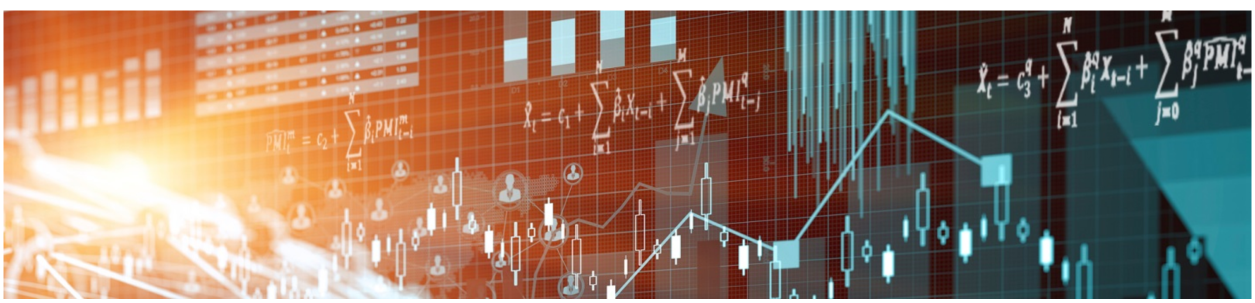
BANK OF CANADA
BANQUE DU CANADA

Staff Working Paper/Document de travail du personnel 2018-5

What Drives Interbank Loans? Evidence from Canada



by Narayan Bulusu and Pierre Guérin

www.bank-banque-canada.ca

Bank of Canada Staff Working Paper 2018-5

January 2018

What Drives Interbank Loans? Evidence from Canada

by

Narayan Bulusu[1] and Pierre Guérin[2]

[1]Funds Management and Banking Department
Bank of Canada
Ottawa, Ontario, Canada K1A 0G9
nbulusu@bankofcanada.ca

[2]Organisation for Economic Co-operation and Development
Paris, France
pierre.guerin@oecd.org

ISSN 1701-9397

Acknowledgements

Thanks to Peter Christoffersen, Antonio Diez, Itay Goldstein, Charles Kahn, Liu Liu, Francisco Rivadeneyra, Francesco Trebbi, Liyan Yang, Yu Zhu, and participants of the IFABS 2017 Oxford Conference, 24th Annual Meeting of the German Finance Association, 27th Annual Meeting of the Midwest Econometrics Group, and seminars at the Bank of Canada, for comments. Thanks also to Mark Rempel for providing the uncollateralized loan data used in this paper.

Abstract

We identify the drivers of unsecured and collateralized loan volumes, rates and haircuts in Canada using the Bayesian model averaging approach to deal with model uncertainty. Our results suggest that the key friction driving behaviour in this market is the collateral reallocation cost faced by borrowers. Borrowers therefore adjust unsecured lending in response to changes in short-term cash needs, and use repos to finance persistent liquidity demand. We also find that lenders set rates and haircuts taking into account counterparty credit risk and collateral market price volatility.

Bank topics: Financial markets; Wholesale funding
JEL codes: C55, E43, G23

Résumé

En utilisant la méthode de la combinaison bayésienne de modèles pour contrer l'incertitude qui entache les modèles, nous distinguons, pour le Canada, les déterminants des volumes et des taux des prêts non garantis et des prêts garantis, ainsi que des décotes appliquées aux actifs donnés en garantie. Nos résultats indiquent que les coûts de réaffectation des actifs donnés en garantie supportés par les emprunteurs constituent la principale friction régissant le comportement des acteurs sur ce marché. Les emprunteurs s'adaptent aux variations de leurs besoins de trésorerie à court terme en modifiant leur recours aux prêts non garantis et comblent leurs besoins persistants de liquidité au moyen des mises en pension. Nous constatons en outre que les prêteurs fixent les taux et les décotes en tenant compte du risque de contrepartie et de la volatilité de la valeur de marché des actifs donnés en garantie.

Sujets : Marchés financiers; Financement de gros
Codes JEL : C55, E43, G23

Non-technical summary

Financial institutions rely on interbank markets to meet demands for cash arising from the conduct of their business. Due to their role in reallocating funding liquidity among participants in the financial system, these markets play a crucial role in the transmission of monetary policy. Despite the importance of interbank lending to the economy, there is little agreement in the literature about the variables influencing the choice of collateral posted by borrowers to obtain cash in the interbank market. Our paper analyzes the drivers of unsecured and collateralized loans (repos), which helps us understand the frictions in the interbank market.

In our analysis, we use weekly data from September 2009 to December 2015 on 65 potential explanatory variables spanning the following categories: (i) funding liquidity indicators, (ii) economic and financial indicators, (iii) proxies for collateral risk, and (iv) prices of alternate short-term sources of cash. The large number of potential determinants makes it infeasible to estimate models with all possible combinations of variables to obtain the model that best explains each of the overnight loan variables. We therefore use the Bayesian Model Averaging (BMA) technique, which compares the goodness of fit of a sequence of randomly chosen subset of regressors against alternatives, and estimates the probability that each regressor is part of the best-fitting models.[1]

Our results suggest that the cost incurred by borrowers to reallocate their collateral across different counterparties is the key friction in the interbank market.[2] Borrowers may be reluctant to pay these costs, especially for temporary changes in the demand for funding liquidity. Therefore, they seek to meet unexpected short-term cash needs by adjusting their borrowing in unsecured loans. Borrowers change the repos in response to anticipated persistent changes in liquidity demand. Lenders, on the other hand, appear to set rates and haircuts on repos to account for counterparty and collateral risk.

These results stand in contrast to the existing literature that suggests that repos against riskier collateral fall in times of financial stress, since lenders prefer safer collateral to protect themselves against the increased likelihood of counterparty default. We believe that the difference between our results and those in the literature could be explained by the heightened sensitivity of lenders to counterparty risk in periods of financial stress. Concerns about bankruptcy of borrowers could be low enough in the absence of financial

[1]The larger this probability, the greater the confidence that the variable determines the dependent variable in question.

[2]The principal cost incurred in reallocating collateral is the time and effort required to renegotiate loan contracts on a bilateral basis with all the counterparties involved in the operation.

stresses for lenders to accede to borrower preferences to keep collateral reallocation to a minimum.

1 Introduction

The importance of interbank markets for the transmission of monetary policy is widely recognized (Ritz and Walther (2015), Iyer et al. (2014) and Chodorow-Reich (2014)). The global financial crisis of 2007–2009 also highlighted the reliance of the financial system on the market for short-term lending (Brunnermeier and Pedersen (2009)). Financial institutions use interbank markets to meet demands for cash arising from the conduct of their business. For example, banks may face unanticipated withdrawals by depositors, and mutual funds could be subject to investor redemptions. Other market participants such as hedge funds regularly need to borrow cash to meet counterparties' margin calls.[3]

Much of the literature focuses on the dynamics of interbank markets under financial stress. The two most common sources of funding liquidity analyzed in the literature are the unsecured overnight market (examples include Afonso et al. (2011), who use FedWire data in the US, and Angelini et al. (2011), who study the Italian unsecured lending market using e-MID data), and the repurchase agreement (repo) market (see Gorton and Metrick (2010) and Boissel et al. (2017), respectively, for analysis of US and Euro-area repos).

Many instruments are available to market participants to raise cash at short notice, e.g., unsecured loans, repos backed by collateral of different credit quality, or sale of money-market instruments. Therefore, the choice of contracts, and the relationship between the terms of the contracts, used to fill liquidity needs could reveal the frictions underlying interbank markets.[4]

We seek to understand the frictions in the interbank market by undertaking a comprehensive analysis of the drivers of overnight loans in the unsecured and repo markets in Canada.[5] The nature of these frictions could have implications for the broader economy, as shown in, e.g., Acharya et al. (2012) and Bianchi and Bigio (2014). An understanding of the drivers of interbank lending could help monetary and financial authorities design more effective policies towards achieving their monetary policy and financial stability mandates.

[3]We use the term "interbank markets" to refer to the venues of trade used to arrange short-term loans between all types of financial institutions. Some authors prefer the term "money markets" to emphasize the exchange of money that is central to these trades. Still others call this the market for funding liquidity to highlight the fact that these short-term loans play an important role in funding longer-term, less-liquid assets.

[4]For example, as Acharya and Merrouche (2013) argue, the sign of the correlation between lending volumes and rates indicates whether lenders either have excess or hoard liquidity. Alternately, the relative preference for collateral of different types could suggest whether borrowers are constrained by the availability of desired collateral.

[5]As in most jurisdictions, overnight unsecured loans and repos make up the bulk of short-term funding in Canada.

However, given the pivotal role played by these markets in the transmission of monetary policy, it is also critical to understand the drivers of interbank lending even in "normal times."

Specifically, this paper attempts to identify the drivers of aggregate loan volumes, rates and haircuts for the four major collateral types in Canada using weekly aggregate data from September 2009 to December 2015.[6] Since there is little agreement in the literature about the set of variables influencing the terms of interbank loans, we collect the broadest possible set of potential determinants spanning the following categories: (i) funding liquidity indicators, (ii) economic and financial indicators, (iii) proxies for collateral risk, and (iv) prices of alternate short-term sources of cash. As shown by Gai et al. (2011), the availability of other sources of cash has consequences for the particular instruments used to obtain funding liquidity. Since all the overnight loans we analyse in this paper are potential substitutes for each other, we include the lagged values of loan volumes, rates and haircuts of each collateral type as additional regressors. Along with dummies for seasonality and the period when a central counterparty (CCP) settles repos in Canada, we have a total of 65 potential explanatory variables for each of the overnight loan contract terms.

Given a large number of explanatory variables, it may be infeasible to estimate each of the possible linear models to choose the one with the best fit.[7] To account for uncertainty about which of our 65 regressors is linearly related to the contract terms of interbank loans, we use the Bayesian Model Averaging (BMA) technique. BMA amounts to comparing the goodness of fit of a sequence of randomly chosen subset of regressors against alternatives, and estimating the posterior inclusion probability (PIP) of each regressor, along with its posterior mean and variance of the coefficient in a linear regression. BMA has previously been used in settings where the number of potential explanatory variables is large.[8] To the best of our knowledge, our paper is the first to use this approach to study interbank loans.

Our results suggest that the cost incurred by borrowers to reallocate their collateral across different counterparties is the key friction in the interbank market. The principal cost of collateral reallocation is the time and effort required to renegotiate loan contracts on a bilateral basis with all the counterparties involved in the operation. Borrowers may

[6]Government of Canada securities, mortgage-backed securities (backed by the Government of Canada) issued by the Canadian Mortgage and Housing Association, and provincial government securities are the three major debt classes used as collateral for repos in Canada. Unsecured loans could be seen as being "collateralized" by the borrower's reputation, with an unobserved haircut.

[7]In our application, even if we were able to estimate a billion linear regressions per second, it would take over one thousand years to estimate all of the 2^{65} possible linear models for each dependent variable.

[8]Examples include the literature on the determinants of economic growth (Fernandez et al. (2001), corporate default (González-Aguado and Moral-Benito (2013)), and foreign investment (Blonigen and Piger (2014)).

be reluctant to pay these costs, especially for temporary changes in the demand for funding liquidity. Therefore, they seek to meet unexpected short-term cash needs by adjusting their borrowing in unsecured loans, while simply rolling over their repos.[9] Lenders primarily appear to set rates and haircuts on repos to account for counterparty and collateral risk.

These results stand in contrast to the existing literature which argues that loan volumes against riskier collateral fall in times of financial stress, since lenders prefer safer collateral to protect them against the increased likelihood of counterparty default (Mancini et al. (2016)). This fall in volume occurs concomitantly with higher rates and haircuts applied to riskier collateral, even as they remain unchanged for the safer collateral (Gorton and Metrick (2010), Afonso et al. (2011)). In the terminology employed by Mancini et al. (2016), repos collateralized by safer assets act as a shock absorber. In our view, the difference between our results and those in the literature could be explained by changes in lender behaviour between normal and stressed periods. During the former, lenders' assessment of counterparty credit risk remains somewhat unaffected by the demand for liquidity, which makes them willing to accede to borrower preferences to keep collateral reallocation to a minimum. However, lenders' heightened concerns about counterparty credit risk could trump borrower preferences in times of financial stress. This would lead lenders to increase rates and haircuts applied to loans against riskier collateral, which, in turn, could make borrowers shift towards posting safer collateral. Viewed through the lens of Acharya and Merrouche (2013), the "arbitrage effect" dominates in the former, while the "liquidity effect" takes precedence in the latter.

Our inference that the costs of collateral reallocation drive interbank funding choice is based on the following evidence.[10] First, weekly repo volumes are persistent, with posterior mean coefficients on their own lags between 0.5 and 0.7 in BMA analysis for the three collateral types we study. Unsecured loan volume does not exhibit such persistence; the posterior mean of the coefficient of lagged unsecured volume is less than 0.03. Second, repo volumes respond to proxies for expectations of future economic activity (and by extension, expectations of persistent future liquidity needs), while unsecured loan volumes react to indices of short-term liquidity needs.

[9]Much of the trading in the unsecured and repo markets is over the counter (see, e.g., Ashcraft and Duffie (2007) and Krishnamurthy et al. (2014) for the case of the US). However, tri-party agents in the US undertake collateral management on behalf of their clients (Copeland et al. (2014)). Thus, the friction identified in this paper could be less relevant for the tri-party lending market. Indeed, as Krishnamurthy et al. (2014) show, the tri-party and bilateral repo markets in the US exhibited markedly different behaviours during the crisis of 2007–2009.

[10]A variable is mentioned in this discussion only if its PIP as estimated by the BMA procedure exceeds 50%. This threshold is commonly used as a rule of thumb for a regressor to be judged as at least having a weak (as opposed to no) effect on the dependent variable (Kass and Raftery (1995)).

To gain further intuition about the nature of the adjustment costs, we run bivariate vector autoregressions (VAR) on each of the loan contract terms separately with the variables related to temporary and persistent changes in the demand for liquidity. We find that temporary funding shocks affect unsecured loan volumes only in the short term (up to two weeks), which confirms our interpretation of the temporary nature of the liquidity shock. Changes to the proxy for the expectation of future economic activity, in contrast, lead to a gradual (lasting up to 25 weeks) adjustment of repo volumes. This suggests that adjustment costs prevent borrowers from immediately shifting to the new preferred loan contracts, following changes in the expectation of future demand for liquidity. The reaction of prices and haircuts to shocks to funding demand – both persistent and temporary – is short lived, lasting up to one month after the initial shock. This observation is consistent with lenders facing few constraints in changing loan contract terms.

Apart from studies investigating the effect of financial crises on interbank markets noted above, our paper is related to two other broad strands of the literature on interbank markets.[11] First, a number of papers use loan-level data to relate contract terms to borrower and lender characteristics (King (2008), Cocco et al. (2009), Angelini et al. (2011)). Our study complements this literature by focusing on the determinants of aggregate loan volumes, rates and haircuts by collateral type. Second, given the difficulties in gathering (historical) data on over-the-counter loan contracts, prior literature has tended to study one particular market for which data were available. Examples include Afonso et al. (2011), who study the unsecured market in the US; Gorton and Metrick (2010), who analyze the bilateral repo market in the US; and Boissel et al. (2017), who focus on repos settled through CCPs in Europe. A few papers that attempt to analyse multiple markets focus on only one contract term, such as loan rates (De Socio (2013) and Acharya and Merrouche (2013)). Our novel data set of unsecured and repo markets in Canada allows us to conduct a more comprehensive analysis of the volumes, rates and haircuts of unsecured and repo markets jointly – a natural direction in which to advance the literature, given that the choice of the use of each collateral type is determined jointly.[12]

The rest of the paper is organized as follows. We begin with a brief description of the Canadian interbank market in Section 2, and then describe the data we use in Section

[11] The full range of issues surrounding interbank markets that has been examined is far too large to fully do justice to here. Examples of strands of literature we have not discussed include the network analysis of participants in the interbank market (e.g., Hatzopoulos et al. (2015) and Affinito (2012)), the role of central bank interventions in the interbank market (see, e.g., Brunetti et al. (2011) and Garcia-de Andoain et al. (2016)), and the effects of policies determining access to unsecured lending facilities on the effectiveness of monetary policy implementation (notable examples include Acharya and Merrouche (2013) and Kraenzlin and Nellen (2015)).

[12] One example of perhaps an even richer dataset than the one we use is the one used by Martinez-Jaramillo et al. (2014); however, their focus is on mapping the network of interbank exposures in Mexico.

3. We then present the econometric framework in Section 4, before discussing the model-averaging results in Section 5. Section 6 presents the results of the dynamic analysis of the interbank market. Section 7 concludes.

2 The Canadian interbank market

We now briefly describe the relevant institutional features and the procedure we use to identify Canadian unsecured loan and repo trades.[13] Our study focuses on repos and unsecured loans since discussions with market participants suggest that these are the predominant sources of overnight loans in Canada.[14]

Financial institutions that are required to maintain reserves with a central bank are usually provided access to the payments network to be able to exchange large-value payments with other such institutions. This specialized payments system – e.g., FedWire in the United States and Large Value Transfer System (LVTS) in Canada – which allows participants to quickly process payments of significant size between one another, is the platform used to execute unsecured lending. Rempel (2016) uses a refinement of the Furfine (1999) algorithm to identify overnight loans from the LVTS payments flows. Every unsecured loan consists of a pair of payments exchanged between the same two institutions on successive (working) days, with the interest payment included in the second day's payment. Furfine (1999) suggests applying filters on the data, e.g., to the initial loan amount and the plausible range of interest paid, to improve the identification of unsecured loans.[15]

Repos in Canada are settled on the CDSX, the settlement system of the TMX Group. Every repo consists of a pair of trades, the first a sale of the security used as collateral to the cash lender, and the second a sale of the same security on a subsequent date to the borrower. The difference between the sale and repurchase prices allows us to identify the repo rate. The similarities in the way repos and unsecured loans are recorded suggests the use of a similar matching algorithm to identify repo trades. However, there is no

[13] Rempel (2016) provides a review of the unsecured lending market in Canada. Garriott and Gray (2016) describe the participants and infrastructure underlying the Canadian repo market in greater detail.

[14] Other short-term funding sources, such as bank certificates of deposit, commercial paper, and securities lending, typically have longer maturities. Asset sales in the spot market is another possible means to raise cash; however, settlement conventions in Canada mean that only debt instruments with less than one year to maturity settle on the same day. More pertinently, since asset sales may be triggered by a plethora of motives unrelated to funding needs, we choose to exclude them from our analysis.

[15] Rempel (2016) argues that a first leg with multiple feasible second legs ("non-unique loans") has a higher probability of being falsely identified as an overnight loan, and proposes retaining only such non-unique loans that share sufficient similarities with closest-in-time unique loans.

information on the parties to the trade in the CDSX data. Since it is reasonable to expect that the counterparties to a repo enter both the first and second legs of the trade within a short interval of time, we use proximity of entry time as proxy for trades by the same counterparties.

In effect, our matching algorithm pairs up trades involving an exchange of an equal par value of the same security, but settling on different days, as long as the trades are entered into the CDSX system not too far apart in time. We are able to compute, from each trade pair, the volume, rate and tenor of the repo.[16] We estimate the haircut applied to the collateral by comparing the price at which the first leg of the repo was settled with the price of the spot trade (in the same security as the repo collateral) closest in time on the date on which the first leg was traded.[17]

Beginning 2012, the Canadian Derivatives Clearing Corporation (CDCC) began clearing repos. Since CDCC also records repos as a pair of sale/buyback trades, we apply the algorithm described above to the data provided by CDCC.[18] We append these trades to those obtained from CDSX; this forms our data of repos in Canada. Since our interest is in identifying collateralized overnight interbank loans, we purge this sample of special repos, which may be motivated by reasons other than the search for funding liquidity (see Duffie (1996) for a description and analysis of special repos, and Bulusu and Gungor (2017) for details of the identification of special repos in our sample).

3 Data

The objective of our analysis is to uncover the underlying frictions in interbank markets by identifying the drivers of overnight lending. Therefore, in contrast to the literature on

[16]The algorithm is discussed in detail in Bulusu and Gungor (2017). Final repo data matches about 60% (by volume) of security-for-cash trades identified as being possible first legs of a repo. The non-matched trades may be because our algorithm is not designed to identify forward, open term, evergreen, or floating-rate repos (see Garriott and Gray (2016) for a description of such repos). Moreover, since misidentification of repos by our algorithm is unlikely to be systematically correlated with security characteristics, we believe that the data are representative of the Canadian repo market.

[17]The estimated haircuts may suffer from estimation errors to the extent that the closest-in-time spot trade is not representative of the base price from which the haircut was calculated. This could be because the difference between entry times of the spot and repo transactions is sufficiently large for the base price to have changed. Alternately, it could be because the price of the closest-in-time spot trade was not representative of the price at which the two repo counterparties would have traded the same security in the spot market. To account for possibly large errors, we set repos with estimated haircuts over 25% or below -5% to "missing."

[18]The following copyright notice applies to the CDCC data used in this paper.

the determinants of individual loans, we focus on aggregate weekly lending by collateral type. We believe that our choice of weekly aggregation strikes the right balance between having a large enough sample size and finding a sufficiently large number of variables to capture possible determinants. Thus, while daily aggregation of overnight loans would both increase sample size and reduce the loss of information due to aggregation, the number of variables available at the daily frequency would be too small to account for the key possible classes of determinants. Instead of taking weekly totals, which would be affected by the number of trading days in the week, we take each of the average daily overnight loan contract terms in a week as our dependent variable. We estimate these variables for each of the four collateral types – Government of Canada bills and bonds (GoC), mortgage-backed securities issued by the CMHC (CMB), provincial government bills and bonds (PRV), and unsecured.[19]

Figure 1 plots the average daily volume of interbank lending for each week in the sample for the different collateral types. Table 1 summarizes the average daily values of each of the dependent variables in a week, along with the first-order coefficient of autocorrelation of the time series (β_{AR1}). It is clear that unsecured loans and GoC repos dominate the interbank loan market in Canada. GoC repos make up about 45% of the total interbank loan market, while unsecured loans form about 35% of the total volume.[20] Log GoC repo volumes are highly autocorrelated, as can be seen from the AR(1) coefficient of 0.83. The share of CMB repo volumes rose from negligible at the beginning of the sample, to fluctuate between 10% and 30% of interbank loan volume. Log CMB repo volumes have an autocorrelation coefficient of 0.77. Provincial repos have taken an increasing share of the total interbank lending, rising from a negligible amount to nearly 15% of overall interbank lending towards the end of the sample. The logarithm of the daily volume of overnight unsecured lending exhibits a significantly lower degree of autocorrelation, 0.19.[21]

Figure 2 shows the evolution of the spread of the different rates over the Bank of Canada overnight target.[22] Unsecured lending is systematically cheaper than collateralized lending

[19]We ignore the other bond classes (such as corporate bonds, Bankers' Acceptances, Commercial Paper) which are used as collateral for less than 5% of total repo volume in our sample. Moreover, repos backed by these collateral types are not traded in every week of our sample.

[20]Given that the average daily volumes are in the tens of billions of Canadian dollars for most of the collateral types, we use the logarithm of the volumes as the dependent variables.

[21]The sharp fall in overnight unsecured loans twice a year coincides with the days when the financial markets are open in Canada but closed in the United States. Excluding these observations from our sample increases the AR(1) coefficient for unsecured lending to about 0.6, which is lower than the AR(1) coefficients for collateralized lending. More importantly, as discussed subsequently, excluding these observations does not change the central message of our paper.

[22]We use the spread of the overnight rates over target as the dependent variable of interest to take into account changes in the overnight rate due to changes in the target rate.

in Canada, to the tune of between 5 basis points (bps) in 2009 and 7 bps in 2015.[23] Among collateralized loans, as would be expected from loans backed by relatively riskier collateral, repos backed by provincial government bonds are on the average more expensive than those backed by CMBs, and GoC repos are the least expensive. As can be seen in Table 1, the spread over the overnight target rate of PRV repos varies significantly over time, ranging from -0.6 bps in 2011 to 2 bps in 2015. Using GoC bonds allows borrowers to obtain loans at between 0.04 bps and 0.7 bps below the overnight target rate until 2014. GoC repo rates are about 0.5 bps higher than the target rate in 2015. Interbank loan spreads are also highly persistent; however, the ADF test rejects the hypothesis that these series have a unit root at the 5% significance level. Since our object of study is not the target rate, we study the spread of the overnight lending rate over target. However, for brevity, we often use the term "overnight lending rate" to mean the spread of the overnight rate over target in the rest of this paper.

Figure 3 plots the haircuts applied to the different collateral types. As would be expected, the haircut applied varies inversely with the perceived safety of the collateral class. In particular, the riskiest collateral class we analyse – Canadian provincial bonds – experiences large swings in haircuts over time. As Table 1 shows, the average daily haircut applied to Canadian provincial bonds was about 22 bps. This rose sharply to 79 bps during the European debt crisis period. During the same period, the haircut on CMBs remained relatively low, at about 10 bps, even though that of GoC bonds grew to 15 bps. It is also interesting to note that while the overall level of haircut for CMBs has remained around 10 bps over the sample (with the exception of 2013), GoC haircuts steadily rose from about 5 bps in 2010 to over 32 bps in 2014.

3.1 Choice of explanatory variables

Table 2 contains the descriptions and the sources of all the independent variables used in the study. The number of variables is large; we consequently discuss the rationale for the choice of the broad categories into which these variables fall.

Gorton et al. (2012) highlights the role of substitute safe assets in the provision of liquidity to the financial system. We accordingly include variables reflecting the cost of substitute sources, viz., bank deposits, Commercial Paper, Bankers' Acceptances, and corporate

[23]The lower cost of unsecured – when compared to collateralized – lending is observed both in the US and in Canada. Rivadeneyra and Rempel (2017) suggest that differential access to, and non-synchronicity of, the unsecured and repo markets could generate this seemingly counterintuitive result.

bonds.[24] Since the choice of interbank loan volumes, rates and haircuts could plausibly depend on the current and expected future state of the economy, we also include macroeconomic indicators that are available at the weekly frequency. Examples include West Texas Intermediate (WTI) crude oil spot prices and a measure of the Canadian effective exchange rate (to account for the importance of trade, especially with the US).

The extraordinary efforts undertaken by central banks since the great financial crisis have spurred efforts to measure the impact of such policies on interbank lending. Given the broad agreement about the influence of such liquidity provision in the literature (see, e.g., Fleming et al. (2010)), we include the actions of the Government of Canada and the Bank of Canada that could affect the interbank market. This includes results of auctions of cash by the Government of Canada, the balances of private participants in the LVTS, and liquidity provision by the Bank of Canada.

Allen et al. (2009) argue that aggregate demand for liquidity increases with asset price volatility. Heider et al. (2015) highlight the importance of market uncertainty in determining the level of interbank lending. Gorton and Metrick (2012) find that proxies for counterparty risk are strongly related to repo rates and haircuts. We therefore include a large set of variables that capture financial market conditions along two dimensions – financial stress indicators, and term premia in various markets. Since the terms of trade that lenders offer may depend on the riskiness of the collateral backing the overnight loan, we include proxies for the risk of each collateral type. Lenders do not typically distinguish between instruments in the same credit basket with different maturities and coupons. We therefore attempt to proxy for the riskiness of the collateral type in a week using the volatility of each of the three principal components of its zero-coupon yield curve within the week.

The Canadian CCP began processing repo trades in 2012, which could affect the mix of collateral used and their terms of trade. Accordingly, we introduce a dummy that takes the value 1 for the part of the sample in which the CCP processed repo trades, and 0 when it did not. In all the analyzes that follow, we also control for trend, and week-of-the-year, month-of-the-year and quarter-of-the-year effects, given the prior evidence of seasonality in the financial system's demand for liquidity (Bindseil et al. (2003)).

While we attempt to obtain all possible variables from Canada that fall into the different classes of drivers described above, data availability limitations force us to turn to

[24] We only include prices since data on the stock of the substitutes are unavailable.

corresponding variables in Canada's largest trading partner, the United States, for supplements. As a small open economy, Canada is influenced by the US economy in general; in particular, the US financial sector has a significant affect on the Canadian financial sector.

In all, our sample consists of 65 variables at weekly frequency from September 2009 to December 2015, including the trend and seasonality controls, and the lagged funding volume, rate and haircut for each week by collateral type. The dependent variables are the unsecured loan volume and rate, and the repo volume, rate and haircut for each of the three classes of collateral.

The use of variables from the US mitigates concerns about reverse-causality, since Canadian interbank markets are unlikely to have a significant impact on the real and financial sector in the US. However, using contemporaneous real and financial variables from Canada as independent variables could raise endogeneity concerns. We therefore lag all potential explanatory variables – even those drawn from the US – by one period to alleviate such apprehensions.

4 Econometric framework

Empirical studies of the determinants of interbank lending are scarce, typically due to the lack of data on these markets. Furthermore, the theoretical literature offers only limited guidance on which variables to include in an empirical model of the interbank lending market. Hence, there remains a substantial degree of uncertainty regarding the drivers of this market. For this reason, we consider a large number of predictors ($K = 65$ in our paper) to explain the terms of trade of interbank loans (loan volume, lending rate, and, for collateralized loans, the haircuts applied), which leads to potentially 2^{65} candidate models for each dependent variable. Further, our unique dataset of unsecured and collateralized lending in Canada allows us to explore possible heterogeneous responses in the sub-markets to the dependent variables we consider.

Bayesian model averaging (BMA) techniques can conveniently deal with model uncertainty in that this avoids presenting the results based on a single empirical specification, which is considered as known.[25] Given the very large number of candidate models, we rely on an algorithm that only explores a subset of suitable models denoted as MC^3, which consists of an extension of Markov-chain Monte-Carlo (MCMC) methods. Generally speaking,

[25] Admittedly, while BMA techniques are suitable to perform model selection (i.e., decide which variables should be included in an empirical model), model uncertainty related to the functional form of the model or the distributional choices for the residuals are not explicitly addressed by standard BMA techniques.

MCMC methods allow one to draw from the posterior distribution of the parameters, and MC^3 draws from the posterior distribution of models (see, e.g., the textbook treatment in Chapter 11 of Koop (2003) for additional details). As a result, this means that the BMA algorithm we use will not explore every possible candidate model, but instead concentrate on the models with high posterior model probability.

The general econometric specification we consider is given by

$$Y = \alpha + \mathbf{X}\beta + \epsilon, \tag{1}$$

where $\epsilon \sim N(0, \sigma^2 I_T)$. $Y = (y_1, ..., y_T)'$ and ϵ are $T \times 1$ vectors of the dependent variable and the random shocks, respectively. $\mathbf{X}$ is a $T \times K$ matrix of regressors that may or may not be included in the model, and β is a $K \times 1$ vector that contains the parameters to be estimated. The BMA analysis is run separately for each scalar dependent variable Y, which is one of the log volume, rate and haircut of each of the four collateral types analysed in this paper: GoC repos, CMB repos, PRV repos and unsecured loans. The matrix of explanatory variables $\mathbf{X}$ includes n of the 65 predictors discussed earlier.

A few additional comments are required. First, we use a Normal-Gamma natural conjugate prior for the model parameters; hence, analytical results for the posterior moments exist. As such, this makes the estimation of a specific model straightforward, which is appealing given the computational burdens of BMA. Given that we have many explanatory variables that are likely to have no effect on the dependent variable, we centre the prior for β around 0. We choose a *g-prior* for the variance of β and we follow Fernandez et al. (2001) to set g.[26]

All MC^3 results are based on sampling 26 million draws, from which we discard the first 1 million draws to ensure convergence of the algorithm. Hence, all results are presented using 25 million draws. Sequential runs of the algorithm led to virtually identical results, providing evidence in favour of convergence of the algorithm.

5 Results of the BMA analysis

In Table 3, we present the posterior inclusion probability (PIP), posterior mean and standard deviation of the coefficients for the relevant subsets of determinants identified

[26]In detail, g is set as

$$g = \begin{cases} \frac{1}{K^2}, & \text{if } N \leq K^2 \\ \frac{1}{N}, & \text{otherwise} \end{cases},$$

where N indicates the total sample size.

in the BMA analysis. The dependent variable in each panel is one of the overnight loan contract terms, viz., volume, rate and haircut. For brevity, only variables with over 50% PIP for at least one of the four collateral types indicated in the columns are included in Table 3.[27] For example, we include lagged GoC repo volume in Panel A because its PIP is above 50% for explaining the current GoC repo volume. We choose the cutoff value of 50% following Kass and Raftery (1995), who interpret a regressor as having weak, positive, strong and decisive effects, respectively, if its PIP is 50%–75%, 75%–95%, 95%–99%, and over 99%. For ease of comparison, in the sequel, we discuss the economic significance of our results looking at the change of the interbank lending variable in relation to a one-standard-deviation increase in a given determinant.

We infer that the key friction driving the interbank market is the cost of reallocating collateral across counterparties based on the determinants of volumes, rates and haircuts of overnight loans backed by the principal collateral types. Before undertaking a detailed discussion of these results, we begin by arguing that two conditions under which collateral reallocation could significantly impact the interbank market are (i) the stock of available collateral does not vary significantly in the short run, and (ii) institutions that participate in high-frequency trading are not the dominant owners of the stock of available collateral.

The aggregate supply of debt instruments – the preferred collateral for interbank loans (see Dang et al. (2015)) – by issuer does not exhibit large high-frequency fluctuations. For example, debt issuance by corporations is the culmination of a significantly expensive and time-consuming process, and is undertaken infrequently. At the other end of the spectrum, sovereign debt issuance is relatively more frequent; however, the bulk of it is usually to replace maturing debt. Large changes in the total stock outstanding of sovereign debt are not usually observed at a high frequency. Under the assumption that asset holders find productive uses for the entire stock of collateral at their disposal, the lack of short-term movements in the stock of debt by issuer type implies that a change of collateral with one counterparty would require changing the collateral provided to at least one other counterparty. Given the frictions involved in over-the-counter negotiations, collateral reallocation takes on significant costs.

Active traders who wish to employ their assets as collateral are, by definition, willing to pay the costs of reallocation necessitated by the frequent changes to their asset portfolios.[28]

[27] The full set of results is available upon request.

[28] Since counterparties in some cases do not have preferences for individual securities, but for collateral types, active trading between different securities of the same type may not involve reallocation costs. Thus, the more relevant set of active traders for this argument are those that switch between instruments of different collateral classes.

The larger the fraction of total stock of collateral in the portfolios of active traders, therefore, the less the behaviour of the interbank market is affected by collateral reallocation costs. The fraction of all collateral held by active traders is hard to estimate. However, given that large, long-horizon investors such as pension funds and insurance companies are significant buyers of fixed-income securities, there is reason to believe that collateral reallocation costs play a significant role in the aggregate.

Having established the plausibility of the presence of significant collateral reallocation costs in the interbank market, we now proceed to the detailed results of the BMA analysis.

5.1 Determinants of lending volumes

We now show evidence that unsecured lending reacts to short-term cash needs, while repo volumes change in response to expectations of long-term funding liquidity demand.

Unsecured loan volume responds positively to one indicator of short-term cash needs – the lagged change in the coverage at the Bank of Canada's Receiver General auctions. An increase in the total bid-offer ratio at the short-term auctions of the Government of Canada's cash suggests an unexpected temporary demand for cash among market participants. The PIP of this variable is 72% for explaining unsecured loan volumes (it is below 4% for each of the repo volumes), and a standard-deviation increase in this variable results in higher log unsecured volume of 0.0281. Repo volumes are not determined by any of the other usual indicators of short-term liquidity needs, such as the VIX or the Financial Stress Index. For example, the lagged changes of the Canadian VIX has a PIP of 36%, 4% and 2%, respectively, in explaining GoC, CMB and PRV repo volume. The lag of the change in the Canadian Financial Stress Indicator has a PIP of less than 5% for each of the repo volumes.

However, all repo volumes fall in response to an expected decrease in the long-term demand for liquidity in the financial system. More specifically, the lagged one-year adjustable-rate mortgage margin has a PIP of 98%, 60% and 86%, respectively, in explaining the GoC, CMB and PRV repo volume. The margin on adjustable-rate mortgages is increasing with uncertainty about the future path of interest rates, which in turn leads to weaker economic activity (see, e.g., Istrefi and Mouabbi (2017)) and lower liquidity demand.[29] In contrast,

[29] Elliehausen and Hwang (2010) argue that financial institutions set margins to protect themselves against the risk of prepayment, which increases with interest-rate uncertainty. Bretscher et al. (2016) show that the latter reduces investment, which manifests itself in declining credit, and consequently, lower demand for liquidity in the financial system.

the PIP of this variable for unsecured lending is 7%. The economic impact of a fall in expected liquidity demand is strongest for PRV, followed by GoC and CMB repos. A one-standard-deviation rise in the mortgage margin reduces log PRV repo volume by 0.1612, log GoC volume by 0.0843, and log CMB repos by 0.0485. It is perhaps worthwhile noticing that the magnitude of the effect of changes in long-term expectations on collateralized loan volumes is larger than that of temporary funding liquidity shocks on unsecured lending volumes, further lending credence to the short-term disruption implied by the latter. Additionally, repo volumes of each collateral type are strongly autocorrelated; the PIP of lagged repo volume of the same collateral type is over 99% in each case. This is consistent with the well-known market practice of rolling over overnight loans, which is a strategy used to meet the large persistent component of total liquidity demand. The autocorrelation term for unsecured lending has a PIP of less than 3%, suggesting no signs of a significant roll-over in the aggregate.[30]

We conclude this section with a discussion of the other drivers of interbank loan volumes. First, the price of substitute sources of short-term funding liquidity appears to matter for loans against the riskier collateral, viz., PRV repos and unsecured loans. In particular, the spread between the 3-month and 1-month Bankers' Acceptance rates has 97% PIP for PRV repo volume. Higher spreads indicate cheaper borrowing through BA over the short term, which decreases borrowing in PRV repos – to the extent of 0.0988 (in log volume) for a one-standard-deviation increase in the spread. A comparable alternative source of funding for unsecured lending is bank deposits. Indeed, the lagged change in retail loan spread has 99% PIP, and a one-standard-deviation rise in this variable increases log unsecured loan volume by 0.0525.[31]

Finally, we find that the introduction of the CCP to settle repos in Canada resulted in an increase of 0.1784 in the log GoC repo, and 0.1313 in the log PRV repo volume. This dummy variable has over 99% PIP for the former, and 58% for the latter. The increased use of the safest collateral (GoC securities) after the introduction of the CCP is evidence

[30] As shown in Figure 1, unsecured lending drops dramatically twice every year – during the days when the US financial markets are shut. We check that our results are robust to the exclusion of these data points. We find that while the autocorrelation term becomes a decisive driver (with over 99% PIP), its coefficient is 0.3, smaller than that for repo volumes. Further, the key result that unsecured loans respond to short-term changes in cash needs remains unchanged: the PIP of another short-term liquidity indicator, the lagged CBOE oil price index volatility, is above 90%.

[31] The retail loan spread can be decomposed into its components as follows: loan premium + deposit rate - overnight target rate. An increase in the spread could be due to a rise in the deposit rate (the alternative funding source becomes more expensive). Alternately, it could be due to a rise in the premium (which is a monotonous function of economic uncertainty). Since an increase in economic uncertainty increases temporary cash demand, this variable could also be interpreted as showing the reaction of unsecured lending to short-term liquidity demand.

in favour of the benefits of netting, which decreases the effective cost of collateral and encourages their use in the financial system.

5.2 Determinants of lending rates and haircuts

We now present evidence in favour of the hypothesis that lenders' primary concern while providing overnight funding is the risk of counterparty default and the market price risk of posted collateral in the event of default.

First, overnight repos are more expensive and the haircuts are higher when the systemic demand for cash is lower (or alternative funding is readily available) – presumably because participants who seek to borrow in times of low liquidity demand may be perceived to be riskier. The spread on repos backed by the safer collateral (GoCs and CMBs) increases with the net amount of cash disbursed by the Government of Canada in Cash Management (CM) auctions in the week. The higher the net disbursement of cash through CM auctions, the more plentiful the liquidity in the system, which could raise concerns that any potential borrowers in such a state could be risky. The PIP of the net cash disbursed in CM auctions is 77% and 99%, respectively, for GoC and CMB repo rates. A one-standard-deviation increase in this liquidity indicator increases GoC rates by 0.0006 bps, and CMB rates by 0.0012 bps. CMB rates also increase with the change in the the 3-month euro-dollar rate: over 99% PIP, with a 0.0014 bps increase with a one-standard-deviation increase in the euro-dollar rate. Since higher euro-dollar rates are used as a proxy for US recessions, lenders may wish to protect themselves from heightened counterparty risk by increasing the interest rate charged on their loans.

The haircut on GoC repos increases with the volatility of the second principal component of the zero-coupon yield curve of mortgate-backed securities issued by CMHC, an indicator of collateral risk. This variable has a 52% PIP, and a one-standard-deviation increase in volatility raises GoC haircuts by 0.0069 bps. CMB haircuts rise by 0.1028 bps with a one-standard-deviation increase in the Government of Canada's deposits at the Bank of Canada; the PIP is 88%. Since higher government cash deposits indicate easy availability of liquidity in the system, any demand for borrowing could make the lender wary of the credit risk of the borrower.

In addition to counterparty credit and collateral market risks, lenders also appear to change rates and haircuts in expected ways in response to changes in demand. First, an increase in the retail loan spread has a negative impact on CMB and unsecured lending rates (PIP of 98% and 70% respectively). As described earlier, this determinant could be interpreted as being driven by an increase in economic uncertainty, which decreases persistent funding liquidity demand. A one-standard-deviation increase in this spread lowers CMB repo rates by 0.0012 bps and unsecured rates by 0.00158 bps. Haircuts on PRV repos fall by 0.0936 bps for a one-standard-deviation increase in the average balance held by market participants in the LVTS. Higher balances are indicative of lower liquidity needs in the financial system.

6 A dynamic analysis of interbank lending

The BMA analysis is helpful to obtain evidence on the possible factors affecting repo market activity. In this section, we examine the dynamic effects of these different factors.

One drawback of the analysis in the previous section is that we only obtain static effects of a given predictor on the dependent variable of interest. In contrast, vector autoregression (VAR) models permit us to model the dynamic interactions in the data. We use bivariate structural VARs to provide a quantitative assessment of the channels of transmission of the different drivers of the repo market. In doing so, we calculate structural impulse responses to quantify the causal relationships in the data. In particular, we consider the dynamic relationship of important determinant–dependent variable pairs identified as having significant association in the previous section. We place the determinants first in the bivariate VAR systems, which means that they are predetermined with respect to the interbank lending variable (volume, rate and haircut for all repos, and volume and rate of unsecured lending). This assumption means that unpredictable changes in one of the determinants affect the interbank lending variable of interest within a given week, but are not themselves subject to instantaneous feedback from the interbank lending variable. This is intuitive when the drivers of the repo market variable are US variables (i.e., the margin on 1-year adjustable-rate mortgages and the 3-month euro-dollar spread), since such variables are not expected to reflect changes in Canadian repo market variables simultaneously. When both variables in the system are Canadian variables, it is harder to defend a recursive identification scheme; hence, in those cases, our impulse response analysis should be interpreted as characterizing dynamic correlations in the data.

A few additional comments are required. First, we choose not to include the price of substitute sources of liquidity in our analyses. The identification of the VAR would be complicated by the fact that the prices and volumes of interbank loans and their substitutes are jointly determined. Second, we also limit ourselves to bivariate VARs, motivated by the fact that structural VAR based on larger systems of variables would necessitate longer sample sizes than the data we use (weekly data from September 2009 to December 2015). Given this setting, we limit our analysis to the dynamic response of the terms of interbank lending to shocks to variables that have been identified as key determinants from the preceding BMA analysis.

In detail, we consider the following bivariate VAR model, which is written in reduced-form as follows:

$$Z_t = A_0 + \sum_{i=1}^{p} A_i Z_{t-1} + e_t,$$

where e_t is a Gaussian white noise process with mean zero and covariance matrix Σ. The vector Z_t includes one of the drivers mentioned above and one interbank loan variable. Let e_t denote the reduced-form VAR innovations such that $e_t = B_t^{-1} u_t$. The structural innovations u_t are derived by imposing exclusion restrictions on the B_t^{-1} matrix, assuming a recursive identification scheme. For all collateral types, the loan volume is taken in log-level. All other variables (rates and haircuts) are in level. Such specifications are chosen to ensure consistency of the estimates regardless of the possible cointegration between the variables (see, e.g., Sims et al. (1990)).[32] All shocks are scaled as a one-standard-deviation increase in the first variable of the system. Scaling the shocks in terms of an increase in observable variables allows us to perform a fair comparison of the effect of a given shock on the different terms of trade of interbank lending (volume, rate and haircut). Moreover, as the VAR models we estimate are linear, the scaling of the shocks is innocuous.

As in Section 3, the sample size extends from the first week of September 2009 to the last week of December 2015. All VAR models are estimated using the least squares method. The lag length of the VAR system is set according to the Akaike Information Criterion (AIC) using a maximum lag of 52. Impulse responses are plotted up to a 25-week horizon, and 90% bootstrapped confidence bands display the precision of the estimates.

The results of the bivariate VAR analysis are organized as follows. Figures 4, 5 and 6 plot the impulse-response functions for volume, rate and haircut for the selected type of lending (unsecured, GoC repos, CMB repos, and PRV repos). Each row of figures plots the response of the dependent variable to shocks to the variable indicated in the title. On the top of each panel, we report the name of the first variable in the system from which the shock originates, and each panel represents the response of the second variable in the

[32] Gospodinov et al. (2013) also show that impulse response analysis conducted with the VAR levels specification tends to be more robust compared with the pretest approach for VAR models. This is especially acute in small sample sizes when the magnitude of the unit roots and the co-movement between the variables is not known.

system, displayed on the y-axis. The choice of the variables in the bivariate system directly follows from the BMA analysis presented earlier.

This dynamic analysis helps us understand that the impact of changes in expected future liquidity demand has a long-term impact on volume, and short-term funding liquidity needs have a temporary effect on unsecured loans. On the other hand, shocks to the determinants do not have long-lasting effects on rates and haircuts.

Figure 4 shows the responses of the volume variables. The first three figures plot the response of repo volumes to persistent changes in funding requirements, which the BMA analysis suggested would be negative. With the exception of the GoC repo volume, a shock to the margin of the one-year adjustable rate mortgage leads to a sizeable decline in provincial bonds repo volume (up to a 60% decline at a 20-week horizon) and to a lesser extent in CMB repo volume, which declines by about 30% at a 3-week horizon. The persistent impact of a shock to liquidity demanded by the financial sector suggests that market participants are unable to immediately adjust either their expectations of liquidity needs, or their ability to finance themselves in the collateralized market with the riskier collateral type (CMB or PRV bonds). In contrast, GoC repo volume does not react significantly to such a shock, perhaps indicating that market participants find it costlier to adjust their GoC collateral, and prefer to begin adjusting the repos with riskier collateral first.

The response of unsecured lending to a shock to the coverage at the RG auction suggests that an unanticipated increase in the demand for cash (reflected in the higher bid/offer ratio at RG auctions) has only a temporary impact on the demand for unsecured lending. This is consistent with the temporary nature of the shock to cash demand.

The remaining two impulse-response functions plotted in Figure 4 suggest that the impact of greater cash availability through substitute sources has a long-term impact on the CMB and PRV repo volumes.

Figures 5 and 6 show that the response of prices and haircuts to shocks to substitute sources of supply is temporary, lasting at most up to one month after the initial shock. The increase in repo rates during periods of lower systemic demand for cash is temporary. Haircuts applied to safer collateral temporarily spike when collateral becomes riskier or when cash demand is low. The sharper, less prolonged, reaction is consistent with lenders facing little cost in quickly reacting to altered economic conditions and changing rates and haircuts on overnight loan contracts.

7 Conclusion

This paper investigates the drivers of interbank loans in Canada using a unique dataset of unsecured and collateralized (repo) loans, using the Bayesian model averaging technique to evaluate the effect of a large number of potential determinants. The analysis suggests that – at least in our non-crisis sample period – the key friction governing the interbank market is the cost faced by borrowers of reallocating collateral. We provide evidence consistent with this interpretation: collateralized lending is largely used to cover persistent liquidity needs, while unsecured loans primarily react to short-term cash needs. This complements the existing literature, which has provided evidence that in times of crisis, expectations of counterparty risk faced by lenders appear to dominate the preference of borrowers not to reallocate collateral for short-term changes in liquidity needs.

The importance of the interbank market both for the implementation of monetary policy and for maintaining financial stability is well known. This paper, by uncovering the drivers of market participants' collateral choice, could aid policy makers in designing policies that could improve the implementation of monetary and regulatory authorities' mandates.

Given the increasing use of central counterparties following the great financial crisis as a means to reduce systemic risk (see the discussion in Duffie and Zhu (2011) and Boissel et al. (2017)), the reaction of market participants to their introduction deserves attention (see Koeppl (2013) for a theoretical treatment). Our results show that the introduction of the CCP in Canada has had a significant impact on the type of collateral used to back repos, and the price of such loans. Hampered as we are due to limitations coming from small post-CCP sample size, we leave the larger question of the mechanisms underlying changes in the interbank loan market due to the CCP to future work.

References

Acharya, V. V., Gromb, D., and Yorulmazer, T. (2012). Imperfect competition in the interbank market for liquidity as a rationale for central banking. *American Economic Journal: Macroeconomics*, 4(2):184–217.

Acharya, V. V. and Merrouche, O. (2013). Precautionary hoarding of liquidity and interbank markets: Evidence from the subprime crisis. *Review of Finance*, 17(1):107–160.

Affinito, M. (2012). Do interbank customer relationships exist? And how did they function in the crisis? Learning from Italy. *Journal of Banking & Finance*, 36(12):3163–3184.

Afonso, G., Kovner, A., and Schoar, A. (2011). Stressed, not frozen: The federal funds market in the financial crisis. *Journal of Finance*, 66(4):1109–1139.

Allen, F., Carletti, E., and Gale, D. (2009). Interbank market liquidity and central bank intervention. *Journal of Monetary Economics*, 56(5):639–652.

Angelini, P., Nobili, A., and Picillo, C. (2011). The interbank market after August 2007: What has changed, and why? *Journal of Money, Credit and Banking*, 43(5):923–958.

Ashcraft, A. B. and Duffie, D. (2007). Systemic illiquidity in the federal funds market. *American Economic Review*, 97(2):221–225.

Baker, S. R., Bloom, N., and Davis, S. J. (2016). Measuring economic policy uncertainty. *Quarterly Journal of Economics*, 131(4):1593–1636.

Barnett, R., Charbonneau, K., and Poulin-Bellisle, G. (2016). A new measure of the Canadian Effective Exchange Rate. *Bank of Canada Staff Discussion Paper No. 2016-1.*

Bianchi, J. and Bigio, S. (2014). Banks, liquidity management and monetary policy. *NBER Working Paper No. 20490.*

Bindseil, U., Weller, B., and Wuertz, F. (2003). Central bank and commercial banks' liquidity management - What is the relationship? *Economic Notes*, 32(1):37–66.

Blonigen, B. A. and Piger, J. (2014). Determinants of foreign direct investment. *Canadian Journal of Economics*, 47(3):775–812.

Boissel, C., Derrien, F., Ors, E., and Thesmar, D. (2017). Systemic risk in clearing houses: Evidence from the European repo market. *Journal of Financial Economics*, 125(3):511–536.

Bretscher, L., Schmid, L., and Vedolin, A. (2016). Interest rate risk management in uncertain times. SSRN.

Brunetti, C., Di Filippo, M., and Harris, J. H. (2011). Effects of central bank intervention on the interbank market during the subprime crisis. *Review of Financial Studies*, 24(6):2053–2083.

Brunnermeier, M. K. and Pedersen, L. H. (2009). Market liquidity and funding liquidity. *Review of Financial Studies*, 22(6):2201–2238.

Bulusu, N. and Gungor, S. (2017). Government of Canada securities in the cash, repo and securities lending markets. *Bank of Canada Staff Discussion Paper*, forthcoming.

Chodorow-Reich, G. (2014). The employment effects of credit market disruptions: Firm-level evidence from the 2008–9 financial crisis. *Quarterly Journal of Economics*, 129(1):1–59.

Cocco, J. F., Gomes, F. J., and Martins, N. C. (2009). Lending relationships in the interbank market. *Journal of Financial Intermediation*, 18(1):24–48.

Copeland, A., Martin, A., and Walker, M. (2014). Repo runs: Evidence from the tri-party repo market. *Journal of Finance*, 69(6):2343–2380.

Dang, T. V., Gorton, G., and Holmström, B. (2015). Ignorance, debt and financial crises. *Mimeo.*

De Socio, A. (2013). The interbank market after the financial turmoil: Squeezing liquidity in a "lemons market" or asking liquidity "on tap". *Journal of Banking & Finance*, 37(5):1340–1358.

Duffie, D. (1996). Special repo rates. *Journal of Finance*, 51(2):493–526.

Duffie, D. and Zhu, H. (2011). Does a central clearing counterparty reduce counterparty risk? *Review of Asset Pricing Studies*, 1(1):74–95.

Duprey, T. (2017). Canadian financial stress and macroeconomic conditions. *Bank of Canada Working Paper,* forthcoming.

Elliehausen, G. and Hwang, M. (2010). Mortgage contract choice in subprime mortgage markets. *Mimeo.*

Fernandez, C., Ley, E., and Steel, M. F. J. (2001). Model uncertainty in cross-country growth regressions. *Journal of Applied Econometrics*, 16(5):563–576.

Fleming, M. J., Hrung, W. B., and Keane, F. M. (2010). Repo market effects of the Term Securities Lending Facility. *American Economic Review*, 100(2):591–96.

Furfine, C. H. (1999). The microstructure of the federal funds market. *Financial Markets, Institutions & Instruments*, 8(5):24–44.

Gai, P., Haldane, A., and Kapadia, S. (2011). Complexity, concentration and contagion. *Journal of Monetary Economics*, 58(5):453–470.

Garcia-de Andoain, C., Heider, F., Hoerova, M., and Manganelli, S. (2016). Lending-of-last-resort is as lending-of-last-resort does: Central bank liquidity provision and interbank market functioning in the euro area. *Journal of Financial Intermediation*, 28(C):32–47.

Garriott, C. and Gray, K. (2016). Repo market ecology. *Bank of Canada Staff Discussion Paper No. 2016-8.*

González-Aguado, C. and Moral-Benito, E. (2013). Determinants of corporate default: A BMA approach. *Applied Economics Letters*, 20(6):511–514.

Gorton, G., Lewellen, S., and Metrick, A. (2012). The safe-asset share. *American Economic Review*, 102(3):101–106.

Gorton, G. and Metrick, A. (2010). Haircuts. *Federal Reserve Bank of St. Louis Review*, November/December:507–520.

Gorton, G. and Metrick, A. (2012). Securitized banking and the run on repo. *Journal of Financial Economics*, 104(3):425–451.

Gospodinov, N., Herrera, A. M., and Pesavento, E. (2013). Unit roots, cointegration, and pretesting in VAR models. In Fomby, T. B., Kilian, L., and Murphy, A., editors, *VAR Models in Macroeconomics - New Developments and Applications: Essays in Honor of Christopher A. Sims*, pages 81–115. Bingley: Emerald Group Publishing Limited.

Hatzopoulos, V., Iori, G., Mantegna, R. N., Miccichè, S., and Tumminello, M. (2015). Quantifying preferential trading in the e-MID interbank market. *Quantitative Finance*, 15(4):693–710.

Heider, F., Hoerova, M., and Holthausen, C. (2015). Liquidity hoarding and interbank market rates: The role of counterparty risk. *Journal of Financial Economics*, 118(2):336–354.

Istrefi, K. and Mouabbi, S. (2017). Subjective interest rate uncertainty and the macroeconomy: A cross-country analysis. *Journal of International Money and Finance*, forthcoming.

Iyer, R., Peydró, J.-L., da Rocha-Lopes, S., and Schoar, A. (2014). Interbank liquidity crunch and the firm credit crunch: Evidence from the 2007–2009 crisis. *Review of Financial studies*, 27(1):347–372.

Kass, R. E. and Raftery, A. E. (1995). Bayes factors. *Journal of the American Statistical Association*, 90(430):773–795.

King, T. B. (2008). Discipline and liquidity in the interbank market. *Journal of Money, Credit and Banking*, 40(2-3):295–317.

Koeppl, T. V. (2013). The limits of central counterparty clearing: Collusive moral hazard and market liquidity. *Queen's Economics Department Working Paper.*

Koop, G. (2003). *Bayesian Econometrics.* Wiley.

Kraenzlin, S. and Nellen, T. (2015). Access policy and money market segmentation. *Journal of Monetary Economics*, 71:1–12.

Krishnamurthy, A., Nagel, S., and Orlov, D. (2014). Sizing up repo. *Journal of Finance*, 69(6):2381–2417.

Kumar, G. (2013). High-frequency real economic activity indicator for Canada. *Bank of Canada Working Paper 2013-42*.

Mancini, L., Ranaldo, A., and Wrampelmeyer, J. (2016). The Euro interbank repo market. *Review of Financial Studies*, 29(7):1747–1779.

Martinez-Jaramillo, S., Alexandrova-Kabadjova, B., Bravo-Benitez, B., and Solórzano-Margain, J. P. (2014). An empirical study of the Mexican banking systems network and its implications for systemic risk. *Journal of Economic Dynamics and Control*, 40:242–265.

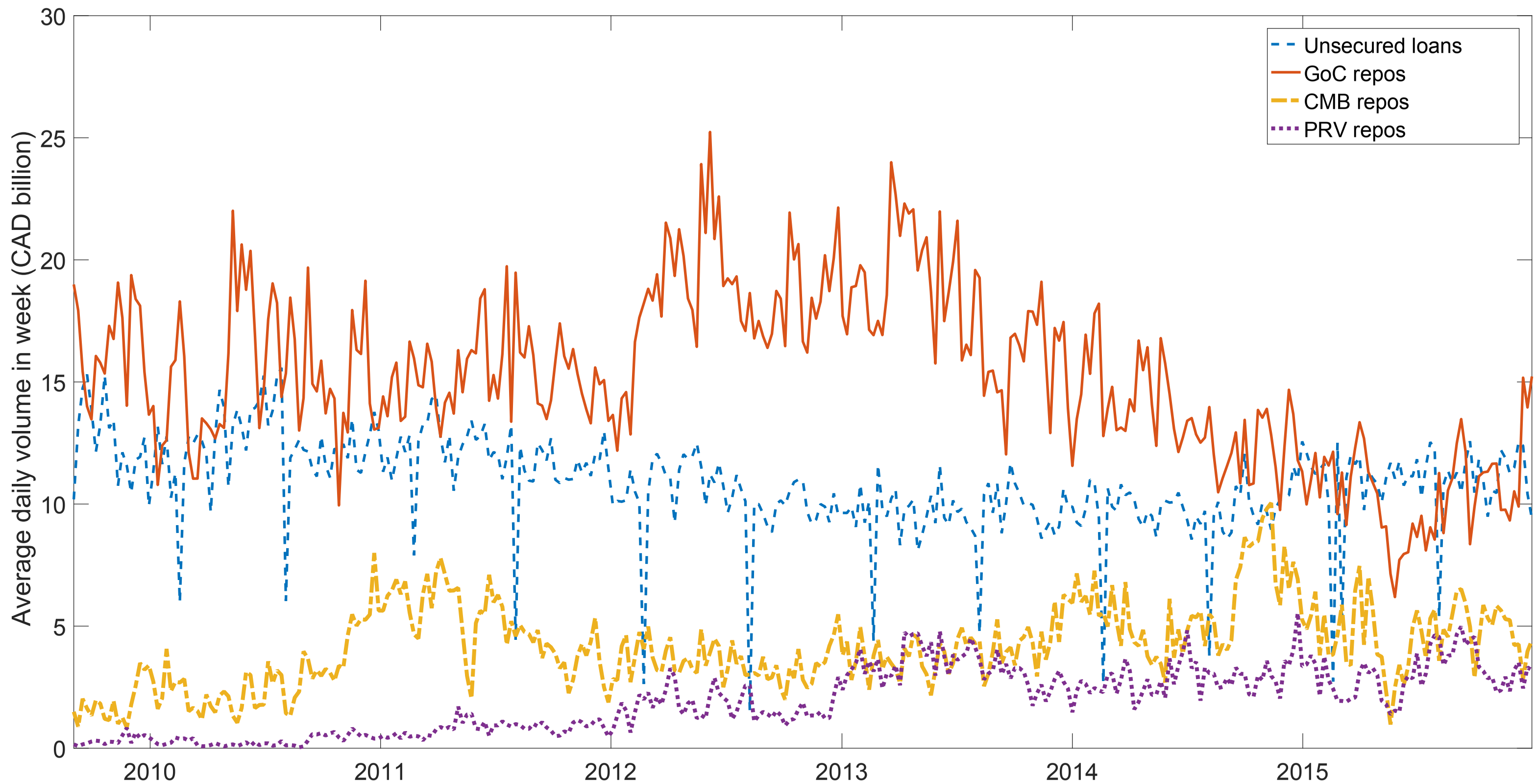
Rempel, M. (2016). Improving overnight loan identification in payments systems. *Journal of Money, Credit & Banking*, 48(2-3):549–564.

Ritz, R. A. and Walther, A. (2015). How do banks respond to increased funding uncertainty? *Journal of Financial Intermediation*, 24(3):386–410.

Rivadeneyra, F. and Rempel, M. (2017). Intraday trade dynamics in short-term funding markets. *Mimeo*.

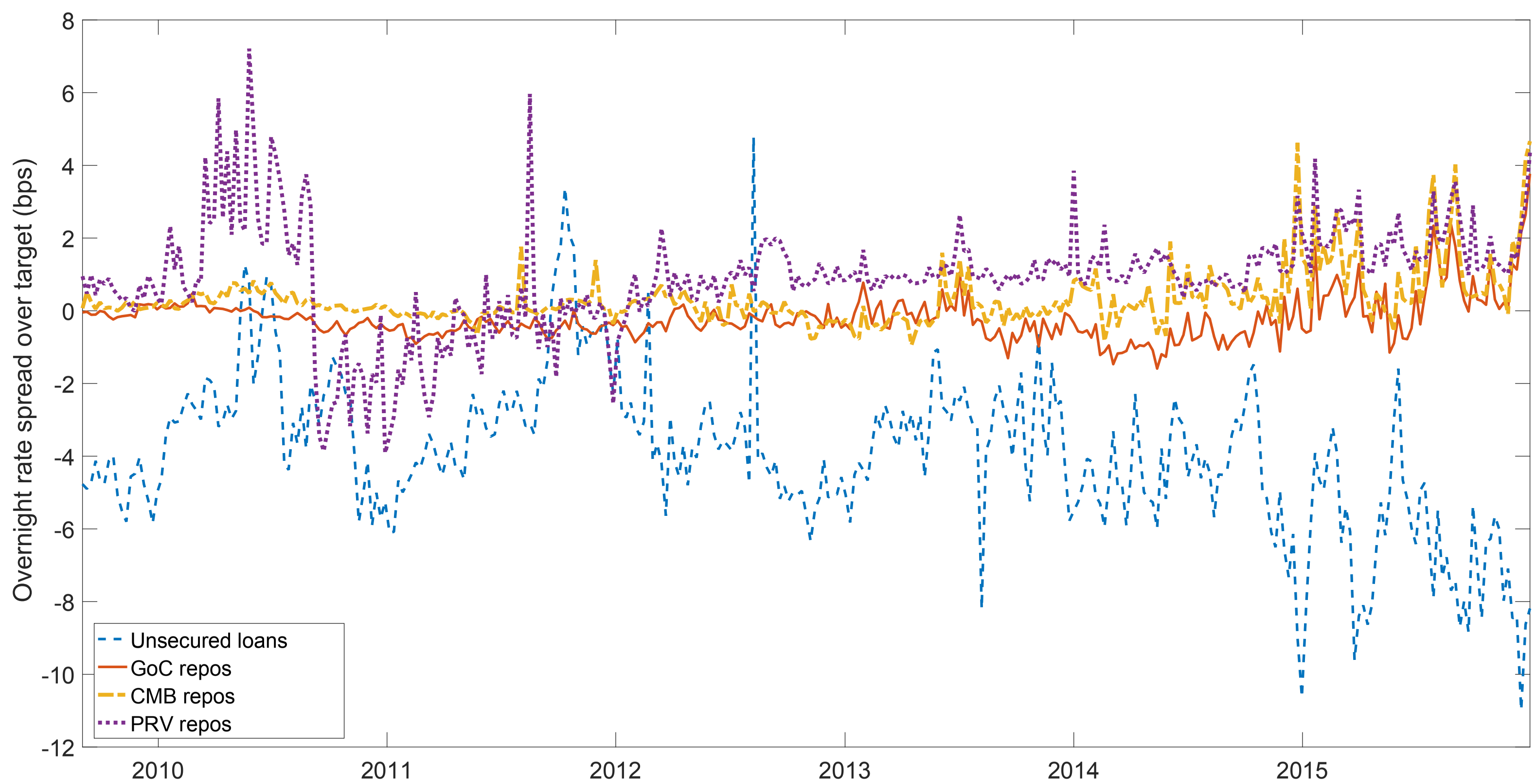
Sims, C. A., Stock, J. H., and Watson, M. W. (1990). Inference in linear time series models with some unit roots. *Econometrica*, 58(1):113–144.

Figure 1: Overnight interbank lending volume



Note: Time series of the average daily volume of overnight interbank loans per week by collateral type.

Figure 2: Overnight interbank lending spread over overnight target rate

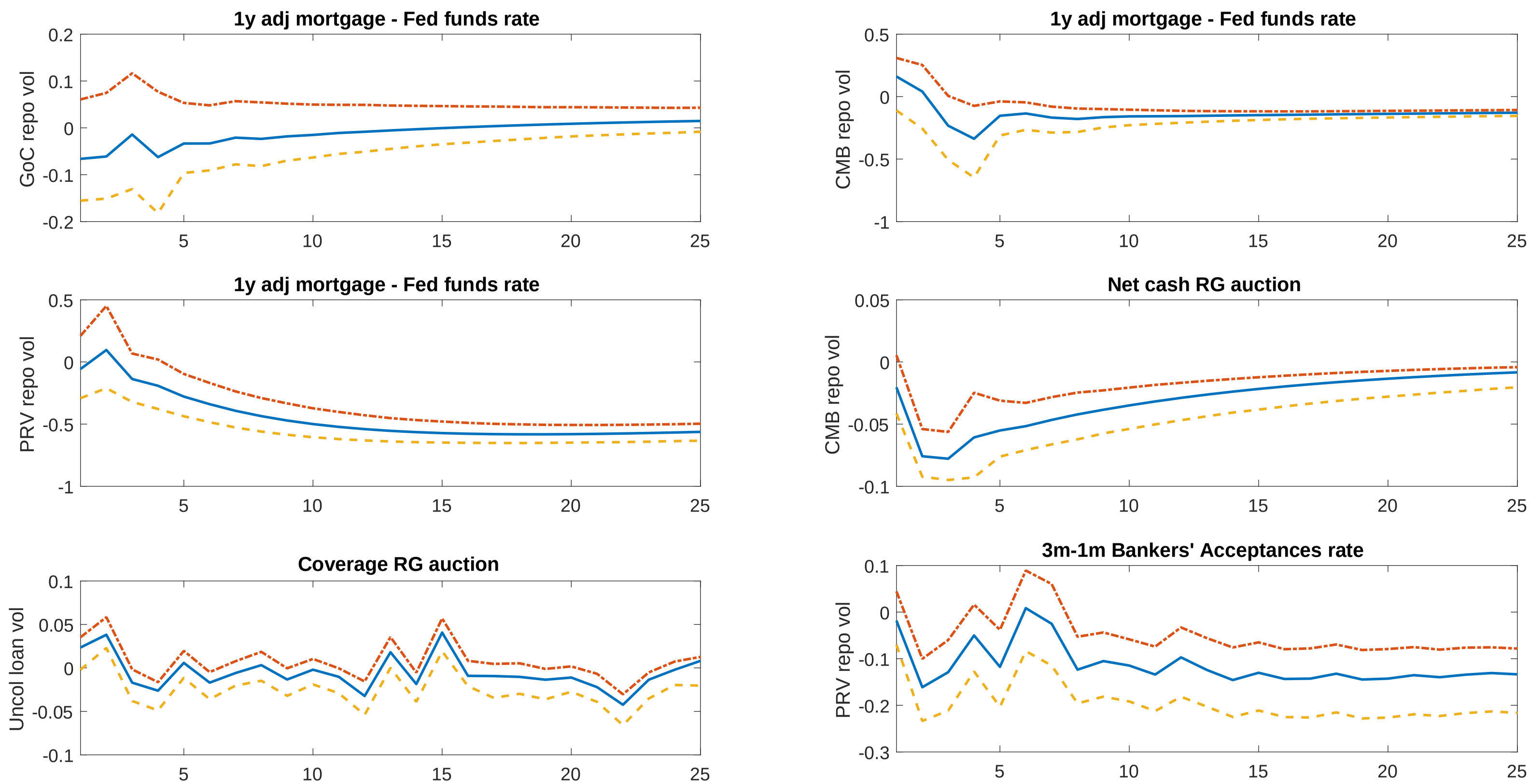


Note: Time series of the average daily volume of the spread of overnight interbank loans over the overnight target rate per week by collateral type.

Figure 3: Overnight repo haircuts

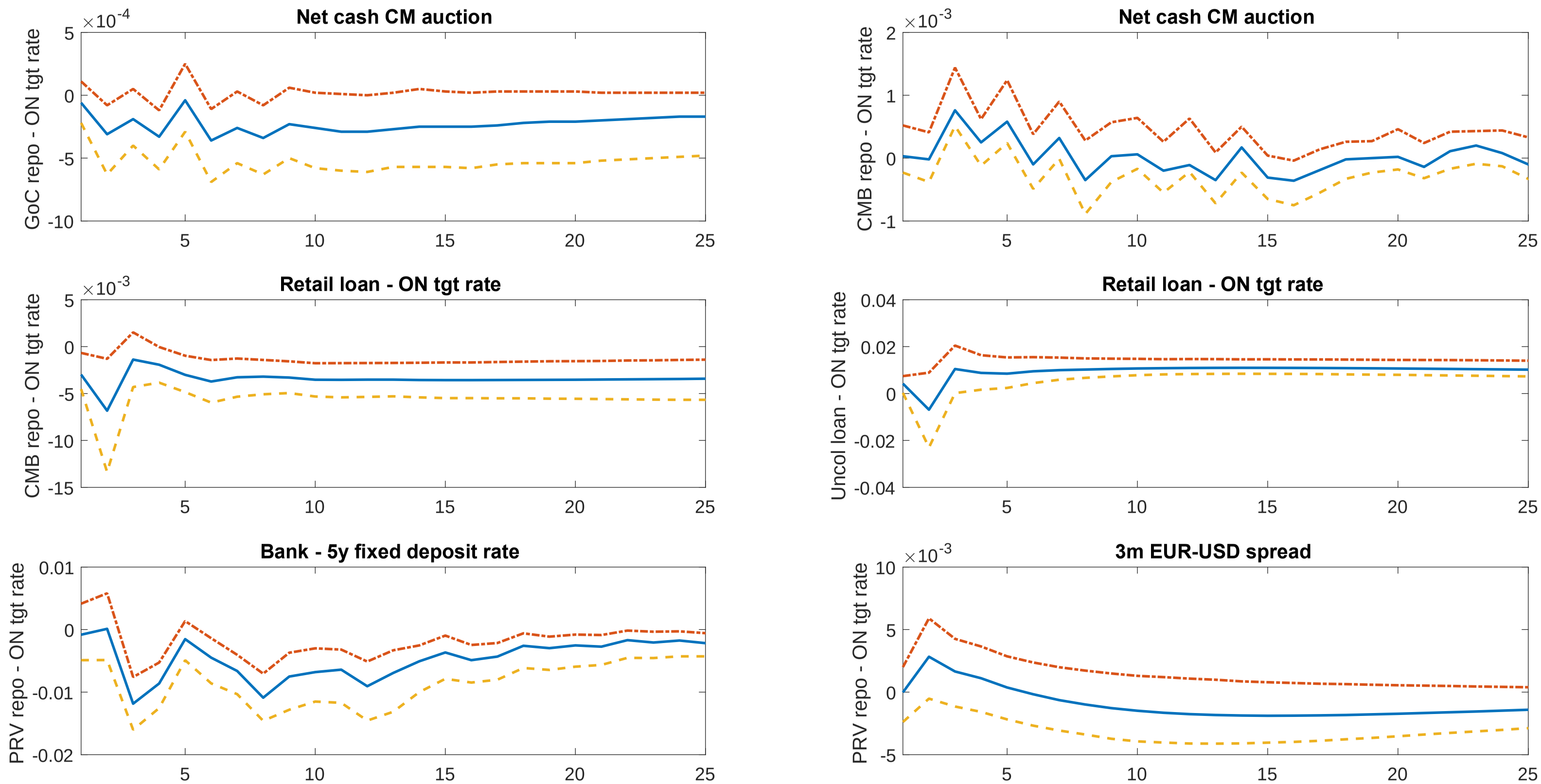
Note: Time series of the average daily haircut of overnight repo loans per week by collateral type.

Figure 4: Impulse responses of the volume of overnight lending to shocks in selected indicators



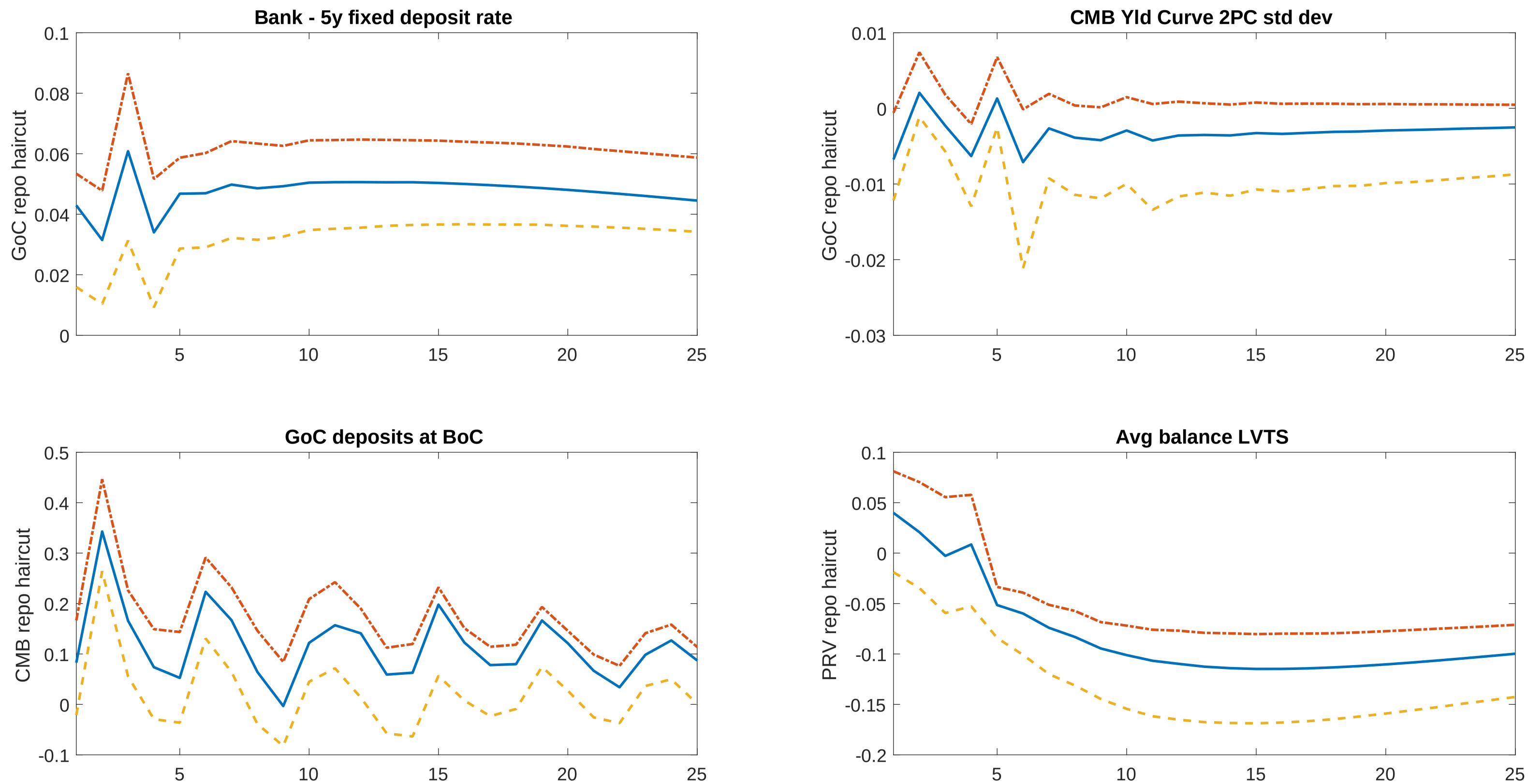
Note: Structural impulse responses from weekly bivariate vector autoregressions with 90% bootstrapped confidence bands. The uncertainty shock is scaled to match a one-standard-deviation increase in the variable indicated in the title.

Figure 5: Impulse responses of the spread of overnight lending rate over the overnight target rate to shocks in selected indicators



Note: Structural impulse responses from weekly bivariate vector autoregressions with 90% bootstrapped confidence bands. The uncertainty shock is scaled to match a one-standard-deviation increase in the variable indicated in the title.

Figure 6: Impulse responses of the overnight repo haircuts to shocks in selected indicators



Note: Structural impulse responses from weekly bivariate vector autoregressions with 90% bootstrapped confidence bands. The uncertainty shock is scaled to match a one-standard-deviation increase in the variable indicated in the title.

Table 1: Summary statistics of dependent variables

	2009	2010	2011	2012	2013	2014	2015	β_{AR1}
log(GoC repo volume)	23.519	23.429	23.449	23.632	23.601	23.310	23.062	0.83
	(0.121)	(0.181)	(0.100)	(0.143)	(0.146)	(0.138)	(0.186)	
log(CMB repo volume)	21.237	21.682	22.283	21.962	22.080	22.439	22.212	0.77
	(0.439)	(0.463)	(0.337)	(0.213)	(0.228)	(0.302)	(0.347)	
log(PRV repo volume)	19.461	19.251	20.462	21.207	21.903	21.746	21.794	0.94
	(0.588)	(0.749)	(0.362)	(0.340)	(0.232)	(0.253)	(0.316)	
log(Unsecured loan volume)	23.245	23.224	23.186	23.009	22.971	22.973	23.085	0.19
	(0.132)	(0.173)	(0.166)	(0.336)	(0.169)	(0.235)	(0.252)	
GoC repo - ON tgt rate (bps)	-0.043	-0.143	-0.484	-0.285	-0.223	-0.697	0.525	0.79
	(0.144)	(0.252)	(0.183)	(0.229)	(0.458)	(0.453)	(0.989)	
CMB repo - ON tgt rate (bps)	0.124	0.300	0.044	0.039	-0.042	0.481	1.257	0.71
	(0.086)	(0.23)	(0.36)	(0.335)	(0.478)	(0.826)	(1.197)	
PRV repo - ON tgt rate (bps)	0.544	1.028	-0.597	0.879	1.039	1.201	1.982	0.81
	(0.31)	(2.755)	(1.376)	(0.614)	(0.354)	(0.615)	(0.817)	
Unsecured loan - ON tgt rate (bps)	-0.048	-0.026	-0.025	-0.038	-0.033	-0.045	-0.066	0.95
	(0.006)	(0.017)	(0.021)	(0.017)	(0.013)	(0.014)	(0.019)	
GoC repo haircut (bps)	0.360	5.811	14.618	15.392	21.826	32.288	26.255	0.94
	(7.151)	(7.48)	(6.181)	(6.184)	(6.869)	(5.85)	(15.972)	
CMB repo haircut (bps)	-1.421	8.641	9.927	15.404	42.698	11.923	10.944	0.75
	(24.325)	(13.334)	(15.046)	(17.212)	(20.814)	(12.311)	(11.177)	
PRV repo haircut (bps)	22.695	46.809	79.786	52.600	34.175	59.777	72.470	0.88
	(30.197)	(61.847)	(41.535)	(28.243)	(23.848)	(20.571)	(27.433)	

Note: This table presents the daily averages and standard deviation (in parentheses below) by year for all the dependent variables in the study, along with the first-order autocorrelation of the time series (β_{AR1}).

Table 2: Variable definitions

Variable	Description and sources
Substitute market prices	
Interbank funding rate	Spread of value-weighted average of daily total overnight lending (collateralized and all repo) in a week over the Bank of Canada overnight target rate. Sources: Uncollateralized lending volumes and rates are from Rempel (2016). Collateralised repo volumes and rates are from Bulusu and Gungor (2017). Daily overnight target rate in Canada is from the Bank of Canada's website.
IOER - Fed funds rate	Average daily spread between Interest Rate on Excess Reserves and the Federal funds rate in week. Source: Federal Reserve Bank of St. Louis, Interest Rate on Excess Reserves and Federal Funds Rate, retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/IOER and https://fred.stlouisfed.org/series/FEDFUNDS.
Retail loan - ON tgt rate	Spread between the rate at which Canadian Chartered Banks offer retail loans and the Bank of Canada's overnight target. Sources: Consumer loan rates are from Table 176-0078 from Statistics Canada. Daily overnight target rate in Canada is from the Bank of Canada's website.
3m-1m Commerical Paper rate	Weekly average spread between Commerical Paper with three months and one month to maturity in Canada. Source: BFS Table F1 of the Bank of Canada weekly financial statistics bulletin, archived at http://epe.lac-bac.gc.ca/100/201/301/weekly_fin_stats/.
3m-1m Bankers' Acceptances rate	Weekly average spread between Bankers' Acceptances with three months and one month to maturity in Canada. Source: One-month and three-month Bankers' Acceptances yields are from Table 176-0078 from Statistics Canada.
Bank - 90d deposit rate	Spread between the Bank of Canada overnight target rate and the rate offered by Chartered Banks in Canada for 90-day term deposits. Source: The Canadian overnight target rate is from the Bank of Canada's website. The 90-day term deposit rate is from Table 176-0078 from Statistics Canada.
Bank - 5y fixed deposit rate	Spread between the Bank of Canada overnight target rate and the rate offered by Chartered Banks in Canada for five-year personal fixed term deposits. Source: The Canadian overnight target rate is from the Bank of Canada's website. The five-year fixed deposit rate is from Table 176-0078 from Statistics Canada.
3m AA finan bond - Fed funds rate	Average daily spread between the three-month yield on bonds issued by AA-rated financial firms and the Federal funds rate in week. Sources: Yield on AA-rated financial firms from Board of Governors of the Federal Reserve System (US), 3-Month AA Financial Commercial Paper Rate, retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/WCPF3M. The Federal funds rate is at the website of the Federal Reserve Bank of New York, https://apps.newyorkfed.org/markets/autorates/fed%20funds.
Aaa corp bond - Fed funds rate	Average daily spread between Moody's seasoned Aaa corporate bond yield and the Federal funds rate in week. Source: Federal Reserve Bank of St. Louis, Moody's Seasoned Aaa Corporate Bond Minus Federal Funds Rate, retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/AAAFFM.
Economic indicators	
Canadian Real Econ Activity Ind	Weekly value of the Canadian Economic Activity Indicator. Source: Kumar (2013).
ADS index	Daily average of the Aruoba-Diebold-Scotti Business Conditions Index in the United States in the week. Source: The website of the Federal Reserve Bank of Philadelphia, available at https://www.philadelphiafed.org/research-and-data/real-time-center/business-conditions-index.
Econ Policy Uncertainty Index	The weekly average of the Baker et al. (2016) measure of economic policy uncertainty in the United States. Source: Baker, Scott R., Bloom, Nick and Davis, Stephen J., Economic Policy Uncertainty Index for United States, retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/USEPUINDXD.
WTI spot price	Average West Texas Intermeidate spot price in week. Source: US Energy Information Administration, Crude Oil Prices: West Texas Intermediate (WTI) - Cushing, Oklahoma., retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/WCOILWTICO.

Continued on next page

Table 2 – *Continued from previous page*

CBOE Crude Oil Volatility Index	The daily average of the expectation of 30-day crude oil price volatility in week. Source: The website of the CBOE, http://www.cboe.com/products/vix-index-volatility/volatility-on-etfs/cboe-crude-oil-etf-volatility-index-ovx.
CERI	Canadian dollar effective exchange rate index, the Bank of Canada's measure of the value of the Canadian dollar against the currencies of its most important trading partners. See Barnett et al. (2016) for details. Source: Bank of Canada weekly financial statistics bulletin, archived at http://epe.lac-bac.gc.ca/100/201/301/weekly_fin_stats/.
1y adj mortgage margin	Daily average of the spread between the rate on 1-year adjustable rate mortgages in the United States and the Fed funds rate in week. Sources: Freddie Mac, 1-Year Adjustable Rate Mortgage Average in the United States, retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/MORTGAGE1US. The Fed funds rate is at the website of the Federal Reserve Bank of New York, https://apps.newyorkfed.org/markets/autorates/fed%20funds.
Bank of Canada / Government of Canada liquidity indicators	
BoC OMO volume	Net amount of open market operations conducted by the Bank of Canada in week. Source: BFS Table B3 of the Bank of Canada weekly financial statistics bulletin, archived at http://epe.lac-bac.gc.ca/100/201/301/weekly_fin_stats/.
BoC term repo volume	Volume of term repo operations conducted by the Bank of Canada in week. Source: BFS Table B3 of the Bank of Canada weekly financial statistics bulletin, archived at http://epe.lac-bac.gc.ca/100/201/301/weekly_fin_stats/.
GoC T-bill auction volume	Net amount of T-bills auctioned by BoC in week. Source: BFS Table B2 of the Bank of Canada weekly financial statistics bulletin, archived at http://epe.lac-bac.gc.ca/100/201/301/weekly_fin_stats/.
GoC deposits at BoC	Daily average Government of Canada cash deposits with the Bank of Canada in week. Source: BFS Table B2 of the Bank of Canada weekly financial statistics bulletin, archived at http://epe.lac-bac.gc.ca/100/201/301/weekly_fin_stats/.
Overdraft loans at BoC	Daily average overdraft loans provided by the Bank of Canada to members of Payments Canada (formerly Canadian Payments Association) in week. Source: BFS Table B3 of the Bank of Canada weekly financial statistics bulletin, archived at http://epe.lac-bac.gc.ca/100/201/301/weekly_fin_stats/.
Avg balance LVTS	Average balance held by members of Payments Canada (formerly Canadian Payments Association) in week. Source: Bank of Canada.
Excess avg balance LVTS	Average balance held by members of Payments Canada (formerly Canadian Payments Association) in excess of requirements in week. Source: Bank of Canada.
Coverage RG auction	Auction-volume weighted-average of the coverage (total amount bid/total auctioned) of cash loaned through all GoC Receiver General auctions in week. Source: Bank of Canada.
Fail size RG auction	Average amount of cash (in CAD billion) per GoC Receiver General auction that was not taken up in the week. Source: Bank of Canada.
Net cash RG auctions	Difference (in CAD billion) between cash loaned and cash returned from previous GoC Receiver General auctions in the week. Source: Bank of Canada.
Net cash CM auctions	Difference (in CAD billion) between cash loaned and cash returned from previous GoC Cash Management auctions in the week. Source: Bank of Canada.
Notes in circulation	Volume of CAD notes in cicrulation in week. Source: BFS Table B2 of the Bank of Canada weekly financial statistics bulletin, archived at http://epe.lac-bac.gc.ca/100/201/301/weekly_fin_stats/.
Collateral risk indicators	
GoC Yld Curve 1PC std dev	Standard deviation of the first principal component of the Government of Canada zero-coupon yield curve in the week. Source: Zero-coupon yield curves constructed using bond settlement data provided by the Canadian Depository for Securities FIPS database. Principal components obtained using daily GoC zero-coupon yield curves for the complete sample period.

Continued on next page

GoC Yld Curve 2PC std dev	Standard deviation of the second principal component of the Government of Canada zero-coupon yield curve in the week. Source: Zero-coupon yield curves constructed using bond settlement data provided by the Canadian Depository for Securities FIPS database. Principal components obtained using daily zero-coupon yield curves for the complete sample period.
GoC Yld Curve 3PC std dev	Standard deviation of the third principal component of the Government of Canada zero-coupon yield curve in the week. Source: Zero-coupon yield curves constructed using bond settlement data provided by the Canadian Depository for Securities FIPS database. Principal components obtained using daily zero-coupon yield curves for the complete sample period.
CMB Yld Curve 1PC std dev	Standard deviation of the first principal component of the Canadian Mortgage-Backed zero-coupon yield curve in the week. Source: Zero-coupon yield curves constructed using bond settlement data provided by the Canadian Depository for Securities FIPS database. Principal components obtained using daily zero-coupon yield curves for the complete sample period.
CMB Yld Curve 2PC std dev	Standard deviation of the second principal component of the Canadian Mortgage-Backed zero-coupon yield curve in the week. Source: Zero-coupon yield curves constructed using bond settlement data provided by the Canadian Depository for Securities FIPS database. Principal components obtained using daily zero-coupon yield curves for the complete sample period.
CMB Yld Curve 3PC std dev	Standard deviation of the third principal component of the Canadian Mortgage-Backed zero-coupon yield curve in the week. Source: Zero-coupon yield curves constructed using bond settlement data provided by the Canadian Depository for Securities FIPS database. Principal components obtained using daily zero-coupon yield curves for the complete sample period.
PRV Yld Curve 1PC std dev	Standard deviation of the first principal component of the Canadian provincial zero-coupon yield curve in the week. Source: Zero-coupon yield curves constructed using settlement data provided by the Canadian Depository for Securities FIPS database for all bonds issued by Canadian provincial governments. Principal components obtained using daily zero-coupon yield curves for the complete sample period.
PRV Yld Curve 2PC std dev	Standard deviation of the second principal component of the Canadian provincial zero-coupon yield curve in the week. Source: Zero-coupon yield curves constructed using settlement data provided by the Canadian Depository for Securities FIPS database for all bonds issued by Canadian provincial governments. Principal components obtained using daily zero-coupon yield curves for the complete sample period.
PRV Yld Curve 3PC std dev	Standard deviation of the third principal component of the Canadian provincial zero-coupon yield curve in the week. Source: Zero-coupon yield curves constructed using settlement data provided by the Canadian Depository for Securities FIPS database for all bonds issued by Canadian provincial governments. Principal components obtained using daily zero-coupon yield curves for the complete sample period.
Financial indicators	
CDOR-OIS spread	The spread between the Canadian Dollar Offer Rate (CDOR) and the Overnight Indexed Swap rate.
U.S. Financial Stress Index	Average of St. Louis Fed Financial Stress Index in week. Source: Federal Reserve Bank of St. Louis, retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/STLFSI, February 27, 2017.
BoC Financial Stress Index	Canadian Financial Stress Index in week. Source: Duprey (2017).
U.S. VIX	Average of the index of 30-day implied volatility of the S&P 500 index in week. Source: Available from the website of the CBOE, http://www.cboe.com/products/vix-index-volatility/vix-options-and-futures/vix-index.
Canadian VIX	Average of the index of 30-day implied volatility of the Canadian S&P/TMX 60 index in week. Source: Available at the website of the TMX Montreal Exchange from 1 October 2009. Back-filled for the month of September 2009 using the daily percentage change in the previous volatility index (MVX) provided on the website of the TMX Montreal Exchange, https://www.m-x.ca/indicesmx_vixc_en.php.
Term premia	

Continued on next page

1y-1m yield spread	Weekly average spread between yields on Government of Canada bills with one year and one month to maturity. Source: The yields on one-year and one-month Candian government bills are available in Table 176-0078 from Statistics Canada.
10y-6m yield spread	Weekly average spread between yields on Government of Canada bonds with ten years and Government of Canada bills with six months to maturity. Source: The yields on ten-year and one-month Candian government bonds/bills are available in Table 176-0078 from Statistics Canada.
5y-1y mortgage rate	The spread between the rate on conventional mortgages offered by commercial banks with five years and one year to maturity. Sources: The five-year and one-year mortgage rates are available from Table 176-0078 from Statistics Canada.
3m-1m fwd premium	The spread between the three-month and one-month forward premium of United States dollars in Canada. Source: The one-month and three-month forward premium is from Table 176-0078 from Statistics Canada.
3m fwd spread	Closing value of the three-month USD-CAD forward spread in week. Source: BFS Table F1 of the Bank of Canada weekly financial statistics bulletin, archived at http://epe.lac-bac.gc.ca/100/201/301/weekly_fin_stats/.
3m EUR-USD spread	Average annualized daily yield on three-month Eurodollar deposits in week. Source: Board of Governors of the Federal Reserve System (US), three-month Eurodollar Deposit Rate (London), retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/WED3, February 27, 2017.
1y swap spread	The spread between the rate payed on a one-year swap by a fixed-rate payer in exchange for the three-month LIBOR, and the Federal Funds rate. Sources: Board of Governors of the Federal Reserve System (US), one-year Swap Rate, retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/WSWP1. The Fed funds rate is at the website of the Federal Reserve Bank of New York, https://apps.newyorkfed.org/markets/autorates/fed%20funds.

Note: This table contains the description and sources of the determinant variables used in this paper.

Table 3: Determinants of terms of interbank lending

	GoC repos			CMB repos			PRV repos			Uncollateralized loans		
	PIP	μ_{post}	σ_{post}	PIP	μ_{post}	σ_{post}	PIP	μ_{post}	σ_{post}	PIP	μ_{post}	σ_{post}
Panel A: Overnight lending volumes												
GoC repo volume	**1.00**	**0.5226**	**0.15**	0.14	-0.0216	0.07	0.11	0.0320	0.11	0.07	-0.0067	0.04
CMB repo volume	0.02	0.0000	0.00	**1.00**	**0.6708**	**0.07**	0.04	0.0032	0.02	0.04	0.0022	0.02
PRV repo volume	0.02	0.0001	0.01	0.03	0.0000	0.00	**1.00**	**0.6769**	**0.06**	**0.83**	**-0.0660**	**0.04**
GoC repo haircut	**0.95**	**-0.2882**	**0.25**	0.12	-0.0491	0.17	0.02	-0.0023	0.04	0.02	-0.0029	0.04
Δ Retail loan - ON tgt rate	0.02	-0.0003	0.02	0.02	-0.0009	0.03	0.06	-0.0144	0.08	**0.99**	**0.4283**	**0.19**
3m-1m Bankers' Acceptances rate	0.02	-0.0011	0.15	0.02	-0.0060	0.18	**0.97**	**-4.3847**	**1.69**	0.03	0.0193	0.25
1y adj mortgage - Fed funds rate	**0.98**	**-0.1413**	**0.09**	**0.60**	**-0.0813**	**0.09**	**0.86**	**-0.2702**	**0.15**	0.07	0.0080	0.04
Δ Coverage RG auction	0.03	0.0004	0.01	0.02	0.0000	0.00	0.01	0.0000	0.00	**0.72**	**0.0593**	**0.06**
Fail size RG auction	0.07	-0.0045	0.03	**0.90**	**-0.2552**	**0.15**	0.38	-0.1046	0.16	0.02	-0.0012	0.02
CDCC indicator	**1.00**	**0.1784**	**0.11**	0.09	-0.0095	0.04	**0.58**	**0.1312**	**0.14**	0.09	-0.0095	0.04
Time trend	**1.00**	**-0.0018**	**0.00**	0.16	0.0001	0.00	0.13	0.0002	0.00	0.03	0.0000	0.00
Panel B: Overnight lending spread over target rate												
GoC repo volume	**0.73**	**-0.0029**	**0.00**	**0.96**	**-0.0069**	**0.00**	0.09	-0.0004	0.00	0.03	0.0001	0.00
Unsecured loan volume	0.02	0.0000	0.00	0.02	0.0000	0.00	0.02	0.0000	0.00	**0.68**	**0.0072**	**0.01**
GoC repo - ON tgt rate	**1.00**	**0.6457**	**0.05**	0.13	0.0256	0.07	0.04	0.0074	0.05	0.15	-0.0629	0.17
CMB repo - ON tgt rate	0.02	0.0000	0.00	**1.00**	**0.4947**	**0.06**	0.04	0.0053	0.03	0.39	-0.1483	0.21
PRV repo - ON tgt rate	0.03	0.0005	0.00	0.02	0.0004	0.00	**1.00**	**0.5758**	**0.05**	0.03	0.0019	0.02
Unsecured loan - ON tgt rate	0.02	0.0005	0.01	0.02	0.0005	0.01	0.27	0.0238	0.04	**1.00**	**0.6640**	**0.10**
GoC repo haircut	**1.00**	**-0.0151**	**0.00**	**0.89**	**-0.0127**	**0.01**	0.03	0.0002	0.00	0.09	0.0015	0.01
Δ Retail loan - ON tgt rate	0.03	-0.0001	0.00	**0.98**	**-0.0099**	**0.00**	0.02	-0.0001	0.00	**0.70**	**-0.0129**	**0.01**
Bank - 5y fixed deposit rate	0.07	-0.0002	0.00	0.03	-0.0001	0.00	**0.91**	**-0.0106**	**0.00**	0.49	0.0056	0.01
Net cash CM auctions	**0.77**	**0.0002**	**0.00**	**0.99**	**0.0004**	**0.00**	0.04	0.0000	0.00	0.02	0.0000	0.00
Δ 1y-1m yield spread	0.02	0.0000	0.00	0.02	0.0000	0.00	**0.59**	**-0.0203**	**0.02**	0.02	-0.0001	0.00
Δ 3m EUR-USD spread	0.40	0.0106	0.01	**1.00**	**0.0621**	**0.01**	0.07	0.0031	0.01	0.06	0.0029	0.01
CDCC indicator	0.16	0.0003	0.00	0.06	0.0001	0.00	**0.54**	**0.0044**	**0.00**	0.21	-0.0014	0.00
Time trend	**0.83**	**0.0000**	**0.00**	**0.87**	**0.0000**	**0.00**	**0.70**	**0.0000**	**0.00**	**0.53**	**0.0000**	**0.00**
Panel C: Repo haircuts												
GoC repo volume	0.04	-0.0014	0.01	0.18	0.0173	0.04	**0.84**	**-0.2408**	**0.13**			
GoC repo - ON tgt rate	**0.76**	**-2.2573**	**1.53**	0.03	0.0571	0.54	0.02	-0.0537	0.66			

Continued on next page

Table 3 – *Continued from previous page*

PRV repo - ON tgt rate	0.03	0.0106	0.09	0.04	-0.0447	0.29	**0.63**	**-2.7116**	**2.35**
GoC repo haircut	**1.00**	**0.5760**	**0.06**	0.05	-0.0073	0.04	0.04	-0.0104	0.06
CMB repo haircut	0.04	-0.0014	0.01	**1.00**	**0.5301**	**0.05**	0.08	-0.0152	0.06
PRV repo haircut	0.02	-0.0002	0.00	0.50	-0.0339	0.04	**1.00**	**0.4757**	**0.07**
Bank - 5y fixed deposit rate	**0.71**	**0.0435**	**0.03**	0.04	0.0013	0.01	0.04	0.0038	0.03
Δ GoC deposits at BoC	0.02	0.0000	0.00	**1.00**	**0.0000**	**0.00**	0.02	0.0000	0.00
Avg balance LVTS	0.05	0.0000	0.00	0.05	0.0000	0.00	**0.88**	**-0.0001**	**0.00**
CMB Yld Curve 2PC std dev	**0.52**	**2.1393**	**2.26**	0.02	-0.0006	0.46	0.16	2.0573	5.35
Time trend	**0.89**	**0.0003**	**0.00**	0.10	0.0000	0.00	0.07	0.0000	0.00
End of month dummy	**1.00**	**0.0440**	**0.01**	0.05	0.0018	0.01	0.02	0.0001	0.00

Note: This table contains the results of the Bayesian Model Averaging analysis for the different terms of interbank loans indicated in the panel titles, and for the different types of underlying collateral (unsecured, GoC repos, CMB repos and PRV repos) indicated in the columns. The following statistics are reported for variables that have at least a 50% posterior probability of inclusion for the dependent variable in the panel for at least one of the collateral types: posterior probability of inclusion, posterior mean, and the posterior standard deviation of the coefficient. Variables that have a posterior probability of inclusion of at least 50% are highlighted in **bold**. The independent variables used in this analysis are described in Table 2 along with their sources.