the remainder for a 1-month term.

- **Settlement date.** In September 2017, Canada moved to T+2 settlement on bonds from T+3. Doing so resulted in a move of one business day later in the month for First Notice on futures contracts as well as delayed the start of the quarterly roll period by a day. These changes have been incorporated into the model.

- **Closing bid/ask on CGB.** We have changed the end-of-day CGB quotation for the closing bid/ask. Rather than utilize the end-of-day bid/ask, we have assumed, safely we believe, a 1-cent wide market from the settlement price of the day for the contracts. This reflects a time of trade that is liquid rather than waiting for liquidity to subside for the day. Importantly, this change is applied to the entire data set so the CGB strategy reflects the P(L) of such a strategy, given existing deep liquidity in contracts.

- **Flattening costs.** Our original 2017 work included an approximation of the costs of a flattening curve by using a 7-10 yield curve proxy. The 2020 model quantifies the variance between the two strategies more accurately by using a constant maturity 8.5-9.5 segment of the yield curve to calculate gains or losses attributable to changes in the curve slope. The CTD for the CGB contract averages 8.5 years to maturity and the 10-year benchmark bond averages 9.5 years to maturity so it makes more sense to use that portion of the yield curve rather than a proxy 7-10 slope.

Results

We find in this updated research that using a CGB position as a substitute for an initial portfolio of $10 million of 10-year benchmark bonds is still appealing, but with caveats for investors concerned with variance or periods of underperformance. The updated model finds that the CGB position outperformed the 10-year bond position over the 9.2 years in the study by a considerable amount as shown in Figure 1, which now includes the P(L) differential in basis points as well as outright dollars. Although the result is quite impressive given the lengthy period studied, we note the 2019 outlier highlighted in the Figure where the CGB strategy underperformed by $26,000 during the year.

FIGURE 1

	CGB P(L) $	10Y P(L) $	Difference $	Basis Points
2011	1,505,889	1,459,806	46,083	5.8
2012	464,499	456,793	7,706	0.1
2013	-608,289	-648,552	40,264	4.8
2014	1,436,473	1,380,065	56,408	5.9
2015	761,160	748,031	13,129	1.9
2016	-44,733	-82,397	37,664	2.8
2017	-68,706	-81,801	13,095	0.9
2018	496,883	390,453	106,429	7.9
2019	538,032	564,109	-26,078	-1.0
***2020**	779,562	730,106	49,456	5.6
Total	5,260,769	4,916,613	344,156	34.7

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

3 February 28th, 2020.

As with our 2017 paper, we present in Figure 2 the annualized Sharpe ratios for both the CGB strategy and the 10-year bond strategy and find them to be similar enough to assuage most concerns about performance volatility.
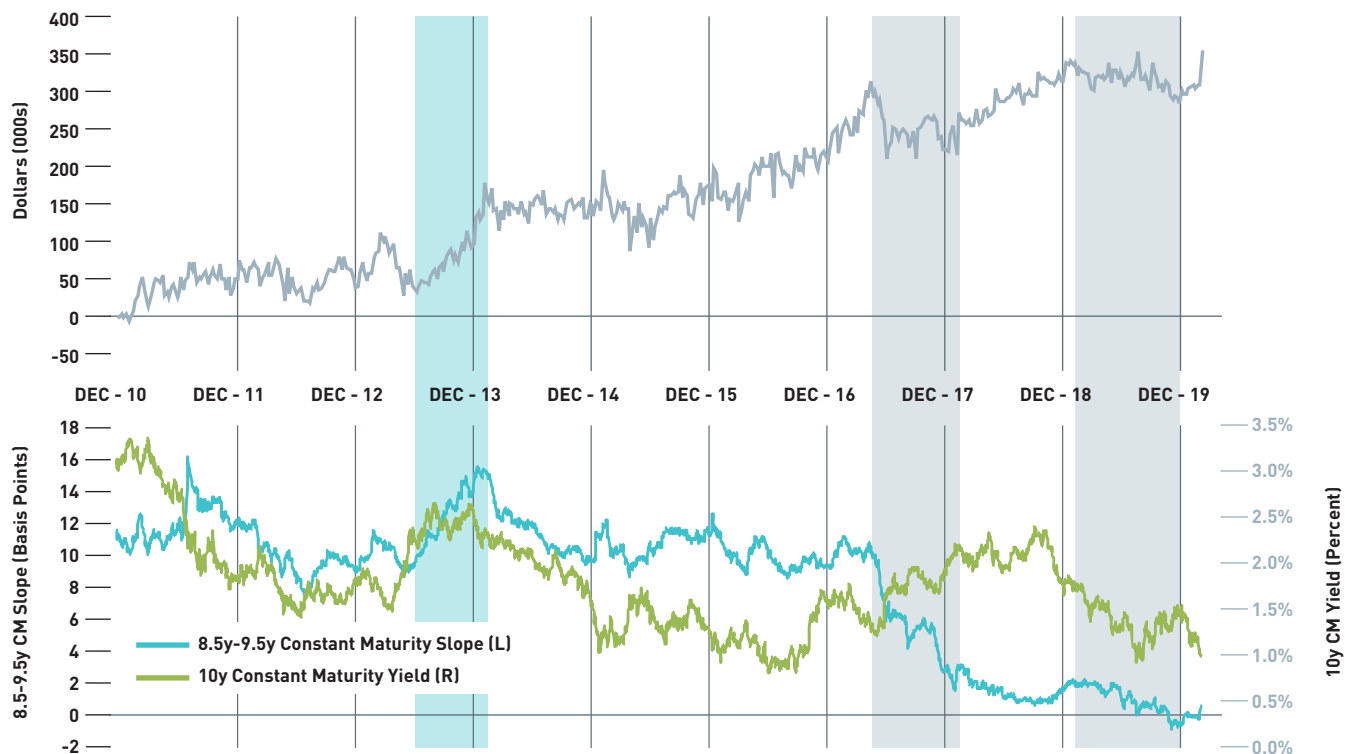
FIGURE 2

SHARPE RATIO TERMS	CGB Annual Sharpe	10Y Annual Sharpe	Difference
2011	2.0	2.0	0.0
2012	0.8	0.8	0.0
2013	-0.9	-1.0	0.1
2014	2.3	2.4	0.0
2015	0.8	0.8	0.0
2016	-0.1	-0.2	0.1
2017	0.1	0.0	0.0
2018	0.7	0.6	0.1
2019	0.8	0.8	0.0
*2020	4.6	4.3	0.2
Total	**0.74**	**0.72**	**0.0**

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

Finally, in Figure 3, we plot the relative performance of the two strategies from January 2011 to February 28, 2020. In Figure 3, the top chart shows the relative performance where a move higher on the chart means P(L) of the CGB strategy is exceeding that of the 10-year cash bond strategy and vice-versa. The lower chart in Figure 3 shows the 10-year constant maturity yield (right axis, in percent) and the slope of the 8.5-9.5 constant maturity yield curve (left axis, in basis points).

FIGURE 3

Relative Performance Weekly P(L) (CGB minus 10y Bonds)

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

We have highlighted in grey two periods of underperformance in Figure 3; May 2017 to February 2018 and February 2019 to December 2019. These two time periods are the periods of greatest underperformance by the CGB strategy relative to the 10-year strategy. It is no coincidence, of course, that one can observe the 8.5-9.5 curve flattening significantly in the lower chart in Figure 3 during these two time periods. In fact, the 2019 underperformance of the CGB strategy is entirely attributable to curve flattening and the fact that 2017 eked out a positive performance over the 10-year bond strategy is only due to the fact that the extended drawdown of $51,000 is split over 2017 and 2018.

Figure 3 also has a blue highlighted region that shows the positive effect that a steepening curve has for the CGB strategy relative to that of the 10-year bond. However, periods of curve steepening have been rare in Canada in the past 10 years.

Sources of Variance

Two obvious sources of variance are the flattening curve, mentioned above, and potential differences in transaction costs. We have quantified each of these in Figure 4 and will discuss them in a little more detail in the following sections.

FIGURE 4

VARIANCE SOURCE	CGB Strategy Outperformance
8.5y-9.5y Flattening	-93,296
Transaction Costs	26,920
Residual (Net Basis)	410,533
Total	344,156

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

Extraordinary Curve Flattening

As mentioned above, as well as in our 2017 paper, a flattening curve can cause the futures contract to underperform the 10-year bond. In fact, shortly after we published the original model in 2017, the curve began to aggressively flatten from about 10 basis points of yield differential between a bond of 8.5 years to maturity and one of 9.5 years to maturity. This flattening resulted in periods of underperformance by the CGB strategy in 2017, 2018, and especially in 2019 as shown in Figure 3. However, we take comfort in the fact that in most years, the sustained flattening of Canada's yield curve since early 2014 was not enough to push the CGB substitution strategy into negative relative performance versus the 10-year bond strategy.

Transaction Costs

One reason the CGB strategy usually beats the bond strategy is that the CGB strategy is more efficient to trade. Although the futures must be rolled each quarter, resulting in more trading, as shown by the count of trades generated by the model over the 2011-2020 period studied in Figure 5, there are no coupons to reinvest and the roll can now always be done at just 1-cent wide bid/offer during the active roll period. The single cent bid/offer on CGB and lack of coupon reinvestment[4] is enough to compensate for the added trading activity.

FIGURE 5

	CGB Transactions	10Y Bond Transactions	Difference
Total Count	87	37	-50
Total Cost	39,970	66,890	26,920
Annual	4,364	7,304	2,939

4   Coupon reinvestment is typically a small cost when coupons are so low.

Basis (despite low yields and worthless options)

As in 2017, we use here the term Basis and Residual interchangeably since any additional P(L) difference between the two strategies is the result of price differentials between futures and bonds. Typically, the contract will fluctuate between rich and cheap relative to bonds, sometimes several times per quarter, depending on supply and demand, and the daily price fluctuations are inconsequential for the long-term holder. In fact, the price differential is a source of outperformance for CGB since the price of CGB is usually a little lower than the price of the CTD bond due to the presence of embedded options[5]. These options, owned by the short position in futures, have almost always expired worthless and the futures buyer generates a small amount of outperformance by allowing any option value to decay during the holding period.

Over the 2011 to 2020 period studied in the updated model, Basis was more than enough to compensate for the approximately $93,000 lost over the 9+ year period due to the significant flattening of the curve. Outside of 2019, the positive drift to P(L) associated with owning CGB contracts instead of 10-year bonds either mitigates losses associated with flattening of the curve or leads to outperformance by the CGB strategy.

2019

The underperformance of the CGB strategy in 2019 represents a near "perfect storm" for the CGB strategy. In addition to the $30,000 of underperformance due to the curve flattening from +1.7 to -0.7 basis points in 2019, additional draws on performance were:

- **Futures started the year rich and ended it quite cheap**. Normally, futures fluctuate between being rich and cheap to bonds but in 2019, they happened to be quite rich at the end of 2018 and finished the year very cheap.

- **Curve inversion.** Normally, CGB enjoys an additional "rolldown" effect versus the 10-year benchmark bond because the curve is steeply convex. However, due to the flat curve, the convex shape disappeared in 2019 and the CTD on the contract didn't outperform the 10-year benchmark bond after accounting for rolldown.

- **Valuable timing options.** The strategy, by being long CGB, was short some embedded options that became valuable rather than decaying to zero. For the first half of 2019, the timing option was valuable due to the negative carry of a short basis position[6]. While early delivery doesn't affect our strategy since we never enter the delivery period, the timing options that the strategy was implicitly short did not converge to zero near the roll date as they would in a normal environment.

Conclusions

Although the results from 2019 are disappointing, we believe the long-term strategy of holding CGB contracts instead of 10-year Canada bonds is still attractive, although some additional variance caution is in order versus our previous observations in early 2017. In a normal year, the lower transaction costs and small gains from embedded option decay are enough to offset any losses associated with flattening of the curve. Fluctuations in the relative price of the futures versus bonds are normally small enough that a long-term investor need not be concerned.

However, given the current state of the yield curve, we can offer some insight into the use of this strategy in the future.

- Depending on the overnight rate between May 2021 and May 2022, timing options in CGB may again become valuable due to the very low coupon on the 1.25% June 2030 bond that will be CTD for the CGBU21 to CGBU22 contracts[7]. Due to the value of these embedded options, the price differential between CGB and the CTD bond may not converge to zero.

- With extremely low rates and flat curves at the time of writing, much of the curve flattening risk appears to be in the past, not the future. Curves could invert more or stay inverted for a long period of time, of course, but the negative P(L) associated with the 11 basis points of flattening in the 10-year sector between May 2016 and December 2019 will be difficult for the market to replicate in future. The CGB strategy as a substitute for 10-year bonds may be attractive to managers with a curve steepening view.

- The benefit of lower transaction costs and the normally small variance between the two strategies is in addition to the enterprise costs that can be saved by the implicit leverage embedded in the futures. A firm can avoid security lending on 10-year bonds entirely via this strategy and, replacing 10-year bonds with CGB may also be an efficient way to generate leverage, if desired.

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5   For a full discussion of all the options embedded in CGF and CGB contracts, refer to "**Embedded Options in CGF and CGB**" published by the Montréal Exchange in late 2018

6   Carry is negative when the bond coupon is below the overnight rate.

7   Typically, the Bank of Canada target rate needs to exceed the coupon rate to make early delivery attractive. At time of writing during the COVID-19 pandemic, the target rate is 0.25%, we assume temporarily.

Appendix

Model Description from 2017

Two total return historical series were calculated to compare their results. To generalize the models, and to reduce the assumptions about investor behavior, the management of the positions is minimized and the systematic strategies operate on very few rules.

Both strategies start with $10 million CAD in cash. Both transact at market closes and sell to the closing bid level or buy at the closing ask level with no reduction in transaction costs for simultaneous buy/sell transactions.

10y Cash Bond Strategy	CGB Strategy
• Investor is 100% invested in the current 10y Canada benchmark bond at all times. • On the first day of a new 10y benchmark bond (generally once per year), the strategy sells all of its previous holdings and invests the total proceeds in the new bond. • Coupons received are fully re-invested on the day they are received.	• DV01 of the CGB holdings matches the 10y Cash Bond Strategy above on each day, rounding up or down to two whole contracts. • Initial margin is posted at the speculator rate and maintenance margin is settled daily. No interest is earned on posted margin. • Leftover cash is invested in highly liquid short-term money market securities at Bank of Canada recorded rates[8]. • The strategy never takes, or risks, delivery. All open contracts are rolled each quarter to the active contract on T-5 from First Notice Date[9].

8   A blend of overnight ($1 million) and 1-month term (the remaining unused cash) in the 2020 version of the model.

9   T-4 after the change from T+3 settlement on bond to T+2 settlement in September 2017.

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