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Re-Use of Collateral in the Repo Market

This paper introduces a methodology to estimate the re-use of collateral based on actual transaction data. With a comprehensive data set from the Swiss franc repo market we are able to provide the first systematic study on the re-use of collateral. We find that re-using collateral was most popular prior to the financial crisis when roughly 10% of the outstanding interbank volume was secured with re-used collateral. Furthermore, we show that the re-use of collateral increases with the scarcity of collateral. By giving an estimate of the collateral re-use and explaining its drivers, the paper contributes to the on-going debate on collateral availability.

JEL codes: D47, E58, G01, G18, G21, G32
Keywords: re-use of collateral, repo, money market, financial stability, Switzerland.

Up to now, central banks and regulators have lacked evidence on the re-use of collateral, although this issue has been at the top of regulators' policy agenda (Financial Stability Board 2012a). Especially, the re-use of collateral has yet not been estimated and analyzed based on actual transaction data.

This paper aims to address this issue. First, we estimate the re-use activity in an interbank repo market by developing an algorithm which identifies re-used collateral

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based on actual transaction data. Second, we analyze the drivers of collateral re-use. We focus on the availability of securities, as re-using collateral allows banks to conduct transactions regardless of a potential collateral constraint (i.e., we test whether collateral re-use is a form of collateral optimization). Analyzing this relationship is of particular interest because current regulatory initiatives have caused an intense debate on collateral availability (see, e.g., Levels and Capel 2012 and Committee on the Global Financial System 2013).

The Swiss franc (CHF) repo market qualifies for a thorough analysis of the re-use of collateral as the re-use is not restricted, neither technically, legally, nor economically. Having a comprehensive data set from the CHF interbank repo market at our disposal allows us, for the first time, to estimate and analyze the re-use of collateral by considering individual transactions. Additionally, the data set spanning from March 2006 to February 2013 enables us to analyze the re-use for different time periods such as before, during, and after the financial crisis.

Our findings can be summarized as follows. Market participants in the CHF repo market re-use collateral. The re-use activity remained relatively constant until mid-2007 when roughly 10% of the outstanding volume was secured with re-used collateral. Afterwards, it increased and reached its highest level in autumn 2007, at almost 20%. In 2008, the re-use activity suddenly declined to very low levels and remained there afterwards. The collateral re-used typically originates from a long-term repo (1 month and longer) and is used in a short-term transaction.

Based on a logit regression model the drivers of collateral re-use are assessed. The regression results reveal that the re-use of collateral increases with the scarcity of collateral, that is, it decreases when the collateral availability increases. This goes along with the evidence that the re-use in the interbank market is positively related with the general securities borrowing activity of banks. Hence, banks simultaneously re-use collateral in the interbank market and borrow securities from clients. Furthermore, there is evidence for a significant impact of the maturity of the transaction on the re-use probability. Banks re-use collateral if they lend cash long term and borrow cash short term. This allows them to keep a relatively small pool of securities when, for example, playing the yield curve.

Overall, the extent of re-use within the CHF repo market segment is rather low compared to the findings by Singh (2011) and Aitken and Singh (2009) that calculate the rehypothecation by large global banks. This is due to the fact that in contrast to these authors, we only evaluate the re-use in CHF repo transactions, that is, a specific market segment and currency.[1] Thus, by the definition of our data set the overall re-use in the banking system cannot be captured and the re-use measured is clearly lower than the overall re-use. However, in this study the re-use activity is for the first time calculated based on actual transaction data which allows to gain a detailed understanding of the determinants of the re-use activity. These determinants are expected to hold also in other market segments and currency areas. Furthermore,

1. Collateral could, for example, also originate from a CHF repo transaction and then be re-used in a EUR repo transaction (on the same trading platform).

the proposed methodology to estimate the re-use of collateral could be applied to data stemming from trade repositories.

Our findings have important implications for policymakers, regulators, and central banks. The measure presented for the re-use of collateral can be used as an indicator for collateral scarcity and financial stress. By explaining the drivers and determinants of collateral re-use, we further create a solid foundation for a discussion about financial stability concerns and market efficiency related to the re-use of collateral. We also show that if collateral scarcity increases, banks will have an incentive to re-use collateral, which in turn increases the leverage and the interconnectedness in financial markets. In the light of stricter standards for over-the-counter derivatives or the liquidity coverage ratio, regulators have to consider that these regulatory initiatives might increase collateral scarcity and, according to our findings, the re-use of collateral.

This paper is related to the literature on rehypothecation and re-use of collateral as well as to the broader literature on repo markets. With the experience of the financial crisis, analyzing the market for liquidity and especially the repo market is of first order relevance (Fecht, Nyborg, and Rocholl 2011). Theoretical and empirical literature has documented and dealt with the important role of margin requirements, fire sales, and potential rollover risks (e.g., Brunnermeier and Pedersen 2009, Gorton and Metrick 2010a,b, 2012, He and Xiong 2012 as well as Hördahl and King 2008). Moreover, empirical studies of the structure of repo markets were provided, for example, by Copeland, Martin, and Walker (2011) for the US tri-party, by Mancini, Ranaldo, and Wrampelmeyer (2015) as well as Bindseil, Nyborg, and Strebulaev (2009) for the Eurozone and by Kraenzlin (2007) for the CHF repo market. In contrast, literature on the re-use of collateral is rare. Related studies are Aitken and Singh (2009) and Singh (2011) which have, however, estimated the magnitude of collateral rehypothecation. They find evidence for a considerable amount of rehypothecation prior to the financial crisis and a rapid decline after Lehman's bankruptcy. In this regard, it is important to note that the terms re-use and rehypothecation have, even though sometimes used interchangeably, distinct meanings (Singh 2014). The Financial Stability Board (2012b) defines "rehypothecation" as "the right by financial intermediaries to sell, pledge, invest or perform transactions with client assets they hold" and the re-use of collateral as "securities delivered in one transaction [that] are used to collateralize another transaction." Put differently, "rehypothecation" refers to the use of client assets by banks in their own funding and is particularly popular in investment banks' prime brokerage services. The term "re-use" is used more broadly and refers generally to any use of collateral received in another transaction (Singh 2014). In a repo transaction, the right to re-use securities arises automatically (if they are conducted under a title-transfer arrangement) and does not need to be explicitly granted by the collateral provider. In this paper, we solely analyze the re-use of collateral within the repo market.

The remainder of this paper is structured as follows. Section 1 provides an overview of the institutional setup of the CHF repo market, while in Section 2 the algorithm to determine repo transactions with a collateral re-use is explained. Section 3 discusses

stylized facts about the re-use activity. Section 4 applies an econometric analysis to evaluate the factors determining collateral re-use. Finally, Section 5 concludes.

1. INSTITUTIONAL SETUP

1.1 Characteristics of the CHF Repo Market

Until April 2014, CHF interbank repo transactions in Switzerland were mostly traded on the Eurex Repo trading platform, which was launched in 1999 (Kraenzlin and von Scarpatetti 2011).[2] The trading platform was set up as a nonanonymous market with bilateral trade relationships. The clearing and settlement systems and the trading platform together constitute the Swiss value chain—an infrastructure that allows the complete electronic integration of trading, clearing, and settlement. The settlement is thereby based on the delivery versus payment mechanism and takes place in central bank money on the real-time gross settlement system for CHF—the Swiss Interbank Clearing (SIC)—and on the Swiss securities settlement system (SECOM).

To obtain access to the CHF repo market, the participants must have a SIC settlement account, which requires a sight deposit account at the SNB. Consequently, the number of participants in the CHF repo market depends on the access policy of the SNB. Compared to other central banks, the SNB has followed a liberal access policy (Kraenzlin and Nellen 2015). Beside banks domiciled in Switzerland, banks domiciled abroad and certain nonbanks (domestic insurance companies) are eligible for a sight deposit account at the SNB (Swiss National Bank 2010). The liberal access policy of the SNB contributed to the steady increase in the number of participants in the CHF repo market—from 37 in 1999 to more than 170 in 2011. Similarly, the outstanding volume in the interbank repo market also increased significantly. It reached its peak in September 2008 after the collapse of Lehman Brothers. At that time, the outstanding volume was about CHF 74 billion (bn).

1.2 Collateral Standards in the Interbank Market

In the CHF repo market, almost all interbank repo transactions (more than 99%) are traded against a collateral basket (i.e., general collateral repos).[3] In more than 95% of all CHF interbank repo transactions the collateral basket, which is defined by the SNB (SNB GC basket) for its monetary policy operations, is used. Compared to other central banks, the SNB's collateral framework is liberal regarding eligible currencies but restrictive concerning the quality of the securities (Kraenzlin and Nellen 2015).[4]

2. As of May 1, 2014 interbank repo transactions are mostly conducted on the new SIX Repo trading platform.

3. The main motivation for a general collateral repo is to get cash and not a specific security, whereas the cash provider's interest is to lend without counterparty risks (Bank of England 2012).

4. The minimum credit rating for eligible securities is AA- (A) for securities denominated in foreign currencies (in CHF). The minimum liquidity requirement is an issuance volume of at least CHF 1 bn (CHF

The SNB GC basket currently contains about 2,700 different securities worth CHF 9,500 bn. As the SNB GC basket is subject to daily modifications (i.e., due to new issues, redemptions, and exclusions), smaller fluctuations in the size of the basket occur.

One of the main differences between the CHF repo market and other repo markets is the absence of haircuts in the former. This means that irrespective of the characteristics of the collateral delivered (e.g., asset type or currency of denomination), the cash amount is always covered by a security position with an identical market value.

1.3 The Legal, Technical, and Economic Setup for Re-Use

The Swiss framework agreement on repo transactions and the PSA/ISMA global master repurchase agreement (GMRA) with Swiss annex form the legal basis for any repo transaction in the CHF repo market (Swiss National Bank 2004). Both agreements state that with the transfer of collateral the parties transfer the full and unencumbered legal ownership of the security. Securities transferred in a repo are thus free of any rights of third parties. Additionally, in standard repo contracts the parties typically agree not to grant the right of substitution. Early termination is theoretically possible but not allowed in most standard contracts (Swiss Bankers Association 1999). The re-use of securities in the CHF interbank market is therefore not restricted by any legal aspects. Further, the re-use of collateral is technically feasible in the securities settlement system (see Appendix for a detailed description).

From an economic point of view, a collateral re-use can only occur if the cash taker has outstanding volume as a cash provider (i.e., received collateral) at the same time. As the CHF repo market is a market with bilateral trade relationships, one can expect two groups of institutions to re-use collateral: market makers and institutions that regularly lend cash long-term and refinance themselves short term. Although in the former case the re-use is typically conducted in the same maturities, the re-use in the latter is rather done in overnight, tom-next or spot-next maturities (i.e., day-to-day maturities). In both cases it is rational to assume that banks might re-use collateral to reduce their own funding collateral needs (own securities used).

1.4 The Bank's Pool of Securities

The availability of securities plays a crucial role for banks, especially in the secured money market. Without re-use, a given pool of available securities constrains the maximum possible turnover in the repo market, thus hampering the efficient allocation of liquidity.[5]

Table 1 shows the securities holdings of banks domiciled in Switzerland. By the end of 2012, Swiss banks held a stock of securities worth CHF 262 bn (9.4% of the

0.1 bn) for securities denominated in foreign currencies (in CHF). Eligible securities can be denominated in CHF, EUR, USD, GBP, DKK, SEK, and NOK (Swiss National Bank 2007).

5. Since the outbreak of the financial crisis banks have significantly shifted their exposures from unsecured to secured markets, which consequently increased the demand for collateral (Guggenheim, Kraenzlin, and Schumacher 2011).

TABLE 1

SECURITIES HOLDINGS OF BANKS DOMICILED IN SWITZERLAND

	2006	2007	2008	2009	2010	2011	2012
Total securities holdings	555,214	551,003	298,703	309,895	321,493	266,825	261,764
In % of total balance sheet	17.4%	15.9%	9.7%	11.6%	11.8%	9.6%	9.4%
Securities borrowing	237,257	271,875	97,549	78,728	66,259	57,208	51,439
SNB eligible securities	64,877	96,995	115,237	127,683	145,394	91,932	84,088
In % of total securities	11.7%	17.6%	38.6%	41.2%	45.2%	34.5%	32.1%
Held in LSFF*	12,100	33,700	34,500	35,900	37,500	32,900	33,700
Available securities**	52,777	63,295	80,737	91,783	107,894	59,032	50,388

NOTES: In CHF million; *Liquidity-shortage financing facility
**Available securities for repos = SNB eligible − held in LSFF
Source: SNB statistical publications, "Banks in Switzerland"; SNB accountability reports.

total balance sheet) in trading portfolios and as a financial investment. Prior to the financial crisis, banks held roughly the double, worth CHF 555 bn (17.4% of the total balance sheet).

The share of securities holdings that are eligible for SNB repos increased from about 12% to about 45% in 2010 but decreased again in 2011 and 2012.[6] A significant share of SNB eligible securities was held in the custody cover account "SNB" for the liquidity-shortage financing facility (LSFF) and was consequently not available for interbank repos as they can only be used for the standing facility (Swiss National Bank 2008). Taking the LSFF holdings into account, the securities available for CHF interbank repos fluctuate between CHF 50 bn and CHF 108 bn.

2. METHODOLOGY

To estimate the re-use of collateral in the CHF repo market, we use transaction data from the Eurex Repo trading platform and the corresponding collateral information from SECOM ranging from March 1, 2006 until February 28, 2013. Only the combination of these two data sets allows an analysis of the re-use of collateral. The repo data set includes for each transaction the transaction ID, cash taker ID, cash provider ID, purchase date, repurchase date, and collateral basket. The collateral data set includes the transaction ID, the International Securities Identification Number (ISIN) of delivered collateral and the respective market value. The transaction ID links the repo data set with the collateral data set.

A repo transaction can be secured with several securities. In our sample, on average about three securities have been used to secure one repo transaction. We analyze these collateral transactions in the following. For this reason, statistics are reported in terms of collateral transactions rather than repo transactions.

6. This increase might have been in part due to the SNB's issuance of own debt register claims (SNB Bills in CHF and USD) from 2008 until 2011, which are part of the SNB GC basket.

To identify collateral transactions with re-used collateral we developed an identification algorithm that was written in MATLAB and works as follows. First, the algorithm sorts the data set by purchase date (in ascending order) and duration of the repo transaction (in descending order), that is, starting with the oldest purchase date and the longest duration. Second, for each collateral transaction (i.e., each entry in the data set) the algorithm iterates over all subsequent transaction included in the data set and checks whether the following conditions hold cumulatively:

- identical securities (i.e., ISINs) are used in both transactions;
- the collateral provider in the second transaction is the same as the collateral taker in the first transaction;
- the repurchase date of the second transaction is not later than the repurchase date of the first transaction.

If these three conditions are fulfilled, the first repo transaction is flagged as a possible "initial transaction" and the second one as a possible "re-use transaction." In the last step, the algorithm reduces the probability of overestimation.[7] A transaction can be the initial transaction of several re-use transactions. However, as soon as the collateral value of the initial transaction is used up by re-use transactions, possible subsequent re-use transactions are no longer flagged as re-use transactions.[8]

The algorithm underestimates the re-use of collateral at the beginning of the observation period, as we do not observe initial transactions before the starting date of the data set, that is, before March 1, 2006. With maturities of repo transactions of up to 1 year, there is a potential underestimation of the re-use during the first 12 months. That is, the identified re-use is potentially underestimated until the end of February 2007. As 97.5% of all transactions have a maturity of up to 3 months, the underestimation is expected to be substantial only during the first 3 months of the data set.[9] Therefore, we exclude the period ranging from March 1 until May 31, 2006 from the analysis and conduct the descriptive statistics and the regression analysis from June 1, 2006 onwards.[10]

3. STYLIZED FACTS ABOUT RE-USE ACTIVITY

3.1 Descriptive Statistics

The analyzed period lasts from June 1, 2006 until February 28, 2013 containing 161,108 repo transactions and 470,823 collateral transactions. During the sample period, repo transactions worth about CHF 11.6 tn were settled. Overall, 162 different institutions were active in at least one transaction. On an average trading day roughly

7. The fungibility of ISINs and the necessity of the repurchase condition are discussed in the Appendix.

8. The algorithm does not flag a re-use due to a too low initial value in 10% of the matches.

9. The potential underestimation is described in detail in the online appendix (https://jmcb.osu.edu/forthcoming-papers).

10. Several robustness checks collected in the online appendix (https://jmcb.osu.edu/forthcoming-papers) confirm that the regression analysis (Section 4) is robust to the choice of the starting date.

TABLE 2

NUMBER OF INITIAL AND RE-USE TRANSACTIONS

# of re-use	1	2	3	4	5	≥ 6	Total
Initial transaction	8,352	3,893	2,352	1,538	1,079	4,156	21,370
Re-use transaction	8,352	7,786	7,056	6,152	5,395	50,430	85,171
In % all re-use transactions	9.8%	9.1%	8.3%	7.2%	6.3%	59.2%	100.0%

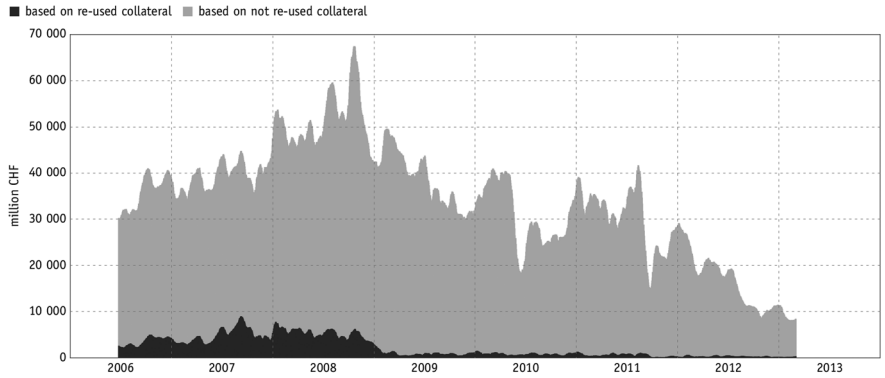

FIG. 1. Outstanding Volume Based on Re-Used Collaterals.

NOTES: Figure 1 shows the outstanding volume based on re-used collateral. The dark gray area is based on re-used collateral, whereas the light gray area stacked on top corresponds to the outstanding volume without re-use (15-day moving average).

240 (before September 2008), respectively 140 (after September 2008) different ISINs have been used.[11]

Of the 470,823 collateral transactions, 246,271 transactions were performed by cash takers who had an outstanding volume as cash provider at the same time. Note that only those transactions could be secured with re-used collateral. Having applied the methodology described in the previous section, we identified 21,370 collateral transactions (4.5% of all transactions) serving as initial transactions for at least one re-use. Moreover, we identified 87,503 re-use transactions (18.6% of all transactions). This implies that the collateral from one initial transaction was re-used on average four times (see Table 2).

As illustrated in Figure 1, re-use transactions contributed on average to about CHF 2.2 bn of the total outstanding volume of CHF 33.9 bn. 73 market participants re-used collateral in at least one transaction, whereas the most active five market participants contributed to 31% of all re-use transactions.

11. See also Figure 3 in the online appendix (https://jmcb.osu.edu/forthcoming-papers), which indicates that there are no security-specific re-use effects.

TABLE 3

DISTRIBUTION OF RE-USE BY MATURITY OF INITIAL (ROWS) AND RE-USE (COLUMNS) TRANSACTION

Day-to-day*		1W	1W-1M	1M-3M	3M-6M	6M-12M	Total
Day-to-day*	100.0%	–	–	–	–	–	2,957
1W	95.3%	4.7%	–	–	–	–	5,764
1W-1M	88.1%	7.2%	4.7%	–	–	–	32,140
1M-3M	81.7%	8.7%	8.5%	1.2%	–	–	32,347
3M-6M	71.3%	9.0%	13.1%	6.3%	0.4%	–	12,534
6M-12M	86.3%	5.8%	4.3%	2.4%	1.2%	0.0%	1,761
Total	84.2%	7.6%	6.8%	1.4%	0.1%	0.0%	87,503

NOTES: *Day-to-day maturities are overnight, tom-next, spot-next.

Table 3 shows that the typical re-use occurs with collateral originating from a rather long-term repo (1M-3M maturities) that is re-used in a short-term repo. In other words, the probability of re-use increases with the duration of the initial transaction. Especially, for transactions with a maturity of 3 months and more the re-use probability increases significantly. Irrespective of the maturity of the initial repo, most of the collateral, that is, 84%, is re-used in day-to-day repo transactions.

3.2 Measures of Collateral Re-Use

To describe the magnitude of collateral re-use, different measures have been used so far in the literature. In this paper two measures to describe the re-use of collateral are presented: the re-use rate and the collateral multiplier.

The re-use rate is a measure used by Bottazzi, Luque, and Páscoa (2012) and is defined as the ratio of the market value of the re-used securities to the overall market activity. The re-use rate (rr) is a value in the interval [0, 1), where a value of zero would imply no re-use at all and a value arbitrarily close to one would imply an almost infinite re-use. Hence, the re-use rate is a relative measure of the re-use activity in a repo market. This measure can be applied to the overall market as well as to individual institutions.[12] The re-use rate at time t is defined as follows:

$$rr_t = \frac{\sum_{n=1}^{N} d_n c_{n,t}}{\sum_{n=1}^{N} c_{n,t}}, \tag{1}$$

where $c_{n,t}$ denotes the value of collateral n of an outstanding repo at time t. To account for the re-use of collateral, a dummy variable d_n is included, which is equal to one if the collateral is re-used and zero otherwise.

The re-use rate does not consider the overall pool of eligible securities and therefore does not give an indication of the impact of the re-use on the overall pool. To account for the availability of securities, the collateral multiplier can be adopted from its

12. In contrast to the overall re-use rate, the individual re-use rate is a value in the interval [0, 1] as theoretically every cash taking transaction of a market participant can be secured with re-used collateral.

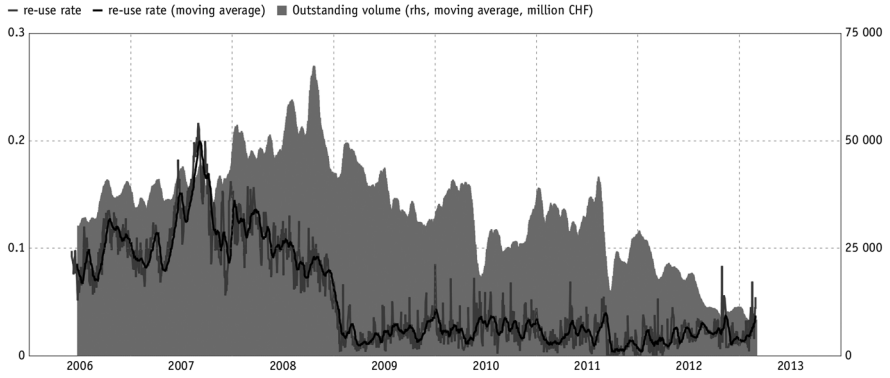

FIG. 2. Re-Use Rate and Outstanding Volume.

NOTES: Figure 2 shows the collateral multiplier over time. The gray area is the total outstanding volume in the CHF interbank repo market (15-day moving average). The light gray line is the daily re-use rate, whereas the black line is the re-use rate with a 15-day moving average.

famous pendant, the money multiplier. For this paper, the collateral multiplier (m) is defined as 1 plus the ratio of re-used collateral divided by the available pool of securities. It is thus a value in the interval $[1, \infty)$ and defined as follows:

$$m_t = 1 + \frac{\sum_{n=1}^{N} d_n c_{n,t}}{\sum_{i=1}^{I} s_{i,t}}, \tag{2}$$

where $s_{i,t}$ is the market value of the available securities (i) eligible for repos at time t (i.e., SNB-eligible securities available). For example, a re-use of securities worth CHF 5 bn and a pool of eligible securities amounting to CHF 10 bn would imply a collateral multiplier of 1.5. The collateral multiplier thus links the re-use to the overall availability of securities, whereas the re-use rate is a measure of the frequency of collateral re-use within the overall market.

3.3 Re-Use Rate and Collateral Multiplier Over Time

Figure 2 shows the development of the re-use rate over time. On average, the re-use rate was about 0.05. In other words, 5% of the outstanding volume was secured with re-used collateral. The re-use rate remained relatively constant until mid-2007, at about 0.075 to 0.125. Afterwards, it increased and reached its highest level in autumn 2007, at about 0.2. In 2008, the re-use rate suddenly declined to a level of roughly 0.02 and remained unchanged afterwards. The collateral multiplier shows a similar pattern (see Figure 3). The collateral multiplier also spiked in autumn 2007, especially when the available collateral suddenly dropped. It reached its maximum value of almost 1.2 in the third quarter of 2007 indicating a relative shortage of collateral. Afterwards,

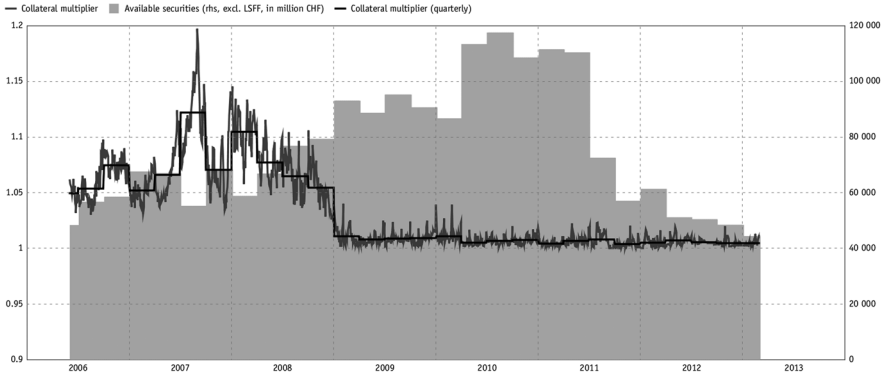

FIG. 3. Collateral Multiplier and Available Securities.

NOTES: Figure 3 shows the collateral multiplier over time. Available securities are SNB eligible securities minus the securities held in the custody cover account "SNB" for the liquidity-shortage financing facility (gray bars). The light gray line is the daily collateral multiplier, whereas the black line is the collateral multiplier on a quarterly basis.

the collateral multiplier shows a similar picture as the re-use rate, even though the available pool of collateral decreased remarkably in 2011.

Both measures reached their highest value in 2007, that is, before the outstanding volume of the CHF repo market peaked and prior to the outbreak of the financial crisis. During this period, the banks' pool of available securities decreased twice (see Figure 3). Therefore, the increasing re-use activity might have been due to collateral constraints of certain banks that were consequently forced to re-use collateral. Furthermore, it is worth mentioning that the re-use activity remained very low after 2009, even though the pool of available securities declined to its lowest level in the observation period. This might be due to the very low trading activity or also due to a structural change in the market. Prior to 2009, market participants acting as cash provider and cash taker were prevalent. After the financial crisis, this share dropped significantly. For example, in August 2011, only 74% of the outstanding volume was due to market participants who had outstanding volume as cash taker and provider, whereas this share was about 97% prior to 2009.

3.4 Individual Re-Use Rates

The re-use of collateral might be driven by the re-use activity of individual banks. A higher re-use activity might indicate a very active collateral management, or even (temporary) collateral constraints of certain market participants. In order to evaluate the re-use activity of different banks, the re-use rates of individual banks are computed. The results reveal that banks re-use collateral at remarkably different rates (see Figure 2 in the online appendix (https://jmcb.osu.edu/forthcoming-papers)).[13] One

13. Of the 162 market participants, 102 would have been able to re-use collateral as they were active as cash taker and cash provider at the same time.

market participant has an average individual re-use rate of close to 1. Another six banks have an average re-use rate of more than 0.5. Overall, about 30 banks have an average re-use rate of above 0.1. Inspecting banks' re-use rates as well as their overall market activity reveals the following facts. On the one hand, the re-use activity of banks is neither increasing in their outstanding volume as cash providers nor as cash takers. On the other hand, small institutions that predominantly lend cash re-use heavily when they exceptionally act as cash taker. Banks with the highest re-use rates act most of the time as cash providers (more than 70% of their trades).

4. DETERMINANTS OF RE-USE

In the following we evaluate the determinants of collateral re-use. The re-use can be seen as a binary decision: either a collateral transaction is covered with a re-used security or not. Thus, we estimate a binary response model. We therefore analyze by what factors the re-use of collateral is influenced and not how much in value is re-used.[14] In the following subsections, we motivate our hypotheses, describe the modifications to the data set, specify our regression model, and discuss the regression results.

4.1 Hypotheses

Without re-use of collateral, the market activity in the CHF repo market is constrained by the pool of available securities. The re-use of collateral reduces this constraint. In other words, a reduction in the availability of securities will *ceteris paribus* require the re-use of collateral to increase, given a specific outstanding volume. Levels and Capel (2012) thus argue that the re-use of collateral is a special form of collateral optimization. Hence, we expect an increasing pool of available securities to have a negative impact on the re-use activity. The availability of securities is measured by the market value of all available (SNB eligible) securities, reported on a quarterly basis by FINMA regulated banks (i.e., banks domiciled in Switzerland).

Hypothesis 1: *An increasing pool of available securities reduces the probability of a re-use.*

The re-use activity in the interbank market might also be determined by the securities borrowing activity of banks from clients' accounts (SNB eligible and non-SNB eligible).[15] Hence, we include securities borrowing from clients' accounts in the analysis. We expect the re-use of collateral to increase if the securities borrowing activity increases. In other words, banks simultaneously re-use collateral and borrow securities from clients' accounts in times of high collateral scarcity. Note that securities borrowing is also determined by the pool of available securities. We consider this

14. The value of a collateral transaction depends on the face value of the underlying security. Thus, a censored normal regression model would not be appropriate to model the decision to re-use collateral.

15. In 2009, FINMA introduced a new legislation concerning SLB transactions, which resulted in a significant decline of securities borrowing from clients' accounts (see Table 1).

fact in the regression analysis by orthogonalizing the securities borrowing variable (see Section 4.3).

Hypothesis 2: *The re-use of collateral increases with the securities borrowing activity.*

Monnet (2011) argues that "rehypothecation lowers traders' funding liquidity needs [or stress], the ease with which a trader can obtain funding." This argument also applies for re-use of collateral. In interbank repo markets, banks often lend cash long term and refinance themselves short term. Re-using collateral in those transactions would reduce bank's collateral needs (the own securities used) and thereby increase overall market liquidity (Brunnermeier and Pedersen 2009). Accordingly, the re-use of collateral is especially valuable for banks in short-term refinancing operations. Put differently, the re-use of collateral facilitates playing the yield curve and allows banks to keep their pool of own securities relatively small, which reduces transaction costs. To empirically test this hypothesis, we include the share of outstanding long-term transactions (i.e., with a term longer than 1 month) as well as the duration of the transaction as independent variables. On the one hand, we expect a positive relationship between the share of outstanding long-term transactions and the probability of re-use. On the other hand, the re-use probability is expected to be higher if the duration of a repo transaction is shorter.

Hypothesis 3: *The re-use of collateral is especially popular for banks when lending cash long term and borrowing cash short term.*

Singh and Aitken (2010) show that rehypothecation has significantly decreased with the intensification of the financial crisis, as market participants became more and more risk averse. If market participants in the CHF repo market were to associate risk with the re-use of collateral, one could expect a negative relation between stress in the CHF money market and the re-use of collateral. To account for money market stress, the credit risk premium, measured by the spread between the unsecured and the secured interest rate for CHF liquidity in the tom-next maturity (TOIS-fixing minus SARTN) is included in the analysis.

Hypothesis 4: *The re-use activity decreases with money market stress.*

Empirical and theoretical research has shown that the relationship between two market participants significantly impacts trading conditions (see, e.g., Furfine 1990). Recently, Duffie (2013) presented evidence that during the financial crisis prime-brokerage clients (collateral providers) made sure that the securities they held in their custodies were not rehypothecated by their broker-dealers. Theoretical models by Infante (2014) and Eren (2014) predict this behavior and show that a collateral provider might have an incentive to withdraw securities during crisis periods. Based on these models, one might also expect that the relationship between two market participants in the CHF repo market influences the re-use of collateral. Collateral providers that re-use collateral might be concerned about not receiving back the collateral which they have to return to the initial collateral provider. This risk amplifies

with a weak diversification of the re-using counterparty. In the regression we thus control for the diversification of the collateral provider, which is measured by the sum of cash taking transactions with the corresponding cash provider to the total sum of cash taker transactions. Thus, the measure for relationship is a value in the interval (0, 1]. A very low value characterizes a relatively low exposure to this counterparty, whereas a value close to one indicates a very large exposure. We expect a high relationship ratio to reduce the probability of a re-use of collateral.

Hypothesis 5: *Weakly diversified collateral providers re-use less collateral than well-diversified collateral providers.*

4.2 Control Variables

As the CHF repo market is set up as a market with bilateral trade relationships, counterparties might also negotiate about the specific collateral delivered. According to Ewerhart and Tapking (2008), counterparties in bilateral markets prefer to use high-quality collateral in the interbank market to balance the counterparties' risk exposure as efficiently as possible. Therefore, they might have an incentive to deliver, and especially to re-use, good rather than bad collateral. Consequently, the credit rating of the corresponding security is taken into account.[16]

As Swiss banks have to fulfill minimum reserve requirements, one might expect that they also re-use collateral to fulfil these requirements (at least in the short run, just prior to the end of the maintenance period). Thus, we control for the individual liquidity position of market participants by including the daily gross excess reserve of a bank in analogy to (Fecht, Nyborg, and Rocholl 2011).

Furthermore, we account for the overall outstanding volume in the CHF repo market. A higher outstanding volume might imply an increasing need for collateral re-use. Moreover, the re-use of securities might be conducted by market makers who are active as cash taker and cash provider in the same maturities on the same day. We therefore include a dummy variable indicating whether a market maker was involved in the transaction.

4.3 Data

For the binary response model below, the data set is adjusted as follows. To exclude the period with very high excess liquidity and very low trading activity, we reduce the sample to the time period between June 1, 2006 and August 2, 2011 reducing the number of collateral transactions to 426,042.[17] Furthermore, only transactions, where the cash taker has outstanding cash provider repos at the same time, are involved, as

16. We consider the best security credit rating from Standard & Poor's, Moody's, or Fitch.

17. On August 3, 2011 the SNB increased the supply of liquidity as a measure against strong CHF. Consequently, the trading activity decreased significantly. As mentioned in Section 2 the re-use is potentially underestimated between June 2006 and February 2007. Several robustness checks collected in the online appendix (https://jmcb.osu.edu/forthcoming-papers) confirm that our regression results are not affected by the potential underestimation. For more details, see online appendix (https://jmcb.osu.edu/forthcoming-papers).

TABLE 4

DESCRIPTIVE STATISTICS

Variable name	Unit	Freq.	Agg.	Abb.	Mean	Std. dev.	Min.	Max.
Collateral re-use	dummy	t	i	Y	0.36	0.48	0.00	1.00
ln(Securities borrowing)	ln(bn)	m	o	SB	5.19	0.51	4.11	5.65
ln(Available securities)	ln(bn)	q	o	AP	4.29	0.24	3.88	4.77
Stress in money market	pp	d	o	MS	0.15	0.40	−0.09	3.28
Relationship ratio	%	d	i	RE	11.25	16.56	0.00	100.00
Share long-term transactions	%	d	o	LT	63.01	10.19	20.10	82.57
Duration of transaction	days	t	i	DU	8.78	24.22	1.00	370.00
Rating AAA	dummy	t	i	RA	0.61	0.49	0.00	1.00
Rating AA+	dummy	t	i	RA	0.08	0.28	0.00	1.00
Rating AA	dummy	t	i	RA	0.06	0.24	0.00	1.00
Rating AA-	dummy	t	i	RA	0.04	0.19	0.00	1.00
Rating A+	dummy	t	i	RA	0.02	0.14	0.00	1.00
Rating A	dummy	t	i	RA	0.01	0.10	0.00	1.00
No rating	dummy	t	i	RA	0.18	0.38	0.00	1.00
Gross excess reserves	bn	d	i	GE	1.91	5.13	−2.68	303.94
Market maker	dummy	d	i	MM	0.20	0.40	0.00	1.00
ln(Outstanding volume)	ln(bn)	d	o	OV	3.70	0.23	2.73	4.28
ln(Volume of transaction)	ln(mn)	t	i	VA	2.225	1.64	−15.53	6.02

NOTES: Number of observations 234,000
Table 4 shows the descriptive statistic of data set used. Freq. = Frequency of variables: t = for each transaction, d = daily, m = monthly, q = quarterly. Agg. = Aggregation of variables: i = individual, o = over all banks. Abb. = Abbreviation of variables.

those participants are the only ones, which are able to re-use collateral. This shrinks the sample to 237,094 transactions. Additionally, 852 transactions are excluded due to missing observations in the money market stress variable.[18] Finally, 2,242 transactions of banks, which do not exhibit a re-use of collateral are not considered in the data set. The final data set contains 234,000 transactions.

The descriptive statistics of the variables can be found in Table 4. Overall, in 36% of the collateral transactions a re-use of collateral is observed. This probability is higher than indicated by the re-use rate due to two reasons. First, the data set includes only transactions where the cash taker also has an outstanding volume as cash provider. Second, short-term transactions do not contribute as strongly to the re-use rate as longer-term transactions do. For variables in cash amounts we employ the natural log, if they are strictly positive. For variables with observation frequencies lower than daily, the last available observation is used.

The securities borrowing variable is closely related to the available securities variable. The correlation coefficient between these two variables is −0.85 (see online appendix (https://jmcb.osu.edu/forthcoming-papers)). To avoid a potential multicollinearity problem in our regression analysis we orthogonalize the securities borrowing variable (see equation (3) and Table 4 for abbreviations) with respect to the available securities variable. The orthogonalized variable (η) is denoted as securities borrowing (orth.). The correlation between the securities borrowing (orth.) and

18. On the following days the SARTN rate was not available: December 29, 2006, December 27, 2007, December 31, 2008, and October 28, 2009.

the original securities borrowing variable is 0.53, showing that the orthogonalized variable qualifies as a valid measure for securities borrowing.

$$SB_i = \beta_1 + \beta_2 AP_i + \eta_i \tag{3}$$

4.4 Binary Response Model

To determine the re-use of collateral, we use a logit model with clustered standard errors.[19] We regress the dummy variable collateral re-use (indicating whether a security has been re-used or not) on the variables specified above. Equations (4) and (5) show our regression specifications (see Table 4 for abbreviations).

$$Pr[y_i = 1|\boldsymbol{x}_i] = \frac{exp(\boldsymbol{x}_i'\boldsymbol{\theta})}{1 + exp(\boldsymbol{x}_i'\boldsymbol{\theta})} \tag{4}$$

$$\begin{aligned}\boldsymbol{x}_i'\boldsymbol{\theta} = {} & \beta_1 + \beta_2 SB_i + \beta_3 AP_i + \beta_4 RE_i + \sum_{j=1}^{J-1} \delta_j RA_{i,j} + \beta_5 MS_i + \beta_6 GE_i \\ & + \beta_7 MM_i + \beta_8 OV_i + \beta_9 DU_i + \beta_{10} VA_i + \beta_{11} LT_i + \sum_{n=1}^{N-1} \gamma_n d_{i,n}\end{aligned} \tag{5}$$

$RA_{i,j}$ dummy variable = 1 if credit rating j was used in transaction i, else 0. J represents the credit rating categories AAA, AA+, AA, AA-, A+, A and no credit rating;

$d_{i,n}$ dummy variable = 1 if bank n was involved in transaction i, else 0.

We control for bank-specific effects by using dummy variables for $N - 1$ cash takers.[20] As for small market participants only periodical observations exist, we group small banks into a single category. Those institutions account for less than 5% of the total turnover in the CHF repo market. Overall, 50 bank-specific dummy variables were included in the regression.

To account for potential intraclass correlation, we use clustered standard errors. Some regressors are variables with a daily, monthly or quarterly frequency. Consequently, transactions, for example, settled on the same trading day exhibit the same values for some of the independent variables. Thus, the regression residuals of these observations might be serially correlated. As most of our independent variables have at least a daily observation frequency, we use standard errors clustered by trading

19. Standard probit and logit models show similar measures of goodness of fit (pseudo R^2 of about 0.19). To compare the two models, the fitted log-likelihoods are calculated (Cameron and Trivedi 2005). Because the fitted log-likelihood of the logit model slightly outperforms the probit model, we focus on the logit model.

20. Note that the data set, containing a fixed number of participants and a large number of observations, allows us to run an unconditional logit regression instead of a conditional logit regression (Cameron and Trivedi 2005).

day in the baseline regression. Another possibility would be to use standard errors clustered by cash taker. As we control for individual heterogeneity by including bank-specific dummy variables, clustering by trading day is preferred to clustering by cash taker.

4.5 Regression Results

The regression results are illustrated in Table 5 column (1).[21] We find a significant and negative effect of the availability of securities (i.e., pool of available securities) on the re-use probability. This implies that market participants tend to re-use in times when the availability of securities is low. Shocks in the collateral universe are thus (at least partially) absorbed by an increasing re-use activity. A shortage of available securities does consequently increase the re-use activity. The re-use of collateral therefore supports market activity in the CHF repo market, especially when available securities become scarce. This evidence supports Hypothesis 1.

Furthermore, the coefficient for securities borrowing (orth.) is positive and significant. The fewer securities borrowed from customers, the lower is the probability of collateral re-use. This clearly indicates that banks re-use collateral when they also borrow securities from client accounts (Hypothesis 2).

The coefficients for the duration of the transaction and the share of long-term transactions are statistically significant and confirm Hypothesis 3. The longer the duration of a transaction, the lower the probability for collateral re-use. Furthermore, the regression results show that collateral re-use does occur more often when the share of long-term repos in the market is high. Consequently, our findings support the hypothesis that the re-use of collateral is used to lend cash long term and to borrow cash short term. Re-use might thus enhance trading activity and reduce traders' funding liquidity needs as proposed by (Monnet 2011).

The coefficient for the relationship ratio indicates a negative impact of a weak diversification of the collateral provider on the re-use probability. Hence, if the re-using counterparty only borrows cash (lends collateral) from a few cash providers (i.e., the relationship ratio is high), it is more careful about re-using collateral. This supports Hypothesis 5 that re-using intermediaries might be worried about not receiving back their collateral, which they have to return to the initial collateral provider. However, the money market stress variable does not exhibit statistically significant coefficients. This might be due to the fact that the re-use of collateral is only observable for the re-using counterparty and not for the initial collateral provider. We therefore cannot confirm that money market stress has a negative impact on the re-use of collateral. Thus, we find no evidence supporting Hypothesis 4.

The coefficients of the control variables are partly significant and show the expected signs. The overall market activity (i.e., the outstanding volume) positively affects the

21. The coefficients of a logit regression represent the log of the odds ratios. Interpretations in the following focus on the sign and the significance of the coefficients, which determine the direction of the corresponding marginal effect. The majority of the coefficients are significant at least at the 5% significance level including most of the coefficients for the bank-specific effects.

TABLE 5

REGRESSION RESULTS

	(1) Baseline	(2) S.E. by month	(3) Excl. SLB	(4) Excl. Pool	(5) No F.E.
Scarcity of collateral					
ln(Available securities (bn CHF))	−0.652***	−0.652***	−0.457***		−0.496***
	(−5.91)	(−2.88)	(−4.20)		(−5.04)
ln(Securities borrowing) (orth.)	0.462***	0.462***		0.353***	0.551***
	(7.03)	(3.93)		(5.49)	(8.88)
Maturity of transactions					
Share long-term transactions (in %)	0.0143***	0.0143***	0.0161***	0.0217***	0.00841***
	(6.12)	(2.92)	(6.81)	(11.06)	(3.91)
Duration of transaction (days)	−0.0245***	−0.0245***	−0.0240***	−0.0243***	−0.0302***
	(−20.76)	(−11.99)	(−20.77)	(−20.69)	(−21.98)
Control variables					
Stress in money market (pp)	−0.0539	−0.0539	−0.104	−0.106	−0.161**
	(−0.71)	(−0.91)	(−1.36)	(−1.42)	(−2.41)
Relationship ratio (in %)	−0.00735***	−0.00735***	−0.00764***	−0.00827***	−0.00165**
	(−8.21)	(−4.44)	(−8.46)	(−9.38)	(−2.23)
Rating AA+ (dummy)	0.363***	0.363***	0.360***	0.343***	0.209***
	(13.73)	(6.47)	(13.57)	(12.93)	(8.38)
Rating AA (dummy)	−0.0538**	−0.0538	−0.0570**	−0.0615**	−0.104***
	(−2.05)	(−1.05)	(−2.17)	(−2.34)	(−4.27)
Rating AA- (dummy)	−0.0439	−0.0439	−0.0326	−0.0330	−0.0926***
	(−1.23)	(−0.53)	(−0.91)	(−0.92)	(−2.90)
Rating A+ (dummy)	0.295***	0.295***	0.312***	0.311***	0.258***
	(6.85)	(3.38)	(7.17)	(7.23)	(6.75)
Rating A (dummy)	0.0708	0.0708	0.0746	0.0694	0.140***
	(1.15)	(0.48)	(1.19)	(1.11)	(2.68)
No rating (dummy)	−0.952***	−0.952***	−0.943***	−0.938***	−1.030***
	(−30.65)	(−10.71)	(−30.15)	(−29.74)	(−33.87)
Gross excess reserves (bn CHF)	−0.00382	−0.00382	−0.00822**	−0.00872**	−0.0125***
	(−1.21)	(−0.72)	(−2.27)	(−2.30)	(−3.02)
Market maker (dummy)	−0.0107	−0.0107	0.0119	0.00827	−0.0373
	(−0.25)	(−0.17)	(0.28)	(0.20)	(−0.91)
ln(Outstanding volume (bn CHF))	0.859***	0.859***	1.073***	0.994***	0.375***
	(9.39)	(4.51)	(12.01)	(11.59)	(3.99)
ln(Volume of transaction (mn CHF))	0.00974	0.00974	0.00492	0.00517	0.0170**
	(1.28)	(0.44)	(0.64)	(0.68)	(2.56)
Constant	−2.076***	−2.076	−3.841***	−5.856***	−0.00661
	(−2.76)	(−1.28)	(−5.27)	(−15.92)	(−0.01)
Number of observations	234000	234000	234000	234000	236242
Pseudo R-squared	0.189	0.189	0.187	0.187	0.0616
Log-likelihood	−124242.6	−124242.6	−124497.1	−124445.2	−144664.0
Log-likelihood (0)	−153159.2	−153159.2	−153159.2	−153159.2	−154160.5

NOTES: t statistics in parentheses.
$^{*}p< 0.10$, $^{**}p< 0.05$, $^{***}p< 0.01$.
Table 5 shows the regression results of our baseline regression (column (1)) and the applied robustness tests (column (2)–(5)). The baseline regression reveals the results with standard errors clustered by date and bank-specific dummy variables. Column (2) shows the regression results with standard errors clustered by month, column (3) the results without the securities borrowing (orth.) variable and column (4) the regression results without the available securities variable. Column (5) shows the regression results when dropping bank-specific dummy variables. The coefficients of a logit regression represent the log of the odds ratios. The predicted re-use probabilities for different variables from the baseline regression (column (1)) are given in Figure 5. The sample period lasts from June 2006 to August 2011. Further robustness checks regarding the selection of the starting date can be found in the online appendix (https://jmcb.osu.edu/forthcoming-papers). For variables in cash amounts we employ the natural log if they are $\gg 0$. Bank-specific dummy variables are not reported (column (1)–(4)). The securities borrowing (orth.) variable is orthogonalized as specified in equation (3).

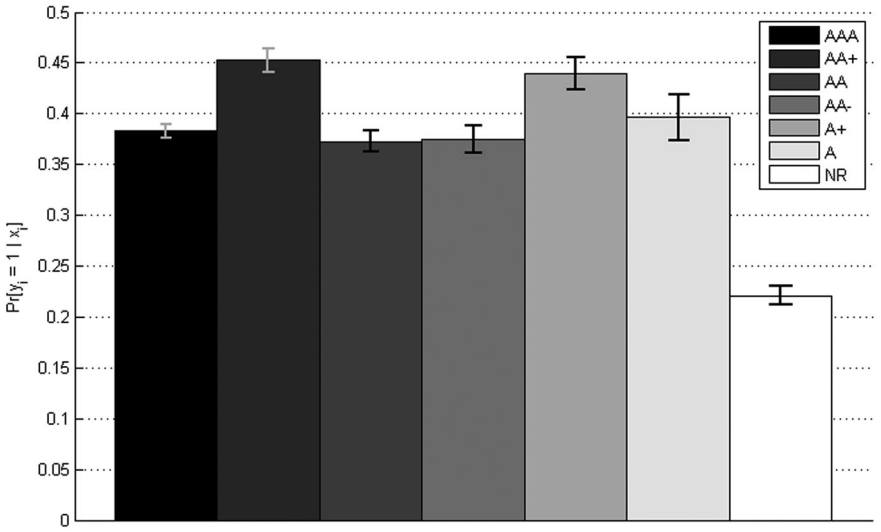

FIG. 4. Credit Ratings.

NOTES: Figure 4 shows the predicted re-use probabilities for different rating categories. The vertical axis is the estimated probability of a re-use conditional on the rating category, with all other variables held constant. The predicted re-use probabilities are based on the regression coefficients. The vertical lines illustrate the corresponding 95% confidence intervals. Note that securities with a credit rating lower than AA- must be denominated in CHF.

re-use probability. The coefficients for the credit ratings show that especially the re-use probability for securities with no credit rating is reduced compared to the reference category (AAA-rating).

4.6 Predictions

The logit model is a nonlinear model and therefore the coefficients cannot be interpreted as semielasticities (Winkelmann and Boes 2006). We therefore calculate predicted re-use probabilities (conditional probabilities) for different levels of one independent variable, with all other variables held constant (see Figure 5).

The increase in the re-use probability tends to be nonlinear especially for the duration of a transaction. The re-use probability decreases sharply with an increasing duration of the transaction. Whereas the re-use probability is around 40% in overnight transactions, it decreases to almost zero in transactions with a duration of more than 200 days. Moreover, also the securities borrowed (orth.) and available securities variables have a strong and nonlinear impact on the re-use probability. For example, the predictions show that the re-use probability decreases from 41% to 31% when the pool of available securities increases from 50 to 100 bn. Furthermore, the outstanding volume exhibits a strong positive effect on the re-use probability.

Figure 4 shows the predicted re-use probabilities conditional on different credit rating categories. The figure reveals that the re-use activity also depends on the credit

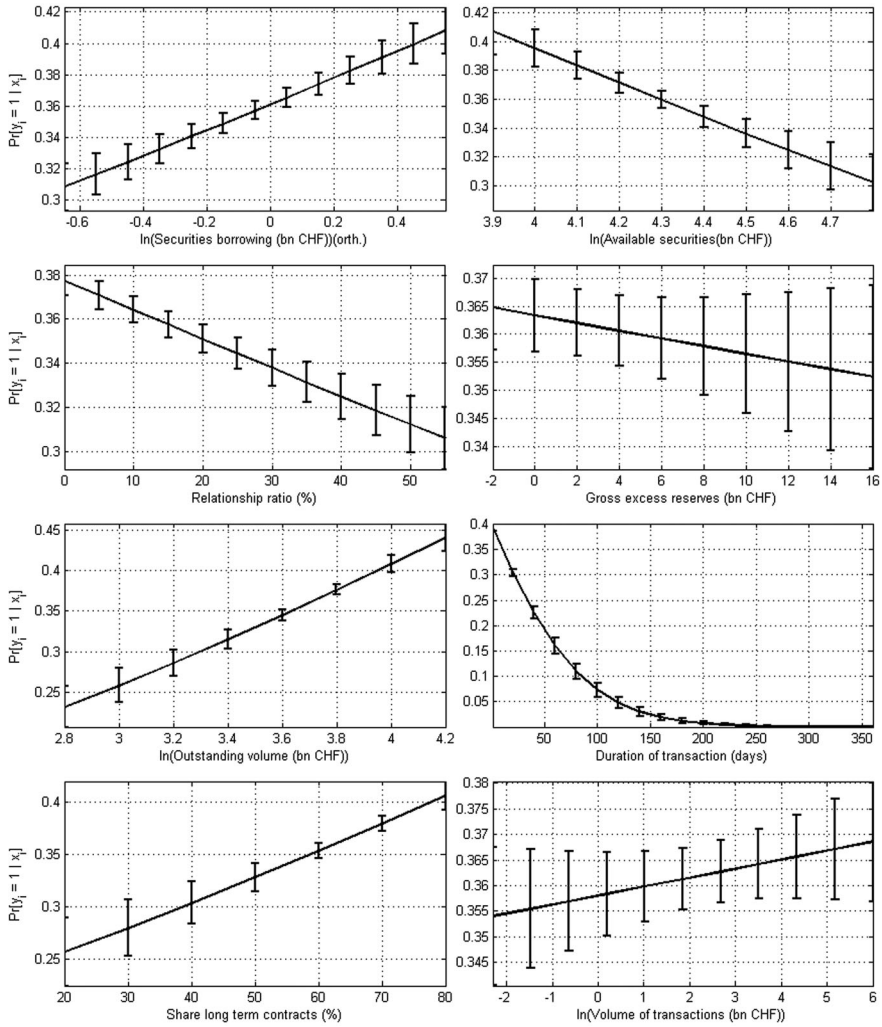

FIG. 5. Predictions.

NOTES: Figure 5 shows the predicted re-use probabilities for different levels of a variable. The vertical axis is the estimated probability of a re-use conditional on different levels of the explanatory variable, with all other variables held constant. The predicted re-use probabilities are based on the significant regression coefficients. The vertical lines illustrate the corresponding 95% confidence intervals. The predicted re-use probabilities need to be considered as hypothetical values, since certain values in certain periods simply did not exist, for example, the gross excess reserves before the crisis never exhibited values as large as after the crisis.

rating of the collateral. Especially, securities without credit rating (e.g., short-term government debt) are re-used less frequently.

4.7 Robustness

To check the robustness of our findings we run several additional regressions. First, we cluster standard errors by month (see Table 5 column (2)). All coefficients remain significant at least on a 5% level except the constant.[22] Second, we check the robustness with respect to the scarcity of collateral variables (i.e., securities borrowing and available securities). Table 5 column (3) and (4) report the regression results when dropping one of the two variables. In both cases, the remaining collateral availability variable persists to be significant with its corresponding sign, whereas other variables change only marginally. Finally, we also run a regression without bank-specific dummy variables (see Table 5 column (5)). Even though we neglect individual heterogeneity in this case, the model performs relatively well and most of the coefficients keep their sign and significance. The only exception is the money market stress variable which becomes negative and significant at the 5% level.

5. CONCLUDING REMARKS

This paper sheds light on the re-use of collateral in an interbank repo market. By developing and applying an algorithm on transaction data from the CHF repo market, we are not only able to document the re-use activity, but also identify the drivers of collateral re-use before, during, and after the financial crisis.

Our estimations show that on average the re-use rate was at about 0.1 prior to the financial crisis. With the reduction of available collateral just before the outbreak of the crisis, the re-use rate reached its maximum of almost 0.2, but declined significantly in the third quarter of 2008 and has not recovered yet. The results complete recent findings by Singh (2011) as well as Aitken and Singh (2009) in at least two important areas. First, we confirm by using actual transaction data that the re-use activity substantially declined after the financial crisis. Second, we show that the re-use within the interbank repo market can significantly differ from the level of rehypothecation.

The regression analysis provides evidence that the re-use activity depends on the availability of collateral. Market participants tend to re-use when collateral scarcity increases and in times when they also borrow securities from their client's. Further, we find evidence for a significant impact of the maturity of the transaction on the re-use probability. The longer the duration of a transaction, the lower is the probability that in this transaction a collateral re-use occurs.

With the methodology and the data at hand, future research on the re-use of collateral can be done. In particular, it might be worth investigating in the cross-

22. Clustering by quarter reveals similar results, see online appendix (https://jmcb.osu.edu/forthcoming-papers).

currency and the cross-instrument re-use of collateral as well as the re-use activity of individual banks.

APPENDIX A

A.1 Selection of Collateral in SECOM

The selection of securities for a repo transaction in SECOM can be done manually or automatically by the so-called GC select algorithm. The majority of market participants use the automatic selection process. The GC select chooses securities from a predefined pool of available securities (SIX Securities Services 2013). The pool of available securities (the so-called release list) has to be maintained by the market participant. Besides other information included on the ISINs, the release list contains the corresponding quantity available, the date of the next coupon payment ("valid till date") and the date until the security is available for repos ("release till date," which is typically equal to the valid till date). Securities received in a repo are classified as "purchased securities." With the default setting, these securities are not shifted to the release list but to the so-called nonrelease list. Furthermore, the release till date of purchased securities is not equal to the valid till date as in the default setting but equals the repurchase date of the initial transaction. However, market participants can change the default setting. Currently, two thirds of all account owners adjust the default option such that purchased securities are automatically transferred to the release list.[23] This means that they intend to re-use collateral. Other account owners—using the default setting—still have the option of transferring specific ISINs from the nonrelease list to the release list.

For a repo transaction, the GC select picks securities by using a predefined methodology. First, it selects securities from the collateral category defined, then it rejects securities that are not eligible (e.g., own banking group securities) and finally it removes all securities that have a valid till date prior to the repurchase date of the repo transaction (SIX Securities Services 2013). From this remaining list, the GC select first chooses the securities with the shortest possible release till date (SIX Securities Services 2013), thus preferring the securities that stem from another transaction.

A.2 Re-Use Activity When Relaxing the Repurchase Condition

The algorithm identifies a transaction as a re-use transaction only if the repurchase date of the re-use transaction is not later than the repurchase date of the initial transaction. However, a re-use might also occur without satisfying this condition, because the collateral taker of the initial transactions only has to return the same ISIN at the repurchase date—but not the same security. In this case, the collateral taker needs to obtain the same collateral somewhere else (e.g., secondary market) to return the security to the initial owner.

23. Securities received from margin calls are transferred to the release list but flagged and are thus not available for the GC select.

Figure 4 in the online appendix (https://jmcb.osu.edu/forthcoming-papers) shows the estimated re-use without the repurchase condition. It becomes clear that the re-use identified is about twice as large but has a very similar pattern. The re-use activity without repurchase condition can be seen as an upper limit of the possible re-use activity in the CHF repo market.

A.3 Fungibility of ISINs and Implications for the Re-Use

The algorithm might overestimate the re-use of collateral, as we are only able to compare the ISINs but cannot guarantee that exactly the same security has been re-used. Securities of the same issuance cannot be distinguished from each other—that is, they are perfectly fungible. In other words, a security—with the same ISIN as the purchased security in the repo transaction—could have already been on the release list and then used in the re-use transaction. The algorithm would identify this as a re-use. However, as the GC select first chooses collateral with the youngest release till date, and purchased securities automatically have an earlier release till date than the same ISIN in the account, we do not expect the overestimation to be significant.

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