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**Working Paper**

## Repo market functioning when the interest rate is low or negative

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Staff Discussion Paper/Document d'analyse du personnel 2017-3

# Repo Market Functioning when the Interest Rate Is Low or Negative



by Jean-Sébastien Fontaine, James Hatley and Adrian Walton

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Bank of Canada Staff Discussion Paper 2017-3

January 2017

# **Repo Market Functioning when the Interest Rate Is Low or Negative**

by

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## Abstract

This paper investigates how a low or negative overnight interest rate might affect the Canadian repo markets. The main conclusion is that the repo market for general collateral will continue to function effectively. However, changes to market conventions—such as the introduction of a charge for settlement fails—or other institutional changes may be required so that the repo market for specific collateral continues to support liquidity on the secondary market for government bonds. The historical experience shows that the special repo market in other jurisdictions can function effectively even if the overnight rate is negative. Closer examination suggests what specific circumstances can lead to persistent settlement fails in the specific collateral repo market. Specifically, the combination of (i) low or negative interest rates, (ii) large aggregate short positions in bonds, and (iii) economic or policy surprises may lead to persistent settlement fails.

*Bank topic(s): Financial markets, interest rates, market structure and pricing*

*JEL code(s): D4, G10, G12*

## Résumé

Cette étude examine l'incidence que pourrait avoir un taux du financement à un jour bas ou négatif sur le marché canadien des pensions. La principale conclusion est que le marché des opérations générales de pension continuerait de fonctionner efficacement. Toutefois, des changements aux conventions du marché – comme l'instauration de frais en cas de défaut de règlement – ou d'autres changements institutionnels pourraient s'avérer nécessaires pour que le marché des opérations spécifiques de pension continue de soutenir la liquidité sur le marché secondaire des obligations d'État. L'expérience démontre que le marché des opérations spéciales de pension dans d'autres États peut fonctionner efficacement même si le taux du financement à un jour est négatif. Un examen plus approfondi met en lumière les circonstances particulières pouvant entraîner un épisode persistant de défauts de règlement dans le marché des opérations spécifiques de pension, à savoir, plus précisément, la combinaison i) de taux d'intérêt bas ou négatifs, ii) d'importantes positions globales à découvert sur obligations et iii) de décisions économiques ou politiques inattendues.

*Sujets : Marchés financiers; Taux d'intérêt; Structure de marché et fixation des prix*

*Codes JEL : D4, G10, G12*

## KEY MESSAGES

- This paper investigates how a low or negative overnight interest rate might affect the Canadian repo markets. The main conclusion is that the repo market for *general collateral* (GC) will continue to function effectively. However, changes to market conventions—such as the introduction of a charge for settlement fails—or other institutional changes may be required so that the repo market for *specific collateral* continues to support liquidity on the secondary market for government bonds.
- These changes may be required because the special repo rate observed in the market for specific collateral would be constrained (from below) when the overnight rate is low or negative and, as a result, may not fully adjust to clear the market.
- Recent experience in other jurisdictions shows that the special repo market can function effectively even if the overnight rate is negative. Closer examination suggests which circumstances can lead to persistent settlement fails in the specific collateral repo market. Specifically, the combination of (i) low or negative interest rates, (ii) large aggregate short positions in bonds, and (iii) economic or policy surprises may *together* to persistent settlement fails.
- At present, Canadian market participants use a standardized repo contract, tying the cost of settlement failure to the level of the repo rate. This is the main impediment to the price mechanism. Several jurisdictions have introduced direct costs of settlement failure to address this issue—e.g., the so-called “fails charge” in the United States. Other possible changes that may mitigate this issue include changes to settlement systems or to the regulatory framework.

## INTRODUCTION

This note asks how Canadian repo markets would function when the overnight interest rates is low (near zero) or negative. Section 1 and Section 2 briefly review the general collateral (GC) repo market and the specific collateral repo market, respectively.

Section 3 discusses the floors and ceilings on the repo rates. Section 4 discusses how these bounds interact with a low or negative overnight rate and potentially affect market functioning. Section 5 discusses potential changes to the market structure that could mitigate the likelihood or severity of this risk. Section 6 concludes.

## SECTION 1: THE GENERAL COLLATERAL REPO MARKET

**The Canadian general collateral (GC) repo market is a core funding market** (Fontaine, Selody and Wilkins 2009). Banks and large institutional investors use the GC repo market to obtain funds in exchange for collateral, which are typically Government of Canada securities. The volume of all CAD-denominated repo transactions (for any bond) averaged roughly \$650 billion per month over the past five years. Roughly one-quarter of these trades are intermediated by a broker—\$150 billion per month on average during 2013. For additional sources of information on the repo markets in Canada, see Box 1.

Each GC repo transaction specifies two legs where funds and bonds are exchanged at two specific dates. In the first leg of a repo, securities are sold in exchange for funds; in the second leg, the securities are repurchased and the funds are returned. The repo contract specifies (i) the price at which the bond is initially sold and (ii) the price at which the same bond is bought back at a future date. The difference between these two prices determines the rate for lending funds. Note that the lender of funds is the borrower of bonds and the borrower of funds is the lender of bonds.

### Box 1—Securities-Financing Transactions in Canada: Sources of Information

Securities financing is included in the Bank of Canada's definition of core funding markets (Fontaine, Selody and Wilkins 2009). Early discussion of the Canadian repo market and its subsequent development can be found in Morrow (1994) and Reid (2007). The evolution of the repo market during the financial crisis is discussed in Chande, Labelle and Tuer (2010). Chatterjee, Embree and Youngman (2012) describe the introduction of a central counterparty for repos. Fontaine, Garriott and Gray (2016) discuss how the repo market supports bond market liquidity in Canada. Garriott and Gray (2016) provide a detailed discussion of the Canadian repo market.

## SECTION 2: THE SPECIFIC COLLATERAL REPO MARKET

**The specific repo market plays a distinct and essential role in the financial system.**

Banks and institutional investors use the specific repo market to borrow a particular security (typically highly liquid securities, such as benchmark Government of Canada bonds). The share of specific repo trades can vary significantly over time, ranging from one- to two-thirds of total brokered volume. In June 2014 (when detailed data are available), the transaction volumes from the largest inter-dealer broker were roughly \$88 billion and \$41 billion for specific and general collateral repo, respectively; the share of specific collateral repo intermediated through the broker was 68%. When considering

the entire repo market—which includes the brokered market—the share of specific repo is smaller, roughly 15% of the total repo market by volume in June 2014.<sup>1</sup>

The specific repo market supports liquidity in the “cash” government securities markets. Borrowing a bond using the specific repo market can be useful to settle a short sale, either for providing market liquidity or for establishing short positions that hedge the risk of interest rate changes.<sup>2</sup> Hence, the market liquidity of government securities may be reduced if the specific repo market cannot function effectively because market-makers rely on specific repos to offer liquidity (Fontaine, Garriott and Gray 2016). Below, we will discuss how the specific repo market may be adversely affected by negative rates.

**The special repo spread matches supply and demand for a bond in normal conditions.**

When a specific bond is scarce, those seeking to borrow it must offer bondholders a repo rate *lower* than the GC repo rate. In this case, the bond is said to be *on special* and its repo rate is called the “special repo rate.” The difference between the overnight rate and the (lower) special repo rate and is the “special repo spread.” Figure 1 illustrates supply from lenders (bondholders) and demand from borrowers of bonds in a simple diagram. This diagram has a bond’s special repo spread on the y-axis and the volume of special repo trading on the x-axis.

The special repo spread represents the “price” to be paid to attract the desired bond. A higher spread is a cost to borrowers of the bond because they earn a lower rate for lending funds. At the same time, a higher repo spread benefits lenders of the bonds since they pay a lower rate for borrowing funds. The simple illustration in Figure 1 will be useful to discuss how the constraint to the price adjustment discussed below introduces a wedge between demand and supply and open the possibility of widespread fails.

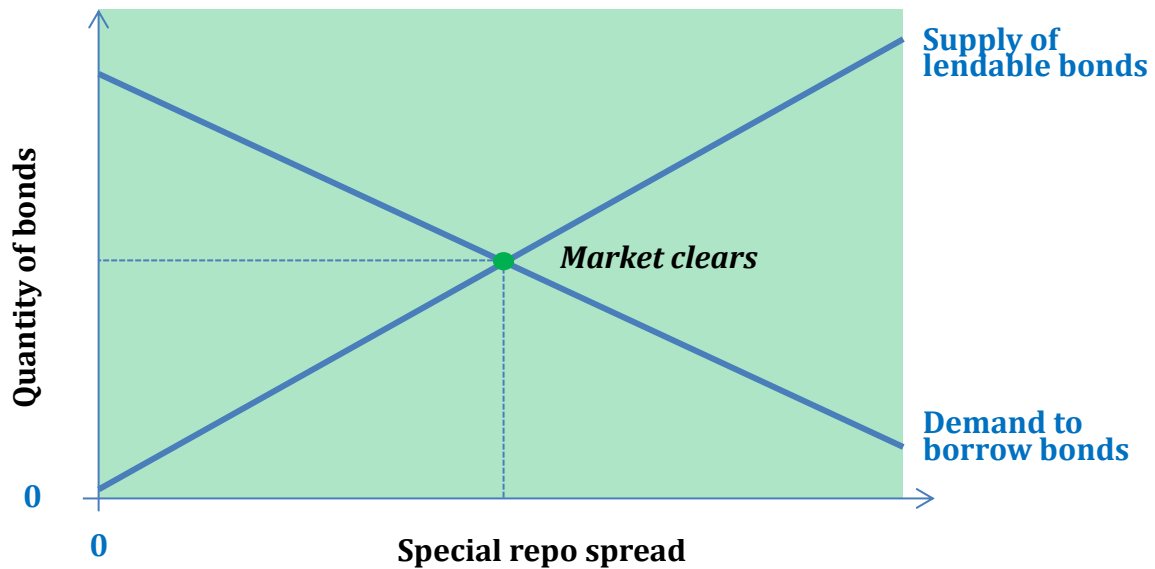
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<sup>1</sup> Data from the Canadian Depository for Securities are used to estimate the size of the total repo market, and reports from Freedom and Shorcan to obtain rough estimates for the brokered repo markets.

<sup>2</sup> Note that market participants do not use GC repos for either of these purposes; the bond received as collateral is unlikely to be the bond required to settle the short sale.



Figure 1: The specific repo spread clears at repo market for specific collateral



### SECTION 3: FLOORS AND CEILINGS IN THE REPO MARKET

**There is a floor—or lower bound—underneath the GC repo rate.** The existence of cash serves as the main constraint on nominal interest rates falling below zero. If holding cash entailed no costs, interest rates on savings and investments could never go below zero because savers and investors would simply switch to holding zero-yielding cash. But holding cash—especially in large quantities—does have costs. These costs, which are primarily for storage and insurance, mean that the effective return on holding cash is negative (Witmer and Yang 2016).

**The effective lower bound in the GC repo market is similar to other money markets.** There seems to be no specific features of the Canadian GC repo market that would affect market functioning when the overnight rate is zero or negative. Therefore, the effective lower bound for the GC repo rate is a function of the costs of alternative stores of value faced by repo market participants, including potential costs of transferring funds between physical currency and other financial assets. In fact, the effective lower bound may be more negative in the GC repo market than in other money markets since the GC repo market provides unique convenience to manage short-term liquidity.

**The special rate has a hard ceiling.** The special rate never rises above the GC rate. The lender of a specific bond—who is paying the repo rate—has the option to deliver the bond of its choice in a GC transaction. Hence, the lender would never accept to pay a special rate higher than the prevailing GC rate.

**If the overnight rate is above zero, the special rate has a soft floor at zero.** To understand this soft floor, it is useful to consider what happens when investors want to establish a short position in the cash market.<sup>3</sup> To settle a short sale, an investor has to borrow the bond sold short. There is a lower limit on the special repo rate an investor is willing to offer to bond lenders. The limit arises because the investor is indifferent between failing to deliver the bond and offering a special rate of zero to borrow the bond through the specific repo market and settle their short sale (Fleming and Garbade 2005). Market conventions dictate that failing to settle today only implies the obligation to execute settlement of its short sale tomorrow at *today's market price*. Offering a special rate of zero implies exactly the same obligation tomorrow (the borrowed bond would be delivered tomorrow to a different counterparty at today's market price). But any special rate less than zero makes the investor worse off today. The floor is soft because participants *can* negotiate lower special rates in bilateral transactions if they face other incentives to avoid failing (e.g., damage to relationships, regulation). These other incentives are discussed in further detail below.

**If the overnight rate is below zero, the special rate has a soft floor equal to the overnight rate.** The logic behind the soft floor when the overnight rate is negative is similar to the case of a positive overnight rate. When the overnight rate is negative, the market convention is still to attempt failed settlement tomorrow at *today's market price*, but the funds carry a negative rate overnight. Hence, the short seller would be willing to pay a rate as low as the overnight rate to exchange its funds for the desired bond and avoid (paying) the negative rate. Again, a lower (i.e., even more negative) special rate would make a short seller worse off today.

This discussion considered the perspective of a short seller. One natural question is whether the incentives are different for investors who have borrowed bonds to cover short sales in the past and who now have to settle the second leg of a repo transaction. As the following explains, this is not the case. To sum up, the features of the settlement system impose bounds on the special repo rate.

Figure 2 shows that the special rate evolves between its floor and ceiling in Canada and the United States, which are given by zero and the GC rate, respectively. Panel A was created using US data on GC rates and special repo rates for the on-the-run 10-year Treasury Note from 2001 to 2007. Over the sample period, the special rate takes on nearly all values between zero and the GC rate but never reach outside of this range.

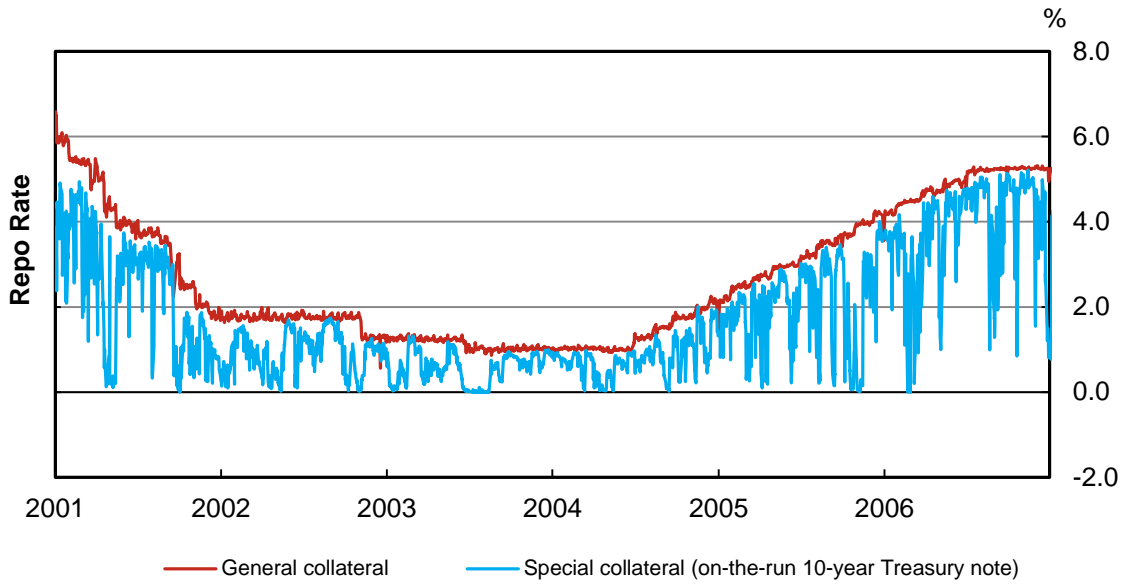
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<sup>3</sup> For clarity, we consider the case when the overnight rate is negative in the next paragraph.

Panel B was created using all traded overnight repo rates in Canada from 2009 to 2015. As in the United States, special rates do not breach the soft floor of zero.

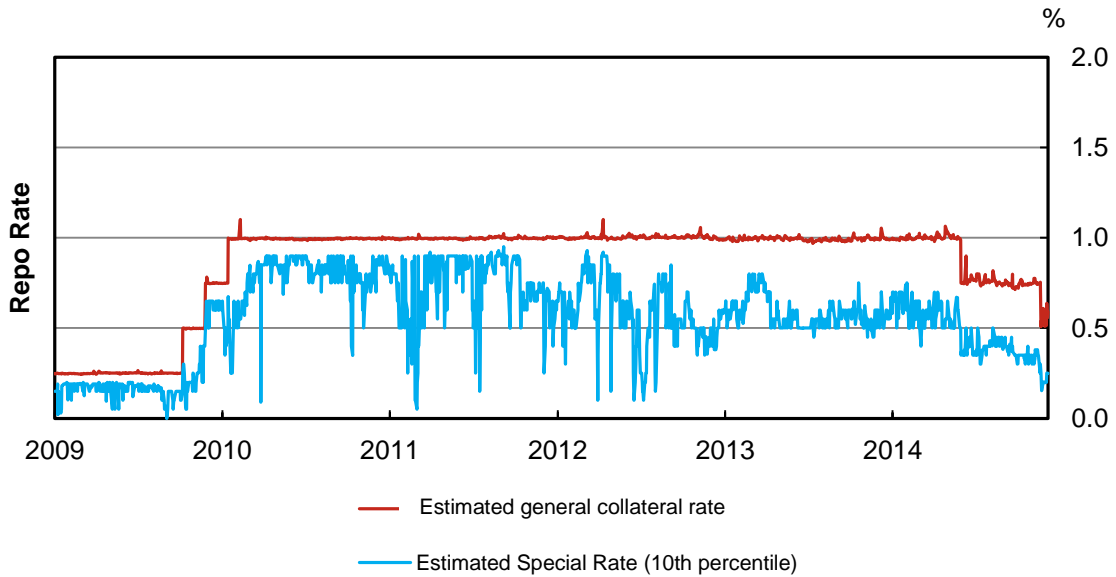
**Figure 2: The special rate is constrained between the GC rate and the soft floor at zero**

**Panel A—US data**



Source: Tullet Prebon ICAP

**Panel B—Canadian data**



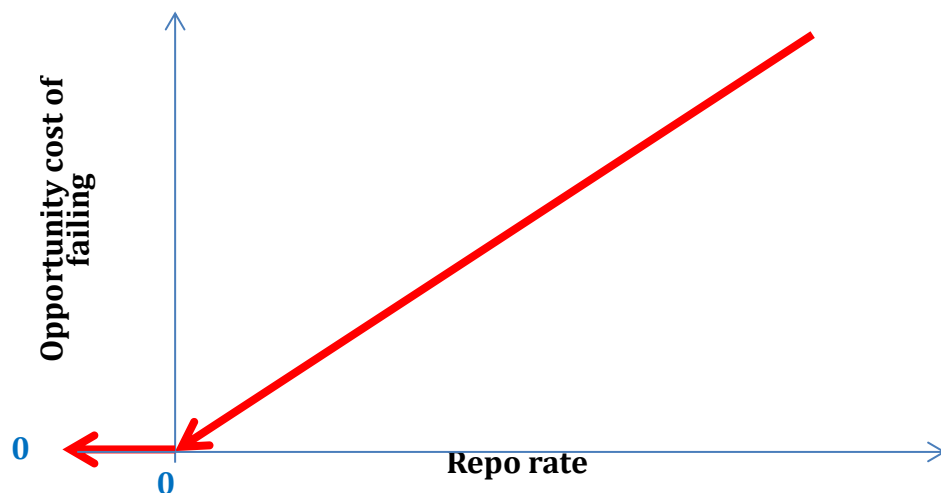
Source: Canadian Depository for Securities Ltd.

## SECTION 4: SETTLEMENT FAILURES IN THE REPO MARKET

**The repo contract allows for failure to deliver a bond.** The borrower of a bond may fail to return the bond when the contract matures (the borrower fails). In this case, the lender of the bond may allow the contract to roll over to the next business day. If the contract rate is positive, interest does not accrue after the initial maturity date of the repo: the lender of bonds pays zero interest to keep funds they initially received in this transaction. Receiving zero interest is an opportunity cost for the borrower of bonds, providing an incentive to locate and return the bond to the bond lender.

**The opportunity cost of failing to return a bond is the repo rate when GC repo rate is above zero.** The opportunity cost of failing tends to be high when the overnight rate is high. In this case, fails may occur sporadically—typically due to operational errors—but they do not occur frequently enough to affect market functioning. Figure 3 shows the opportunity cost of failing, decreasing one-for-one with the level of the GC rate. A low level of the GC repo rate constrains the ability of market forces to adjust the special repo rate, and the special repo rate will reach its lower bound more frequently. When the GC repo rate reaches zero, there is simply no room for adjustment. At this point, participants who need to deliver the security become indifferent between (i) borrowing the security and avoiding failure and (ii) forgoing the potential accrued interest in the failed transaction. Both choices imply lending funds at an interest rate of zero. Hence, market participants have no incentive to offer a lower special rate to attract a security for the purpose of settlement. Similarly, there is no incentive to offer a higher price to buy back the bond on the secondary market to settle this transaction. In fact, there may be forgone benefits from covering a short position used for hedging purpose.

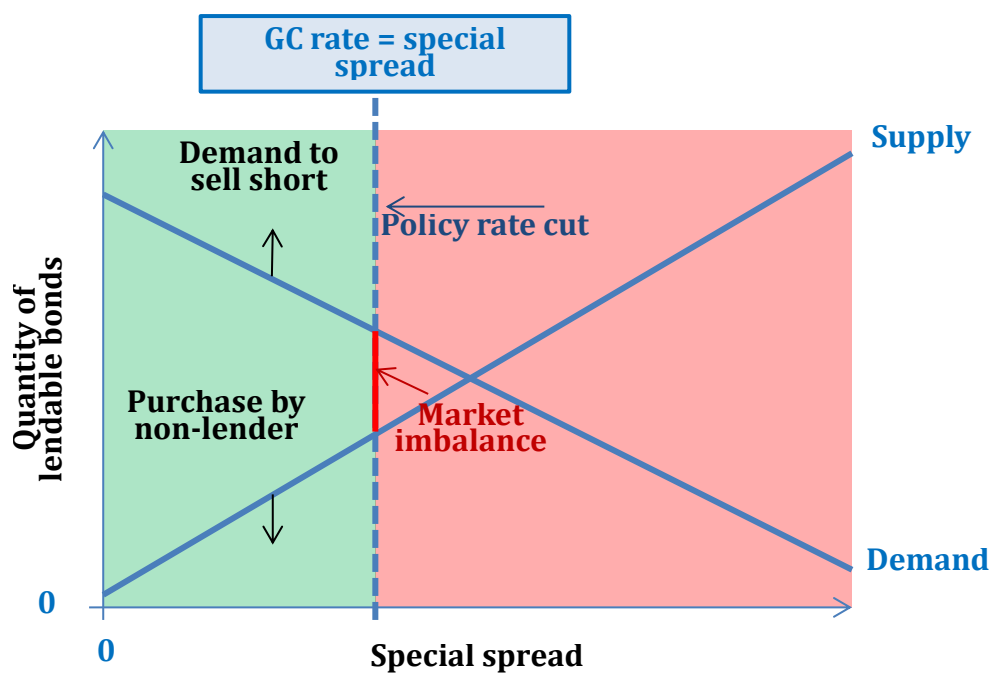
**Figure 3: The opportunity cost of failing to return a bond is the repo rate**



**The opportunity cost of failing is also zero when the GC repo rate is negative.** The repo contract treats settlement fails differently when the overnight rate is negative. The difference ensures that the borrower of the bond cannot benefit by failing to return the bond—i.e., to avoid paying the negative rate.<sup>4</sup> Specifically, if the contract rate is negative, interest continues to accrue after the initial maturity rate. In this case, the lender of the bond (the borrower of funds) continues to receive interest if the contract is rolled over.

Figure 4 illustrates how a ceiling can inhibit market clearing in the special repo market. The figure shows that a cap on the market price (the special spread) drives a wedge between the quantity of bonds demanded and offered. *There is no effective price mechanism to close the wedge.* The soft floor on the special rate constrains price adjustment. In this case, the market is rationed and bonds are allocated by other means (e.g., first-come, first-served; relationships).

**Figure 4: The price mechanism for special repo can break down**



<sup>4</sup> The lender of bonds can terminate the repo transaction if the borrower fails to return the bonds. In this case, the lender can use the cash received in the first leg to buy the bonds and require its counterparty to cover any deficiencies. This channel may provide further discipline to the market but discussions with market participants suggest this has never been used in Canada.

**Small shocks can lead to widespread and persistent fails.** The supply and demand analysis in Figure 4 suggests three types of shocks can lead to sudden spike in fails: (i) an increase in the demand to sell the bond short (demand shifts upward), (ii) increased bond purchases by investors who are not participating in the repo or lending markets (supply shifts downward), and (iii) an unanticipated decrease in the overnight GC repo rate. Shocks (i) and (ii) may follow unexpected economic news. Shock (iii) reduces the incentives to avoid settlement fails and tightens the constraint on the size of the special spread, further impairing the market mechanism. The GC rate of zero or becoming negative is the extreme case of this impediment to market clearing.

**The market price mechanism is impaired due to moral hazard at zero or negative overnight interest rates.** The repo contract does not provide *any* opportunity costs of failing to return bonds when the overnight rate reaches zero or falls below zero. This situation implies moral hazard in a repo contract since the borrower of a bond may use this security for private benefit—to maintain beneficial short positions—in a way that increases the probability of failing without bearing the costs of any externalities that failing imposes on other market participants. Relationships between repo market participants can help mitigate this hazard. When the borrower of securities fails to deliver, its counterparty may either be reluctant to lend securities in the future or offer worse rates. However, imparting blame to a particular market participant when fails occur in clusters is difficult because the initial fail cannot be identified using settlement or trading data, and an initial fail arising as a result of a technical factor cannot be differentiated from one that was squarely aimed at private benefit. In addition, the significance of relationships for the repo market in Canada has likely diminished as more repo trades have become anonymous as a result of clearing through the Canadian Derivatives Clearing Corporation ([CDCC], e.g., brokered trades cleared through CDCC). In the next section, “Past Experiences with Low Rates,” we will discuss historical episodes in other jurisdictions when reputational effects were not strong enough to prevent large volumes of failed settlements.

**Widespread settlement failures are very unlikely in the GC repo market.** By definition, bonds trading as GC are not scarce relative to other bonds. If a bond can only be obtained at a higher fee (through the securities lending market) or at a spread (through the specific repo market), it is not part of the GC market anymore (the specific repo market is discussed in detail below). Market participants understand that it is generally easy for their counterparty to locate and return a bond that trades in the GC repo market. Therefore, even small reputational concerns provide enough motivation to obtain and return bonds in the second leg of a GC repo transaction.

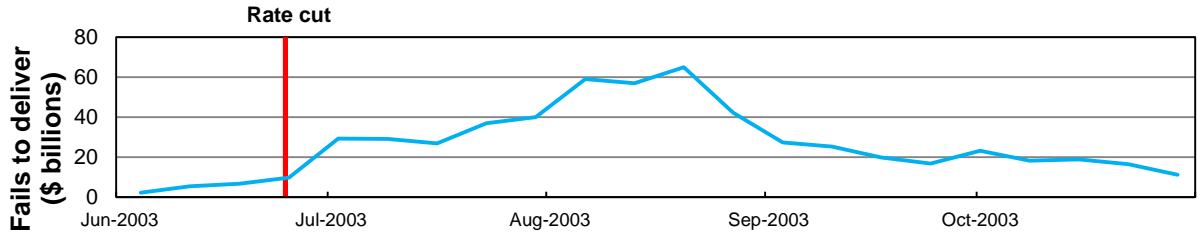
## PAST EXPERIENCES WITH LOW RATES

### UNITED STATES

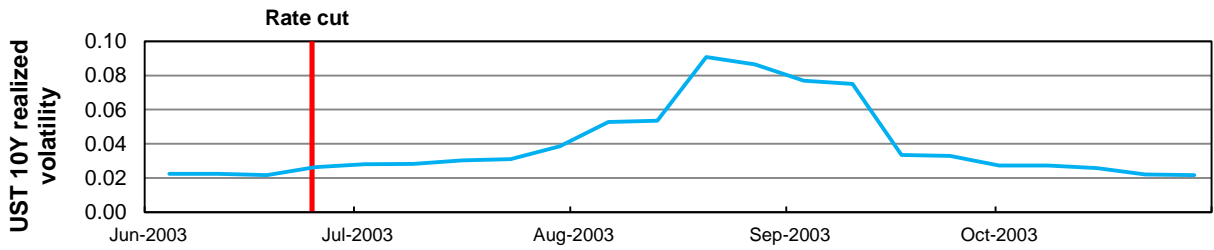
**Before 2009, when market convention changed, settlement fails were problematic in the United States when the overnight rate was low.** The experience of the US repo market shows the importance of preserving the opportunity costs of failed settlements. In the summer of 2003, the overnight rate in the United States was low and aggregate short positions were elevated. In June 2003, a specific on-the-run 10-year Treasury Note was used extensively by market participants to hedge interest rate risk. In its June meeting, the Federal Open Market Committee lowered its target rate from 1.25% to 1%. This announcement created a large surprise in the Fed Funds futures market (Figure 5, Panel C). In addition, the lower target rate constrained the special repo spread at 1% (Figure 5, Panel D). As predicted from the mechanism shown in Figure 4, this eventually led to a persistent mismatch between outstanding positions and a reduced supply of bonds. Without a functioning market mechanism, and with no incentives to deliver, fails on the Note became chronic (Figure 5, Panel A). The volume of failed settlements peaked at \$232 billion per day in August 2003—the worst episode of fails outside of the 2007–09 crisis—and fails did not subside until a new series of 10-year Treasury Notes was issued in November. The volatility of the 10-year yield increased substantially through the period (Figure 5, Panel B).

Figure 5: In the United States, fail rates became chronic in 2003 after a surprise cut in the target rate

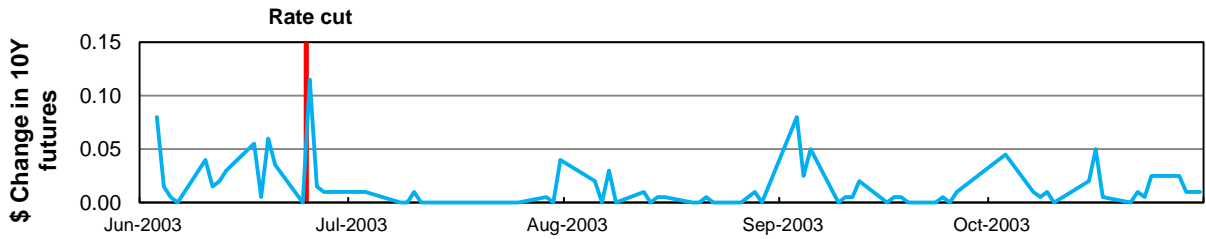
Panel A: Total fails



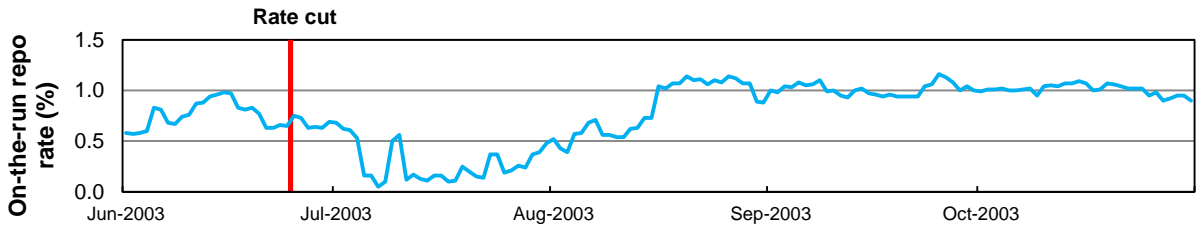
Panel B: Volatility



Panel C: Change in futures prices



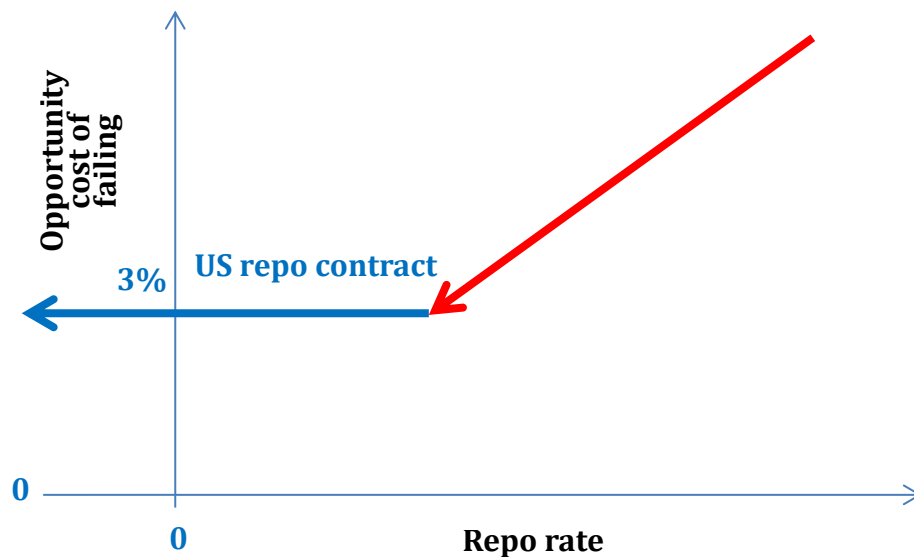
Panel D: Repo rate





**US repo market reform significantly reduced the severity of settlement fails.** In 2009, the Treasury Market Practices Group in the United States introduced changes to the market convention.<sup>5</sup> Essentially, the reform guaranteed that the opportunity cost of failing on a repo contract is not less than 3% (see Figure 6). This change allows the US special repo rate to reach as low as -3% (while GC is close to zero) to achieve a more efficient allocation of bonds. Since the reform, settlement failures have remained far below their historical peaks in 2003 and 2009 despite the US overnight rate having been lower than during the summer of 2003 (discussed in the previous section). For instance, financial conditions worsened across several markets around the “taper tantrum” in 2013, but fails reached only 10% of the peak observed in 2003. Data are shown in Figure 7. In this example, the absence of fails (or a low level relative to historical peaks before the market reform) provides support for our analysis.

**Figure 6: US 2009 reform restored costs of settlement failure**

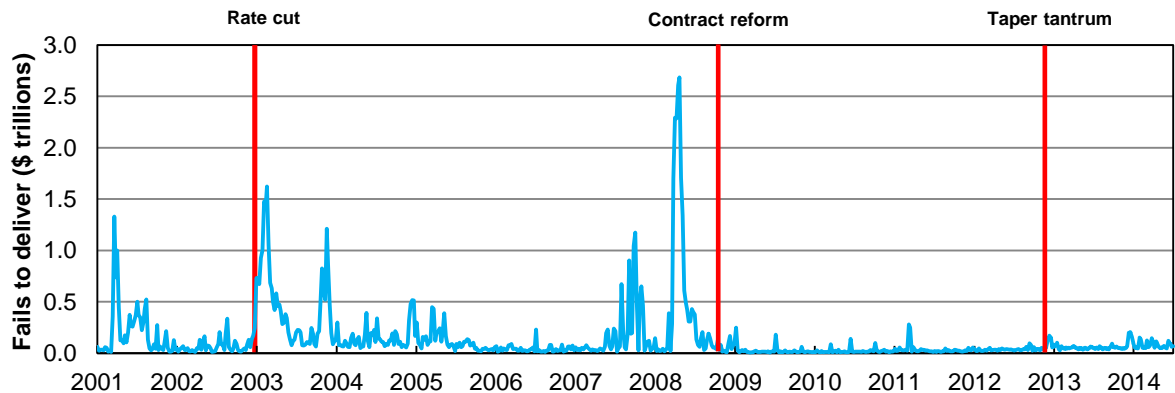


<sup>5</sup> For more details, see Garbade et al. (2010) and the release by the Treasury Market Practices Group at [www.newyorkfed.org/medialibrary/microsites/tmpg/files/PR081112.pdf](http://www.newyorkfed.org/medialibrary/microsites/tmpg/files/PR081112.pdf).

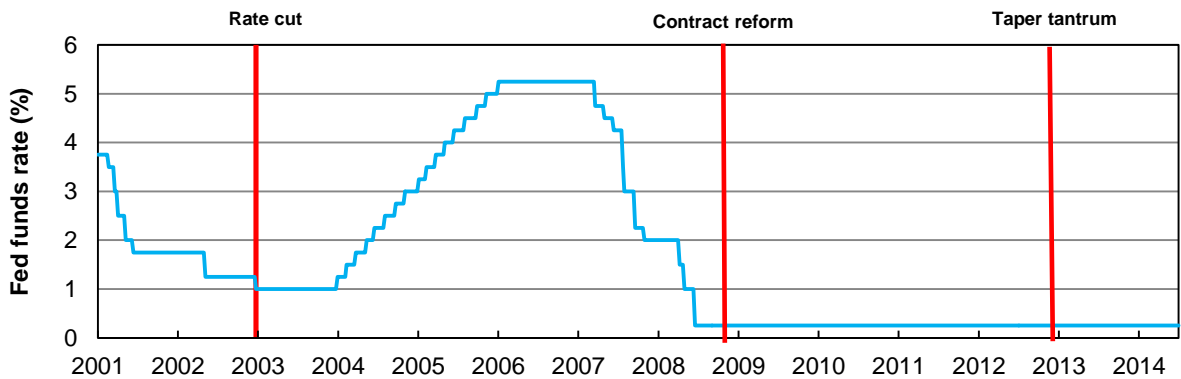
Until the first half of 2016, the special rates had not fallen to -3%. In 2016, special rates often fell to -3%, indicating that the disincentive effectiveness of the 3% fail penalty for those trades had diminished, and anecdotes confirm that failed settlements increased at the same time.<sup>6</sup> This example also provides evidence that settlement fails are more likely when the special rate reaches its floor at the point of indifference between borrowing the bond and failing to deliver.

**Figure 7: Fail rates decreased substantially once market conventions were changed despite market conditions associated with chronic fails.**

**Panel A: Failed settlement volume**



**Panel B: Federal funds rate**



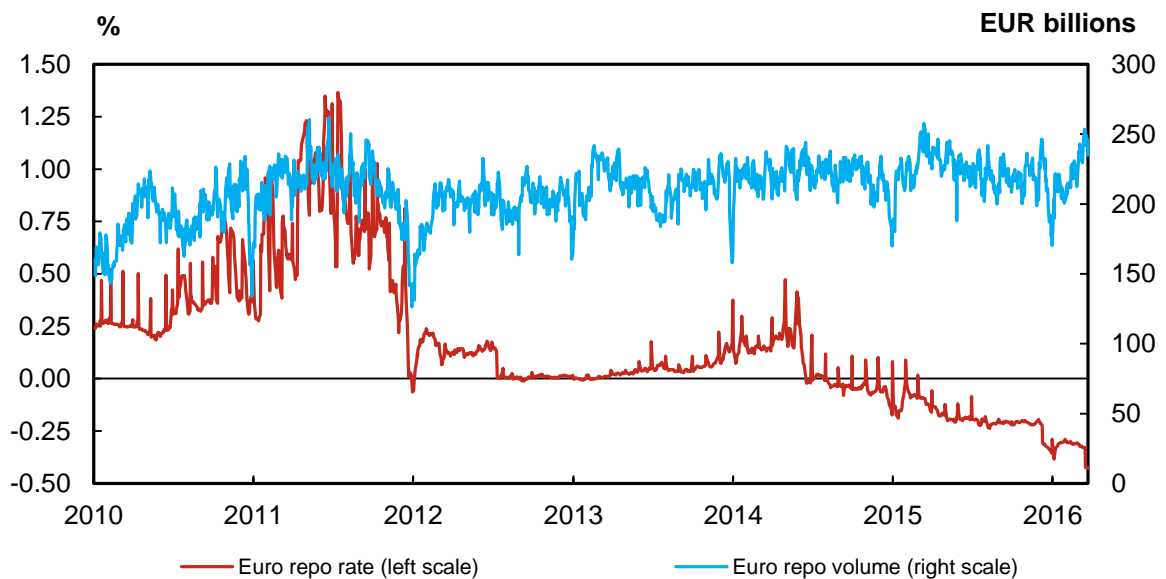
## EUROPE

**Our analysis suggests that the European GC repo market has continued to function normally despite repo rates very close to zero since 2012 and persistently negative since**

<sup>6</sup> McCormick, L., "Failed Trades in 10-Year Treasury Soar as Note Stays 'Special,'" 9 March 2016. Available at <http://www.garp.org/#!/risk-intelligence/detail/a1Z40000031sGLEAY>

2014 (Figure 8). The experience of the European repo market supports our conclusion that the GC repo market would function normally in Canada with negative overnight rate. Repo volumes have been steady over this period, and there is no evidence of market disruption related to negative interest rates. Repo fails also appear benign. One reason could be that a large demand to borrow securities on special has not been common in Europe. In addition, some other features of the European repo market may help explain the lack of settlement fails in Europe. These include the existence of an active European Central Bank (ECB) securities lending facility and the European Union (EU) restrictions on short sales of sovereign bonds. We examine these institutional features in more detail below.

**Figure 8: Volume of brokered euro repo remains stable**



Source: Bloomberg

Last observation: 22 March 2016

**Some institutional features of the European markets could be mitigating settlement failures.** In 2012, the EU introduced rules requiring short sellers to “locate” a bond before entering into a short position.<sup>7</sup> As expected, the rules were found to have decreased fail rates.<sup>8</sup> In 2015, the ECB began a securities lending facility to alleviate the potential scarcity of securities purchased in its Public Sector Purchase Programme

<sup>7</sup> The definition of short-selling specifically excludes transactions that are part of repo or securities lending contract. The new rules also exclude buying “naked” credit default swaps on sovereign issuers. Exemptions are provided for market-making activities in both cases.

<http://www.esma.europa.eu/page/Short-selling>.

<sup>8</sup> <http://blogs.cfainstitute.org/marketintegrity/2013/06/07/impact-of-european-short-selling-regulation-mixed-effects-on-markets>

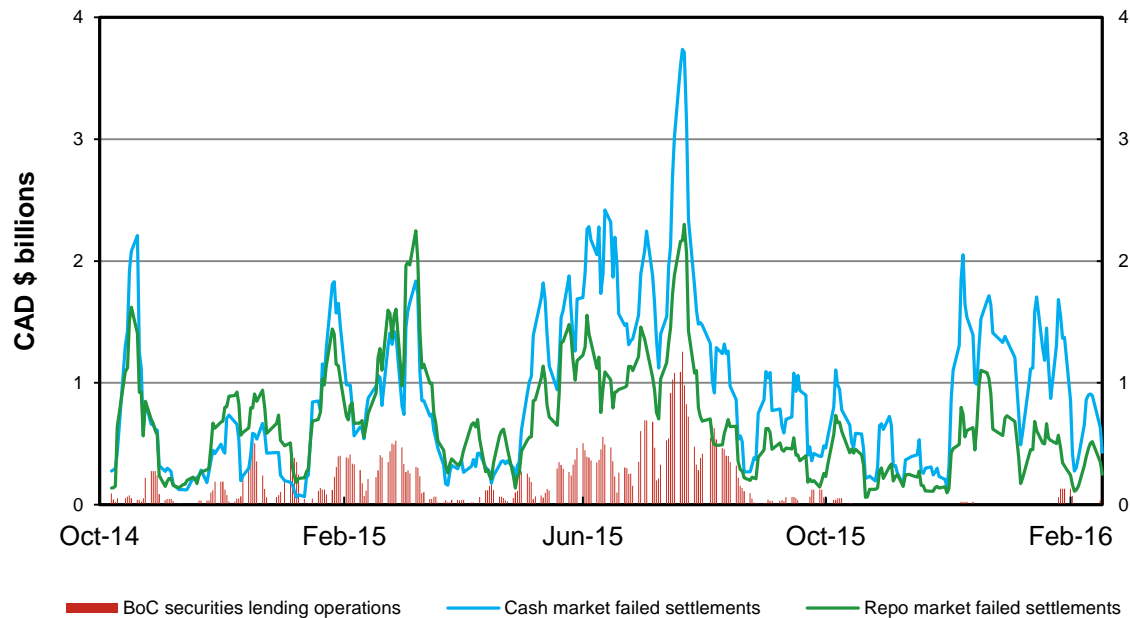
(PSPP). Eurosystem central banks make their PSPP holdings of specific collateral available either bilaterally or through other lending infrastructures. For example, Deutsche Bundesbank's PSPP holdings are made available through the Automated Securities Lending (ASL) system at Clearstream, an international securities depository that provides settlement services. Clearstream's ASL is a system designed to mitigate settlement failure by allowing Clearstream members' inventory of lendable assets to be made available for lending automatically if a borrower fails to deliver. Euroclear has a similar system for fails mitigation as part of its securities lending and borrowing program. Both systems charge a penalty if the borrower fails to return borrowed securities after a period of time. Finally, explicit fail penalties vary across jurisdictions in Europe. One notable case is Spain, which has a "no fails" regime. The Spanish settlement system, Iberclear, has an automated lending facility similar to those described above that triggers a buy-in if securities are not returned four days after the planned settlement date. Borrowers are charged 2% on the bought-in amount.

#### CANADA

**Fails did not cause disruptions during the period of low rates in Canada in 2009.** In 2009, the Bank of Canada target rate was cut from 0.5% to 0.25%. Data on the repo market are scarce for this period, but market participants report that the GC repo market continued to function normally. However, they also report there was very little activity in the special repo market and that there were very few fails. This absence of fails signal that not all of the three conditions that we identified were met. Specifically, a relatively low level of aggregate short positions and the lack of significant economic or policy surprises could explain the low level of settlement fails. In addition, trading volume in Government of Canada debt instruments in 2009 was the lowest it had been since 2004 and has been significantly higher since.

**Securities lending by the Bank of Canada may not fully alleviate the issue.** The Bank of Canada operates a securities lending facility that can be used by market participants to alleviate scarcity of a bond. Hence, periods of increased settlement failure in the repo market and in the cash market tend to be periods when the securities lending facility at the Bank of Canada facility is used heavily. Data are shown in Figure 9. However, usage of this facility has declined since the overnight rate was reduced to 0.5%. The reasons for this decline may be short-lived, but further analysis is required to understand these reasons.

**Figure 9: Settlement fails and Bank of Canada (BoC) securities lending operations no longer move together.**



## SECTION 5: POSSIBLE CHANGES TO THE CANADIAN REPO MARKET

In this section, we list a number of possible market structure, market convention and institutional details that could incentivize settlement discipline, mitigating heightened, chronic and pervasive levels of failure to deliver in the repo market. Although heightened repo fails periods are more likely to arise during periods of low or negative GC repo rates, these may occur in other circumstances when particular set of bonds is scarce.

**A fails charge could be integrated into market convention.** As described above, market convention how include a fail charge in the United States. The charge is capped at 3% (Figure 6). This approach has almost certainly reduced the number of fails since it came into effect. However, the US fail charge remains tied to the absolute level of the overnight rate. Albeit lower, a soft floor still exists. The special rates reached -3% in 2016 and settlement failures subsequently increased substantially. The approach has the advantage of being simple, but its effectiveness seems to vary with the overnight rate.

**A repo clearinghouse could make securities available for lending.** There are mechanisms in place in other jurisdictions that increase incentives for a counterparty to avoid settlement failure when rates are low or negative. In Europe, penalties are paired with clearing houses' automatic lending systems to mitigate collateral scarcity. Bonds

that are not delivered in centrally cleared repos are automatically sourced from bondholders who are members at the clearing house while interest is paid by the failing counterparty for everyday settlement is delayed. The system has the advantage that scarce bonds are allocated by a centralized authority, mitigating search frictions that arise when bonds must be sourced on a bilateral basis to offset short positions or an (earlier) fail to deliver from another counterparty.

**Participants could agree to a code of conduct or different market convention for repo settlement.** The code of conduct would set out industry-wide best practices for avoiding settlement failure as well as standards for conduct when strategic fails are possible. In cases where a single dealer holds a substantial inventory of a scarce security, they may not be incentivized to lend it. Indeed, maintaining scarcity is in their interest if they are owed the security and can collect fail penalties or continue to borrow funds at a low rate. A fail penalty may even exacerbate the situation where a dealer has cornered the market in a specific security. A code of conduct is one possible measure to prevent cornering.

**Bank supervisors could introduce a capital charge.** In the United States, the Securities and Exchange Commission requires brokers and dealers to hold regulatory capital when a fail persists over time (Garbade et al. 2010).<sup>9</sup> Capital charges mitigate risks and provide incentives to settle in a low or negative rate environment.

**Participants could negotiate a settlement failure penalty bilaterally.** Repo transactions could include another parameter to compensate either party in the event of a settlement failure. This parameter could be negotiated on a bilateral basis. However, it may be costly for participants to negotiate both a price and a fail penalty for every repo and would represent a significant departure from conventional business practices. There is also a risk that a fail penalty that varied across market participants results in a market fragmentation and diminishes the level of liquidity. This option is less practical than others but we list it here for thoroughness.

## SECTION 6: CONCLUSION

The market for GC repo is generally unaffected by low or negative overnight rates. The GC repo market would be subject to an effective lower bound determined by storage costs of alternative stores of value, similar to other money markets.

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<sup>9</sup> In Canada, securities financing transactions, including repos, are exempt from any capital charge related to settlement failure. See [www.osfi-bsif.gc.ca/Eng/Docs/CAR\\_chpt4.pdf](http://www.osfi-bsif.gc.ca/Eng/Docs/CAR_chpt4.pdf) for details.

The market for specific repo, however, can be affected in an environment of low or negative rates without changes to market convention or institutional structures. This in part reflects the fact that repo contracts allow counterparties to fail, but do not typically allow counterparties to negotiate a penalty for failure to deliver. When the GC rate is low, the market-clearing special spread is constrained from being sufficiently large to incent adjustments in supply or demand for specific collateral to offset a scarcity of that security. In this situation, an unexpected decrease in the overnight rate, a decrease in the lendable supply the bond, or an increase in demand to borrow bonds may lead to episodes of heightened levels of settlement failure.

While there is evidence that settlement failure in repo markets has negatively affected bond market functioning under certain circumstances in the past (Fleming and Garbade 2005), evidence from equity markets suggests a positive relationship (Fotak, Raman and Yadav 2014). Further analysis is needed to measure the effect of settlement fails on market functioning.

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