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The impact of the Bank of Canada's Government Bond Purchase Program

Staff Analytical Note 2021-23 (English)

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October 2021

Introduction

In response to disorderly market conditions in March 2020, the Bank of Canada began an asset purchase program designed to improve market functioning in the Government of Canada (GoC) bond market. In the Government of Canada Bond Purchase Program (GBPP)—announced on March 27, 2020—the Bank committed to:

- purchase at least \$5 billion of GoC bonds per week in the secondary market
- continue the program until the economic recovery is well underway

To meet these commitments, GBPP purchases targeted all maturities across the yield curve.

In July 2020, the focus of the GBPP pivoted from restoring market functioning to providing additional monetary stimulus with a quantitative easing (QE) program (see Bank of Canada 2020a). It is important to analyze the impact on GoC bond yields of this large and unprecedented amount of purchases (about \$307 billion as of August 31, 2021), especially because it was the first time in Canada that the Bank used a QE program as part of its extended monetary policy tool kit.

When we look at the impact of the March 2020 GBPP announcement on GoC bond yields, we find that it:

- lowered GoC bond yields by an average of 10 basis points (bps)
- had a larger impact on GoC bond yields with shorter maturities

However, precisely assessing the total impact of the GBPP is difficult, as many factors contribute to changes in GoC bond yields. For example, the GBPP took place at a time when gross GoC bond issuance tripled. Put another way, we can't observe or easily estimate what the level of GoC bond yields would have been without the GBPP.

Further, the yield impact of the initial announcement likely understates the impact of the GBPP because it measures only the surprise component of the GBPP announcement. The full impact of the GBPP is likely larger given that market participants:

- may have already been expecting an asset purchase program by the Bank at the time of the initial announcement because of
 - the disfunction observed in the GoC market (see Fontaine, Ford and Walton 2020)
 - the fact that markets had also adjusted to expectations that the Bank would lower the policy interest rate to its effective lower bound of 0.25 percent
- likely later increased their estimates of the total expected size of the program, in particular as it pivoted from a tool targeted primarily at restoring market functioning to one used to provide additional monetary policy stimulus¹

We also investigate the response of GoC bond yields to the Bank's daily GBPP bond purchases. We call this response the “flow effect” (D’Amico and King 2013). We find a modest and transitory flow effect on GoC bond yields that tends to fully reverse in the four days following the GBPP operation.

A small flow effect is consistent with efficient markets. That is, the price/yield effects associated with the GBPP should reflect information and revised expectations about the amount and type of securities to be purchased over the course of the program. These expectations may change slowly over time and may not necessarily change on operation days. Thus, a small flow effect is consistent with the operations themselves. These operations provide minimal new material information that could affect security prices beyond what markets already expect based on previous announcements and past operations.

The announcement of GBPP reduced GoC bond yields by about 10 basis points

The initial announcement of the GBPP can lower GoC yields through two main channels:

- **Supply channel.** The GBPP announcement might change the expectations of investors and dealers about the future supply of available GoC securities in the market. If investors and dealers believe the Bank will reduce the net supply of GoC bonds in the market (i.e., bonds outstanding less Bank of Canada holdings) by buying Can\$5 billion per week across all maturities, then yields can adjust instantly in anticipation of this lower net supply.²
- **Signalling channel.** Market participants may see the use of an asset purchase program as a signal that the outlook has become weaker and that the policy rate will remain lower for longer. Further, the initial GBPP announcement was accompanied by the announcement of a policy rate cut of 50 bps—from 0.75 percent to 0.25 percent. This may have also conveyed information about the future path of the policy rate.

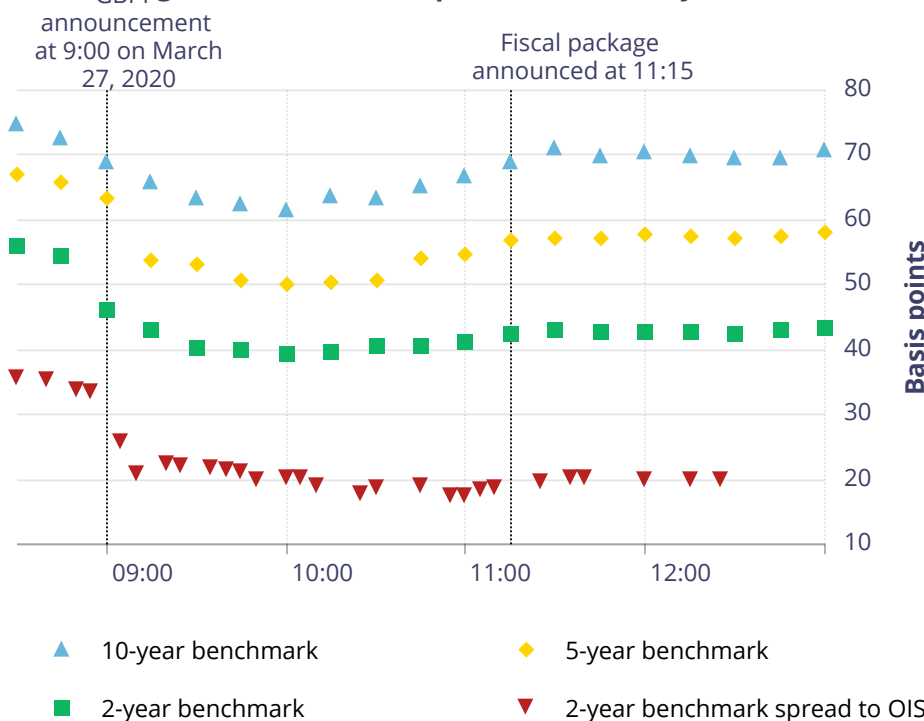
We use an event study methodology to estimate the effect of the announcement of the GBPP. This consists of looking at intraday movements in GoC yields in the hour after the Bank first announced its intent to purchase GoC bonds in the secondary market—on March 27, 2020, at 9 a.m.³

The rationale for focusing on a short time window surrounding the announcement is that forward-looking financial markets should quickly incorporate all information from the GBPP announcement shortly after the news is made public.⁴ A short time window also reduces the chance that GoC bond yields are responding to other important news or information. In particular, Prime Minister Trudeau announced a large fiscal package in a speech at 11:15 a.m. on that same day, which impacted expectations of GoC bond supply and would have an opposite impact on bond yields.

We find that the announcement of GBPP had a strong and immediate impact on GoC bond yields. The yields on 2-year, 5-year and 10-year benchmark GoC bonds declined by about 10 bps right after the announcement of GBPP (Chart 1). We deem this impact as strong because the 10 bps drop represented the 98th percentile of daily movements observed in the GoC bond market over the past 20 years.

Overall, the estimated announcement effect could partly reflect the novelty or surprise factor associated with the GBPP, as it was the first time the Bank implemented a large-scale asset purchase program involving GoC securities. Also, the pace of the announced \$5 billion weekly purchases was large relative to both the size of the GoC market and the pace of asset purchase programs in other jurisdictions (adjusting for their larger market size).

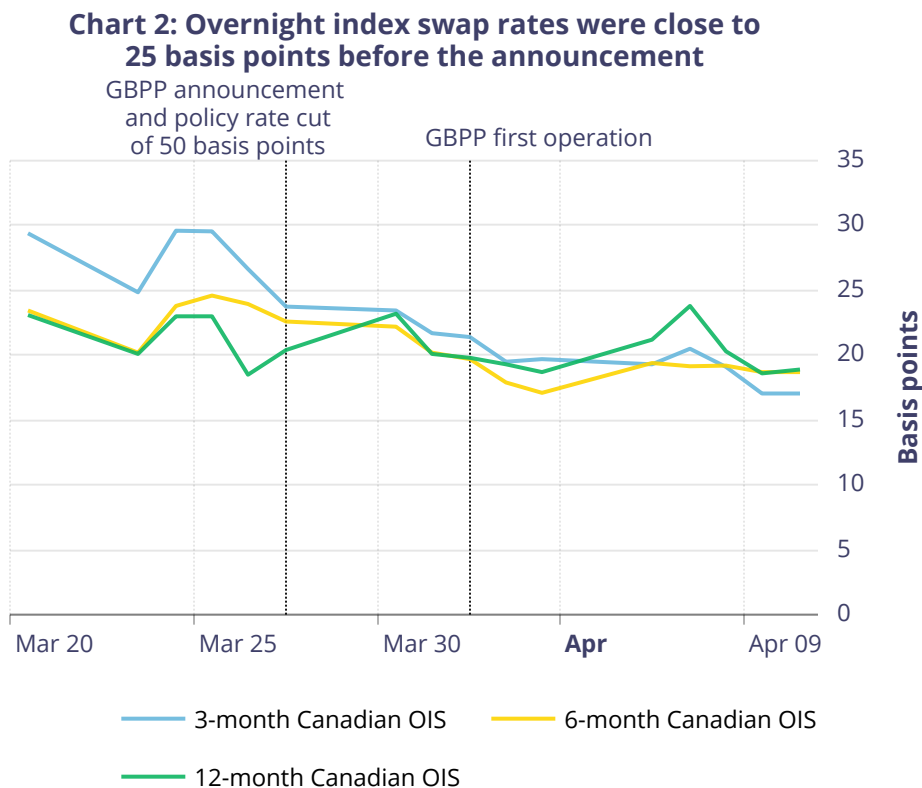
Chart 1: The announcement of the GBPP had a strong and immediate impact on GoC bond yields



Note: The blue triangles, yellow diamonds and green squares are calculated as the average yields over 15-minute intervals, while the red triangles are calculated as the average spreads over 5-minute intervals. GBPP is the Government of Canada Bond Purchase Program, GoC is the Government of Canada and OIS is the overnight index swap.

Sources: Canadian Depository for Securities Ltd. and Bank of Canada calculations

The movement in GoC bond yields on March 27 is more likely due to the supply channel than to the signalling channel. This conclusion is consistent with information from Canadian overnight index swap (OIS) rates during this period. Canadian OIS rates are often used as a barometer of market expectations for future movements in the Bank's policy rate. **Chart 2** shows that OIS rates were already at about 25 bps one week before the March 27 announcements of the GBPP and the policy rate cut. This suggests that market participants had expected the Bank would lower the policy rate to the effective lower bound well before it released the announcement. In addition, the difference between the 2-year benchmark GoC bond yields and the 2-year OIS fell by a similar magnitude to the drop in benchmark GoC bond rates (**Chart 1**). This suggests that policy rate expectations were not responsible for most of the drop.



Note: GBPP is the Government of Canada Bond Purchase Program and OIS is the overnight index swap.

Source: Bloomberg Finance L.P.

Last observation: April 10, 2020

Overall, we find a strong GBPP announcement effect on GoC bond yields. The announcement effect can be interpreted as one component of the well-documented stock effect of asset purchase programs on bond yields (D'Amico and King 2013). The stock effect is the total yield response to the current and expected future reduction in bond supply.

The stock effect can thus change over time, notably when market participants receive new information about:

- the overall size of the bond portfolio that the central bank is expected to accumulate over the life of the program
- the period of time over which it is expected to be used
- key parameters of the program (e.g., maturity composition of asset purchases)⁵

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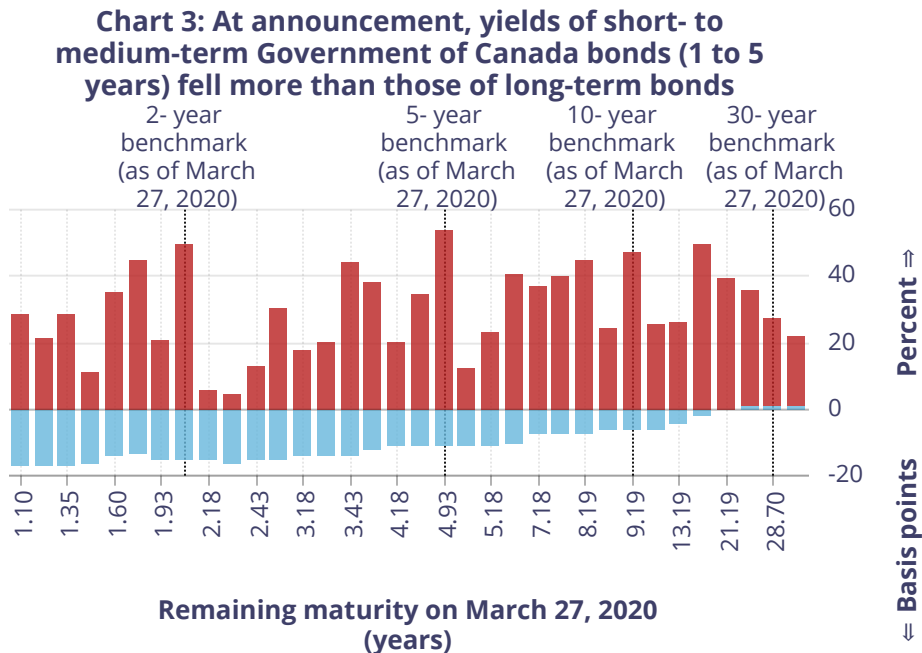
For example, additional information about future reductions of bond supply could be released when the asset purchase is announced, at the time of the purchase operations, when a new policy decision is released by the Bank's Governing Council, or after the program is completed.

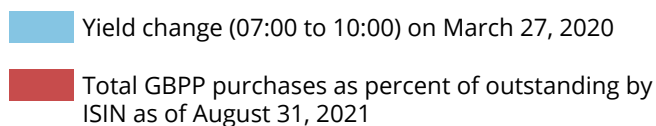
Therefore, our event study captures only the market reaction to the announced GBPP as perceived by market participants at the time of the announcement. However, we note that market reactions, notably in the GoC bond yield space, were relatively muted following the Bank's recalibration announcement in October 2020 (Bank of Canada 2020b) and the adjustments in the pace of monetary stimulus in April 2021 (Macklem 2021a) and July 2021 (Macklem 2021b). This suggests that markets largely expected these adjustments and that the initial announcement effect remains an important component of the total GBPP stock effect.

The yield effect was larger for bonds with shorter maturities

We estimate how the effect of the GBPP announcement varied depending on the GoC bond's characteristics, such as remaining term to maturity, benchmark status and percentage of the outstanding amount held by the Bank.

We first compare the intraday yield changes of GoC bonds on March 27 with the maturity distribution of the Bank's subsequent purchases of these bonds. **Chart 3** shows that the GBPP announcement effect was uneven across bonds. After the GBPP announcement, the yields of GoC bonds with shorter durations fell more than those of bonds with longer durations. On average, yields of GoC bonds with less than 3 years of remaining maturity fell by about 15 bps, while yields of GoC bonds with remaining maturity between 5 years and 10 years fell by about 7 bps.⁷





Note: The bars above the horizontal axis show the cumulative amount of each Government of Canada (GoC) security purchased (expressed as a percentage of that bond outstanding) under the Government of Canada Bond Purchase Program (GBPP) between April 1, 2020 and August 31, 2021. The GoC bonds are indexed by their remaining maturity at the time of the announcement depicted on the horizontal axis. The bars below the horizontal axis show the change in intraday GoC yields on March 27, 2020 from market open to 10 a.m. ISIN stands for International Securities Identification Number.

Sources: Bloomberg Finance L.P. and Bank of Canada calculations Last observation: August 31, 2021

Interestingly, yield changes for benchmark bonds did not differ significantly from neighbouring bonds with similar remaining maturities. This finding could have two explanations:

- Bonds with similar maturities are close substitutes and price movements should behave similarly.
- Market participants did not anticipate larger purchases of benchmark bonds at the time of the announcement, as these securities are typically more liquid and more beneficial to market functioning (Bulusu and Gungor 2017).

In practice, the Bank did not purchase any benchmark bonds through GBPP until early July 2020.

The literature suggests that asset purchase programs are more effective in lowering yields of longer-duration bonds, primarily by reducing the term premium (Bhattarai and Neely 2016).⁸ A natural question that arises from this is why the announcement effect of GBPP appears stronger for GoC bonds with shorter durations.

We highlight two potential answers:

- When the GBPP was announced, market participants could have expected more dollar purchases in the short end of the curve largely because 66 percent of GoC bonds outstanding had maturities of less than five years in March 2020.
- Market participants may have expected that an asset purchase program implemented in a small open economy like Canada has less influence on the term premium in long-term bond yields. This is because the term premium of long-term bonds is more exposed to global factors, potentially limiting the impact of the GBPP (Diez de los Rios and Shamloo 2017). This explanation is consistent with the literature arguing that QE is less effective in compressing yields in small open economies compared with large economies such as the United States (Kabaca 2016).

The flow effect on GoC bond yields is modest and temporary

We estimate the response of GoC nominal bond yields to daily purchase operations under the GBPP. We define this response as the flow effect.

To estimate the flow effect, we use granular daily data on all GBPP-eligible securities. We use information on which GoC bonds are eligible at a given operation, how much of each bond is purchased and the yield changes of those bonds around the time of the operation (see the appendix for more details). Our methodology allows us to estimate, for each eligible bond, the impact on its yield of:

- direct purchases of that particular bond
- the purchase of other bonds with similar characteristics

Given that daily GBPP operations target bonds with specific maturities, purchases of other eligible securities in an operation can have an impact on a bond's yield. This is because some investors may prefer to hold bonds with a similar duration and view these other similar bonds as close substitutes to the bond being considered.

The set of eligible bonds for the GBPP are typically announced at least one business day ahead of the actual daily operations. However, flow effects could arise for several reasons:

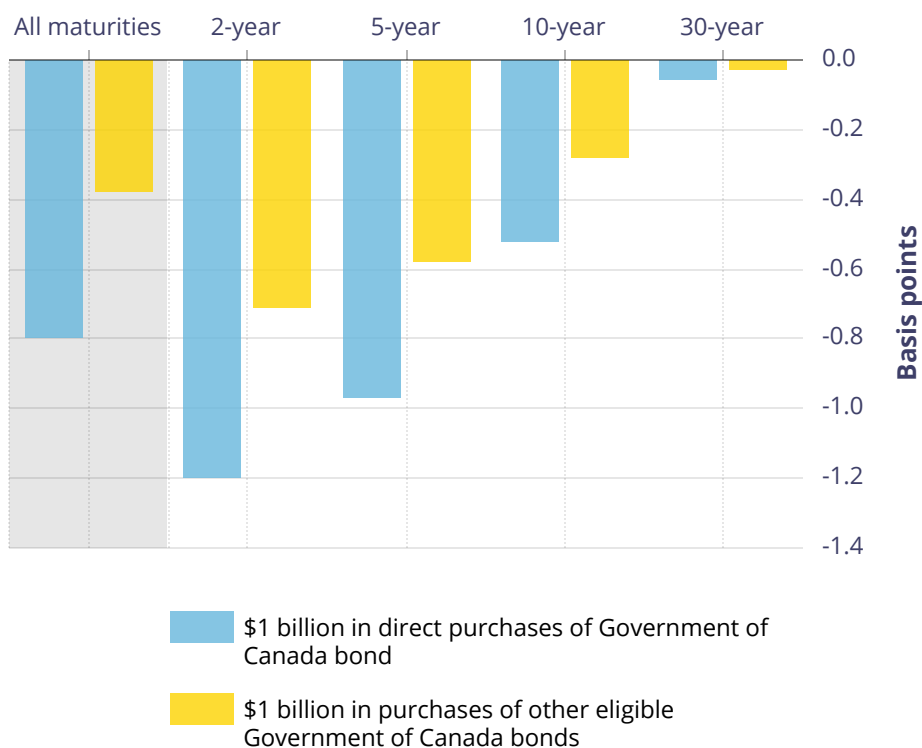
- Limits to arbitrage might prevent financial market participants from fully incorporating the information the Bank provides in advance of each operation even if it is expected.
- The outcomes of each purchase operation are uncertain, including the allocated dollar amount among eligible securities, the price at which bonds are purchased and the quantity of offers from counterparties willing to sell GoC bonds to the Bank.
- Since purchase transactions by the Bank are conducted through a limited set of counterparties, financial frictions and constraints affecting these counterparties could lead to price/yield effects that were unpredictable at the time of the GBPP announcement.

Our analysis suggests that a \$1 billion GoC purchase caused an average decline in yields of about 0.8 bps on purchased bonds on the day of a QE operation ([Chart 4](#)). Flow effects may materialize through both:

- a reduction in the yields of securities being actually purchased (blue bars in [Chart 4](#))
- a transmission in the yield impact from those purchased securities to other securities eligible for purchase on that day (yellow bars in [Chart 4](#))

Notably, our results indicate that purchases have about half the impact on the yield of other eligible bonds compared with the effect on the yield of the bonds actually purchased. That is, even if the bond is not purchased by the Bank on a given day, we find a yield drop of about 0.4 bps associated with the purchase of \$1 billion of other eligible bonds of the same maturity on the day of the operation.

Chart 4: QE operations caused a drop in Government of Canada bond yields



Note : All results are economically and statistically significant at 5 percent except for purchases of 30-year bonds.

Source: Bank of Canada calculations

Last observation: August 31, 2021

Chart 4 also shows that the flow effect varies slightly depending on the maturity targeted by the daily purchase operations. While the flow effect of a \$1 billion purchase in direct purchases on yields is slightly higher for 2-year and 5-year GoC bonds (estimated at a 1 to 1.2 bps range), it is negligible for 30-year bonds.

In unreported results, we find that the flow effect was somewhat larger (by about 0.5 bps on average) during operations conducted between April and June 2020. This period was marked by market liquidity and functioning issues in fixed-income markets. This finding is consistent with well-documented evidence that the effectiveness of an asset purchase program depends on the underlying financial and economic conditions at the time of the announcement (Johnson et al. 2020; Diez de los Rios and Shamloo 2017). For example, Bailey et al. (2020) show that in the United Kingdom the impact of QE on gilt yields is larger when market functioning is impaired. This is because in times of stress, QE purchases can support bond market liquidity, help restore market functioning and ease the transmission of monetary policy.

Overall, the presence of a meaningful flow effect corroborates the view that investors:

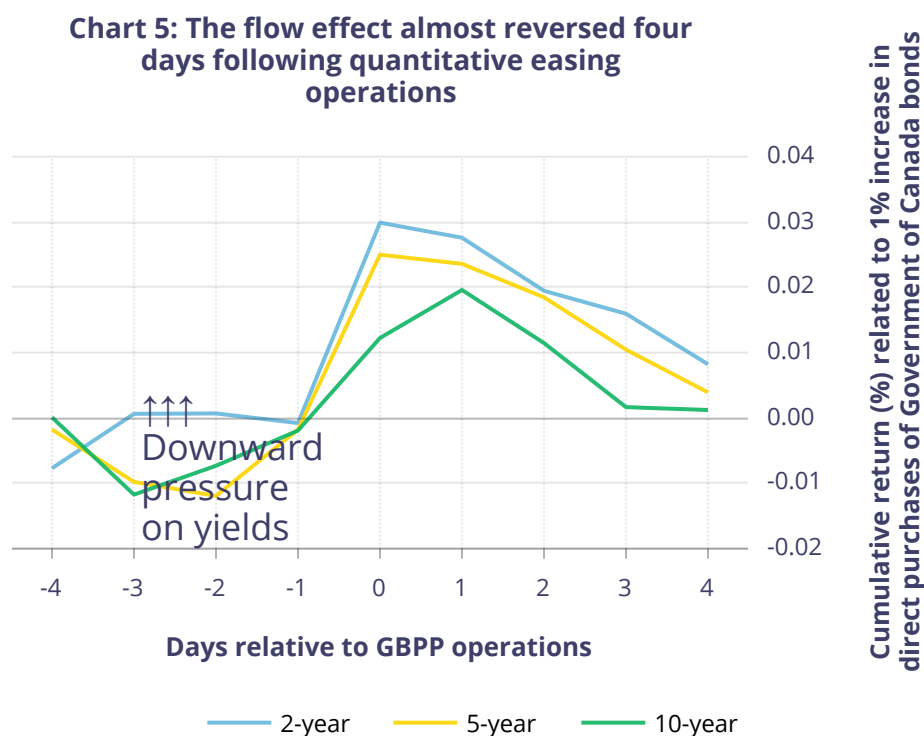
- value specific security characteristics
- are willing to bid up their prices in response to a reduction in the supply of GoC bonds induced by Bank purchases under GBPP

The flow effect fades after four days

We then ask whether the flow effect found is transitory or persistent.

To answer this question, we slightly change the specification of our baseline empirical model. The dependent variable is now the cumulative return of GoC bonds from four days before the operation to different horizons up to four days after a daily purchase operation (see the appendix for more details). This approach enables us to assess the cumulative response of the GoC bond prices in an eight-day period around the purchase operation.

Chart 5 shows that the flow effect related to direct purchases of GoC bonds almost fully reversed four days after the GBPP operation. We also note that the flow effect displays a similar dynamic pattern for 2-year, 5-year and 10-year bonds, as well as for purchases of other eligible bonds.



Note: The chart shows the evolution of the flow effect over time. It plots the coefficients of direct purchases (i.e., β_1 of equation 2 in the appendix) of a specific Government of Canada bond, as a percentage of its amount outstanding, where the dependent variables are cumulative percentage price changes for that security from four days before the operation to four days after the operation. GBPP is the Government of Canada Bond Purchase Program.

Source: Bank of Canada calculations

Last observation: August 31, 2021

This relatively short-lived response of the yields on securities being purchased is consistent with the results in D'Amico and King (2013). They find that the direct price response of US Treasury notes and bonds to purchase operations by the US Federal Reserve during its initial round of QE dissipates after two to six trading days.

Given that a purchase operation in a specific maturity sector typically occurs once per week, this result suggests that the flow effect of GBPP has broadly dissipated when the Bank conducts new operations targeting the same maturity.

Conclusion

Our analysis suggests that the GBPP kept yields lower than they would have been without the program. We show that GoC bond yields fell by around 10 bps when the GBPP was initially announced on March 27, 2020. We also find the presence of flow effects on GoC bond yields from actual purchases, but these effects are modest and transitory. On average, \$1 billion in purchases of GoC bonds led to a temporary 0.8 bps drop in yields of the bonds purchased on the day of operations and a drop of 0.4 bps in the yields of other eligible bonds with the same maturity. This flow effect tends to fade out after four days.

Overall, most of the yield impacts we measure materialized on the date of the initial announcement of the GBPP. In contrast, the flow effect accounted for only a limited share of the overall impact of the GBPP on GoC bond yields. Our findings are broadly consistent with empirical studies that analyze the QE announcement and flow effects in the euro area, the United States and the United Kingdom.

Our methodology captures only the impact of the GBPP that was observed at the initial announcement and on days of individual operations. Importantly, it does not capture the full impact of the program given that expectations about the size and the parameters of the program evolved over time. These evolving expectations are not easily observable.

Appendix

Data

This note uses a balanced panel of 51 nominal GoC bonds from April 1, 2020 (the day of the first GBPP operation) to August 31, 2021. We exclude GoC real return bonds and securities with a remaining maturity of less 90 days.

The primary variables of interest we use in our empirical analysis are:

- the daily price changes in percent for each GoC bond
- the par values of the security-level outstanding amounts
- the security-level purchase amount (in par value) for each GBPP operation
- dummy variables to identify eligible securities for all GBPP operations as well as benchmark GoC bonds
- remaining maturity expressed in years for each security

To test the robustness of our results, we also use control variables such as:

- daily market liquidity proxies for GoC-level bonds, such as Roll and Amihud's measures (see Gungor and Yang 2017 for more details)
- the number of offers/bids for each security in each GBPP operation
- the total security-level quantity held by the Bank in par value (which includes primary and secondary market purchases) as a proportion of the security-level outstanding amount

Data are collected from Bloomberg L.P. , the Canadian Depository for Securities Ltd. and Bank of Canada GBPP operations.

In total, our sample contained 281 purchase operations of nominal GoC securities. [Table A-1](#) gives the breakdown of operations that occurred for each targeted maturity.

Table A-1: Number of operations by targeted maturity in the sample

Maturity	2-year	5-year	10-year	30-year	Total
Number of operations	73	72	67	69	281

Note: The period covered in our sample is from April 1, 2020, to August 31, 2021.

Empirical specifications

Table A-2 reports the result from equation 1 on how the price of eligible GoC bonds changes following the direct purchase of the individual security as well as the purchase of other eligible bonds.

Equation 1: Fixed-effect regression model to quantify the flow effect

$$R_{n,t} = \beta_1 (DP_{n,t}) + \beta_2 (OP_{n,t}) + \gamma \times \mathbf{Controls}_{n,t} + \alpha_n + \delta_t + \epsilon_{n,t},$$

where $R_{n,t}$ denotes the daily gross return of GoC bond n on day t . The specification closely follows the literature on the flow effect. The coefficients of interest are β_1 and β_2 since they capture the effects of purchases on GoC bond returns. $DP_{n,t}$ is the nominal amount of the GBPP purchase of security n on day t expressed as a percentage of its nominal outstanding amount. The coefficient β_1 thus captures the direct effect on the daily gross return of the respective security being purchased. $OP_{n,t}$ is the total amount of the other eligible securities being purchased on the day of the operation expressed as percentage of their cumulative nominal amount outstanding. The coefficient β_2 captures the indirect effect of the price impact transmission of securities purchased with similar characteristics on the day of operation. Equation 1 also accounts for security-level fixed-effects (α_n) and daily time effects (δ_t). For brevity, the coefficient estimates of the control variables are not shown in **Table A-2**. Results are consistent and robust using different specifications. We have also checked for the risk of endogeneity and simultaneity bias in the estimation of the flow effects.

To interpret the individual regression coefficients and to compare them between direct and other eligible purchases, we re-scale our flow effect estimates to report the yield impacts in bps for each billion dollars purchased. For direct purchases, the yield impact is calculated as $(\beta_1/10000) * (\frac{1 \text{ billion}}{A}) * (\frac{1}{\text{Average duration}})$, where

A denotes 1 percent of the average amount purchased of a specific security during the GBPP operations.⁹ We then multiply by the inverse average duration of eligible GoC bonds to translate our flow effect estimates into a yield impact per billion dollars purchased.¹⁰ We recalculate these variables when we estimate our flow effect by maturity (**Table A-2**).

Table A-2: Flow effect estimates

Maturity	2-year	5-year	10-year	30-year	All maturities
Direct purchase	0.60***	1.21***	1.30**	0.45	1.38***
Other purchases	1.10***	1.69***	2.10**	0.68	1.96**
Number of observations	457	399	427	331	1614
Number of eligible bonds	17	14	13	7	51
Adjusted R ²	0.95	0.93	0.91	0.85	0.90

Note: Standard errors are clustered at the fund level. Asterisks indicate statistical significance at 10 percent (*), 5 percent (**) and 1 percent (***).

For robustness, we considered alternative sample restrictions or specifications to assess how much the estimated flow effects change over time. Time dependence of the flow effects can be caused by many factors, such as market liquidity conditions in the GoC bond market, a shift in the QE objective and learning by market participants. Overall, the magnitude of the flow effect remains statistically and economically meaningful, although results imply a slight decline in flow effects over time.

Equation 2: Fixed-effect regression model to examine the dynamic of the flow effect

$$Cum(R_{n,t-4 \rightarrow t+j}) = \beta_1 (DP_{n,t}) + \beta_2 (OP_{n,t}) + \gamma \times \mathbf{Controls}_{n,t} + \alpha_n + \delta_t + \epsilon_{n,t},$$

for j = -3 to 4

where the dependent variable is the cumulative gross return of GoC bonds from four days before the operation to four days after the operation. Modelling the cumulative GoC-level return around operations as a function of direct purchases and other eligible security purchases allows us to check whether the flow effect is persistent or temporary.

Endnotes

Footnotes

1. For example, the Bank now (as of August 31, 2021) holds roughly 43 percent of the GoC bond market—much more than the 12.7 percent it held before the Bank implemented the GBPP.[←]
2. By reducing the supply of GoC bonds outstanding, GBPP purchases can reduce risk premiums. This is because dealers and investors may demand less compensation for bearing interest rate and liquidity risks.[←]
3. Our study follows a methodology applied to study the effect of the Bankers' Acceptance Purchase Facility (see Arora et al. 2020).[←]
4. For robustness, we examined different event windows on March 27, 2020, to assess the GoC yield reactions to the GBPP announcement. Our findings on the announcement effect remain unchanged.[←]
5. In the literature, stock effects tend to operate through different channels, notably by reducing duration, by compressing liquidity and credit risk premiums, by signalling a lower future path of policy-controlled short-term interest rates, and by creating local scarcity in market segments of certain groups of investors.[←]
6. The stock effect can also be influenced by current and expected fiscal programs and their potential effect on increasing GoC bond issuance.[←]

7. In unreported results, we also confirm these findings with a regression approach. Although the yield impact is smaller for long-term bonds, these bonds experienced larger price changes. This is because their longer duration implies a larger price change for any given yield change.[←]

8. Some theoretical models show that it is the removal of duration risk from private sector portfolios that leads to a reduction in the term premium (Vayanos and Vila 2009).[←]

9. For other eligible GoC bond purchases, we calculate the yield impact in bps as

$$(\beta_2/10000) * \left(\frac{1 \text{ billion}}{A}\right) * \left(\frac{1}{\text{Average duration}}\right),$$

where A denotes 1 percent of the average amount purchased of all other eligible GoC bonds during the GBPP operation.[←]

10. Duration is a useful measure of the sensitivity of a bond's price to small movements in a yield.[←]

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