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MONTREAL EXCHANGE

CGF as Substitute for 5y Benchmark Bonds

Strategy Comparison: 2013-2020

Summary

In 2017, we released a paper describing a model, adapted from a CGB versus 10-year model released earlier, that evaluated the performance of 5-year futures contracts (CGF) relative to cash bonds in a systematic, DV01 matching process. That approach applied historical price changes for the futures contract and benchmark bond in a simple investment process to compare the amount of trading required, costs of the investment process, and relative performance of each instrument.

As of February 2020, using updated prices for the three years since the original model was released and tweaking the methodology to make incremental improvements, we find that the CGF model has generally outperformed the 5-year cash bond strategy over the past 7 years and should continue to do so now that the contract has attained respectable liquidity.

2017 versus 2020

In 2017, we stated that “the historical performance of replicating a cash position in the Canada 5y benchmark bond using only CGF contracts has been reasonable since 2013 despite limited liquidity in the contract and the potential for additional transaction costs incurred by rolling a futures position each quarter.”

More specifically, the liquidity limitations were clear at the time for CGF; open interest each quarter was around 5,000 contracts, had fallen to just over 4,100 for the June contract, and the closing bid/ask was often 5-10 cents wide although it did normally trade much tighter during market hours. We had reservations in 2017 as it was unclear what type of client could truly benefit from the strategy so we included a disclaimer about liquidity and scalability, as well as a note about the “safety valve” of simply taking delivery of the bonds if liquidity to exit the position wasn’t available at the end of the contract life.

As we revisit the model in 2020, the improvement in the liquidity of the CGF contract in just a few years is remarkable. CGFH20 had an open interest of over 80,000 at the end of February¹ and usually closed with a 1-cent bid-offer spread and traded at that 1-cent spread most of the time while the market was open. Typically, the entire open interest is closed easily during the roll period and the notion of a long or short position becoming trapped is barely worth mentioning any longer.

2020 Update and Refinement

The 2017 model followed almost the exact same rules as the CGB model. The model was simple and robust and covered as much time as we could reasonably call the “post-Financial Crisis” era in Canada given the more limited data set available for CGF contracts. In 2020, we have made several refinements² to the model, which we list below. The model description from 2017 is included in the Appendix at the end of this paper.

¹ A near 20-fold increase in open positions.

² Virtually the identical refinements were made to the CGB model to update it to 2020.

Model Refinements

Changes made to the 2020 version of this model include:

- **Variation margin.** Due to large up and down moves in interest rates, margin rates on CGF have varied from year to year. For example, per-contract initial margin has varied from a low of \$700 in 2013 and high of \$1900 in 2017 to \$1145 in early 2020. 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. For CGF, this aspect of the model is less important than for CGB given that little margin is posted during the period studied.
- **Cash management.** Most of the unused cash in the CGF 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 CGF 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 CGF.** We have changed the end-of-day CGF quotation for the closing bid/ask. Rather than utilize the end-of-day bid/ask, we have assumed, safely we believe, a 2-cent wide market from the settlement price of the day for the contracts³. Importantly this change is applied to the entire data set so the CGF strategy reflects the P(L) of such a strategy, given existing liquidity in contracts.
- **Flattening costs.** Our original 2017 work included an approximation of the costs of a flattening curve by using a 3-5 yield curve proxy. The 2020 model quantifies the variance between the two strategies by using a constant maturity 4.5-4.8-year segment of the yield curve to calculate gains or losses attributable to changes in the curve slope. The CTD for the CGF contract averaged 4.5 years to maturity and the 5-year benchmark bond averaged 4.8 years to maturity so it makes more sense to use that portion of the yield curve rather than a proxy 3-5 slope. Note that recent changes to the delivery terms of the CGF contract have nearly eliminated any maturity difference between the contract and the benchmark 5-year bond.

Results

We find that, with existing liquidity in CGF, using a CGF position as a substitute for an initial portfolio of \$10 million of 5-year benchmark bonds in a simple DV01-matching process has outperformed in each calendar year, despite curve flattening or a substantial rise or fall in 5-year bond yields.

Looking first at the yearly P(L) summaries in Figure 1, we see that the CGF strategy has outperformed the 5-year cash bond by just under \$400,000 over the 7 years and 2 months covered in the existing data set. These results are remarkably consistent, although we note that 2019 generated a lower excess profit than any other year in the data.

FIGURE 1

	CGF P(L) \$	5Y P(L) \$	Difference \$	Basis Points
2013	17,142	-54,080	71,222	16.2
2014	565,450	508,568	56,882	12.0
2015	536,961	476,444	60,516	16.1
2016	-23,924	-73,553	49,629	6.2
2017	-109,843	-185,506	75,663	15.0
2018	277,565	237,765	39,801	7.5
2019	282,112	255,031	27,080	5.7
*2020	333,975	326,247	7728	1.9
Total	1,879,438	1,490,917	388,520	80.6

*January to February 2020

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

3 The contract trades either 1 or 2-cents bid/ask during opening hours.

As in 2017, we generated annualized Sharpe ratios for each year in Figure 2 based on weekly performance for both the 5-year bond strategy and the CGF equivalent. Generally, these results are similar, and the CGF Sharpe is higher than the 5-year, indicating that the outperformance was not accompanied by greater P(L) volatility.

FIGURE 2

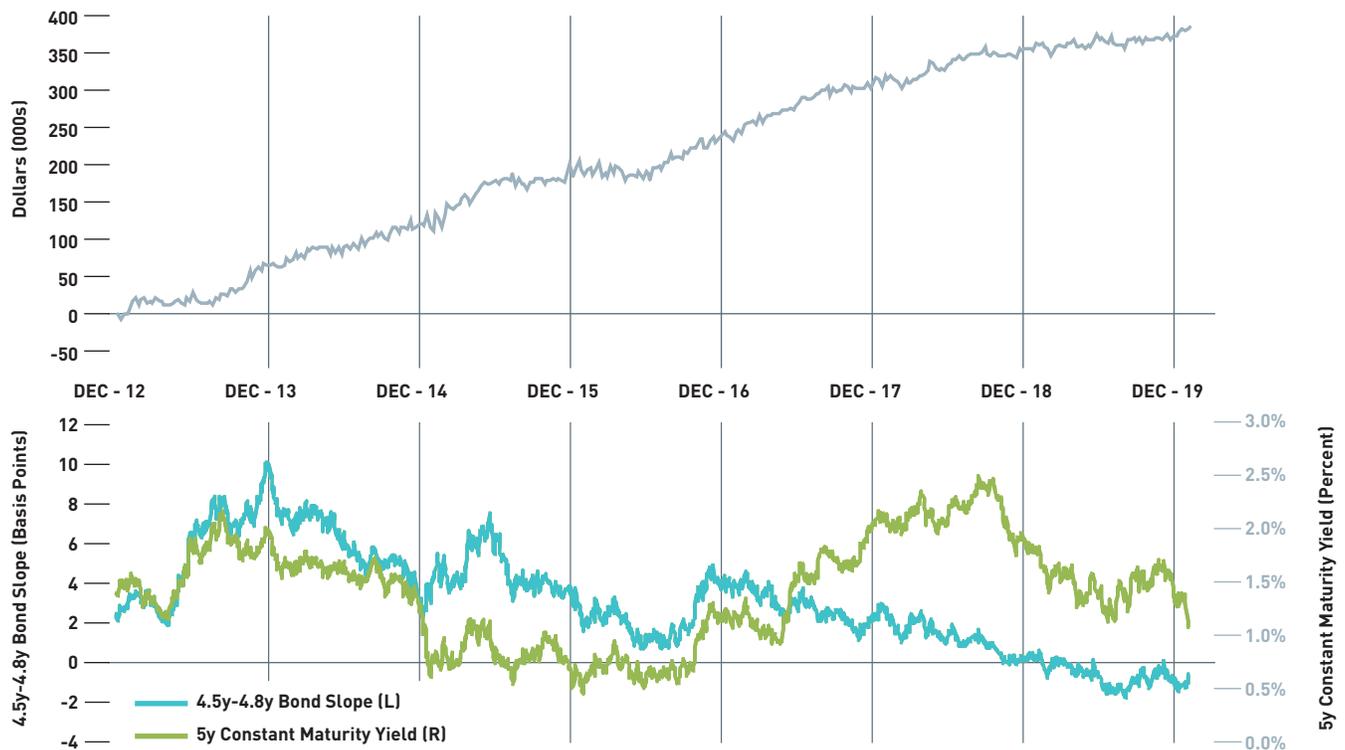
SHARPE RATIO TERMS	CGF Annual Sharpe	5Y Annual Sharpe	Difference
2013	0.0	-0.2	0.3
2014	2.3	2.1	0.2
2015	1.5	1.2	0.3
2016	-0.1	-0.2	0.1
2017	-0.4	-0.7	0.3
2018	1.0	0.9	0.1
2019	1.0	0.9	0.1
*2020	4.5	4.5	0.1
Total	0.9	0.74	0.2

*January to February 2020
Source: Montréal Exchange, BMO Capital Markets' Fixed Income Sapphire database

Finally, in Figure 3, we present the full results in graphical format. In Figure 3, the top chart shows the relative performance, where a move higher on the chart means P(L) of the CGF strategy is exceeding that of the 5-year cash bond strategy and vice-versa. The lower chart in Figure 3 shows the 5-year constant maturity yield (right axis, in percent) and the slope of the 4.5-4.8-year constant maturity yield curve (left axis, in basis points).

FIGURE 3

Relative Performance Weekly P(L) (CGF minus 5y Bonds)



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

Sources of Variance

Two obvious sources of variance are a flattening curve and potential differences in transaction costs. Just as we did in 2017, 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	CGF Strategy Outperformance
4.5y-4.8y Flattening	-7,550
Transaction Costs	12,542
Residual (Net Basis)	383,529
Total	388,520

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

Curve Flattening / Inversion

Unlike in the CGB model, which suffered considerably from flattening curves due to the normal 1-year difference in maturity between the CGB contract and the 10-year benchmark bond, the extreme flattening of the yield curve during the period studied had little effect on the CGF model and cost it only about \$1000 per year in underperformance. Until recently, the normal difference in maturity between CGF and the 5-year benchmark averaged just 3 months and, after a recent change in the contract terms for delivery, the 5-year benchmark is almost always the CTD bond.⁴ This aspect of the 5-year model thus differs substantially from the 10-year model and makes CGF an excellent hedging instrument going forward⁵.

Transaction Costs

Transaction costs were not a very significant portion of the outperformance for CGF either. In fact, the annual difference, shown in Figure 5, is just under \$2000 per year, although that in itself is remarkable given the need to roll the contracts each quarter. Generally, for the 5-year model, very little buying and selling is done except to roll contracts or to increase DV01 slightly when a change in benchmark occurs in the 5-year cash bond strategy.

FIGURE 5

	CGF Transactions	5Y Bond Transactions	Difference
Total Count	74	46	-28
Total Cost	57,980	70,522	12,542
Annual	8,097	9,848	1,751

Basis (despite low yields and worthless options)

By far the largest source of variance in the 2020 model, especially now that the CTD for CGF is almost always the benchmark 5-year bond, is the basis between the price of the 5-year bond and the cost of obtaining similar duration from the CGF contract. For the majority of the time studied, CGF enjoys a steady grind upward in terms of relative profits because it picks up yield by buying the forward rather than spot and earns a small premium on the unused cash invested.

June 12th, 2017 Example

To demonstrate, we examine a single day which is typical of the strategy. On June 12th, 2017, the 5-year bond had a yield of 0.956% while the converted yield of the CGF contract was 0.964%. The contract, due to an upward sloping yield curve between overnight and 5-year, and a slightly lower price caused by a cheapness in futures relative to bonds on that date, earned a basis point more than the bonds. This is typical in an upward sloping curve environment.

⁴ For additional information about the modifications to the CGF delivery standards, please refer to the Bourse [Circular 100-19](#) published on July 23rd 2019.

⁵ Although all investors should note that changes in relative price between the contract and bond still occur daily, i.e.) the gross basis fluctuates day to day.

Additionally, during some of the period studied, the embedded options had some value such that the value of these options decays to zero, or nearly to zero, by the end of the active life of the contract. The buyer accrues this decay in option value, assuming a CTD switch or early delivery is not triggered. For some contracts in 2018 and 2019, the coupon rate on the CTD was lower than the overnight rate meaning the timing option was valuable (early delivery was implied) and the owner of CGF during these times didn't accrue the profits associated with decaying timing options.

Note also that most cash wasn't needed on this date for margining purposes. In fact, the strategy posted only \$158,752 of margin that day, largely initial margin as the market value of the contracts was negligible at that point. The strategy keeps \$1 million of overnight cash to insure against calls for incremental margin and that cash earned 0.50%, the overnight rate on that date, but invests the remainder at the 1-month BA rate and picks up additional basis points on the excess cash by doing so. Using contracts means the investor is mathematically paying away the Implied Repo rate but that rate has historically been lower⁶ than the 1-month BA rate so the strategy earns basis points on its cash, even after accounting for the implied financing costs associated with earning the forward rate in the contracts.

This example day is repeated during nearly the entire period except, importantly, for part of 2018 and 2019 when the overnight rate exceeded the 5-year bond yield for part of the year. During that period, the strategy stopped earning excess profits of the magnitude observed from 2013 to 2017 but still outperformed.

Conclusions

As we update and refine this model, we conclude that CGF has evolved into a very efficient hedging instrument for 5-year bond exposure. An investor can outperform cash with a few simple rules while also eliminating the (unquantifiable for us) hassle of security lending if bonds are used to generate leverage or re-investment of incremental amounts as coupons are paid⁷. Some additional trading is required to roll contracts each quarter.

⁶ Advanced users of futures contracts may recognize here that a low Implied Repo rate is equivalent to saying futures have typically been priced lower than the equivalent CTD bond which in itself is another way of stating that there are options with some value or also that the converted yield is higher as mentioned in the above paragraphs.

⁷ Additional DV01 must be purchased on the same day in the CGF strategy but most futures trading can be completed with a mouse click now and settlement processes are often completely automated.

Appendix

CGB Model Description from 2017 (CGF model rules were nearly identical)

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
<ul style="list-style-type: none">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.	<ul style="list-style-type: none">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 rates⁸.The strategy never takes, or risks, delivery. All open contracts are rolled each quarter to the active contract on T-5 from First Notice Date⁹.

CGF Model Modifications from 2017

The 5y replication model is identical except for the following changes.

- Shorter Time Period.** Due to lack of good data on the CGF contract, the time period is reduced to 4 years from 6 years and covers late 2012 to late 2016.
- Scrubbed Data.** The CGB data was complete and required no adjustment. The CGF data is incomplete for some dates¹⁰, recording either an End of Day bid or offer of zero. On dates that the recorded End of Day bid or offer is not complete, the Settlement Price is used, minus or plus one half of the preceding days' average bid/ask spread. This occurs on only 4 dates in the 2012-2016 dataset, always around the time of the quarterly roll. Since the quarterly roll has remained liquid, we feel that the data adjustment is not only justified, but probably conservative.

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 bonds to T+2 settlement in September 2017.

¹⁰ In the 2020 model, the settlement price is used, instead of the closing bid/ask from the after-hours market, less 50% of the assumed 2-cent bid/ask spread.



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