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THE FED'S DISCOUNT WINDOW: AN OVERVIEW OF RECENT DATA[®]

Felix P. Ackon

Huberto M. Ennis

Research Department

Federal Reserve Bank of Richmond

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ABSTRACT

From July 2010 until June 2015, the Federal Reserve made over 16,000 loans to financial institutions through the discount window. Recent regulations mandate the release of detailed information about individual loans two years after their occurrence. We study the newly available loan data and uncover the main patterns that broadly describe activity at the Fed's discount window in recent years.

I. INTRODUCTION

The Dodd-Frank Act of 2010 requires the Federal Reserve to publish data on discount-window transactions with approximately two years' delay, starting from the passage of the Act in July 2010. The availability of this data provides an opportunity, for policymakers and researchers alike, to get a more detailed perspective on the nature of lending in this important and traditional central bank credit facility.

The Fed provides credit through the discount window using three different programs: primary credit, secondary credit, and seasonal credit. Primary credit and secondary credit are emergency credit programs. These programs constitute a back-up source of short-term funding for eligible financial institutions. Seasonal credit is aimed at smaller institutions with a predictable (and demonstrable) seasonal pattern in their funding needs. Each loan must be secured by collateral from the borrowing institution.

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The primary credit program is a standing facility in which depository institutions in good financial conditions (in the form of a high score on their examination rating) can access (mainly) overnight funding with “no questions asked” and at an interest rate higher than the target policy short-term rate. Those institutions not eligible for primary credit can receive secondary credit.

Normally, secondary credit is offered at a rate that is 50 basis points above the primary credit rate. Furthermore, secondary credit loans are subject to an extra degree of scrutiny (by the Fed) and cannot be used for certain purposes, such as interest rate arbitrage.

To receive seasonal credit, a financial institution must have a demonstrated seasonal need for funding and an approved seasonal line of credit with its corresponding Reserve Bank. The interest rate is a floating rate that is calculated based on the average of some selected rates in the money market – it is not intended to be a penalty rate such as the others (the interest rates at the primary and secondary credit programs). A bank that is able to receive seasonal credit can also tap the primary credit program if the need arises and the bank is in sound financial condition.

There is an extensive theoretical literature exploring issues related to the provision of discount window credit by a central bank (see Ennis [2016] for a recent review). However, the empirical literature is much more scant.¹ One obvious reason for this situation is that, over the years, disaggregated data on discount-window activity has not been made available to the public or researchers on a regular basis. There are (potentially) good reasons for this lack of transparency: central banks are often concerned about the possibility that some degree of stigma is associated with accessing the discount window (for a discussion of this issue see, for example, Courtois and Ennis [2010]). By keeping loan information private, central banks seek to minimize the incidence of stigma.

On the other hand, more information is a constant demand from stakeholders looking to oversee the central bank’s activities. The desire for more transparency was duly recognized in the Dodd-Frank Act and, as a result, a detailed description of the Fed’s discount-window actions is now easily accessible on the internet with a two-year lag, approximately. We take advantage of the new data availability in this paper and provide an overview of the main patterns identifiable in such data so far.

The paper is organized as follows. In the next section, we discuss the data used as well as some preliminary statistics. In Section III, we present information about primary credit loans. In Section IV, we study secondary credit loans, and in Section V, seasonal credit. Section VI provides an analysis of the collateral pledged by borrowing banks to their corresponding Reserve Banks. Finally, Section VII concludes.

II. THE DATA

Our data is a comprehensive list of discount window loans made by Federal Reserve Banks between July 22, 2010 and June 30, 2015. The Federal Reserve releases the information on a quarterly basis, with

¹ There is some empirical work on emergency lending by government institutions in the U.S. The early work by Furfine (2003), for example, uses data on market transactions and interest rates and compares that information with the interest rate and volume at the Fed’s discount window to infer the attitudes of market participants toward central bank liquidity provision. More recently, several studies have used data on the Term Auction Facility to study different aspects of how emergency credit provision worked during the recent financial crisis (see, for example, Benmelech [2012, Berger et al. [2015], and Armantier et al. [2015]). From a historical perspective, Anbil (2015) and Vossmeier (2016) study borrowing from the Reconstruction Finance Corporation during the Great Depression. Finally, for a detailed study of the European experience during the recent crisis see Drechsler et al. (2016).

approximately a two-year lag. The data for the second quarter of 2015 is the last data release at the time of this writing.

There are 16,514 individual loan observations. In some cases, an observation is the result of the consolidation of several loans granted to the same borrower on the same day with the same term to maturity. Furthermore, some loans in the sample are the consequence of a bank rolling over a previous loan. In those cases, loans are counted separately (i.e., a loan taken for one day and rolled over for a second day counts as two independent loans if at origination each of the loans was granted as an overnight loan).

For each loan, the data include: the date that the loan was granted, the term to maturity, the date that the loan was repaid, the name and location of the borrower and the Reserve Bank playing the role of lender, the type of credit (primary, secondary or seasonal), the interest rate and loan amount, whether the bank had other loans outstanding and a description of the collateral pledged by the borrowing bank.

Because the target policy rate (or range) did not change during the sample period, all primary credit loans in the sample were granted at the same interest rate of 0.75 percent and all secondary credit loans but one, were granted at the interest rate of 1.25 percent (see Section IV for a detail discussion of the exceptional loan).

Many of the loans in the sample are likely to be “test” loans. These are loans that depository institutions take in order to test whether the systems involved in processing a discount window loan are working as expected. Test loans are generally for a very small amount: one thousand dollars is probably the most common amount, but most of the ten-thousand-dollar loans in our sample are likely to also be tests, and a few loans of larger amounts may also be tests.

Unfortunately, the data available does not include information about whether a given loan is a test or not. There are a lot of one-thousand-dollar loans in the data: 27% of the primary credit loans in the data are one thousand dollars or less. For secondary credit loans, the percentage of loans with amounts at or below one thousand dollars is much higher, 82%. If we take an even more conservative approach and consider test loans as all loans for amounts equal to or less than \$10 thousand in order to identify actual credit events, then we can see from Table 1 that about a third of the loans were in that category.

Table 1. Discount Window Lending – Totals

	Total Number of loans	Total number of loans ≤ \$10,000	Total amount lent (\$mm)
All	16514	5277	36124.977
Primary credit	11429	4655	26286.218
Secondary credit	650	611	118.976
Seasonal credit	4435	11	9719.781

Note: We use all the data in our sample for these calculations. In a few cases, a given loan entry is composed of multiple loans to the same institution with the same term but, possibly, different amounts, which are consolidated in one entry for the purpose of reporting.

Table 1 also reports the number of loans granted under the different programs. Two thirds of the loans were granted under the primary credit program. Interestingly, there seem to be a lot less test loans happening in the seasonal credit program. Using our threshold for test loans (amounts less than or equal to \$10 thousand), we calculate that the number of non-test loans in the primary credit and seasonal credit programs is comparable. In contrast, the number of secondary-credit non-test loans is much less (around forty).

The total amount lent, instead, is much higher in the primary credit program. For calculating the total amounts lent, excluding the test loans does not make much of a difference. For example, the total value of all primary-credit loans with a face value equal to or below \$10 thousand is approximately \$18 million, which is much less than one percent of the total amount lent (\$26.3 billion, as reported in the third column of Table 1). It seems clear from these numbers, then, that the primary credit program is the more active and significant lending program operated by the Fed's discount window.

Table 2. Loan size, excluding “tests” – Basic statistics

	Number of loans	Total amount lent (\$mm)	Average size of loans (\$mm)	Median size of loans (\$mm)	Maximum loan size (\$mm)
All	11237	36105.762	3.213	1.000	1017.018
Primary credit	6774	26268.305	3.818	1.000	1017.018
Secondary credit	39	117.775	3.020	2.000	17.000
Seasonal credit	4424	9719.681	2.197	1.000	26.000

Note: We define as “tests” all loans of size equal or smaller than 10 thousand dollars. These loans are excluded from the sample used to compute these statistics. In a few cases, a given loan entry is composed of multiple loans to the same institution with the same term but, possibly, different amounts, which are consolidated in one entry for the purpose of reporting.

Since the proportion of test loans is very different across different programs, to get a sense of the size of loans in each program, it is important to take into account the implied composition effect. To this end, Table 2 reports some basic statistics when we exclude from the sample all loans of size \$10 thousand or less. We see in the table that the average size of loans is similar for primary and secondary credit, and relatively smaller for seasonal credit loans. Interestingly, the largest primary credit loan in the sample is several orders of magnitude larger than the largest loans in the other two programs.

Table 3 gives a sense of the evolution over (recent) time of the amount of credit provided through the discount window. We choose to aggregate loans on an annual basis because, as we will discuss later, credit activity exhibits some yearly seasonal patterns.

Table 3. Discount Window Lending over Time
Panel A

Year	Total amount lent (\$mm)				
	All	All, w/o “tests”	Primary credit	Secondary credit	Seasonal credit
2011	6656.703	6653.530	5821.794	50.251	784.659
2012	7859.556	7856.076	6087.402	7.868	1764.286
2013	6176.920	6172.846	3795.127	3.743	2378.050
2014	6849.539	6844.392	3419.413	4.855	3425.271

Panel B

Year	Number of loans							
	All		Primary credit		Secondary credit		Seasonal credit	
	w/ “tests”	w/o “tests”	w/ “test”	w/o “tests”	w/ “tests”	w/o “tests”	w/ “tests”	w/o “tests”
2011	2801	1941	2026	1316	169	21	606	604
2012	3021	2049	2115	1290	150	4	756	755
2013	3491	2390	2326	1357	129	1	1036	1032
2014	3996	2554	2679	1333	98	5	1219	1216

Note: We aggregate at the annual level to compare across time the recent evolution of discount window lending. For these calculations, we do not use the available data for 2010 and 2015 because we do not have full-year information for those years and, as we will see

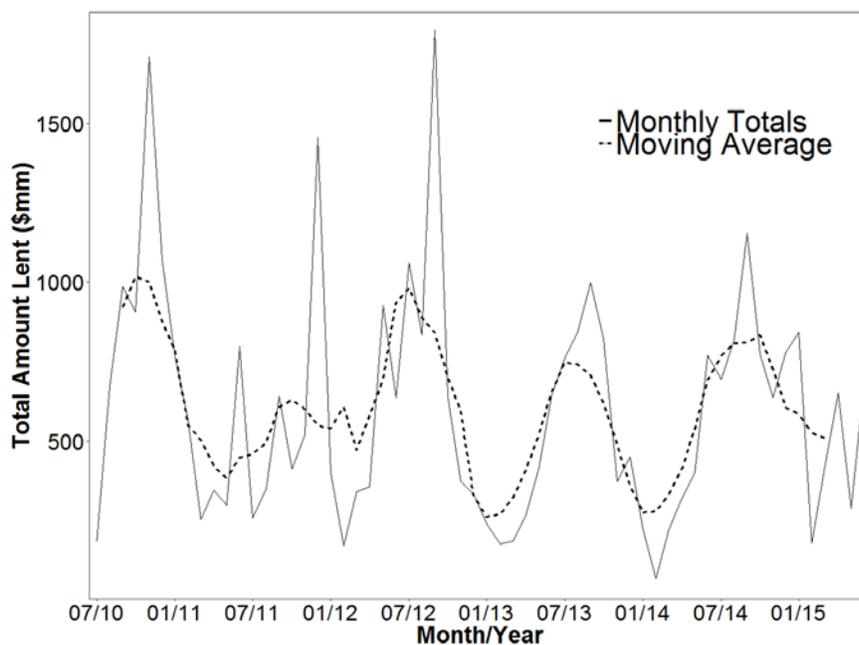
later, the data displays seasonal yearly patterns that can make the comparison of full-year and half-year aggregates misleading. We define as “tests” all loans of size equal or smaller than 10 thousand dollars.

The total amount lent is relatively stable between the years 2011 and 2014 (see Panel A of Table 3).² This relative stability is the combination of two trends: on one side, the amount of lending in the primary credit facility decreased significantly (a 40% drop) after 2012. On the other side, the total amount lent at the seasonal credit facility has been increasing over time.

The total amount lent through the secondary credit facility was relatively large in 2011 but became much smaller in the years after that. It is possible that the repercussions of the financial crisis were still driving banks to borrow secondary credit, as this is the facility available for banks in weaker financial condition. In support of that possibility, note that, for example, the number of “problem banks” in the U.S. (as reported by the FDIC) peaked in 2011 at (around) 900 and since then has been experiencing a steady decline reaching 200 in 2015.

Panel B of Table 3 shows the evolution over time of the total number of loans granted through the different programs. The total number of loans in all three programs is growing over time. This phenomenon is basically explained by two main factors: first, the number of test loans in the primary-credit program has grown over time and more than proportionally (to the total number of loans) in 2014 – note that the number of loans in the primary credit program, net of our measure of the number of test loans, is basically stable over the years at around thirteen hundred loans. The second factor is that the number of seasonal loans has been increasing consistently over the years under consideration.

Figure 1. Total Discount Window Lending



Note: For each month in our sample, we aggregate all loans in that month to generate the monthly series plotted as the solid line. We also compute a symmetric, six-month moving average which is the smoother dashed line.

² Relatively speaking, as a source of funding for banks, the discount window is miniscule during normal times (such as the years covered in our sample). For example, total deposits at FDIC-insured institutions in the last quarter of 2014 were close to \$12 trillion.

Figure 1 plots the monthly total amount lent at the discount window during our sample period. Since the data is volatile, we include in the figure a six-month moving average to highlight any trends present in the data. It is evident in the figure that lending generally increases in the second half of the year. As we will see later, this pattern is present both at the primary-credit and seasonal-credit programs. Aside from those fluctuations, lending seems relatively stable over the five-year period.

Given the fact that now the expectation in financial markets is that information about activity at the discount window will become public after two years of its occurrence, one natural question to ask is whether banks have used the discount window less as a result of this added transparency. To get a sense of this, it would be good to compare the levels of lending during our sample period with lending in previous periods of similar characteristics – mainly, non-crisis periods. While loan-level data is not publicly available for the period before 2007, the Federal Reserve has been publishing for a much longer time the average daily amount of outstanding loans at the discount window in its H.4.1 weekly data release.

Table 4 uses the data from the H.4.1 release to compare the annual average of daily outstanding loans at the three main discount window programs for the period 2003-2007 and for the period 2011-2015. We see in the table that the level of discount window activity is relatively lower in the period after the Dodd-Frank Act. This is consistent with the view that disclosure tends to discourage borrowing. However, other changes in the financial landscape after the crisis may have also contributed to reduce discount window activity. For example, the high levels of interest-paying excess reserves (Ennis and Wolman, 2015) tend to reduce the risk for depository institutions of finding themselves short of funds due to unexpected payment shocks. Similarly, more recently, heighten regulatory focus on balance sheet liquidity might be inducing banks to hold liquidity buffers that can also protect them from unexpected late-in-the-day payment shocks. Presumably, then, these liquidity enhancements make banks less likely to need to tap the discount window as a backup source of funding.

Table 4. Total Discount Window Lending before and after the Crisis

BEFORE THE CRISIS		AFTER THE CRISIS	
Year	Average daily loan amount outstanding (\$mm)	Year	Average daily loan amount outstanding (\$mm)
2003	98.000	2011	62.058
2004	153.038	2012	72.442
2005	199.346	2013	78.654
2006	224.654	2014	117.585
2007	587.788	2015	124.673

Note: The annual number is the average of the daily average number reported for each week of the year in the Federal Reserve H.4.1 Data Release.

A look at more disaggregated data shows (see Table A1 the appendix) that *both* primary credit and seasonal credit have decreased after the crisis –secondary credit is very small (and volatile) in both periods. Interestingly, after a significant decrease during the crisis, seasonal credit seems to be converging back to the numbers that were common in the pre-crisis period. Primary credit, instead, has been consistently smaller and decreasing in time after the crisis (see also Table 3).

Note, finally, in Table 4 that discount window lending increased significantly in 2007. In fact, the corresponding amounts for 2008 and 2009 (see Table A1) are an order of magnitude larger than the numbers in the table (\$32 billion and \$40 billion, respectively), and the second half of 2007 was already showing the sings of that forthcoming increases. These “crisis” numbers put in perspective the levels of lending that occur in “normal” times (as in our sample period), which is not zero but relatively moderate.

Going back to the transactions data, it is also possible to get a sense of the variation in activity across Federal Reserve districts. In Panel A of Table 5 we show the total amount lent by each Reserve Bank over our sample period. The largest lenders in terms of total amount lent are the Federal Reserve Bank of Atlanta, Chicago, and San Francisco. The San Francisco Fed lent mostly through the primary credit program and the Atlanta Fed lent more than half of the total through the seasonal credit program. Indeed, the Atlanta Fed is the largest lender of seasonal credit among all the Reserve Banks, followed by Minneapolis. The other Reserve Banks lent a lot less seasonal credit than the Atlanta and Minneapolis Banks. Based on the information on the number of loans granted, as provided in Panel B, it seems that the Chicago and Minneapolis Reserve Banks grant a lot more loans at the seasonal credit facility than the other banks, and in particular, Atlanta. This, in turn, implies that the average size of the seasonal-credit loans is much smaller in the case of the Chicago than in the case of Atlanta: the first grants a lot of small seasonal loans, and the second, less loans but larger.

Table 5. Discount Window Lending across Federal Reserve Districts

Panel A

District	Total amount lent (\$mm)			
	All	Primary credit	Secondary credit	Seasonal credit
Boston	1656.874	970.536	1.608	684.730
New York	3375.340	3354.844	20.496	0
Philadelphia	1713.236	1678.804	34.432	0
Cleveland	482.539	482.530	0.009	0
Richmond	1550.483	1546.627	3.856	0
Atlanta	5748.636	2176.948	0.244	3571.444
Chicago	4889.066	3892.651	28.196	968.219
St. Louis	2963.001	2105.557	0.420	857.024
Minneapolis	3493.014	1464.924	0.118	2027.972
Kansas City	1761.168	1053.308	0.500	707.360
Dallas	3765.147	3044.297	0	720.850
San Francisco	4726.473	4515.191	29.100	182.182

Panel B

District	Number of loans							
	All		Primary credit		Secondary credit		Seasonal credit	
	w/ "tests"	w/o "tests"	w/ "test"	w/o "tests"	w/ "tests"	w/o "tests"	w/ "tests"	w/o "tests"
Boston	989	542	701	262	10	2	278	278
New York	932	615	909	604	23	11	0	0
Philadelphia	456	284	429	281	27	3	0	0
Cleveland	399	230	390	230	9	0	0	0
Richmond	865	333	825	331	40	2	0	0
Atlanta	1963	1194	1133	608	244	0	586	586
Chicago	3616	2333	2194	1111	202	6	1220	1216
St. Louis	1279	737	871	373	42	0	366	364
Minneapolis	2080	1931	826	715	38	0	1216	1216
Kansas City	1624	1286	1079	745	1	1	544	540
Dallas	645	639	480	474	0	0	165	165
San Francisco	1666	1113	1592	1040	14	14	60	59

Note: There are 12 Federal Reserve districts, each with its corresponding Reserve Bank (which takes the name of the city where it is located). Reserve Banks make loans to institutions headquartered in their district.

Philadelphia, San Francisco and Chicago are the top providers of secondary credit in terms of total amount lent. While the Atlanta Fed provided a large number of secondary credit loans (244), all of them were one thousand dollars and, hence, most likely, test loans. If we restrict the sample to those loans that are greater than \$10 thousand, we see (in the column labeled “Excl. tests”) that San Francisco and New York rank at the top in terms of the number of secondary credit loans granted during the sample period. It should be said, though, that the small sample size makes it particularly hard in this case to draw strong inferences about general patterns.

The largest lender through the primary credit program (in terms of total amount lent) is the San Francisco Fed. The Chicago Fed made the largest number of loans through this program but almost half of them were loans that are very likely to have been test loans (for amounts equal or below \$10 thousand dollars). For most of the Reserve Banks, between a third and a half of the primary credit loans can be safely categorized as test loans.

Perhaps surprisingly, when we restrict the sample to loans greater than \$10 thousand and look at the average size of primary credit loans across districts (not reported in the table), we see that the Dallas Fed is providing the largest loans on average (\$6.4 million), followed by Philadelphia (\$5.9 million) and Saint Louis (\$5.6 million). Only in fourth place comes the New York Fed (with an average loan amount equal to \$5.5 million). In principle, since the highest concentration of large banks is in the New York district, one might have expected that the largest discount-window loans were being originated there. That is not the case in our sample period.

Finally, note (Panel B of Table 5) that there are very few loans of \$10 thousand or less granted by the Dallas Fed (in all three programs). Upon closer inspection of the transactions data, one can see that 264 loans (out of the 645 loans) were for exactly \$100 thousand dollars. This suggests that different Reserve Banks may have different practices when it comes to the size of the loans used for testing, with the Dallas Fed perhaps being a bank that recommends larger test loans than other Feds.

III. PRIMARY CREDIT

In this section, we explore further the main characteristic of loans granted through the primary-credit program. We look at the distribution of loan sizes and maturity terms. We also investigate the extent to which lending displays seasonal patterns and, lastly, whether some banks are more prone than others to tap the primary credit facility (that is, the intensity of use across banks).

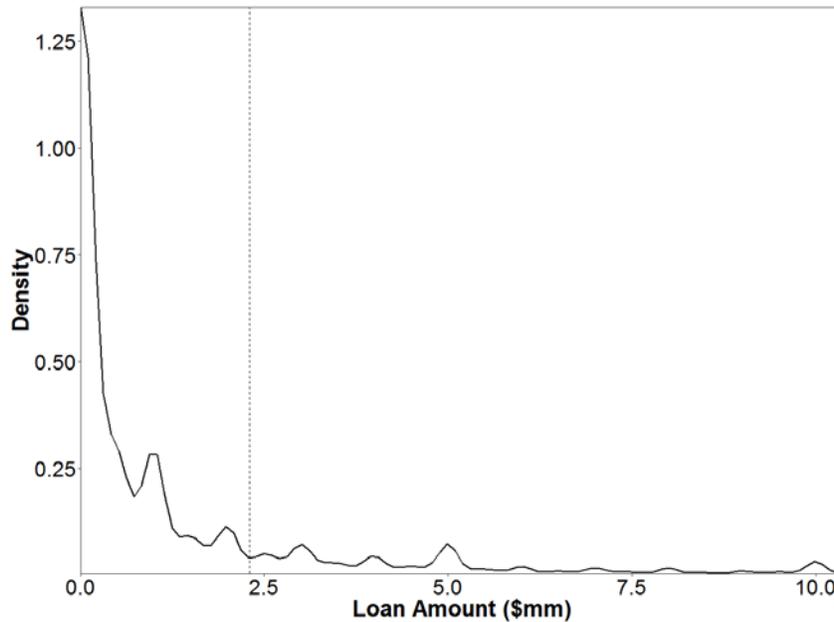
Loan sizes: As was discussed in Section II, the median primary credit loan is much smaller than the average. This is a result of the fact that the largest loans in our sample were granted through the primary credit facility, which also made a significant proportion of relatively small loans. Even when we abstract from the majority of the small test loans, as we did in Table 2, we see that the average size of primary credit loans is four times larger than the median.

Figure 2 plots the distribution of loans sizes for all loans smaller than or equal to \$10 million. It seems clear from the figure that most loans are in the size range that is below \$5 million. In fact, during our sample period, 40 percent of all primary credit loans were ten thousand dollars or less, and more than half were one hundred thousand dollars or less. On the other end of the distribution, 10% of loans were greater than \$5 million.

The distribution of loan sizes in Figure 2 appears to be approximately log-normal (with additional concentration of mass at certain amounts). To shed further light on these patterns, we plot in the appendix (see Figure A1) the distribution of the log size of loan amounts, which should have the shape of a normal distribution if the distribution in Figure 2 were log-normal. While the resulting distribution is relatively symmetric, the figure makes more evident the high concentration of mass around certain specific amounts, such as one, ten, one hundred thousand, and one million dollars. Some of these spikes in the distributions are likely to be explained by the preponderance of small-amount test loans, but there may also be a tendency from banks to borrow round-number amounts.

To gain some perspective on the financial stakes at play when a bank decides to borrow from the primary credit program, we calculate the interest charge on a \$10 million overnight loan at the interest rate relevant for all the primary credit loans in our sample, 75 basis points. The amount charged is approximately two hundred dollars in interest payments per day. Given that almost ninety percent of primary credit loans are overnight loans (see Table 5 below), we can conclude that a significant portion of the activity at the primary credit facility constitutes relatively small loans with no significant interest cost for the borrower.

Figure 2. Distribution of loan sizes. Primary credit



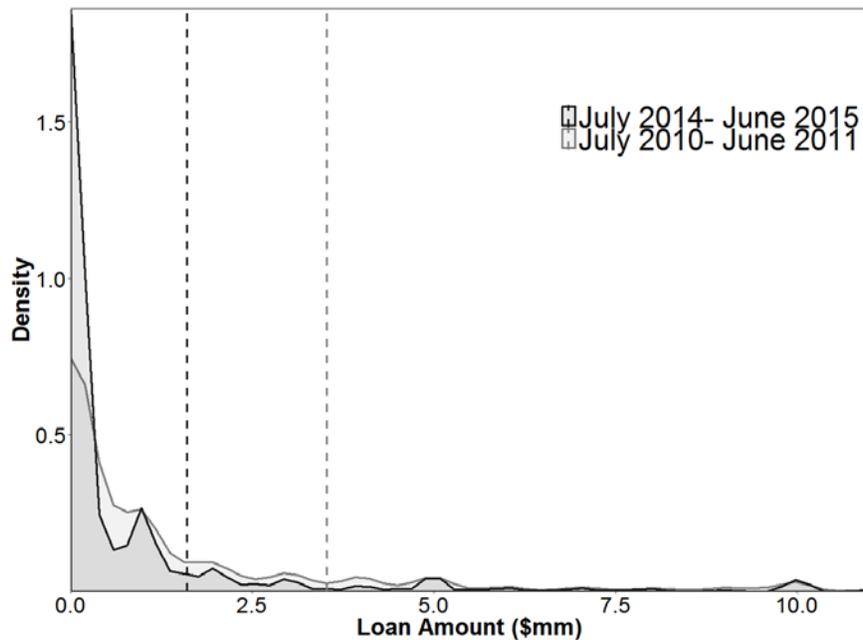
Note: We plot the distribution of loan sizes for loans of amount \$10 million or lower. We omit loans greater than \$10 million from the plot to reduce the length of the right tail. We then scaled the distribution by the proportion of loans less than \$10 million. There are 436 loans that are greater than \$10 million in the sample. The vertical dashed line represents the mean of all loans (\$2.3 million as reported in Table 1).

However, there are also some very large primary credit loans being made in the period under consideration. For example, the largest primary credit loan in the sample was for \$1.02 billion and was granted by the St. Louis Fed on Wednesday, November 24, 2010 to First Tennessee Bank, N. A. The term of the loan was 2 days, which is relatively unusual, as most primary credit loans are overnight. First Tennessee Bank had \$24.5 billion in assets and \$3.2 billion total equity as of December 2010, so the discount window loan was a significant financial transaction for the bank. The second largest primary credit loan in the sample was for \$900 million and was granted by the New York Fed to the New York branch of the Belgian bank KBC on Friday, December 9, 2011. The term of the loan was 3 days and was repaid at maturity, on the following Monday.

Evolution of the distribution over time: As indicated in Table 3, total lending at the primary credit facility was significantly lower towards the end of our sample period, relative to what it was at the beginning of that period. It is also interesting to see that the number of loans increased moderately and, consequently, the mean size of primary credit loans decreased substantially.

Figure 3 plots the distribution of loan sizes for the first 12 months in our sample period (from July 2010 to June 2011) and compares it with the distribution of loan sizes for the last 12 months of that period (from July 2014 to June 2015). This confirms the pattern suggested by Table 3: in the later part of our sample period, the proportion of loans that are small is much higher. Figure A2 in the appendix provides a more complete picture of the evolution of the distribution of loans sizes over time.

Figure 3. Distribution of loan sizes – Evolution over time



Note: We consider the first and the last 12-month period in our data. For the period July 2010-June 2011 we exclude from our density calculations one clear outlier: a loan for (approximately) \$1 billion (which is ten times larger than the second largest loan in this sub-sample). We plot only the portion of the distribution that corresponds to loans of amount \$10 million or less.

During 2010 and 2011, the U.S. banking system was still recovering from the financial crisis. Furthermore, economic turmoil in Europe at the time impacted the financial condition of some banks in the U.S. (recall, for example, that foreign-bank subsidiaries have access to the Fed’s discount window). This may partly explain the elevated levels of primary credit activity during that period and the relatively large size of the average loan. In contrast, by the second half of 2014, the banking system in the U.S. was in much better financial shape, a fact that is likely to have contributed to reducing banks’ demand for emergency credit.

Term to maturity: Primary credit loans are mainly overnight loans. Loans made on a Friday, however, are held for a minimum of 3 days and are charged interest accordingly (that is, for at least three days). Furthermore, in certain specific situations, loans are granted for longer periods of time. While primary credit is provided relatively automatically (“no questions asked”), when banks request loans of a longer maturity than overnight, some extra administrative oversight may occur.

Table 5 provides a description of the maturity profile of primary credit loans in our sample. There are a lot of loans in the 2 to 4 days maturity term. Many of those are associated with holidays and weekends. Of the 962 loans with 3-day maturity term, 955 were granted on a Friday. Similarly, many (but not all) of the 4-day loans involved a weekend, preceded or followed by a holiday. We see in Table 5 that there are a few loans with amount lower than or equal to \$10 thousand and maturity term higher than one day. This may be indicative of the fact that not all loans in that size-range constitute test loans, in the sense that it seems unlikely that a bank would choose a Friday to conduct a test given that the interest cost is higher than when the test is done with an overnight loan.

Table 5. Primary credit loans. Maturity term.

	Term of loan (days)									
	1	2	3	4	5	6	7	8	12	14
Number of loans	10208	110	962	122	5	3	15	2	1	1
Number of “test” loans	4339	26	269	21	0	0	0	0	0	0
Total amount lent (\$mm)	20528.381	1361.845	3566.472	686.669	6.000	27.000	87.850	8.000	10.000	4.000
Avg size of “non-test” loans (\$mm)	2.011	12.380	3.707	5.628	1.200	9.000	5.857	4.000	10.000	4.000

Note: The term of the loans is expressed in days and the quantities are all in millions of dollars. We call “test” loans all loans for amounts less than or equal to \$10 thousand.

The longest maturity term for a primary credit loan in our sample was a 14-day loan granted by the Dallas Fed to First National Bank of Rotan, Texas in January 2015. The loan was for \$4 million, which is about equal to the average amount of all overnight loans greater than \$10 thousand and not much different from many of the other longer-term loans in our sample. Interestingly, the loan was actually paid back early, after nine days.

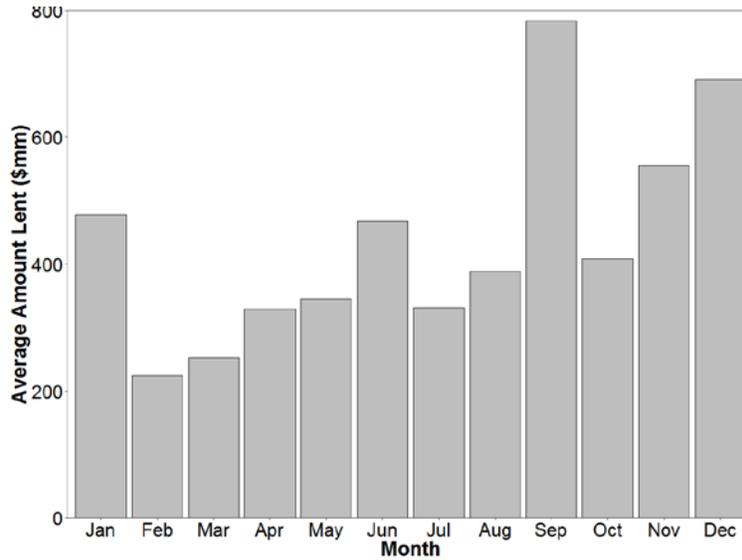
Of the more than ten thousand primary credit loans in our sample, only ten of them were paid before maturity. We provide a list of these loans in the appendix (Table A4). The loans that are paid before maturity tend to be relatively large: the average size is \$4.8 million and all but one of them are larger than \$100 thousand. Their maturity is not concentrated in any particular term and it does not appear to be the case that only the longest maturity loans get repaid earlier.

Seasonality: The average amount lent in each month of the year during our sample period seems to increase as the end of the year approaches. Figure 4 shows that after fairly high levels of total borrowing in January, borrowing slows down in February and only gradually increases as the year progresses.

The high level of lending observed in September is partly driven by an event in September 2012 when a bank in Texas took several loans of a significant amount during that month. This episode is discussed in more detail below.³ Even when we remove the large loans to the Texas bank, the month of September exhibits more lending than August and October. In effect, June, September, and December (end-of-quarter months) seem to be months where lending tends to increase. We confirm this below in Table 6.

³ It is important to realize here that the way these numbers are calculated tend to overweight the importance of short term loans that get rolled over. As an example, if a bank borrows \$100 thousand for two days and another bank takes a loan of \$100 thousand for one day and then another loan of the same amount the following day, the second lending strategy would add up to \$200 thousand of lending, while the first will only count as \$100 thousand toward the total amount lent in that month.

Figure 4. Average total amount lent of primary credit in each month



Note: Each month appears five times in our sample period. For each month, we sum the total amount lent during that month and average that amount among the five corresponding totals. That is, for the month of January we sum all the lending done in January in each of the years in our sample and then take the average over the five month of January in our sample.

Quarterly and monthly frequency: The first row of Table 6 shows how much primary credit lending takes place at the beginning, middle, and end days of the month. The pattern suggests that lending is higher at the beginning and end of the month, and slows down during the days in the middle. A similar pattern arises when we compute the average amount lent in the first, second, and third month of the quarter (second row of Table 6): lending picks up noticeably towards the end of the quarter.

Table 6. Total amount lent at different times of the month and the quarter (\$mm)

	Beginning	Middle	End
Month	136.316	111.110	194.801
Quarter	387.220	378.519	548.571

Note: For the month calculations, we divide the month in three periods of (approximately) ten days each and call the first ten days the beginning of the month, the next ten days the middle of the month and the last ten days the end of the month. For the quarter calculations, the beginning of the quarter is the first month of the quarter, the middle is the second month and the end is the third month. We calculate the total amount lent in each sub-period and we report the average across all the corresponding sub-periods in the sample.

Daily frequency: Table 7 shows the average total number of loans granted in each day of the week during our sample period and the average number of test loans. We see that banks tend to avoid “testing” on Fridays and other special days such as the end of the month, quarter, and year. This makes sense to the extent that, for example, conducting a test on a Friday would be more costly since the loan would be outstanding for two extra days during the weekend.

We also report in Table 7 the total amount lent on average in each of those days (third row) and the average size of loans granted each day and that were greater than \$10 thousand (fourth row). The last three columns report similar statistics for the day that corresponds to the end of a month, a quarter, or a year in our sample period.

Table 7. Total amount lent in a day (average over sample)

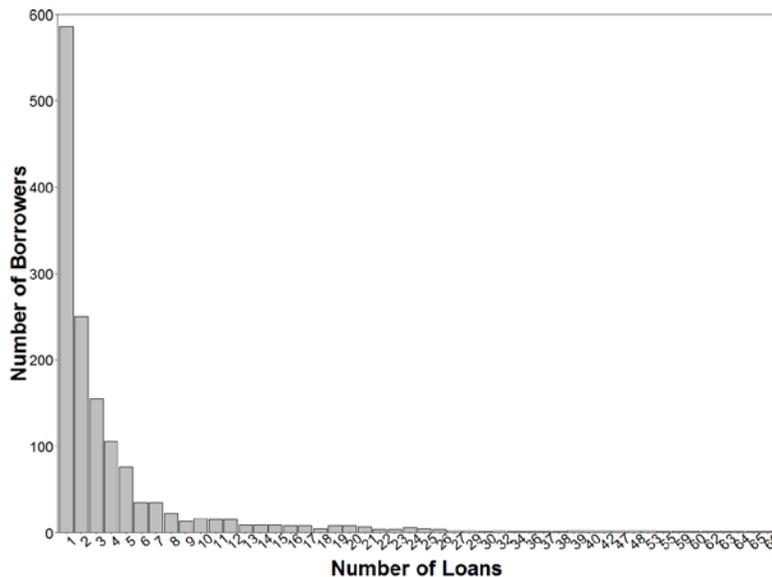
Averages	Monday	Tuesday	Wednesday	Thursday	Friday	End of month	End of quarter	End of year
Number of loans made	11	11	10	10	4	8	9	12
Number of “test” loans	4	4	4	4	1	1	1	0
Daily amount lent (\$mm)	23.773	18.502	26.968	20.444	16.499	42.892	57.493	98.217
Size of non-test loans (\$mm)	3.806	2.851	4.603	3.554	5.392	6.581	7.141	8.184

Note: We identify the number of days of each day-category (Monday, Tuesday, etc.) when the discount window was open during our sample period. We then count the number of loans and the amount lent in each of those days and report the average for each day-category (taking into account, hence, that, for example, most of the holidays – for which the discount window is closed – fall on a Monday). We also compute the average size of the non-test loan made in each day-category, where by “non-test” we mean loans greater than \$10 thousand.

In general, there is less lending happening on regular Fridays but the size of the loans is larger, on average. This could be the consequence of the fact that Friday loans are automatically three-day loans, and hence more expensive. Also, the table shows that there is a lot more lending happening on days that are the end of a month, quarter, or year and the average size of those loans is larger than for other regular weekdays.

Intensity of use: A lot of banks access the primary credit facility during our sample period. Overall, a total of 2758 different banks (identified by the corresponding ABA number) borrowed at least once from the facility. Of these, 1756 of them borrowed at least twice, and some banks borrowed over 60 times in the period of five years included in our sample. Many of these loans are likely to be tests, of course. For these reason, we also look at intensity of use after restricting our sample to loans greater than \$10 thousand.

Figure 5. Histogram of the number of primary credit loans by individual banks



Note: We compute the number of individual non-test transactions (loans greater than \$10 thousand) that each individual bank entered at the primary credit facility and plot the histogram of these numbers; that is, each bar in the histogram denotes the number of banks that borrow n amounts of time from the primary credit facility, with n = 1,2,3... up to 66, which is the maximum number of non-test primary credit loans taken by an individual bank in our sample, during the five-year period under consideration. We identify a bank by its ABA number because it is a more consistent identifier than the bank’s name.

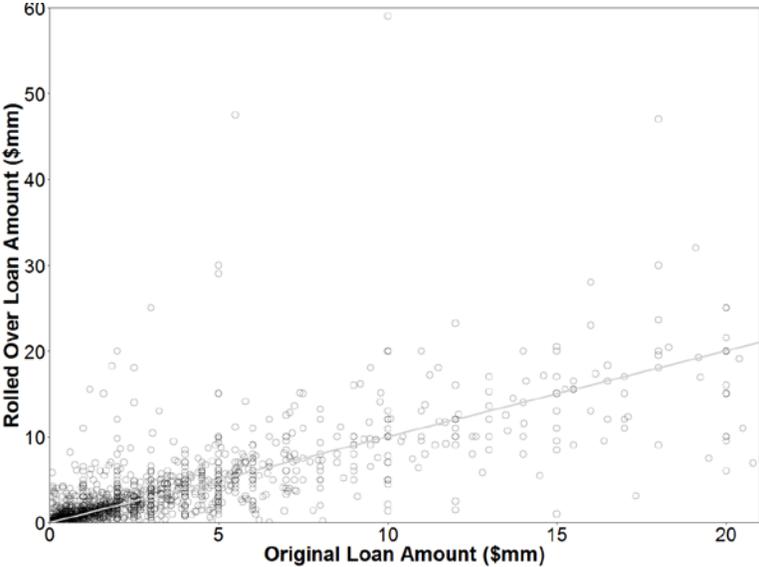
Figure 5 presents the histogram of the number of times that individual banks borrow loans for amounts greater than \$10 thousand from the primary credit facility during our sample period. We see in the figure that almost 600 banks took one “non-test” loan during the period, but there are also 28 banks that took 30 or more “large” (non-test) loans from the discount window primary credit program in the span of five years. In other words, some banks appear to be relatively frequent users of the facility.⁴

In terms of intensity of use of primary credit, one noticeable case is the situation of the Texas Capital Bank, N.A. which in September 2012 borrowed significant amounts overnight for several consecutive days from the Dallas Fed, with balances that were as high as \$250 million (on September 5). Between October 2011 and January 2013, Texas Capital Bank borrowed 19 times from the Dallas Fed, and in ten of those instances the loans were for an amount larger \$100 million (See Table A3 in the appendix for details).

While the calculations used to produce Figure 5 can be informative, they are not able to reveal some particularly relevant details of the lending patterns observed in the data. For example, some institutions may be rolling over a loan for several days with each loan counted as a new loan while, in a sense, the credit event could be considered to be just one. Other institutions, instead, may be “repeat users” in that they periodically take an overnight loan and repay it at maturity. Additionally, some institutions may be repeat users but of loans of a very small amount.

There are, of course, many ways to present information that speaks to these issues. We pursue several ones here. For example, we compute the number of primary credit loans that were the result of a roll-over of a previous loan. There were 1731 loans that were followed by a loan by the same institution in the day that the first loan matured. This amounts to approximately 15% of all primary credit loans in our sample.

Figure 6. Roll-overs in Primary Credit



Note: The solid diagonal line is the 45-degree line. We only consider consecutive loans that were originally for an amount less than or equal to \$20 million.

⁴ Even if we restrict attention to loans greater than \$100 thousand (given that it is possible that some Reserve Banks, such as Dallas, ask for test loans of an amount equal to \$100 thousand), the number of banks that borrowed at least 30 loans greater than \$100 thousand in the space of five years is equal to 26.

Of the loans that were rolled over, only 302 loans were rolled over for the same dollar amount. Figure 6 plots the amount of the original loan and the amount of the subsequent loan (the rolled-over amount) to get a sense of whether or not loans get rolled over to smaller amounts (as a way to pay down the loan gradually). To make the figure readable, we only plot those loans that were \$20 million or lower.⁵

The figure shows that there is no clear pattern: some loans get rolled over into larger amounts, some into smaller amounts, and some into the same amount (these last are represented by the dots that fall exactly over the 45 degree line plotted in the figure).⁶

Of the 11,429 primary credit loans, 9,000 of them were loans that were not followed by another loan from the same institution at the maturity day (that is, they were not rolled over). Of these loans, 4650 were loans of an amount lower than or equal to \$10 thousand. Given that there were 4655 primary credit loans of an amount lower than or equal to \$10 thousand, that tells us that most of those smaller loans, predominantly “test” loans, were not followed by a consecutive loan.

If we call a credit event a sequence of consecutive loans taken by a bank where one loan is followed by another loan (of potentially a different amount) at the time of the maturity of the previous loan, then there were 350 events involving one roll over (see Appendix), 146 events involving two roll-overs, and there are events of all numbers of roll-overs up to 16, the maximum observed in our sample (only one event involves 16 consecutive loan roll-overs).

The average size of the loans that get rolled over at least once is \$4.7 million – somewhat larger than the average for all primary credit loans with amounts greater than \$10 thousand, which is equal to \$3.8 million, as reported in Table 2. This indicates that banks that end up rolling over primary credit loans tend to borrow larger amounts.

We also look at situations where a bank takes a loan that we can consider an isolated situation, in the sense that the same bank does not take a loan in the two months around the loan in question (one month prior and one month after). The number of isolated loans identified this way is 7078, but presumably many of them were taken as test loans. Indeed, only 2871 of these isolated loans were for an amount greater than \$10 thousand. This means that within the sub-sample of loans for amounts greater than \$10 thousand, 42% of them were isolated. When we look this sub-sample of loans (i.e. loans that are greater than \$10 thousand and isolated), the average size was \$3.7 million which is similar to the average size of all loans greater than \$10 thousand, as reported in Table 2. In other words, isolated loans that are unlikely to be test-loans do not tend to be much different in size than other non-test loans.

IV. SECONDARY CREDIT

Secondary credit is used much less often than primary credit. There are 650 loans in our five-year sample, of which only 39 of them are greater than ten thousand dollars. Virtually all secondary credit loans were overnight loans. The volume in the secondary credit program has been trending down over the years under consideration, with the total amount lent and the number of loans both decreasing over time (see Table 3).

⁵ Note also that loans that were initially larger than \$20 million but were rolled over into amounts smaller than \$20 million do not appear in the figure.

⁶ We looked at larger than \$20 million loans and there is no indication that larger loans produce a more definitive pattern.

The number of test loans has probably been decreasing as a result of banks moving out from the “poorly capitalized” category, either by becoming eligible for primary credit – as banks (and the economy) exit the crisis state – or by exiting the industry (through mergers or liquidations). Similarly, the intensity of use of the secondary credit program, beyond just testing, is also likely to be strongly influenced by prevailing financial conditions: As those improved over the years in the sample period, usage declined.

Loan Sizes: In general, secondary credit loans tend to be smaller than primary credit loans. The largest loan at the secondary credit facility during our sample period is much smaller than the largest primary credit loans (\$17 million and \$1 billion, respectively). Except for a loan granted by the Philadelphia Fed to Nova Bank in December 2010 for \$17 million, all other secondary credit loans in our sample were under \$10 million in value.

This pattern is stronger toward the later part of our sample period. Indeed, since the end of 2012, there has been very little lending of significant amounts at the secondary credit program. If we consider only larger loans, using as a threshold a one-million-dollar threshold, then there was only one loan at or above that amount in 2013, three in 2014, and again only one in the first half of 2015. For the whole sample, only 29 loans were for amounts greater than or equal to one million dollars. Clearly, secondary credit is used in a meaningful way only in rare occasions (outside crisis periods).

Term to maturity: Most secondary credit loans have a 1 or 3-day maturity term (and all the 3-day loans were taken on a Friday). Contrary to primary credit, there are no secondary credit loans of longer maturity than 4 days (see Table 8) and all 4-day loans were made on a Friday, followed by a holiday. Potentially, the extra scrutiny by loan officers at Reserve Banks, and the fact that the financial institution seeking the loan is not in obviously sound financial conditions, drives this pattern of low maximum maturity length.

Table 8. Secondary credit loans. Maturity term.

	Term of loan (days)			
	1	2	3	4
Number of loans	587	4	48	11
Number of “test” loans	558	3	43	7
Total amount lent (\$mm)	73.249	17.003	6.010	22.716
Average size of “non-test” loans (\$mm)	2.489	17.000	1.180	5.675

Note: The term of the loans is expressed in days and the quantities are all in millions of dollars.

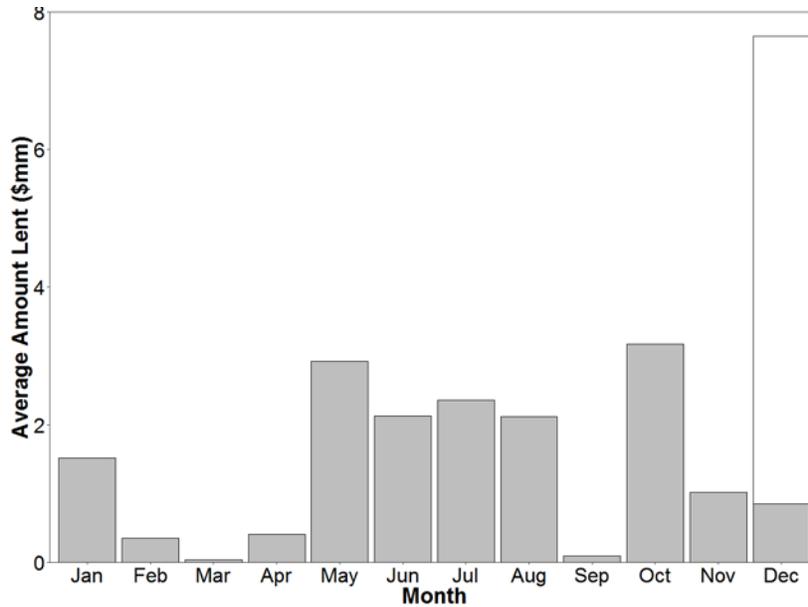
When reading Table 8, it is worth noting that there are only 4 secondary credit loans of 2-day maturity (middle column in the table), of which three of them are for a thousand dollars, and one of them is for \$17 million. This fact drives the high average value of loans of the 2-day maturity term but it seems reasonable to attribute the anomaly to the small sample size.

The \$17 million 2-day loan is unusual in that it is the only secondary credit loan in our sample that was charged an interest rate higher than the standard 125 basis points (that is, 50 basis points higher than the primary credit rate).⁷ The loan was granted by the Philadelphia Fed to Nova Bank, of Berwyn, PA on December 28, 2010, and the interest rate charged was 6.25 percent. Interestingly, this loan was a roll-over loan from a loan of the same amount granted for 4 days on December 24, 2010, at the standard interest rate

⁷ This loan is the only 2-day loan that is not the result of a holiday: that is, the other three 2-day loans (see Table 8) were extended on a day that was followed by a holiday.

of 125 basis points. There are no other loans to Nova Bank around that time, which suggests that the bank paid the loan in full on December 30, 2010.⁸

Figure 7. Average total amount lent of secondary credit in each month



Note: This figure is constructed in the same manner as Figure 4. Each month appears five times in our sample period. For each month, we sum the total amount lent during that month and average that amount among the five corresponding totals. That is, for example, for the month of January we sum all the lending done in January in each of the years in our sample and then take the average over the five month of January in our sample. For the month of December, the grey bar represents the average after we exclude the two large loans to Nova Bank in December, 2010. The white bar is the average including those two large loans.

The initial loan for \$17 million to Nova Bank on December 24, 2010, is also responsible for the high average size of the 4-day loan category (see last column of Table 8). Excluding that loan, the average 4-day loan size is much lower (\$1.9 million). Here, again, the small sample size is a significant limiting factor but it is worth pointing out that this amount is smaller than the average size for all overnight secondary-credit loans (\$2.489 million).

Seasonality: Figure 7 shows that secondary credit is concentrated around the middle of the year, with activity being very moderate in the initial months of the year. The December average is heavily influenced by the large loans to Nova Bank in December, 2010. After excluding these two loans, average total amount lent in December at the secondary credit program is similar to the average level for November and relatively small comparing with the middle months of the year. The sensitivity of the December average to the exclusion/inclusion of two loans, however, underscores the fact that the sample for secondary credit is relatively small and, as a result, idiosyncratic events may be biasing some of the statistics computed here.

Just for completeness, Table 9 shows the average level of lending at the secondary credit program at the beginning, middle, and end of the month and of the quarter (to compare it with Table 6). The pattern shows that lending tends to increase at the end of the month and the quarter.

⁸ On Friday, October 26, 2012, the Pennsylvania Department of Banking and Securities closed NOVA Bank, of Berwyn, PA and the Federal Deposit Insurance Corporation (FDIC) was named Receiver.

Table 9. Total amount lent at different times of the month and the quarter

	Beginning	Middle	End
Month	0.464	0.384	1.149
Quarter	1.866	1.603	2.479

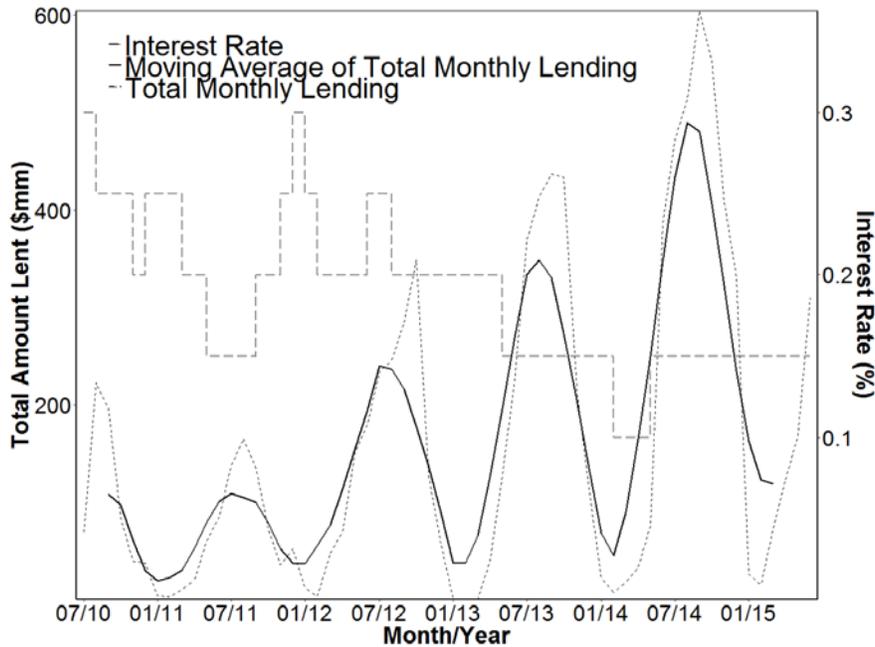
Note: We use the same methodology as used in the construction of Table 5 above.

We do not compute a table comparable to Table 7 in the Primary Credit section, because the sub-samples needed to deal with daily patterns (given the presence of test loans) are too small to draw any meaningful inferences. For computing total amounts lent, the test loans play very little role: for example, the 611 test loans (loans equal or lower than \$10 thousand) at the secondary credit program account for \$1.2 million of the total \$119 million lent over the sample period (see Table 1). Effectively, then, the total amounts lent reflect the 39 non-test loans in the sample. As we split the sample in sub-samples, the number of (non-test) loans in each category becomes too small to make any reliable inference.

V. SEASONAL CREDIT

Even though seasonal credit presents a strong annual seasonal pattern, it is clearly discernable from Figure 8 that there has been an upward trend in the total amount lent over the years of our sample. This is also evident in Table 3. Of course, the strong seasonal pattern is not surprising given the objective of this program: to provide ample access to credit to smaller institutions with a predictable (and demonstrable) seasonal pattern in their funding needs.

Figure 8. Total monthly seasonal credit (\$ million)

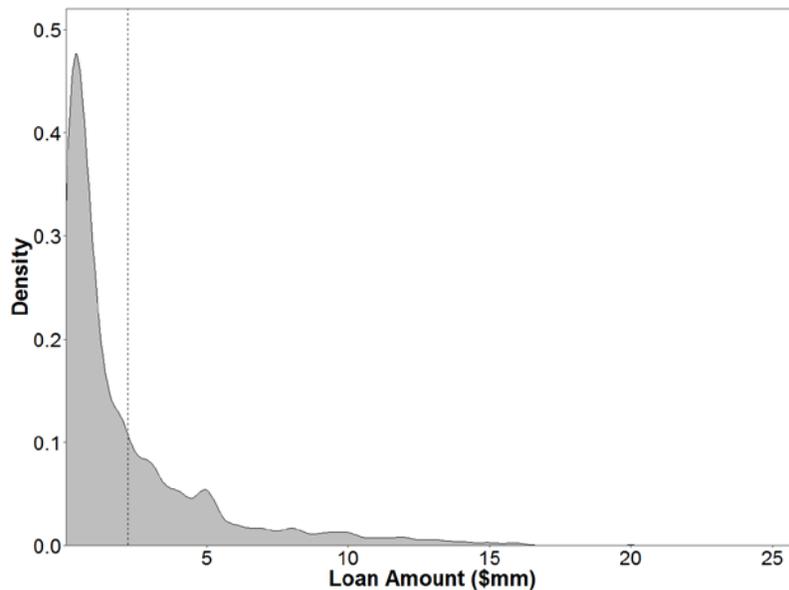


Note: For each month in our sample, we aggregate all loans in that month to generate the monthly time series plotted as the dotted line. We also compute a symmetric, six-month moving average, which is the smoother solid line. We overlay the most frequent (discount window) interest rate in the period as the dashed line.

We included in the figure, the interest rate charge for seasonal credit. The rate is calculated as an average of market rates and it has fluctuated over the years, while exhibiting a moderate downward trend. It may be the case that the gradual decrease in the cost of borrowing over the sample period is partly responsible for the (also gradual) increase in lending shown in the figure (although, of course, the cost of other sources of funding probably move together with market rates, as well, making those other sources of funding also more attractive).

Loan Sizes: The distribution of loan sizes is plotted in Figure 9. As we know from Table 2, the median size of seasonal credit non-test loans is similar to the median for primary credit non-test loans, but the maximum loan amount is much smaller. As a result, the distribution shows more density in intermediate values, such as loans between \$1 million and \$10 million. Since seasonal credit is not provided at a penalty interest rate, the nature of its usage is likely to be very different than for primary credit, with mid-size loans being more common (as reflected in the distribution of loan sizes).

Figure 9. Distribution of loan sizes. Seasonal credit



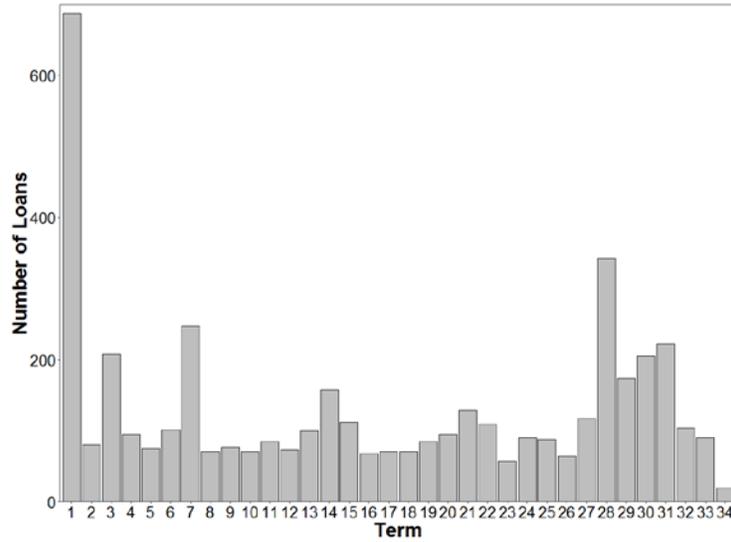
Note: We plot the distribution of loan sizes for all seasonal credit loans in the sample. The dotted vertical line is the mean.

Testing also seems less common in the case of seasonal credit. In fact, there are no seasonal credit loans in our sample for an amount equal or lower than one thousand dollars and 11 loans for an amount between one and ten thousand dollars. This is of course in sharp contrast with the patterns observed in primary and secondary credit where a large proportion of the loans fell within that range of very small amounts.

Term to maturity: Aside from the difference in the distribution of loan sizes between primary, secondary, and seasonal credit, the maturity of seasonal credit loans is also much less concentrated around short periods (overnight and three days) than the maturity term of primary and secondary credit loans.

Figure 10 presents a histogram of the maturity term of seasonal credit loans in our sample. Interestingly, loans that are approximately a month long tend to be relatively common among this class of loans. But this relative concentration does not mean that other maturities are not used. In fact, there are many loans for each of the maturity terms in the range between 1 and 34 days. It is still the case, though, that overnight loans are the most common in this subsample representing 15 percent of the total.

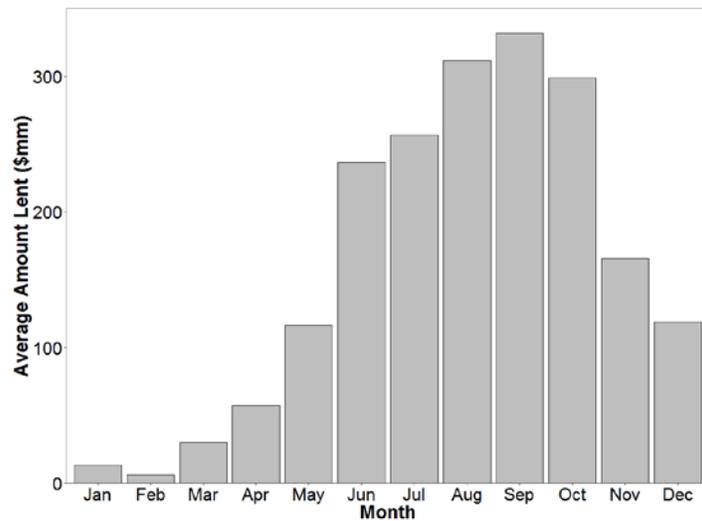
Figure 10. Seasonal credit loans. Maturity term



Note: We compute the number of loans of each maturity term from 1 day (overnight) to 34 days, the maximum maturity observed in the sample, and we plot the histogram of the resulting data.

Seasonality: As a complement to Figure 8, in Figure 11 we plot the average amount of seasonal credit provided during each month of the year. The seasonal pattern at the annual frequency is again evident in this figure, with the amount of seasonal credit increasing during the second half of the year and being minimal during the winter months of January and February. While one might suspect that some of this credit follows the agricultural cycle, it is interesting to note that some of the Reserve Banks in agricultural areas, such as St. Louis and Kansas City, are not large providers of seasonal credit (see Table 5).

Figure 11. Average total amount lent of seasonal credit in each month



Note: See note for Figure 4.

VI. COLLATERAL

Depository institutions can choose to enter credit agreements with their respective reserve banks which, then, allow them to borrow from the discount window if they need to do so at some point. Not all institutions enter credit agreements with their reserve bank. When they do, as part of such agreements, depository institutions pledge collateral with reserve banks, a process that requires the submission of all the relevant information that would allow loan officers at reserve banks to assess the value of the corresponding collateral. Many institutions do not take any loans from the discount window in a given period of time even when they have an outstanding credit agreement with their reserve banks and potentially large amounts of pledged collateral.

Our data only includes collateral information as of the time when a bank actually takes a loan from the discount window. In that sense, the information about pledged collateral in our dataset is not comprehensive. To be more specific, for each loan in the sample, the dataset includes information on the value and composition of the collateral available to the borrower with the corresponding Reserve Bank at the time of the loan. The reported value of collateral is adjusted using the appropriate margins (haircuts) so that, in principle, the borrower could receive a loan for the total amount of the reported collateral.

To get a sense of how collateral is being used in these credit relationships, we look at the average composition of the collateral and the level of utilization (how much lending actually occurs relative to the total amount of collateral available). For this latter calculation, we use the total amount of loans outstanding, including the new loan, which is also reported in our data. The collateral pledged at the discount window can be used in any of the discount-window programs so, for example, a bank can take a loan at the primary credit program and another loan, simultaneously, at the seasonal credit program. The reported amount of collateral in our dataset is usable in both types of loans.

Interestingly, none of the banks that took a secondary-credit loan during our sample period had any other outstanding loans from the discount window. For those banks taking loans at the primary-credit program, having loans outstanding is more common but not very prevalent.

The situation is much different for those banks taking seasonal credit loans, as more than 40% of those banks have loans outstanding at the time of taking the loan reported in our dataset. While most of the outstanding loans are previous seasonal-credit loans, we also verified that some banks were borrowing simultaneously from the primary and seasonal programs during our sample period.

Collateral composition. The composition of collateral varies systematically across credit programs, as reflected in Table 10. For primary credit loans, almost 50 percent of the collateral is accounted for by commercial and consumer loans, with high-quality securities such as U.S. Treasuries and agency mortgage back securities taking roughly another 20 percent of the total. Loans granted under the secondary credit program, instead, have almost 60 percent of the collateral in the form of commercial real estate (CRE) loans. Finally, the collateral of banks taking loans in the seasonal credit program is mainly composed of commercial loans and CRE loans.

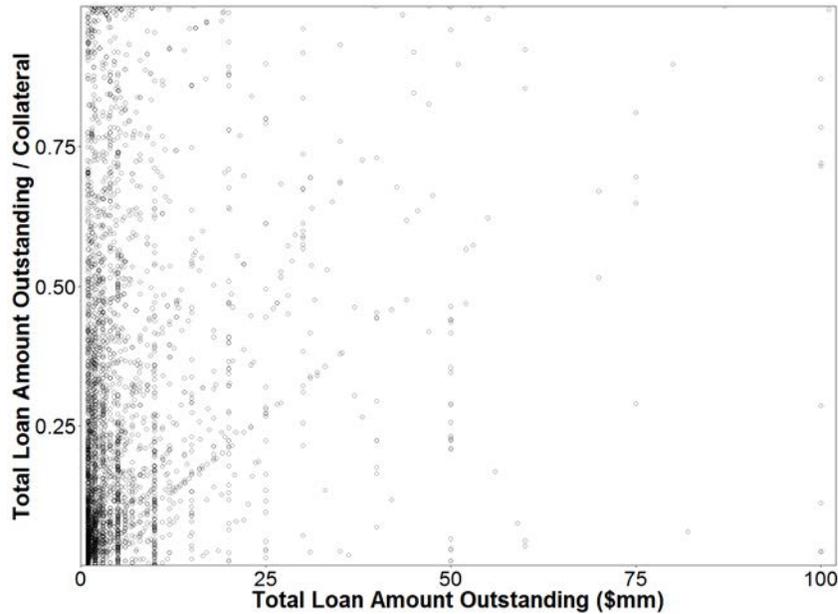
Table 10. Type of collateral (as a proportion of total).

Type of collateral	Primary credit	Secondary credit	Seasonal credit
Commercial loans	0.277	0.135	0.422
Consumer loans	0.199	0.046	0.002
CRE loans	0.069	0.585	0.281
US Treasury/Agency securities	0.067	0.070	0.091
Agency MBS	0.123	0.057	0.092
ABS	0.083	0.039	0.000
Other	0.182	0.068	0.112

Note: For each individual loan taken by a bank, the data includes the total amount of collateral available to the borrowing bank and its composition. We aggregate across all loans in our data set and compute the proportion of each collateral component. There are other categories of collateral not reported in the table and for which the proportions were relatively small. These categories are all aggregated under the label “Other.” Note that if a bank takes several loans, its collateral is counted multiple times in the aggregation, one time for each time that the bank took a loan.

Collateral utilization. We measure collateral utilization as the ratio of total outstanding loans for a given bank and its total collateral pledged with the corresponding Reserve Bank. To understand collateral utilization, it is important to keep in mind that the large proportion of test loans in the primary and secondary credit programs, by their nature, tend to use a very low proportion of the collateral available to the borrowing bank.

Figure 12. Collateral utilization ratio (Primary Credit Program).



Note: We consider loans at the primary credit program which, added to the outstanding loans, sum to an amount between \$1 million and \$100 million. For each loan we compute the ratio of the total loan amount outstanding and the total collateral available to the borrower. For each loan, then, we plot the level of utilization in the vertical axis and the outstanding-loans amount in the horizontal axis.

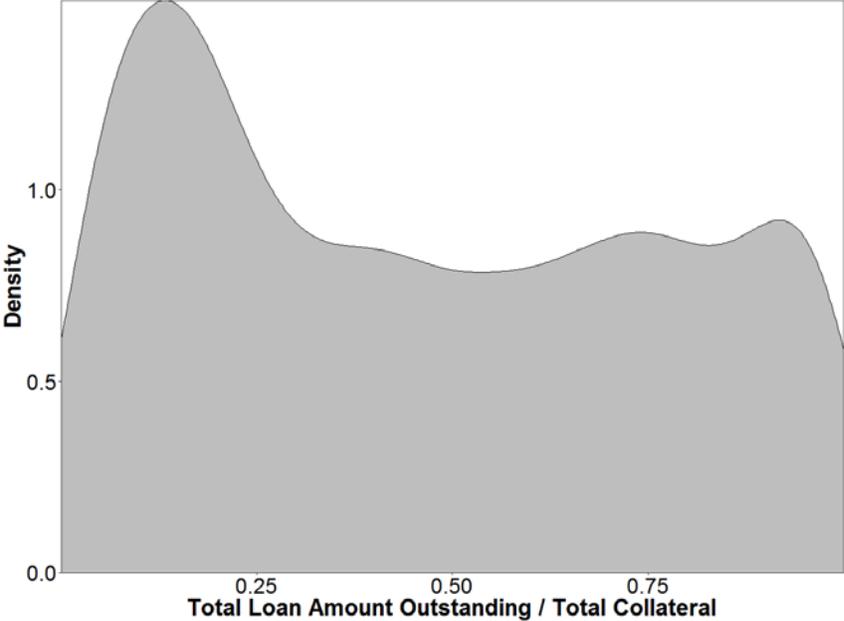
For primary credit, we concentrate attention on loans that are greater than \$1 million, since the predominance of test loans can be expected to be very low at those levels of borrowing. Figure 12 shows the level of utilization in the vertical axis and the amount of outstanding loans in the horizontal axis (we plot outstanding amounts up to \$100 million to make the figure more readable, but the pattern is similar for all

loans over \$1 million).⁹ We can see from the figure that there are a lot of large primary credit loans that use a significant proportion of the collateral available to the borrowing bank. Smaller loans also can have relatively high utilization ratios. Furthermore, the figure suggests that there is no strong correlation between the size of the loan and the level of collateral utilization.

For secondary credit, we restrict attention to loans greater than ten thousand dollars, which in our sample amount to a total of 39 loans. Of those 39 loans, 19 of them used more than half of the collateral available to the borrower. Collateral utilization for the 39 loans is not concentrated in any particular value, and instead is (roughly) evenly spread in the unit interval.

Just as with primary credit loans, for secondary credit loans, there is no indication of a tight correlation between size of the loans and their collateral utilization. The two largest loans in this sub-sample of 39 loans – those made to Nova Bank in 2010 for \$17 million each – have a collateral utilization ratio of 55 %. In the upper end of the utilization margin (for loans greater than \$10 thousand), there are three loans with utilization ratio greater than 90%.

Figure 13. Distribution of collateral utilization ratio. Seasonal Credit.



Note: For each loan we compute the ratio of the total loan amount outstanding and the total collateral available to the borrower.

For seasonal credit, collateral utilization is spread (roughly) evenly over values between zero and one. Figure 13 shows the density of the collateral utilization ratio for seasonal credit loans. Since test loans seem to be much less common in the seasonal credit program, we include all loans in the figure. For seasonal credit, it is critical to measure utilization using outstanding loan amounts, given that in most cases these loan amounts can be much higher than the amount of the new individual loan that originates the reporting.

⁹ The amount of outstanding loans includes the amount of the loans for which the data is being reported. For this reason, the amount of outstanding loans is always greater than \$1 million in the figure. Since, for this restricted subsample, only 33 out of 2829 loans were made when previous loans to the borrowing bank were outstanding, the figure basically reflects the utilization ratio calculated using the amount of the current loan.

VII. CONCLUSION

In the five years of now available discount-window transactions data, from mid-2010 to mid-2015, the Federal Reserve made over 16,000 loans for a total amount of more than \$36 billion. Most of the lending was done through the primary credit program. The seasonal credit program was also a significant source of funding for banks during our sample period. In the span of those five years, the amount of primary credit shows a slow secular decline and the amount of seasonal credit has been gradually trending up but with large seasonal swings.

A significant proportion of the transactions reported in the data are likely to be “test” loans. These test loans tend to be for very small amounts, and they do not have a significant impact on the total amounts lent when aggregated across all loans. Still, for understanding the typical size of loans and other relevant aspects of the data, it is helpful to minimize the influence of test loans in the results. We choose a threshold of \$10,000 and exclude the loans at or below that threshold when we want to focus on the characteristics of nontest loans. In the case of secondary credit, this procedure leaves us with a very small number of nontest loans, which reduces our ability to draw robust inferences.

In contrast, for the case of the primary credit program, the sample of nontest loans is large. The size of primary-credit loans is relatively widespread with some very large loans present in the sample. Most loans are overnight, but there are loans with up to a 14-day maturity term. A lot of banks accessed the primary credit program during our sample period, and many of those banks used the program on several occasions. Primary credit loans are more common at the end of the month, the quarter, and the year, but in general there is credit extended at all times. Most of the primary credit loans constitute one-time events, in the sense that they do not get rolled over. Those loans that do get rolled over tend to be somewhat larger on average and do not always get rolled over into equal or smaller amounts (sometimes they are rolled over into larger amounts).

Very large secondary credit loans are rare. Abstracting from test loans, there are actually not many loans being granted through this program. Comparing secondary credit loans with primary credit loans, we see that the former tend to be smaller and shorter term. This is consistent with the fact that those are loans offered at higher interest rate and the corresponding borrowers are subject to more supervisory scrutiny.

Consistent with its name, the volume of seasonal credit present a strong annual seasonal pattern, with lending generally picking up significantly in the second half of the year. Test loans are a lot less common in the seasonal credit program, and loan size is more uniformly spread in the range of \$1 million to \$15 million. The maturity term is also widespread between one and 30-plus days.

Collateral utilization is not concentrated around a certain level and does not tend to reflect a correlation with the size of the loans. Because collateral is measured adjusted for the appropriate haircuts and the utilization ratio is below unity for most of the loans, the level of credit risk involved in these transactions seems likely to be fairly low.

It is, of course, difficult to determine the appropriate amount of discount-window credit needed by U.S. banks. Those needs are likely to also depend on the state of aggregate financial conditions. The period we study includes some episodes of heightened financial turmoil (such as at the peak of the European crisis in 2011) but not a full-blown financial crisis (in the U.S.). Also, during our sample period, banks were holding significant amounts of excess reserves (and liquidity more generally), which likely reduced banks’ needs for emergency funding. Still, the data we have analyzed here show that many banks do access the discount

window regularly, suggesting that the routine provision of back-up funding by the central bank is a valuable option for many participants in the U.S. banking sector.

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Appendix

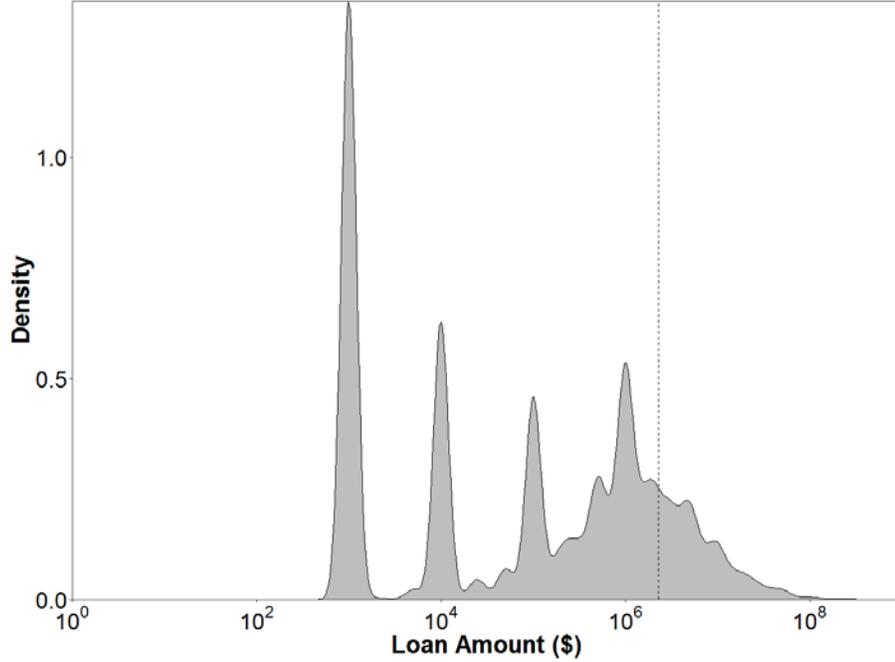
Table A1. Annual average of daily loan-amount outstanding (\$mm)

Year	Primary credit	Secondary credit	Seasonal credit	Total
2003	34.038	1.264	62.698	98.000
2004	42.115	0	110.923	153.038
2005	52.673	4.212	142.462	199.346
2006	58.962	0.154	165.538	224.654
2007	479.750	3.192	104.846	587.788
2008	31,817.943	34.642	39.698	31,892.283
2009	40,221.212	192.731	45.115	40,459.058
2010	4,429.154	309.923	39.212	4,778.288
2011	25.942	0.173	35.942	62.058
2012	22.981	0.019	49.442	72.442
2013	13.173	0.019	65.462	78.654
2014	12.830	0	104.755	117.585
2015	17.250	0.019	107.404	124.673
2016	17.808	0	83.615	101.423
2017	13.212	0.019	81.846	95.077

Table A2. Primary credit loans paid before maturity

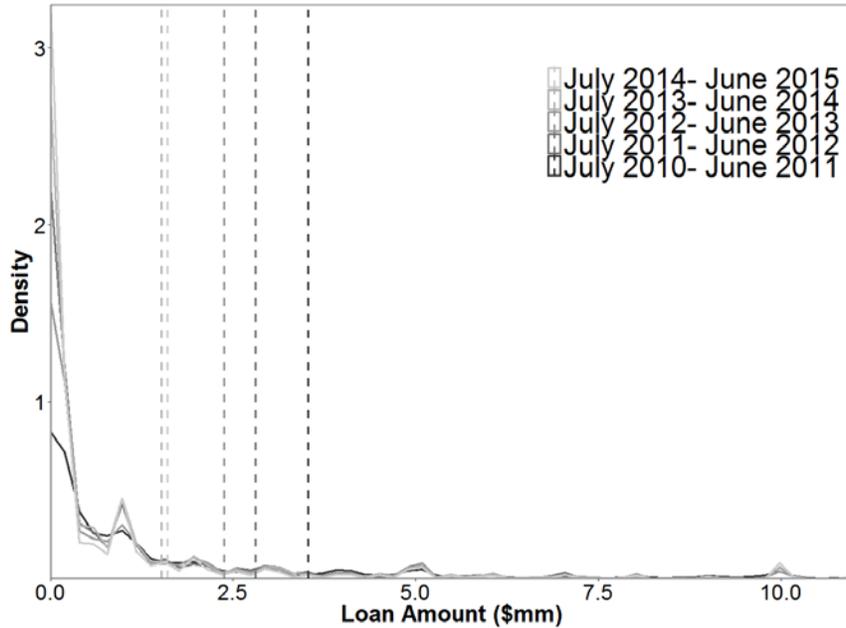
Borrower	Location	Amount borrowed (\$mm)	Date of loan	Term	Date of repayment	Lender
Community First Bank	Fairview Heights, IL	0.300	8/5/2010	6	8/6/2010	St. Louis Fed
Community First Bank	Fairview Heights, IL	0.950	8/26/2010	5	8/30/2010	St. Louis Fed
Community First Bank	Fairview Heights, IL	0.050	9/2/2010	5	9/3/2010	St. Louis Fed
Community First Bank	Fairview Heights, IL	0.800	9/7/2010	3	9/9/2010	St. Louis Fed
Douglas County Bank	Lawrence, KS	25.000	12/29/2014	7	1/2/2015	Kansas City Fed
First National Bank	Rotan, TX	4.000	1/13/2015	14	1/22/215	Dallas Fed
First National Bank	Chadron, NE	1.350	1/5/2015	7	1/12/2015	Kansas City Fed
First State Bank	Norton, KS	5.000	6/17/2013	8	6/19/2013	Kansas City Fed
Lakeside Bank	Chicago, IL	10.000	1/31/2011	4	2/3/2011	Chicago Fed
University&Community FCU	Stillwater, OK	0.700	6/28/2011	3	6/30/2011	Kansas City Fed

Figure A1. Distribution of primary credit loan sizes. Log amounts



Note: We compute the distribution of primary credit loan sizes after taking log of each corresponding amount.

Figure A2. Distribution of primary loan sizes. Evolution over time



Note: We compute the distribution of primary credit loan sizes for each 12-month period starting in July 2010. The distribution is calculated after excluding from the data all loans greater than \$100 million (15 loans in total for all five years). This helps to make the estimated distributions smoother. We then plot only the portion of the distribution that corresponds to loans of \$10 million or less.

Table A3. Primary credit loans from Texas Capital Bank

Date	Term	Loan amount (\$mm)
10/31/2011	1	15.000
11/2/2011	1	60.000
11/15/2011	1	35.000
11/30/2011	1	82.000
12/1/2011	1	7.000
12/30/2011	4	132.000
1/31/2012	1	7.000
4/30/2012	1	115.000
5/1/2012	1	115.000
5/2/2012	1	296.000
5/3/2012	1	7.000
8/31/2012	4	115.000
9/4/2012	1	200.000
9/5/2012	1	250.000
9/6/2012	1	215.000
9/7/2012	3	150.000
9/10/2012	1	160.000
9/12/2012	1	50.000
1/30/2013	1	20.000

Table A4. Loan roll-overs

Number of roll-overs (x)	Number of credit events involving x roll-overs	Average size of loans
0	9000	1.649
1	350	3.277
2	146	3.631
3	69	6.377
4	37	2.594
5	27	10.366
6	16	6.427
7	18	5.209
8	7	3.101
9	6	8.751
10	7	4.405
11	1	9.575
12	5	3.58
13	4	7.075
14	2	0.85
15	2	3.097
16	1	13.929