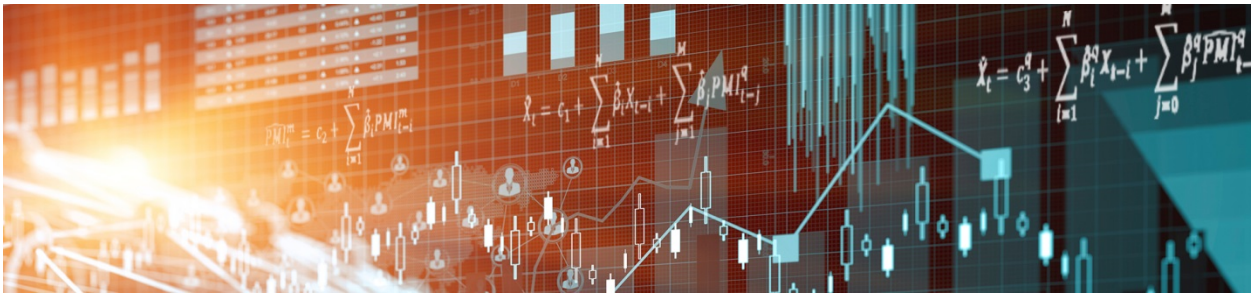
BANK OF CANADA
BANQUE DU CANADA

Staff Analytical Note/Note analytique du personnel 2018-41

The Cost of the Government Bond Buyback and Switch Programs in Canada



by Bo Young Chang,[1] Jun Yang[2] and Parker Liu[2]

[1]Funds Management and Banking Department
[2]Financial Markets Department
Bank of Canada
Ottawa, Ontario, Canada K1A 0G9
bchang@bank-banque-canada.ca; junyang@bank-banque-canada.ca

Acknowledgements

We would like to thank Amanda Sang, Maksym Padalko, Matthieu Truno, Andriy Stolyarov, Guillaume Nolin, Guillaume Bédard-Pagé and Léanne Berger-Soucy for their valuable assistance and comments.

ISSN 2369-9639

Abstract

This note examines the costs of the Government of Canada bond buyback and switch programs between 1998 and 2016. Our analysis indicates that the auction design of the buyback program was effective in retiring government debt with minimal costs resulting from bid shading in auctions and price impact. We find that the estimated cost is much less than the average bid-ask spread and the cost of similar buyback programs conducted by other countries. We also find that the variation in cost of the switch operations is largely explained by the price movement of the replacement bond in the 30-minute window between the announcement of the replacement bond price and the submission deadline of the bids. This result suggests that an auction design that decreases uncertainty around the replacement bond price can potentially reduce the variation in cost of the switch operations.

Bank topic: Debt management

JEL code: D44

Résumé

Dans cette note analytique, nous examinons les coûts des programmes de rachat d'obligations et de rachat assorti d'une conversion de titres du gouvernement du Canada entre 1998 et 2016. Selon les résultats de notre analyse, le processus d'adjudication du programme de rachat a permis au gouvernement de rembourser sa dette en réduisant au minimum les coûts associés à l'incidence sur les prix et à l'atténuation des soumissions par rapport à la valeur véritable. Nous constatons que le coût estimatif est nettement inférieur à l'écart acheteur-vendeur moyen et au coût de programmes de rachat semblables mis sur pied dans d'autres pays. Nous remarquons aussi que la variation du coût des opérations de rachat assorti d'une conversion de titres s'explique essentiellement par les fluctuations du prix de l'obligation de remplacement dans l'intervalle de 30 minutes entre l'annonce de son prix et l'heure limite de dépôt des soumissions. Cette observation porte à croire qu'un processus d'adjudication qui diminue l'incertitude concernant le prix de l'obligation de remplacement pourrait aussi réduire la variation du coût des opérations de rachat assorti d'une conversion de titres.

Sujet : Gestion de la dette

Code JEL : D44

Introduction

The Government of Canada first implemented the bond buyback program on a cash basis in 1998. The objective of the program was to maintain liquidity for benchmark bonds in an environment of fiscal surplus in which budget surpluses of the Government of Canada (GoC) reduced the need to issue large quantities of new benchmark bonds.[1] The program allowed the Government to maintain a steady supply of GoC benchmark bonds by repurchasing older and typically less liquid off-the-run bonds, financed through the issuance of new benchmark bonds.[2] The Government implemented the bond buyback program on a switch basis shortly after, in 2002, with the same objective but with a different exchange mechanism; instead of cash, off-the-run bonds are exchanged for building-benchmark bonds on a duration-neutral basis. Both programs are currently still in place, although only switch operations have been conducted since 2012.[3]

One important component of the costs associated with buybacks is the cost due to price impact and bid shading. When primary dealers have limited risk-bearing capacity and end investors, such as pension funds and insurance companies, have imperfect capital mobility, a large buyback operation could temporarily push up the prices of GoC bonds that are eligible for repurchase. Bid shading is the practice of bidders placing bids that are below what they believe a good is worth to compensate for the winner's curse in auctions. The winner's curse is a tendency for the winning bid in an auction to exceed the intrinsic value or true worth of an item. Given that the buyback and switch programs require the repurchase of large amounts of off-the-run bonds through the auction mechanism, the Government faces the risk of overpaying for these securities due to price impact and bid shading.

Our analysis of buyback and switch operations in Canada between 1998 and 2016 shows that the costs due to bid shading and price impact were much smaller for bond buybacks than for regular bond auctions. There are at least two reasons why this result is not surprising. First, both buybacks and switches involve much smaller amounts of bonds than regular bond auctions. Second, there is less inventory risk because cash buybacks are conducted on the same day as regular bond auctions and switches are essentially repurchases coupled with issuance.

Although the buyback costs due to bid shading and price impact are small on average, they vary significantly across operations. For switch operations, in particular, we find that the movement of the replacement bond price between 10:00 and 10:30 explains a significant amount of the cost variation across operations. This result suggests that an auction structure that decreases uncertainty around the replacement bond price can potentially reduce the variance of buyback costs.

It is important to keep in mind that the buyback costs due to bid shading and price impact constitute only one component of the overall financial consequences of the buyback operations. There are other costs and benefits that we do not attempt to measure in this note.[4] Quantifying the overall financial

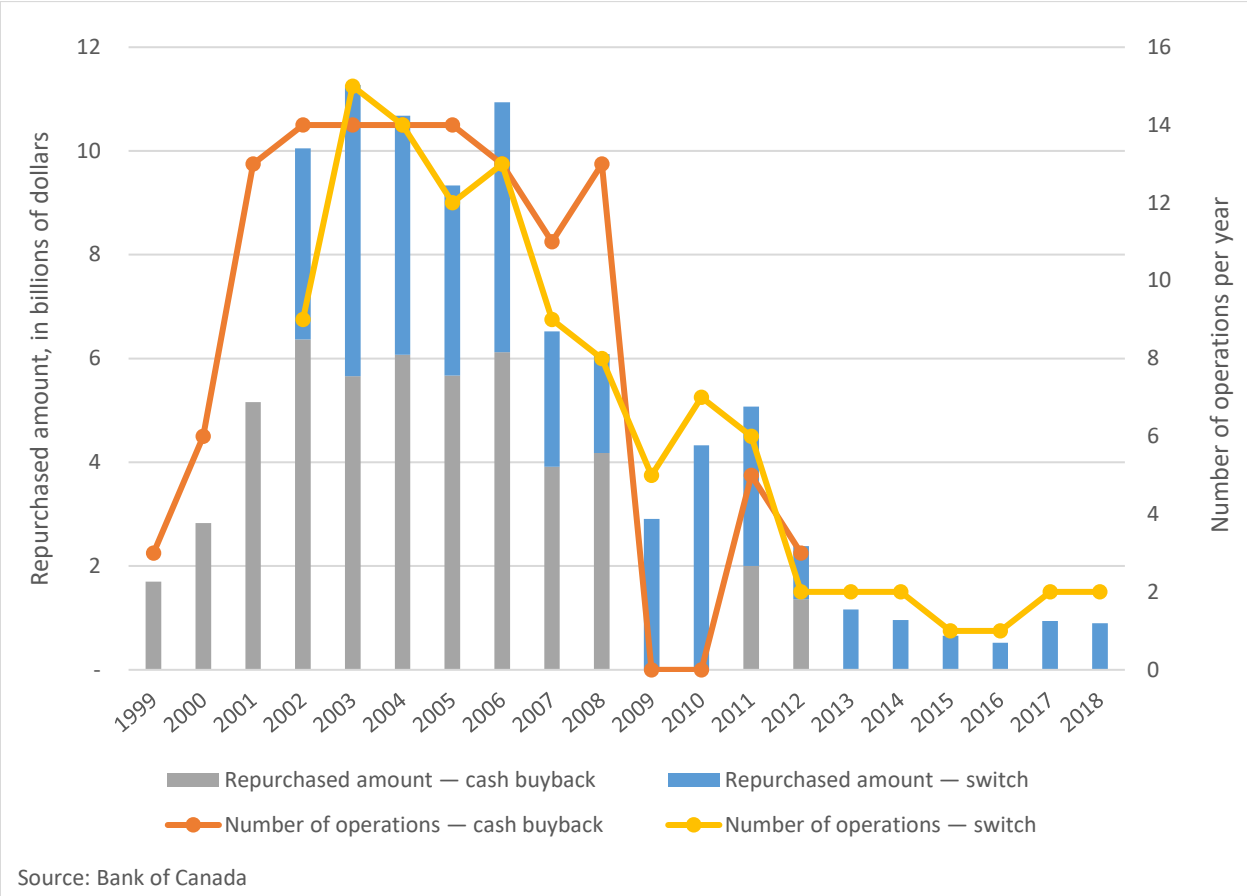
[1] For more information, see the Bank of Canada, "Details on Bond Buyback Operations," April 2012.
[2] Off-the-run bonds refer to bonds that are not current or building benchmarks.
[3] The Bank of Canada also conducts the Cash Management Bond Buyback operations for cash-management purposes, but in this note we focus only on the buyback and switch operations for liquidity purposes.
[4] For example, the Government can reduce its funding cost when it replaces off-the-run bonds of relatively high yields with benchmark bonds of relatively low yields. One of the objectives of the buyback operations is to keep this cost negative (i.e., saving is positive). Also, the Government incurs operational costs in terms of staff and technology for conducting auctions.

impact of buyback operations to the Government is beyond its scope. In the rest of the note, we refer to the buyback costs due to bid shading and price impact simply as the "buyback costs" for brevity.

Overview of buyback and switch operations for liquidity purposes

Since 1998, the Government has conducted a total of 123 cash buyback operations and 109 switch operations, totalling approximately $51 billion worth of bonds repurchased through cash and $43 billion worth through switches (see **Chart 1** for annual breakdowns). The number of eligible bonds for repurchase in each operation ranged from 3 to 15 with an average of 9 bonds per auction. The maturity term of repurchased bonds also ranged from 0.7 to 26.8 years, with an average of 9 years (see **Chart 2** for annual averages).

Chart 1: Buyback and switch operations, amount and count

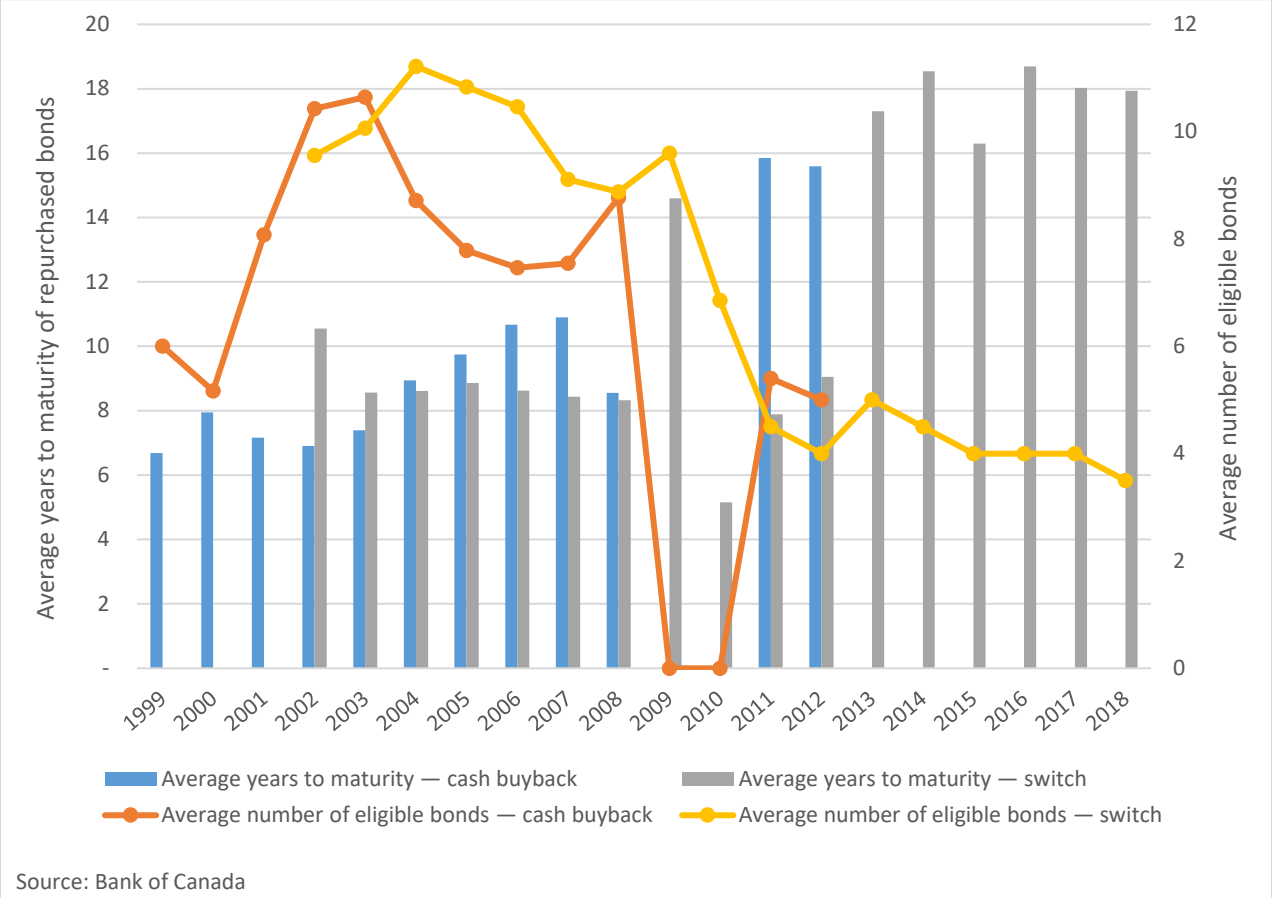


Source: Bank of Canada

The average number of eligible bonds for repurchase increased after the program launch and coincided with the expansion of repurchase amounts from 2000 to 2004. The trend reversed after 2004 as the Government surplus declined and became a deficit in 2009. Since 2012, only switches have been conducted, and these have mainly targeted the four or five off-the-run bonds at the long end of the curve. As discussed in the introduction, the number of eligible bonds is important because we expect

that it has a negative relationship with buyback cost. However, this effect may be offset by the expected positive relationship between repurchase amount and buyback cost.

Chart 2: Average years to maturity and number of eligible bonds



Source: Bank of Canada

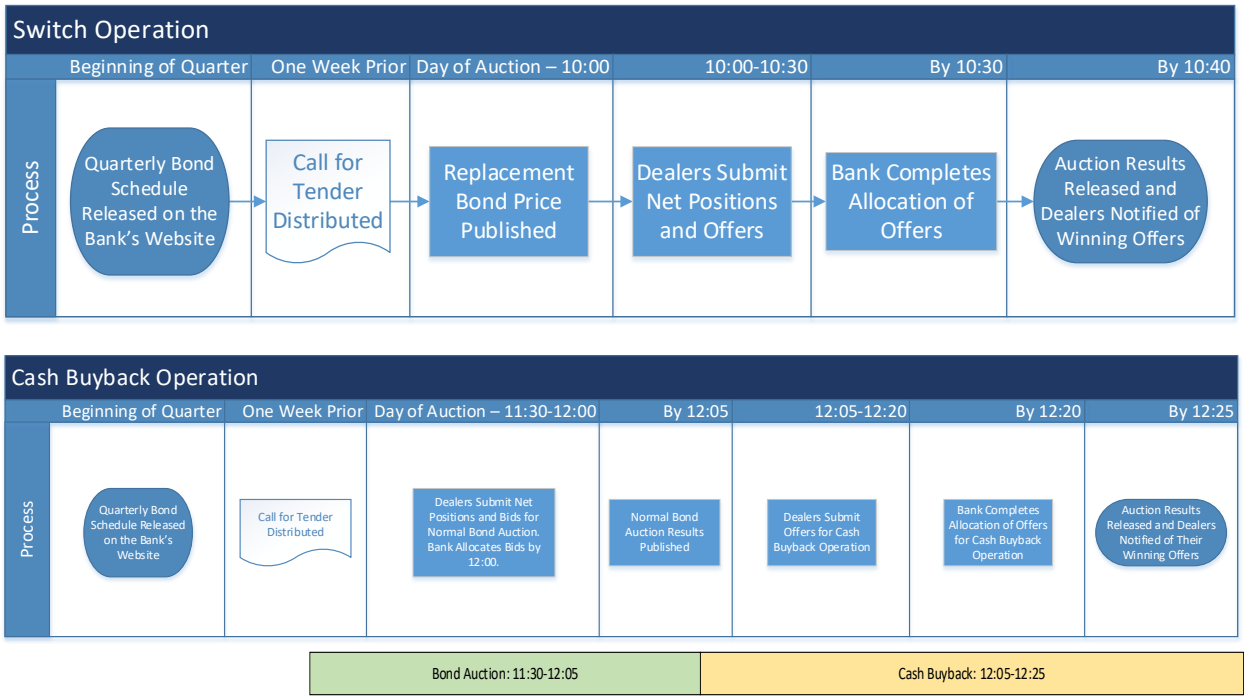
Mechanics of the buyback and switch operations

The Government issues treasury bills and nominal bonds through discriminatory price auctions. The buyback and switch operations are also conducted through discriminatory price auctions in which each winning bidder is awarded the yield (or price) submitted rather than an average of all winning bid yields. Tenders with the highest bid yield will be accepted and allocated first, while those with successively lower bid yields will continue to be accepted until the auction is completely allocated. Armantier and Lafhel (2009) find that, in the case of the Canadian market environment where there are 20 to 30 government security dealers (GSDs, also called dealers in this note) but few very large participants, the discriminatory price auction may be more beneficial to the Government.

The buyback and switch auctions differ from regular bond auctions in that they involve more than one bond. The call for tender specifies the maximum value of bonds that will be repurchased, but not the value of each bond to be repurchased. This allows the Bank to pick and choose among eligible bonds. The specifications for repurchase and multiple eligible bonds introduce greater uncertainty to dealers in determining the likelihood of their offers being accepted. They may bid more aggressively to unload

their long positions accumulated in the secondary market after the call for tender. This approach is similar to the aggressiveness of bids by dealers having initial short positions in the when-issued market ahead of a conventional auction (Gravelle 1998; Rydqvist and Wu 2016). Other factors such as auction type and the method to determine cut-off yields may also affect dealer behaviour.

Figure 1: Timelines of the buyback and switch operations



The Government first announces its intention to conduct a buyback or switch operation through the quarterly bond schedule, which is released before the beginning of each quarter and lists all scheduled auctions for the quarter (**Figure 1**). The schedule contains the date of the auction but not its exact details. The maximum repurchase value, bonds eligible for repurchase and replacement bond (for switch operations) are released one week before the auction date in a call for tender. The chosen eligible bonds typically include high-coupon bonds and certain large off-the-run issues. They exclude bonds building toward the benchmark, current or preceding benchmarks, and bonds with a maturity greater than 25 years. Only approved GSDs are eligible to directly submit offers for buyback or switch operations, but others can submit offers through the GSDs.

Cash buyback operations are generally conducted after a bond auction on the same day. Offers must be submitted by the auction deadline, which is 12:20. Switch operations are typically held on Wednesdays with a deadline of 10:30. The replacement bond price, however, is published and fixed at 10:00 on that day, which leaves a 30-minute window for dealers to manage their offers relative to fluctuations in the

replacement bond price on the secondary market. Results are subject to a maximum turnaround time of 10 minutes, but are usually released within 3 minutes after the deadline.[5]

Data and methodology

All auction data are compiled from publicly available information posted on the Bank's website.[6] For intraday prices, we use a data set provided by the electronic bond trading platform CanDeal. The data set contains intraday quotes of time-stamped bid/ask prices and yields, as well as intraday trades containing information about the date, time, customer category, buy/sell selection, CUSIP number, security description, price, yield, trade amount and dealer.[7]

We define the buyback cost as the sum of two components: (i) auction-time cost due to bid shading and (ii) auction-day price impact.

$$Buyback\ cost = \frac{(Average\ auction\ price - Market\ price\ immediately\ after\ auction)}{Market\ price\ immediately\ after\ auction}$$

$$+\frac{(Market\ price\ immediately\ after\ auction - Market\ price\ end\ of\ day)}{Market\ price\ immediately\ after\ auction}$$

The auction-time cost is measured as the average auction price of the bond (weighted by the notional amount repurchased) minus the secondary market price of the bond immediately after the auction deadline. Bid shading occurs mainly because of the winner's curse in auctions and the concentration of bidders. Since most of the repurchased bonds do not trade often, we use the closest bid quote after the auction as the market price. The average time between the auction deadline and the closest market quotation is 40 seconds, which is small enough to suggest that they are simultaneous prices. The auction-day price impact is calculated as the market price at auction time minus the market price at the end of the auction day. The price impact in the government bond auctions is mainly because of the inventory risk and limited risk-taking capacity of the dealers.

Empirical results

Buyback costs are low on average, but variation across operations is large

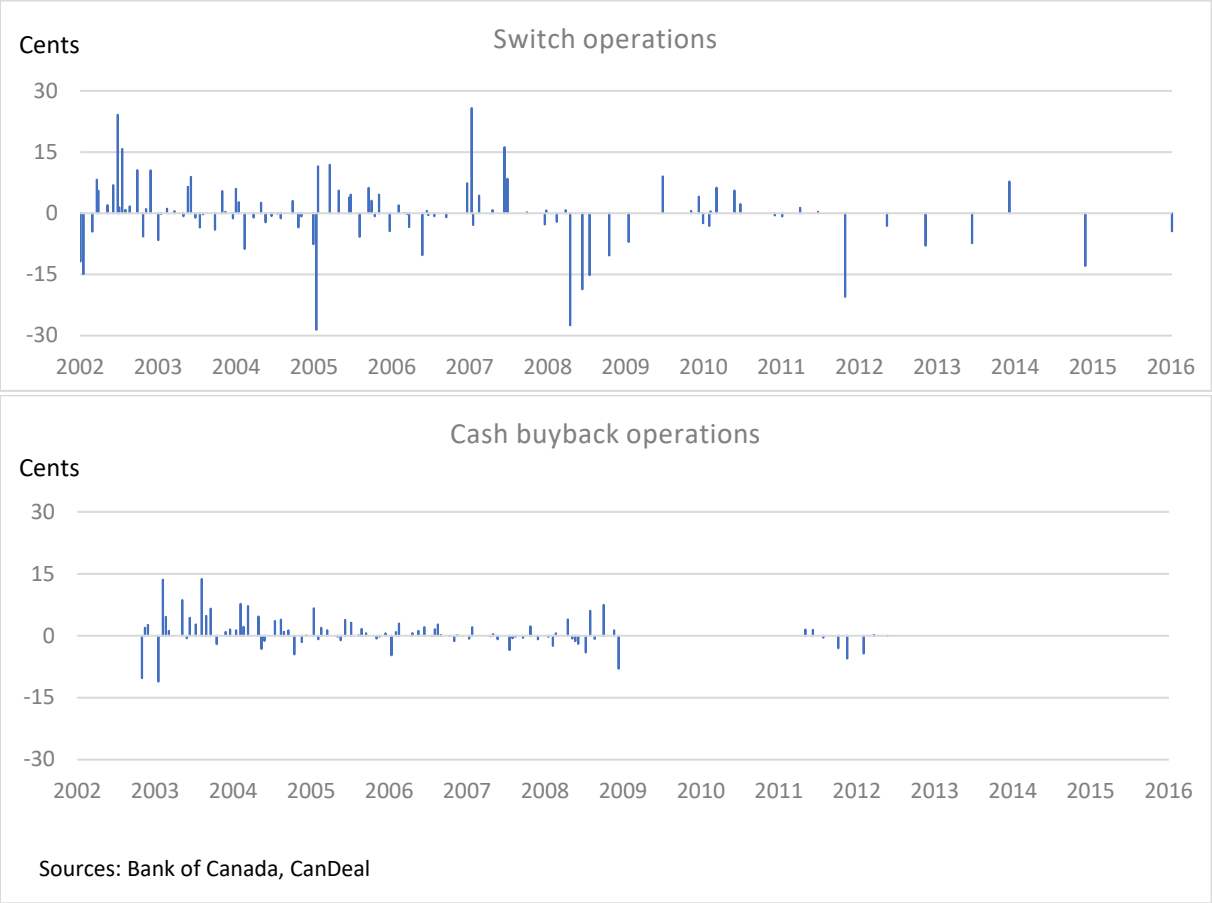
We find that the average auction-time cost for all operations is only 0.4 cents (all costs are measured in cents per $100 notional) (**Table 1**). The variation, however, is large with a standard deviation of 6.7 cents and ranging from -30 cents to 25 cents (**Chart 3**). The costs are low relative to the average bid-ask spread of 3 cents for non-benchmark bonds. They are also low compared with similar buybacks in 2000–02 conducted by the United States Treasury (4.4 cents) and the United Kingdom (3.4 cents) (Han, Longstaff and Merrill 2007; Breedon and Turner 2016).

[5] For more information, see the Department of Finance Canada and Bank of Canada, "Standard Terms for Switch Operations of Government of Canada Marketable Bonds," November 2016.
[6] Bank of Canada, "Government Securities Auctions."
[7] CUSIP stands for Committee on Uniform Security Identification Procedures.

Table 1: Comparison of the auction and buyback costs of government bonds

(Cents/100 notional)	Canada buyback operations			Comparison measures				
	All buybacks	Cash buybacks	Switch buybacks	Avg. GoC bid/ask spread	Avg. transaction cost of GoC bonds of $10 million	Regular GoC bond auction cost	US bond buyback cost (2000–02)	US bond buyback cost (2010–11)
Avg. auction-time cost	0.4 (6.7)	0.8 (3.9)	-0.04 (8.4)					
Avg. price impact	-0.7 (18)	-0.2 (10.9)	-1.2 (22.6)					
Total	**-0.3**	**0.6**	**-1.24**	**3**	**0.5**	**5**	**4.4**	**0.7**

Chart 3: Auction-time costs

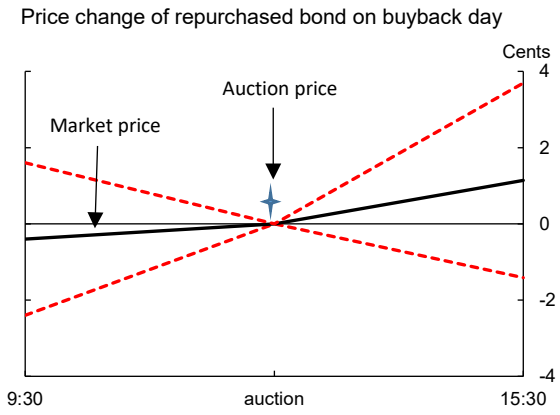


Sources: Bank of Canada, CanDeal

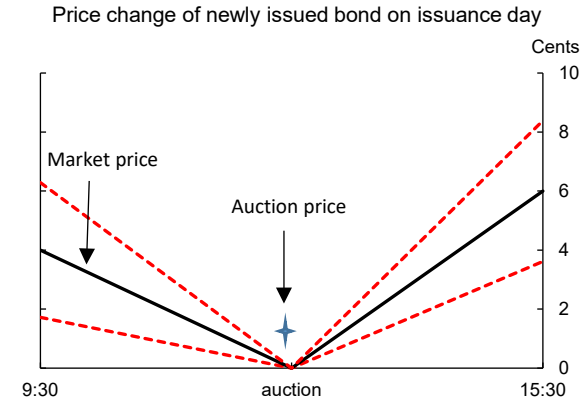
We also find that the auction-day price impact is low and negative (-0.7 cents) with a high standard deviation of 18 cents. The results in **Chart 4** suggest that, on average, the secondary market price does not change significantly from the auction time to the end of the day. The large variation in price impact, however, may be due to other market-related movements such as yield curve shifts or data releases. The price impact for buybacks is also low compared to US buyback options in 2010–11 (2 cents; Song and Zhu 2018) and regular GoC bond auctions (5 cents; Table 1). The low price impact may be because

combining cash buybacks with regular bond auctions, as well as exchanging bonds in the switch operation, reduces the inventory risk for dealers.

Chart 4: Price impact of regular bond auctions and buybacks



Dotted lines represent the 95 per cent confidence interval
Sources: CanDeal and Bank of Canada calculations



Dotted lines represent the 95 per cent confidence interval
Sources: CanDeal and Bank of Canada calculations

The large variation in buyback cost is due to uncertainty about the replacement bond price

We find that the variation in auction-time costs of switch operations is primarily explained by price movements of the replacement bond between 10:00 (the announcement of the replacement bond price) and 10:30 (the bid submission deadline). This result is consistent with the fact that the dealers can bid more aggressively if the price of the replacement bond moves favourably between 10:00 and 10:30. For example, if the replacement bond price increases during the 30-minute interval, dealers may offer less for their bonds because they are receiving a more attractive price on the replacement bond. The result of the ordinary least squares regression analysis supports this explanation (**Table 2**). The results show that for every cent increase in the replacement bond price, the auction-time cost decreases by 0.6 cents and the buyback cost decreases by 1.05 cents. Fixing the replacement bond price closer to the auction deadline may reduce this variation.

Table 2: Regression of buyback costs

Dependent variables / Independent variables		Auction time cost		Buyback cost	
Replacement bond price change	coefficient (t-stat.)	**-0.59***** **(-11.51)**	**-0.60***** **(-12.12)**	**-1.03***** **(-5.16)**	**-1.05***** **(-5.14)**
Coupon	coefficient (t-stat.)		0.25 (0.94)		0.33 (0.56)
Maturity	coefficient (t-stat.)		-0.20** (-2.88)		-0.56** (-2.33)
Volatility	coefficient (t-stat.)		1.7** (2.22)		1.08 (0.54)
Bid-ask	coefficient (t-stat.)		-1.96 (-1.30)		1.34 (0.52)
	Sample size R^2	354 0.23	354 0.27	354 0.12	354 0.15

Note: *, ** and *** indicate significance at the 90, 95 and 99 per cent confidence levels, respectively.

Conclusion

Our analysis indicates that the auction design of the buyback program was effective in retiring illiquid debt with minimal costs. We find that the Government paid an average of 0.4 cents more than the prevailing market price to repurchase its debt and 0.3 cents less than the end-of-day market price. This amount is much less than the average bid-ask spread and the cost of similar buyback programs conducted by other countries. We also find that the variation in cost of the switch operations is largely explained by the price movement of the replacement bond in the 30-minute window between the announcement of the replacement bond price and the submission deadline of the bids. This result suggests that an auction design that decreases uncertainty around the replacement bond price can potentially reduce the variation in cost of the switch operations.

References

Armantier, O. and N. Lafhel. 2009. "Comparison of Auction Formats in Canadian Government Auctions." Bank of Canada Staff Working Paper No. 2009-5.

Breedon, F. and P. Turner. 2016. "On the Transactions Costs of Quantitative Easing." Bank for International Settlements Working Paper No. 571.

Gravelle, T. 1998. "Buying Back Government Bonds: Mechanics and Other Considerations." Bank of Canada Staff Working Paper No. 1998-9.

Han, B., F. A. Longstaff and C. Merrill. 2007. "The U.S. Treasury Buyback Auctions: The Cost of Retiring Illiquid Bonds." *Journal of Finance* 62 (6): 2673–2693.

Rydqvist, K. and M. Wu. 2016. "Pre-Auction Inventory and Bidding Behavior: Evidence from Canadian Treasury Auctions." *Journal of Financial Markets* 30: 78–102.

Song, Z. and H. Zhu. 2018. "Quantitative Easing Auctions of Treasury Bonds." *Journal of Financial Economics* 128 (1): 103–124.