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Exploring an uncharted market: Evidence on the unsecured Swiss franc money market

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Abstract

To date, various central banks have lacked detailed statistical evidence on developments in the unsecured interbank money market. Furfine (1999) introduced the idea of calculating unsecured overnight interbank lending by using data of a RTGS system. Based on data from the Swiss payment system (SIC) we developed an algorithm to identify unsecured interbank loans in Swiss francs. In contrast to Furfine (1999) we also identify longer-term transactions. We thereby gain a deeper insight on the size and structure of the unsecured interbank money market in Swiss francs. This is the first time that SIC data have been used to identify transactions and market rates in the unsecured Swiss franc money market. Overall, the estimates show that after the collapse of Lehman Brothers loss of confidence led to a freezing-up of the market for several months and a decrease in daily turnover.

JEL-Codes: E40, E42, E44
Keywords: unsecured interbank money market, development, money market turmoil, financial stability, Switzerland

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1 Introduction

The financial crisis that began in 2007 affected a number of funding markets, among them the secured and the unsecured interbank money markets. The phase after the collapse of Lehman Brothers in September 2008, in particular, was marked by a considerable loss in counterparty confidence. According to market participants, this loss of confidence resulted in a shift from the unsecured to the secured market.

The Swiss National Bank (SNB) implements its monetary policy via repo transactions on the electronic trading platform of Eurex Zurich Ltd. As this platform is also used for repo transactions between banks, the SNB is able to monitor developments on the interbank repo market closely. It is fair to say that the Swiss franc repo market has proved to be a crisis-resistant source of liquidity, thanks to the consistent minimisation of counterparty risks.[1] To date, however, the SNB has lacked adequate data on developments in the unsecured interbank money market.

Data from the Swiss RTGS system, Swiss Interbank Clearing (SIC), provides an opportunity to evaluate unsecured interbank loans without relying on data surveys with money market participants and brokers. SIC is the core payment system in Switzerland for settling large value and retail payments. This is the first time that RTGS data have been used for the identification of transactions and market rates in the unsecured Swiss franc money market. The identification algorithm was used to identify unsecured interbank transactions with a maturity of up to three months. SIC transaction data is available since 2005, which allows us to examine the period before and during the financial market crisis. This data not only gives us the opportunity to estimate transactions in the unsecured interbank money market but also the chance to evaluate whether volume in the Swiss franc money market actually fell sharply or not. With the data at hand, we can further test whether the Libor fixings represent the actual market rate or not.

Our estimates show that both, daily turnover and outstanding volume in the unsecured Swiss franc money market (overnight to three months), declined heavily during the financial market crisis. After the collapse of Lehman Brothers loss of confidence even led to a freezing-up of the market for several months. Yet, it has not recovered fully. The decline of the activity in this mostly domestic market was mainly due to departing counterparties. We take this as an evidence that cash providers refrained from lending out money on an unsecured basis. We also observe a shift from the unsecured to the secured interbank money market during the crisis. To date, we have found no evidence for a reversal in the relative importance of these two money market segments.

[1] See Kraenzlin/von Scarpatetti (2010) for a detailed analysis on the repo market.

In March 2008, Libor panel banks were accused of talking up their creditworthiness by reporting lower rates than what they actually had to pay in order to avoid negative signals about their refinancing conditions. These accusations were mainly raised for the Libor fixings in US-Dollar. With the data at hand, we find evidence that the Libor rates in Swiss franc, and hence also the three-month Swiss franc Libor, adequately reflected conditions on the unsecured money market. We can thus conclude that on average, Swiss franc Libor panel banks did not talk up their creditworthiness by reporting lower rates than what they actually paid.

The paper is structured as follows. Section 2 provides a short overview on the related literature. In the subsequent section, the methodology applied for the Swiss data as well as potential drawbacks of the methodology are presented and discussed. A description on the properties of the dataset are given in section 4. Section 5 analyses the turnover, outstanding volume as well as the number of participants on the unsecured money market in Swiss francs. In section 6 the question is addressed if the Libor rates correspond to prices paid. In the subsequent section the development of the unsecured money market is compared to that of the Swiss franc repo market. Section 8 concludes.

2 Related Literature

Furfine (1999) introduced the idea of calculating unsecured overnight interbank lending by using data of a RTGS system. He established the basic algorithm for the identification of loans which were subsequently used in a number of related papers. Using Fedwire data from the first quarter of 1998 interbank loans with a maturity of one day (overnight) were identified as follows: Payments greater than USD 1 million with fairly round numbers (rounded to the nearest integer of USD 100,000) are flagged as potential candidates for the initial payment of an interbank loan. On the following working day, payments between the same parties but in opposite direction, with a slightly bigger amount than the candidate, are earmarked as a potential repayment. Provided that the slightly larger amount qualifies for a reasonable interest rate of an overnight loan – i.e. within a range of 50 basis points below and above the federal funds rate[2] – the two payments are identified as an unsecured interbank loan. Furfine (1999) found, that on a daily average about 24% of the Fedwire funds transfer value or about USD

[2]Furfine (1999), p. 26: "What was assumed to be a reasonable rate of interest varied each day depending on standard, publicly available measures of the federal funds rate. Such measures record each day's 11:00 rate, closing rate, and effective (value-weighted) funds rate. As interest rates charged are likely to vary across transactions, payments that implied an interest rate ranging from 50 basis points below the minimum of these three published rates and the Federal Reserve's target rate to 50 basis points above the maximum of these four rates were allowed."

144 billion per day accounted for unsecured interbank loans. In addition, he stated that larger institutions are more active, regardless of whether they are cash taker or provider. In general, small banks tended to lend funds to large banks. Nevertheless small banks also acted on both sides of the market. Furfine (1999) finally found that the majority of the payments took place between 4 and 6pm, whereas repayments were evenly spread during the day.

Furfine (2002) re-examined the unsecured interbank money market during the financial market disruptions in autumn 1998, when Russia defaulted on its sovereign debt. He found that the interest rate did not deviate from the federal funds target rate. Further there was neither evidence for a decrease in the volume in the federal funds market nor for an increase in credit spreads depending on the counterparty characteristics. He concluded that the individual institutions seemed to be able to achieve the desired level of liquidity also during the crisis.

Demiralp et al. (2004) also analyzed the federal funds market but extended Furfine's methodology by applying a filter on implied interest rates. Therefore an interest rate had to be in units of 1/32 percentage points or in whole basis points. In addition they lowered the minimum size of loans to USD 50,000 and widened the range for acceptable interest rates. The total value of identified loans was close to Furfine's calculations and therefore, the widening of interest rate range and size threshold did not lead to major differences.

Millard/Polenghi (2004) examined the unsecured overnight interbank money market in pound sterling by applying Furfine's algorithm on the data from the Sterling payment system (CHAPS[3]). Similar to Furfine (1999) they set the size threshold to GBP 1 million. They found evidence that unsecured overnight loans accounted to about GBP 22 billion on average, which is about 11% of the flows in CHAPS Sterling. Since in CHAPS Sterling only 13 participants act as settlement banks, the identification of the final beneficiary and originating party behind an interbank transaction was not possible. To their surprise, they found that four CHAPS Sterling members accounted for almost all payments which were identified as overnight loans. Furthermore, Millard/Polenghi (2004) examined the time stamp of each payment and found that these were fairly evenly spread throughout the day. Therefore they concluded that "the overnight interbank loan market does not greatly increase the impact of an operational event in CHAPS Sterling at the moment, at least from the point of view of the system operators."

A further contribution to the calculation of unsecured interbank loans was made by Hendry and Kamhi (2007) by applying Furfine's algorithm to

[3]CHAPS stands for Clearing House Automated Payment System.

the large value payment system of Canada (LVTS[4]). Analog to Demiralp et al. (2004) they extend the algorithm by introducing a filter on the implied interest rate. Thus, only loans with an interest rate in units of half a basis point are considered as eligible. Their data shows, that the overnight interest rate on average only lay one basis point below the Bank of Canada's target overnight rate. The average size of a loan is CAD 50 million. Further they note that big banks lend more in total value and frequency but at lower rates and smaller tickets. Examining the time of settlements, they find a different pattern as for overall payments in LVTS. Generally, the number of loans gradually increases during the day, peaks at around 4pm and sharply declines during the last trading hour. Finally they try to estimate the overnight interest rate determinants through a regression analysis. They find amongst others a positive relationship between interest rate and size of value which proved to be non-linear. They take this as an evidence that "very large borrowers are likely to get preferential treatment by the banks as part of an ongoing relationship". Further they find, that loans concluded in the morning are most expensive and small banks get cheaper loans when borrowing from big banks.

All of the literature mentioned above used the basis algorithm introduced by Furfine (1999). Some of the authors extended the method by introducing different filters or widening the interest rate range or lowering the size threshold. However, all of them tried to identify unsecured overnight loans only. Longer terms were not taken into account.

Most recently Heijmans et al.(2010) applied an extended Furfine algorithm on TARGET2 data and identified unsecured interbank loans with a maturity up to one year. They tested the algorithm with different search bands[5]. Thus, in order to reduce the under-identification of interbank loans, they widened search band during periods of large volatility in interest rates. In addition, to reduce the over-identification of transactions for certain maturities they appointed a higher priority to most likely maturities (one day, full weeks and full months) and to shorter terms, since the market is the deepest in shorter maturities. They find evidence of a significant decrease in the Dutch part of the euro unsecured interbank money market. The hypothesis that a shift from longer to shorter term lending took place during the financial market crisis could not be confirmed. However they found a significant increase in the spread and volatility of the interest rates. Heijmans et al.(2010) conclude that the algorithm should also be used in order to monitor the unsecured interbank money market and hence as an early warning indicator for sudden shocks.

[4]LVTS stands for Large Value Transfer System.

[5]We define a search band as the interest rate interval within which calculated interest rates qualify as a reasonable interest rate for an unsecured interbank transaction.

3 Methodology applied for Swiss data

As in the latest contribution mentioned above, we expand the algorithm in order to not only identify day-to-day transactions (overnight, Tom-Next and Spot-Next)[6], but also longer maturities (up to twelve months). The algorithm was written in MATLAB.

The algorithm starts by searching large (at least CHF 500,000) and round (integer steps of CHF 100,000) payments flowing from bank A to B. Subsequently, the algorithm searches for payments which flow back from bank B to A. For overnight transactions, for example, the reverse payment would need to take place on the subsequent working day. If there is a payment flowing back, we calculate the interest rate by using the value on the purchase day and the value on the repurchase day. If this interest rate is reasonable, or in other words, if it is within a certain search band, an overnight transaction is identified.

3.1 Methodology in detail

The first step is by filtering the dataset to include only payments with values higher than or equal CHF 500,000 and payments that are marked as bank-to-bank payment[7]. Furthermore, all payments from or to Continued Link Settlement (CLS) and SNB accounts are excluded. In addition payments stemming from SECOM, the Swiss security settlement system, as well as repo transactions were canceled out. To each remaining payment a unique payment number was then attached.

In order to identify not only day-to-day transactions but also transactions with a longer term (1W, 2W, 3W, 1M, 2M, 3M, 6M, 9M, and 12M) we replicate a trading calendar. We can thereby identify for each maturity the purchase and the corresponding repurchase date. We did not consider transactions with non-standardized terms.

At first, the algorithm starts with the search for day-to-day transactions. If day-to-day transactions are found, the respective two payments, one for the purchase date and one for the repurchase date, are blocked. As soon as the whole dataset is analyzed for one maturity, the dataset is analyzed for the next longer maturity. By beginning with shorter terms we account for the higher activity in shorter terms and in turn also reduce the probabilities of over-identifying longer terms (see below discussion on potential

[6]Tom-Next and Spot-Next stand for transactions with a maturity of one day. In contrast to overnight transactions, the value date for Tom-Next (Spot-Next) transactions is one (two) working day(s) after conclusion of the transaction.

[7]In the SIC system both large value and retail payments are settled. In order to identify bank-to-bank payments they are earmarked with a corresponding message type. Therefore we are able to identify such payments unambiguously.

drawbacks). Within the day-to-day segment, one can distinguish between overnight, Tom-Next and Spot-Next transactions. In contrast to overnight transactions, the value date for Tom-Next (Spot-Next) transactions is one (two) working day(s) after conclusion of the transaction. With the payment system data at hand we have the information on the entry date as well as the value of the transaction. Hence, we are able distinguish between the three day-to-day maturities. As banks do not need to enter a Spot-Next or Tom-Next transaction necessarily on the date it had been concluded, there is a potential of categorizing a Spot-Next and Tom-Next transaction as an overnight transaction. Therefore, we subsequently refer to all three types of transactions as day-to-day transactions.

Subsequently for every day of the dataset, the algorithm calculates interest rates between payments with round numbers (initial payments) and the specific payments on the repurchase date. Only payments which flow between the same two banks are considered. In case there are several repurchase payments for the same initial payment, we use the repurchase payment with the smallest difference between the calculated interest rate and the respective Libor rate. If the calculated interest rate is within a search band, we mark the two payments as an unsecured interbank transaction.

The search band is set to 15 basis points above and below the respective Libor rate for the specific working day.[8] In contrast to previous work (see section 2), we define a more narrow search band in order not to overestimate interbank loans.[9] However, in order to account for day-specific volatility, e.g. end of month or last day of the minimum reserve requirement period, the width of the search band is adjusted. On days with a high volatility the width of the search band is a function of the intraday volatility. As a measure for the intraday volatility we use the intraday volatility of the overnight rate on the Swiss franc repo market, as these transactions are reported to the SNB on a daily basis. In total, on around 5% of the days under consideration, the volatility of the overnight repo rate was higher than 15 basis points. On these days each side of the search band for day-to-day transactions was set to the level of the intraday volatility of the repo rate. For all other terms, the search band was only widened if the overnight

[8]The Libor is fixed for 15 maturities ranging from day-to-day to one year on a daily basis. In contrast to other currencies, the day-to-day Libor fixing in the Swiss franc reflects the spot-next maturity (T+2), i.e. the value date is two working days after the business date. For the overnight rate at date T the spot-next Libor fixing at date T-2 was used as reference rate.

[9]To test for stability, we recalculated the dataset with different band widths. By doubling the band, i.e. using 30bp, the average turnover increased roughly by CHF 10 million per term and per day. Overall, this leads to an increase of roughly CHF 100 million. Overnight transactions increased slightly stronger than longer maturities. As wider search bands increase the probability of over-identifying transactions, we decided to set the band width to 15 basis points above and below the respective Libor rate.

volatility was above 30 basis points. On these days each side of the search band was set to half of the level of the overnight volatility. The search band is a fraction of the intraday volatility rather than a multiple, as the intraday volatility of longer-term transactions is smaller than for day-to-day transactions. Overall, the search band for longer-term transactions was widened in less than 1% of the analyzed days.

Payments related to the Swiss franc repo market are also settled via SIC and are known to the SNB. As we are able to identify such payments unambiguously, they can be used to test the algorithm. Tests have shown that the bulk of the payments related to the Swiss franc repo market, namely 90%, could be identified. The matching quote was best for transactions with a maturity longer than one day (day-to-day transactions). Day-to-day transactions are harder to identify due to the high interest rate volatility. Despite the fact that the search band is widened on days with high volatility, the search band cannot cover the entire volatility in day-to-day rates. Consequently, the algorithm under-identified day-to-day repo transactions.

3.2 Potential drawbacks of the methodology

The identification of unsecured interbank transactions using Swiss payment system data has four potential drawbacks, namely (i) the over-identification of longer-term transactions, (ii) the under-identification of day-to-day transactions, (iii) the determination of final beneficiary and originating bank and (iv) the splitting of large payments in SIC.

First, longer-term transactions are more likely to be over-identified than shorter-term transactions. This is due to the increasing size of the interest rate payment with the maturity. While the search band does not increase with the maturity, the interest rate payment increases with the maturity. Hence, a larger interest rate payment leads to more payments within the search band. In order to evaluate the relevance of this potential drawback, we calculate the kernel distribution of the difference between estimated (actual) interest rates and the related Libor rate. A nearly uniform kernel distribution indicates that the algorithm identified interbank payments irrespective of the search band. The kernel graphics for each maturity are in section 6 and in the annex. We find that transactions with a higher maturity than three months show a nearly uniformly distributed kernel. Hence, we excluded identified transactions with a maturity of more than three months from the sample.

Second, the volatility in day-to-day rates in Switzerland is in general higher than for longer-term rates. Among others, the higher volatility results from the fact that the SNB conducts its monetary policy by steering the three-month Libor instead of a day-to-day interest rate. In order to account for the higher volatility the width of the search band is a function

of the intraday volatility. Nevertheless, the widening of the search band does not cover the entire volatility in day-to-day rates. Hence, day-to-day transactions are more likely to be under-identified.

Third, there are still a number of money market players, especially such domiciled abroad, who do not have direct access to SIC. Many of these banks use a correspondent bank (e.g. UBS, Credit Suisse or a cantonal bank) to settle their transactions. Therefore we are not able to identify the final beneficiary and originating bank in all cases.

Fourth, there is a technical issue with respect to SIC payments. Money market transactions in SIC must be split into segments of CHF 100 million each. On the repayment date, interest may be paid back on one segment of the loan only, instead of averaging out the interest payment on all segments. Consequently, payments larger than CHF 100 million might be underestimated and, in addition, could be identified as long-term loans due to the higher interest rate.

4 Dataset

In this paper data from the Swiss payment system (SIC) is used. SIC is the core payment system in Switzerland for settling large value and retail payments. There are over 370 participants, of whom roughly one-third are domiciled outside Switzerland. Another third of the participants are Swiss branches of foreign banks and foreign-controlled banks.

The sample covers all payments settled in SIC from 1 January 2005 to 1 October 2010. Overall, the dataset consist of roughly 2 billion payments. On average 1.3 million payments with a total value of CHF 195 billion were settled per day. The majority of the payments (99%) possess a value of less than CHF 500'000. This mainly stems from the fact that SIC is not only used for bank-to-bank payments but also for retail payments. Excluding all retail payments, transactions stemming from securities settlements (including repo) and CLS payments as well as all transactions with the SNB, 6.1 million payments remain in the dataset. These payments were subsequently used to identify unsecured interbank transactions. Of these potential payments we classified 12.4% as payments resulting from unsecured interbank transactions. In total, we identified 377,916 unsecured interbank transactions. As the dataset also covers the period of financial market turmoil that started in August 2007, we can analyze to what extent the unsecured interbank money market was affected by the loss of confidence. Subsequently we define three periods, (i) the time before the outbreak of the crisis on August 8, 2007, (ii) the phase after the outbreak of the financial crisis until the collapse of Lehman Brothers on September 15, 2008 and (iii) the phase from mid September 2008 to the end of the sample. We divide the crisis

into two different periods, as loss in counterparty confidence considerable increased after the collapse of Lehman Brothers in September 2008.

	day-to-day	**1W**	**2W**	**3W**	**1M**	**2M**	**3M**	**Total**
2005	209	33	8	4	23	9	17	303
2006	200	32	9	4	28	11	19	303
2007	163	27	8	5	27	11	21	262
2008	102	16	6	4	19	9	18	175
2009	72	16	6	3	7	5	9	118
2010	48	11	4	3	5	4	8	83

Table 1: Daily average number of identified transactions

Table 1 shows that the algorithm on average identified 200 unsecured interbank transaction per day. The majority of the transactions (65%) are identified as day-to-day transactions. The 1W to 1M maturity segment accounts for 25% (50 transactions) of identified transactions, whereas 25 transactions on average were classified into the longer maturity segment (2M to 3M). Table 1 further shows that the number of identified transactions decreased substantially after 2007. In 2005, 300 unsecured interbank transactions per day were found on average, whereas in 2009 and 2010 the value lay two-thirds below the 2005 level. In Figure 1 we see that roughly 5% of SIC turnover can be ascribed to unsecured interbank transactions. This share gradually decreased from August 8, 2008. Starting from September 2008 the share lay below 2% of the total SIC turnover. This is due to the fact that daily turnover in the unsecured Swiss franc money market declined whereas the activity in SIC remained stable.

Figure 1: Share of unsecured interbank transactions of SIC turnover

In Figure 2 we see that the majority of identified transactions possess a

size of CHF 50 or 100 million. Transactions with a size of more than CHF 100 million are seldom concluded.[10] We further evidence that longer-term transactions (2M-3M) in general own a size of less than or equal CHF 50 million, whereas transactions with a maturity between 1W and 1M mainly feature volumes of either CHF 50 or CHF 100 million. Moreover, we find that the size of a transaction is typically concentrated at integers of CHF 5 million (Figure 2). Overall, we can conclude that the average value per transaction decreases with increasing maturity. The average size of a transaction lay at CHF 21 million. For day-to-day transactions it lay at roughly CHF 27 million, whereas the size lay at approximately CHF 22 and 17 million for the 1W-1M and 2M-3M segment, respectively.

As mentioned previously, the algorithm was extended in order to identify interbank transactions with a maturity of up to twelve months. In order to determine the robustness of the methodology we took the difference between estimated (actual) interest rates and the related Libor rate and calculated the Kernel distribution function. A narrow distribution indicates that there is a clustering of prices paid, irrespective of the methodology and search band chosen. If prices are distributed uniformly no clear pattern is identified and estimates are likely to be misleading. In general we find that transactions with a maturity of less than or equal to three months are non-uniformly distributed, whereas transactions with a maturity above three months show a nearly uniformly distributed kernel (see Figures in annex). Transactions with a maturity of more than three months are thus likely to be misleading and therefore not further outlined.[11]

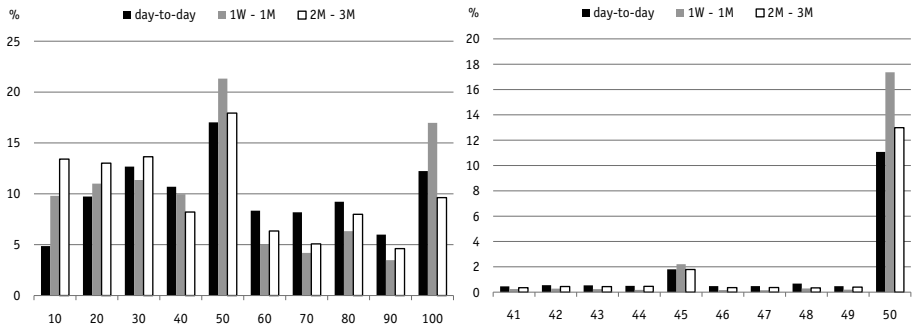

Figure 2: Volume distribution (in CHF billion)

[10]This provides evidence that banks comply with SIC's non-binding recommendation that payments shall not be above a value of CHF 100 million.

[11]A three month interbank transaction can only be identified if the payment as well as the repayment are covered in the data set. The sample covers all payments in SIC from 1 January 2005 to 1 October 2010. As transactions with a maturity of more than three months are not further outlined, transactions can consequently only be identified between 1 April 2005 and 30 June 2010.

5 Developments in the unsecured money market

Turnover and outstanding volume

Before the crisis, daily turnover in the unsecured Swiss franc money market stood at approximately CHF 8 billion (see Figure 3 and Table 2). The day-to-day market segment (overnight, Tom-Next and Spot-Next) accounted for 70% on average, whereas 7% of total turnover can be ascribed to the longer-term segment (2M to 3M).[12]

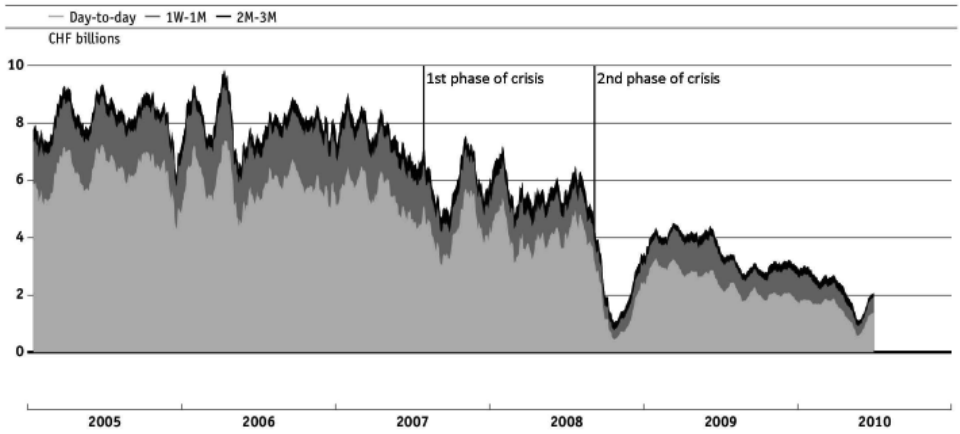

Figure 3: Turnover (20 day moving average)

During the first phase of the crisis (August 2007 to September 2008), we see a reduction in activity to a level of roughly CHF 5 billion. However, estimates show that, after several months, confidence between banks was restored and daily turnover stabilised at CHF 6 billion. The shares of the three market maturity segments remained more or less constant. We can thus conclude that no clear trend towards shorter-term maturities took place.

After the collapse of Lehman Brothers – in other words, at the height of the crisis – loss of confidence led to a freezing-up of the market for several months. During the first two months, daily turnover lay below CHF 2 billion. In mid December 2008 – when the SNB started to provide the banking system with generous amounts of liquidity – activity in the unsecured interbank money market turned up slightly (CHF 3,5 billion). However, by January 2009, total turnover had only reached the CHF 4 billion level. We conclude that both the EURCHF swaps (in concert with the ECB, as well

[12]Note that ON, TN, SN, 1W, 2W, 3W, 1M, 2M and 3M maturities were analysed. In the following, we refer to these maturities when talking of total turnover and total outstanding volume.

as the Polish and Hungarian central banks) and the SNB's longer-term repo transactions (up to one year) restored confidence to some extent and that this gave rise to increased lending activity. However, the pick-up in activity was short-lived. We ascribe the fall-back in activity first, to a low level of interest rates, which made interbank lending unattractive and second, to a more balanced liquidity distribution between banks, which rendered it superfluous. The day-to-day market segment still accounted for 70% of the total turnover on average. Consequently, we do not note a clear shift towards shorter-term maturities in relative terms in either of the sub-periods.

	day-to-day	**1W**	**2W**	**3W**	**1M**	**2M**	**3M**	**Total**
2005	6'281	1'025	169	63	364	137	270	8'309
2006	5'940	1'049	172	88	447	173	273	8'141
2007	4'999	765	160	98	416	165	323	6'926
2008	3'260	397	121	69	333	154	293	4'626
2009	2'447	507	144	72	174	93	160	3'597
2010	1'460	296	83	58	146	92	161	2'296

Table 2: Daily average turnover of identified transactions (in million CHF)

In May 2010 we again evidence a drop in daily turnover to a level below CHF 2 billion. The drop in activity coincides with the increased uncertainty caused by anxiety about Greece's excessive national debt. A proposal of austerity measures and the ratification of the EU/IMF loan package helped restore investor and counterparty confidence. Nevertheless, the volume has not picked-up substantially and stabilized at a level slightly above CHF 2 billion. In May 2010 the level of Swiss franc liquidity resulting from the SNB's foreign exchange interventions increased to CHF 100 billion – substantially above the pre-crisis level of CHF 5 billion.[13] The high level of Swiss franc liquidity led to a more balanced liquidity distribution among market participants making interbank trading superfluous. The more balanced liquidity distribution as well as the fact that the 3-month Libor, for example, reached its all-time low of 7.7 basis points beginning June 2010 – which goes along with a low return – may thus have contributed to the drop and limited resurgence in activity.

The computation of the outstanding volume reveals that approximately CHF 45-50 billion had been lent between banks on an unsecured basis before the collapse of Lehmann Brothers (see Figure 4). Until September 2008, the amount outstanding remained constant and the average time to maturity stood at approximately 30 days.

[13] See SNB (2010), table A1 for a development of the sight deposits.

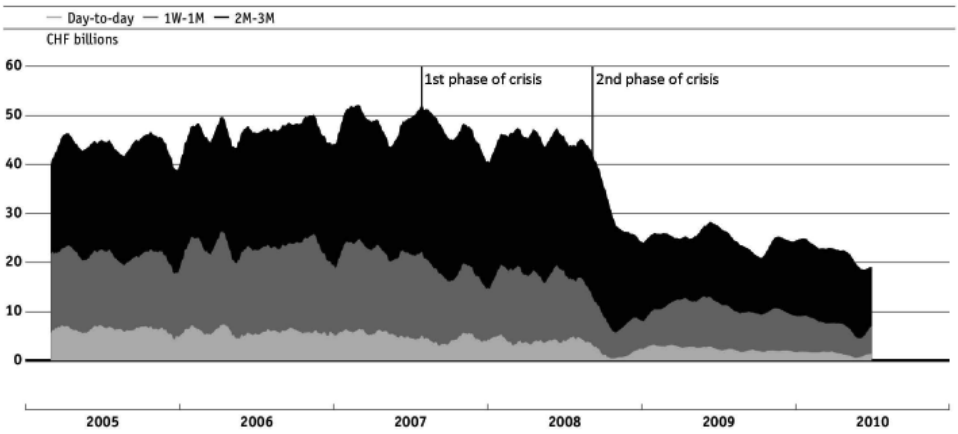

Figure 4: Outstanding volume (20 day moving average)

The drop in turnover after mid September 2008 is also reflected in overall outstanding volume. In April 2009, for example, outstanding volume stood at CHF 25 billion – which was roughly half of the estimated outstanding volume before the crisis. The drop in turnover in May 2010 in turn only had a negligible effect on the outstanding volume (minus CHF 5 billion on average).[14] The average time to maturity decreased only slightly, from 30 days to approximately 25 days. The share of the longer-term maturity segment (2M-3M) remained at roughly 60% of the outstanding volume.

Participants

Depending on their activity in the unsecured interbank money market, participants can be classified into cash providers, cash takers or so-called market makers. A cash provider is a bank, which is traditionally long in Swiss francs and is seeking an investment opportunity. A cash taker is a bank, which is traditionally short in Swiss francs or a third currency and is seeking a refinancing opportunity.[15] Finally, we define market participants to be market makers if they are both cash providers and cash takers. In general, a market maker is defined as a market participant, that provides bid and ask prices for a given maturity. Contrary to this definition, we classify a market participant as market maker if the participant figures as cash taker as well as cash provider irrespective of whether the turnover results from

[14]The outstanding volume only reacts with a lag on a drop in turnover as longer-term remain in the outstanding volume until repayment.

[15]Banks with a refinancing need in euros can, for example, fund euros via a Swiss franc repo transaction and subsequently swap the Swiss francs in to euros via an fx-swap. The willingness to fund euros via Swiss franc repo transactions depends on the repo rate charged relative to direct funding in the euro repo market. See also Kraenzlin/Schlegel (2009).

same-maturity transactions or not.

Before the crisis, the unsecured money market was characterized by a large number of cash providers facing a much smaller number of cash takers (up to 80 active cash providers versus about 30 cash takers). Roughly 60 (10) banks were pure cash providers (cash takers), whereas roughly 20 banks figured as market maker (see Figure 5). The market makers were almost exclusively banks domiciled in Switzerland. In total an average of 90 banks were active per day. The numbers were relatively stable until mid 2007. Estimates show that small and medium-sized market players appear as cash providers disproportionally often and that large market players often borrow money from these banks.

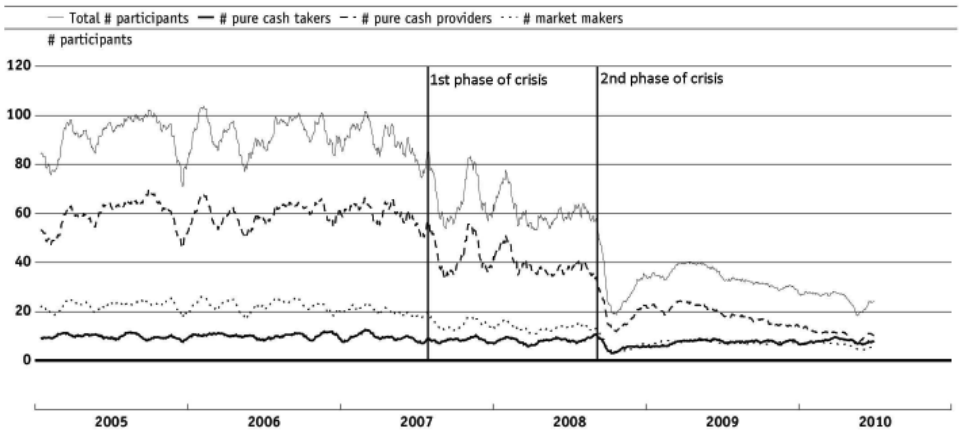

Figure 5: Number of cash takers and cash providers

After mid 2007, the overall number of active participants fell by roughly 40%. Lack of confidence in other market participants' creditworthiness is most likely the main explanation. The lack of confidence – which peaked after Lehmann Brothers collapsed – led to a substantial decline, not only in turnover, but also in the number of active banks. This number plummeted to fewer than 30 in October 2008. Shortly after, the number of active banks per day rose again slightly to 40 banks. However the increase was short-lived and the number of active banks steadily decreased and stabilized at a very low level compared to the situation before the crisis (20 banks). The decline is mainly ascribed to departing cash providers. We take this as evidence that cash providers refrained from lending out money on an unsecured basis either because of increased risk perception and/or low returns of lending resulting from a low interest rate level. The drop in supply led to excess demand for Swiss francs in the unsecured money market, which eventually led to an increase in market rates in mid October 2008.[16]

[16]Cf. Auer/Kraenzlin (2009) for a discussion on measures taken by the SNB to overcome

We also evidence that the number of active market makers dropped from 20 to five banks after August 2007. The decline can be ascribed to various factors: Firstly, banks aimed at reducing the size of their balance sheets (deleveraging). In Switzerland, the netting of open interbank transactions can only be effected under certain circumstances.[17] The reduced netting possibilities induced market participants to withdraw from market making. Secondly, the SNB lowered the target level of the three-month Libor from 2.75% to 0.25% within two months. The low level of the interest rate, the flat interest rate curve as well as expectations of an extended period of low interest rates rendered term transformation redundant. Thirdly, many banks had to cut back their counterparty credit limits, limiting the scope of term transformation.

Figure 6: Number of participants by domicile

Finally Figure 6 demonstrates that only few banks domiciled outside Switzerland are active in the unsecured interbank money market. Interestingly, the number of banks domiciled abroad remained relatively stable throughout the period of observation. The small number of borrowers, the fact that large market players often borrow money and only few banks outside Switzerland participate in the unsecured money market may result from correspondent banking. Acting as correspondent banks, large market players receive Swiss francs on behalf of a third bank. These third banks are mainly domiciled abroad and borrow Swiss francs.

tension in Swiss franc market interest rates.

[17] According to Art. 9 of the Guidelines on Accounting Standards (published by the Swiss Financial Market Supervisory Authority, FINMA) netting on claims and liabilities is only permitted if the underlying transactions are of the same type and denominated in the same currency, and are concluded between the same counterparties, and if the maturity date of the claims is before or equal to that of the liabilities.

Net borrowing and lending

Participants on the unsecured interbank money market can be analysed in terms of whether they are net cash providers or cash takers over one business day. A bank is a net cash taker (provider) if it borrows more (less) money than it lends. Figure 7 reveals that the group "big banks and Raiffeisen banks", are net cash takers, while the others are cash providers on average. Before the crisis, for example, all cantonal banks together lent roughly CHF 1.4 billion but borrowed only CHF 650 million, therefore they were net cash providers, at CHF 750 million. The group "big banks and Raiffeisen banks" appear as net cash takers, among others, as they act as correspondent banks for a large number of banks domiciled abroad. Interestingly, banks domiciled abroad are net cash providers. This stands in contrast to the secured interbank money market, where banks domiciled abroad are almost exclusively cash takers (see Kraenzlin/von Scarpatetti (2010)). The discrepancy can be explained by the fact that banks domiciled abroad can clear via correspondent banks in the unsecured money market, whereas this is not possible in the Swiss franc repo market.[18] Hence the so-called cross-border segment for the unsecured money market cannot be identified accurately. Furthermore, the few banks domiciled abroad – which are direct clearer – are mainly located in countries with high fiduciary investments and hence seek for a short-term investment opportunity of excess Swiss franc balances.[19] This presumption is supported by the fact that approximately 88% of their lending has a maturity of less than or equal one week. Consequently these banks figure as net cash providers in the very short-term maturity segment of the unsecured interbank money market.

During the period of observation, most individual bank categories remained on the same side, i.e. they remained either net cash takers or net cash providers. However, at the end of the second phase of the crisis, the group "big banks and Raiffeisen banks" switched to the net lender side, while the cantonal banks switched to the net borrower side. This may be ascribed to the fact that several banks domiciled abroad switched their correspondent bank functions for receiving Swiss francs to the cantonal banks. Also, the importance of the various cash providers changed substantially throughout the period examined. According to our estimates, the 'other banks' category (mostly banks in Liechtenstein) and the cantonal banks advanced to major net cash providers during the first phase of the crisis. While the 'other banks' still played an important role on the cash providing side in the second phase, the cantonal banks became the predominant cash taker. Interestingly, stock exchange banks and later on also foreign banks (domiciled in Switzerland), scaled back their activity.

[18] In December 2009, for example, 25 banks domiciled abroad were active on the Swiss franc repo market.

[19] See SNB (2009), Table 38 on data regarding fiduciary business by country.

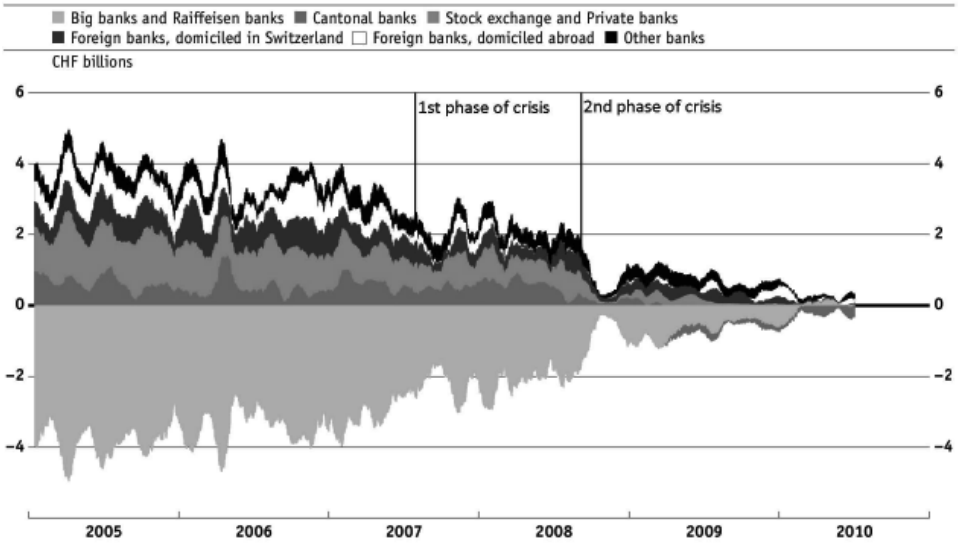

Figure 7: Net borrowing and lending (20 day moving average)

6 Do Libor rates correspond to prices paid?

The panel for the Swiss franc Libor comprises 12 banks, including Credit Suisse and UBS. The Libor is computed as a trimmed mean of the rates contributed, where only the middle two quartiles are considered in calculating the Libor. In March 2008, Libor panel banks were accused of talking up their creditworthiness by reporting lower rates than what they actually had to pay in order to avoid negative signals about their refinancing conditions.[20] In the following we investigate the representativeness of the Swiss franc Libor rate based on the kernel distribution function for the day-to-day, 1W and 3M maturity. The kernel distribution function is estimated for the difference between actual prices paid and the respective Libor fixing. The distribution indicates whether there is a clear concentration of prices paid and if these prices, on average, were above or below the Libor fixing. Figures 8, 9 and 10 plot the Kernel distribution functions for the three maturities and for the three phases. The estimated kernel distribution functions for the remaining maturities can be found in the annex.

[20] According to the economics literature (Schlegel (2009)), a bank's reluctance to contribute above average (i.e. the effective Libor rate) is probably non-linear, i.e. a rate slightly above average is perceived as much less unpleasant than a rate far above average. Cf. also Millard/Polenghi (2004)) and Tett(2008).

Day-to-day maturity

For the day-to-day segment the distribution of the spreads between actual interest rates and the related Libor shows that – irrespective of the width of the interest rate band – three-quarters of transactions lie within the band of -10 to +10 basis points from Libor. For the period before the crisis the kernel distribution is skewed to the right and shows a high concentration at a level of -5 basis points. This indicates that before the crisis the majority of the banks in general paid 5 basis points below the Libor fixing. During the first phase of the crisis we see that the distribution function has become slightly more skewed to the right peaking at a level of -10 basis points. Interestingly the Kernel distribution does not continuously decrease but rises again at integer intervals of five basis points (i.e. at -5, 0, 5 and 10 basis points). This indicates that, in general, a cash provider distinguished between the cash taker's creditworthiness and accordingly adjusted the interest rate. After the collapse of Lehman brothers we find that the distribution function is no longer skewed to the right, but rather equally distributed around zero. This in turn, shows that the majority of the banks were no longer able to refinance themselves below the Libor fixing. Furthermore, the revolving peak pattern has disappeared. This does not mean that no systematic price differentiation had been undertaken with respect to the cash taker's creditworthiness, but rather that the range of 'successful' cash takers became narrower or that the low level of interest rates hampered a systematic price differentiation. A narrower range of cash takers in turn implies a smaller heterogeneity in creditworthiness and hence a smaller price differentiation.

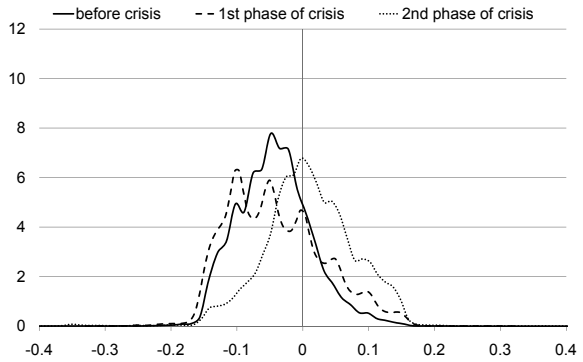

Figure 8: Kernel distribution: day-to-day transactions

1W maturity

For the period before the crisis the kernel distribution in the 1W maturity is skewed to the right and shows a very high concentration at a level of

-7.5 basis points. This concentration is highest for all maturities under consideration (see annex). This indicates that before the crisis the majority of the banks in general paid roughly 8 basis points below the 1W Libor fixing. During the first phase of the crisis we see that the distribution function has become 'flatter' and is slightly more skewed to the right peaking at a level of -11 basis points. Hence during the first phase we find evidence that several banks were able to refinance themselves at lower prices – compared to the respective Libor rate – than before August 8, 2008. However, the 'flatter' distribution and the second peak at the Libor level demonstrates that cash providers are likely to have differentiated between cash takers, in other words, not all banks were able to refinance themselves at interest rates below Libor. Furthermore the 'flatter' distribution indicates a higher volatility in prices paid due to increased uncertainties during the crisis. After the collapse of Lehman brothers we find that the distribution function is no longer skewed to the right, but rather equally distributed around zero. This in turn, shows that the majority of the banks were no longer able to refinance themselves below the Libor fixing.

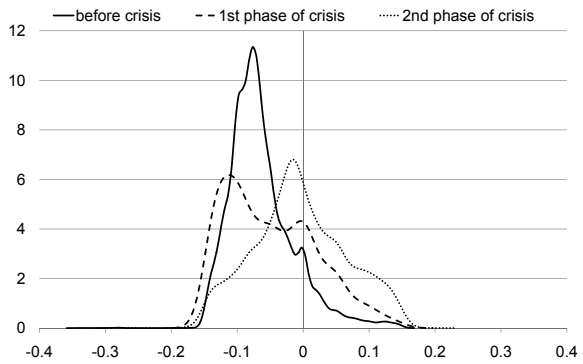

Figure 9: Kernel distribution: 1W transactions

3M maturity

Before the crisis the kernel distribution for the 3M maturity is skewed to the right. On average, banks paid one basis point below the three-month Libor fixing. Compared to the other maturities the peak is nearest to zero, which means that the prices paid for unsecured interbank transactions were concluded nearest to the Libor fixing. Since the start of the crisis we observe a slight increase in prices and in the volatility of the spread, leading to a 'flatter' distribution function. We find two bulks, one at a level of ten basis points and the other at one basis point below the three-month Libor fixing, indicating a segmentation into a more and a less creditworthy cash taker group. Starting from the collapse of Lehman Brothers, the kernel

distribution is more evenly distributed around zero. On a number of days, the difference to Libor amounted to as much as 20 basis points. The more uniform distribution may be taken as indication that the algorithm identified interbank payments irrespective of the search band and hence over-identified 3M transactions. In addition this more uniform distribution indicates a higher volatility in prices paid due to increased uncertainties during the crisis. However, after the collapse of Lehman Brothers the three-month Libor rate fell below 15 basis points, limiting the search band on the lower side with the zero lower bound. The search band was limited by the zero lower bound in 42 cases. This, on the contrary, counteracts the potential drawback of over-identification. In general, one needs to bear in mind that the kernel distribution for the 3M maturity for the period after the collapse of Lehman Brothers is based on fewer transactions, hampering the validity of the distribution function.

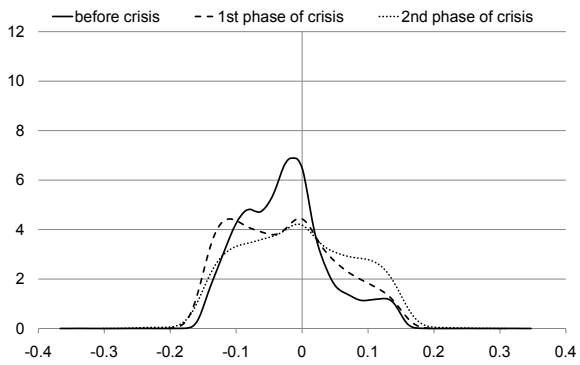

Figure 10: Kernel distribution: 3M transactions

Overall, our estimates for the interbank data show that prices paid are not uniformly distributed. This provides evidence that the identified prices are representative. Further, we find that before the crisis the level of interest rate paid was about five to ten basis points below the corresponding Libor. During the first phase of the crisis the level shifted even farther below Libor, whereas after the collapse of Lehman Brothers it moved towards the Libor. However, the average interest rates paid seldom reached a level above Libor. Therefore, we can conclude that throughout the crisis the Libor fixings, including the three-month Libor, adequately reflected conditions on the unsecured money market. Accusations that banks talked up their creditworthiness by reporting lower rates than what they actually had to pay, in order to avoid negative signals about their refinancing conditions, can be refuted on the basis of the data to hand.

7 Comparison to secured Swiss franc money market

Day-to-day interbank transactions are mainly used by banks to balance short-term liquidity fluctuations. Due to their short-term nature, these transactions play a subordinate role in the refinancing of loans to non-banks. In contrast to longer-term maturities, counterparty credit risk considerations play an inferior role in determining the interest rate.

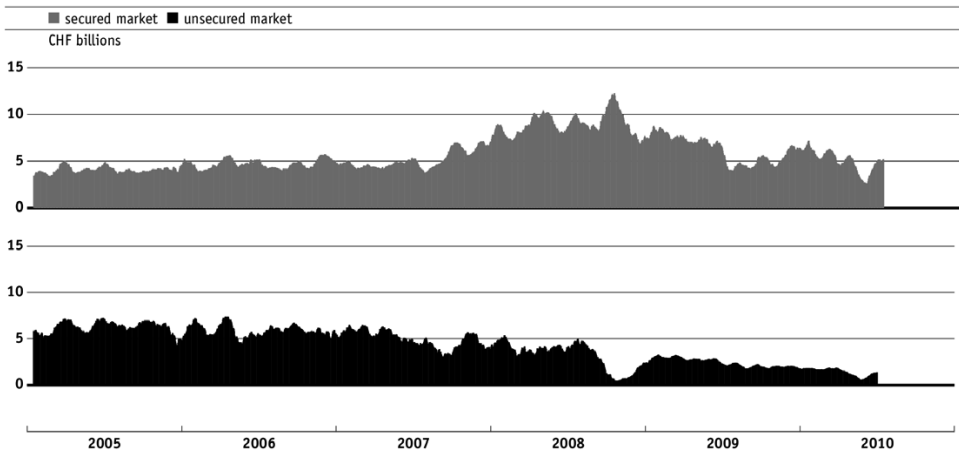

Figure 11: Secured versus unsecured money market

In general, turnover in the day-to-day market segment is the highest of all maturities. This applies for the unsecured money market (70%) as well as for the repo market (77%). Estimates show that the unsecured money market reached an average turnover of roughly CHF 6 billion compared to CHF 4 billion in the repo market (see Figure 11). Already in the first phase of the crisis, we observed diametrically opposite developments in the two money market segments. Average turnover in the unsecured money market fluctuated below the CHF 5 billion line, whereas it increased steadily in the repo market. This divergence was most pronounced at the height of the crisis in September 2008: a real boom in the repo market, while turnover in the unsecured money market plummeted to roughly CHF 600 million.

Thereafter activity also decreased in the repo market, mainly because of the generous liquidity provision by the SNB and the low level of interest rates. Nevertheless we observe that turnover in the day-to-day segment of the repo market stabilised at a level of roughly CHF 5 to 6 billion, which is above the pre-crisis level and more than double the day-to-day turnover in the unsecured money market.

In May 2010 we again evidence a drop in daily turnover in the repo as

well as a in the unsecured money market. The drop in activity coincides with the high level of Swiss franc liquidity resulting from the SNB's foreign exchange interventions (see also discussion in section 5). The increased uncertainty caused by anxiety about Greece's excessive national debt may also have contributed to the decline in turnover on the unsecured money market. As counterparty credit risk considerations play a subordinated role in the repo market this explanation does however not apply for the repo market.

Overall we observe a shift from the unsecured to the secured interbank money market during the crisis. Up to now we find no evidence for a reversal in the relative importance of these two markets. Based on the turnover data we can further assess that the Swiss franc repo market has proven to be a crisis-resistant refinancing source (see Kraenzlin/von Scarpatetti (2010) for a detailed discussion on the resilience of the Swiss franc repo market during the financial crisis).

8 Conclusion

To date, the SNB has lacked evidence on developments in the unsecured interbank money market. Data from the Swiss RTGS system, however, give the opportunity not only to estimate volume in the unsecured interbank money market but also to test whether the three-month Swiss franc Libor – which serves as the operational target for the SNB – represents the actual market rate or not.

Estimates show that, before the crisis, daily turnover in the unsecured Swiss franc money market (ON to 3M) stood at approximately CHF 8 billion. During the first phase of the crisis, we see a reduction in activity to a level of roughly CHF 6 billion. After the collapse of Lehman Brothers – in other words, at the height of the crisis – loss of confidence led to a freezing-up of the market for several months and a decrease in daily turnover to less than CHF 2 billion. The drop in turnover after mid September 2008 is also reflected in the overall outstanding volume. However, we do not observe a clear shift towards shorter-term maturities in relative terms in either of the sub-periods. The decline in market activity was mainly due to departing counterparties. In addition, we observe a shift from the unsecured to the secured interbank money market during the crisis. We take this as evidence that cash providers refrained from lending out money on an unsecured basis mainly because of increased risk perception and less to low returns of lending resulting from a low interest rate level.

Estimates also show that, throughout the crisis, the Libor rates and hence also the three-month Libor adequately reflected conditions on the unsecured money market. Accusations that banks talked up their credit-

worthiness by reporting lower rates than what they actually had to pay, in order to avoid negative signals about their refinancing conditions, can be refuted on the basis of the data to hand.

With the data at hand, future research can be done in order to evaluate, for example, the network efficiency of the unsecured interbank money market, the robustness of bank relationships during the financial crisis and if certain market participants had been systematically avoided. Furthermore with the data, the representativeness of the Libor rates can be tested, by comparing the rates the Libor panel banks contributed with the rates that they ultimately paid for unsecured interbank loans.

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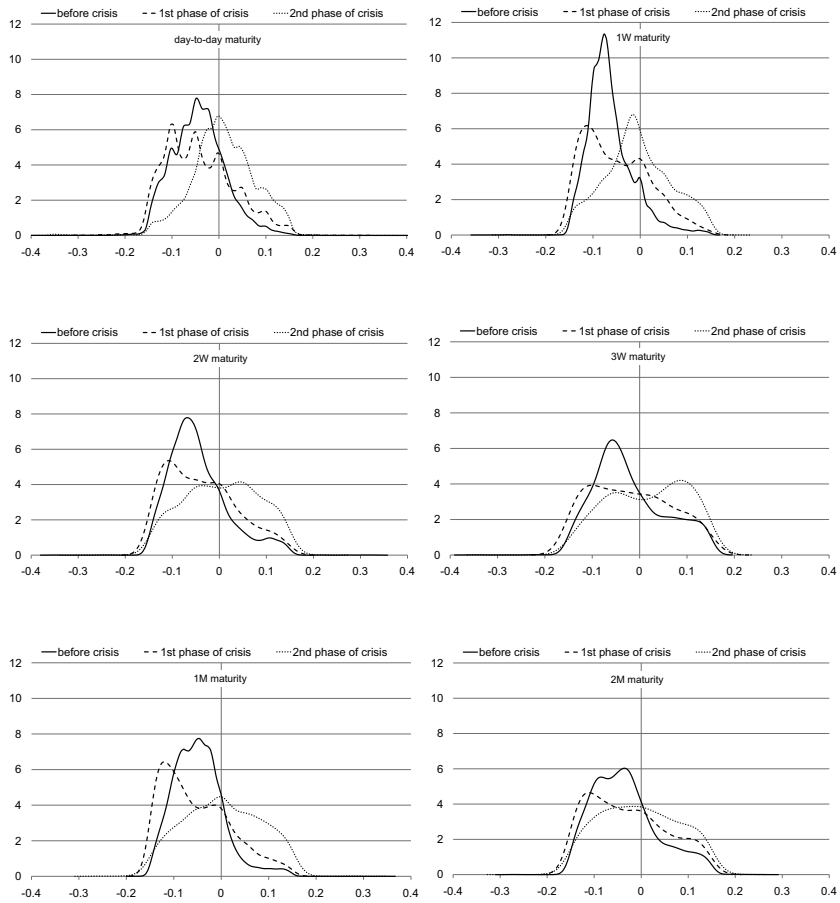
Annex


before crisis
1st phase of crisis
2nd phase of crisis
day-to-day maturity
1W maturity
2W maturity
3W maturity
1M maturity
2M maturity

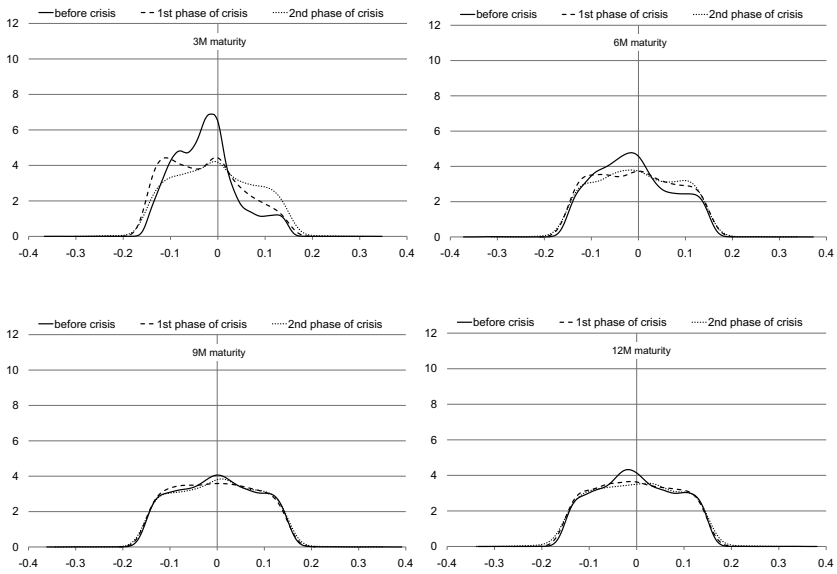


Figure 12: Kernel distributions

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