Further Results on a Black Swan in the Money Market[*]

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ABSTRACT

Using alternative measures of term lending rates and counterparty risk and a wide variety of econometric specifications, we find that counterparty risk has a robust significant effect on interest rate spreads in the term inter-bank loan markets. In contrast, we do not find comparably robust evidence of significant negative effects of the Fed's term auction facility (TAF) on term lending rates. This analysis incorporates the latest data from the ongoing turmoil in the money markets and confirms earlier findings reported in Taylor and Williams (2008).

In a recent paper we investigated the unusually large spreads in the money markets which first began to appear on August 9[1] of last year.[1] Our purpose was to "to document these unusual developments in the money market, assess various theories underlying them, and evaluate the impact of policy actions". We focused on the spreads between the London Inter-bank Offered Rate (Libor) and the interest rate on Overnight Index Swaps (OIS) of the same maturities. These spreads jumped in August and have remained elevated ever since. Using various measures, we found strong and robust statistical evidence that counterparty risk significantly affected these spreads. We found no comparable statistical evidence that the Federal Reserve's Term Auction Facility (TAF) significantly affected these spreads.

We are gratified by the large amount of discussion and additional research that has occurred since our paper was posted on the Internet. In the spirit of continued discussion and research, we present further results on this subject in this paper. We consider comments we have received, other approaches to estimating the effects of counterparty risk and the TAF on spreads, and recent evidence from money markets.

For reasons of space, we focus primarily on just three issues, and direct the reader to our previous paper for a fuller discussion of developments in money markets during this period. First, news reports in the financial press in April have cast doubts about the accuracy of Libor as a measure of actual interest rates charged by banks. We therefore examine three alternative measures of term interest rates and compare results to those based on Libor. Second, we explore further the roles of liquidity and counterparty risk in term lending spreads, expanding upon the analysis in our earlier paper. Finally, we

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[1] Taylor, John B. and John C. Williams (2008), "A Black Swan in the Money Market," April 2, 2008

consider alternative specifications of the empirical equation relating spreads to measures of counterparty risk and the TAF. Throughout, we update our analysis to include recent data through early May 2008.

In summary, we continue to find that measures of counterparty risk are an important factor in explaining the elevated level of spreads in money markets over the past nine months. This finding is robust to a wide range of empirical specifications and measures of term lending rates and counterparty risk. In contrast, we do not find comparably robust evidence of a significant negative effect of the TAF on spreads.[2] Although some empirical specifications indicate that the TAF has lowered spreads, we find that these results are not robust to alternative measures of term lending rates and relatively modest changes in specification.

1. False Signals in the Libor Survey

Soon after our paper on the Libor spread was released, concerns began to circulate in the financial markets that the Libor survey was "sending false signals," which is how it was put in an April 15 article in the *Wall Street Journal* highlighting the problem.[3] The main concern was that individuals at banks completing the survey may have been understating the interest rate, and that the actual rate they were paying or receiving was higher than they reported. Indeed, in the days after this *Wall Street Journal* article was published, the Libor rate rose somewhat. In response to these concerns, the British Bankers Association announced that it would conduct a review of Libor in close

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[2] As we noted in our earlier paper, by focusing on the impact of the TAF on spreads, we do not mean to imply that the Federal Reserve did not have other goals in creating the TAF, including reducing the stigma associated with discount window borrowing by banks.

[3] Mollenkamp, Carrick, "Bankers Cast Doubt on Key Rate Amid Crisis," *Wall Street Journal ,* April 15, 2008.

collaboration with the Bank of England. In addition, some observers have raised the more general issue that quoted Libor rates may not accurately reflect bank borrowing costs owing to the paucity of term inter-bank loans during the period of turmoil in the money market.

In researching our original paper, we compared the Libor data to other comparable interest rate data and found that these measures were highly correlated over time. Although this high correlation has continued, persistent deviations between the different measures and the possibility of systematic misreporting in the Libor data imply the need to cross-check empirical results based on Libor with alternative data on term lending rates.

Percent
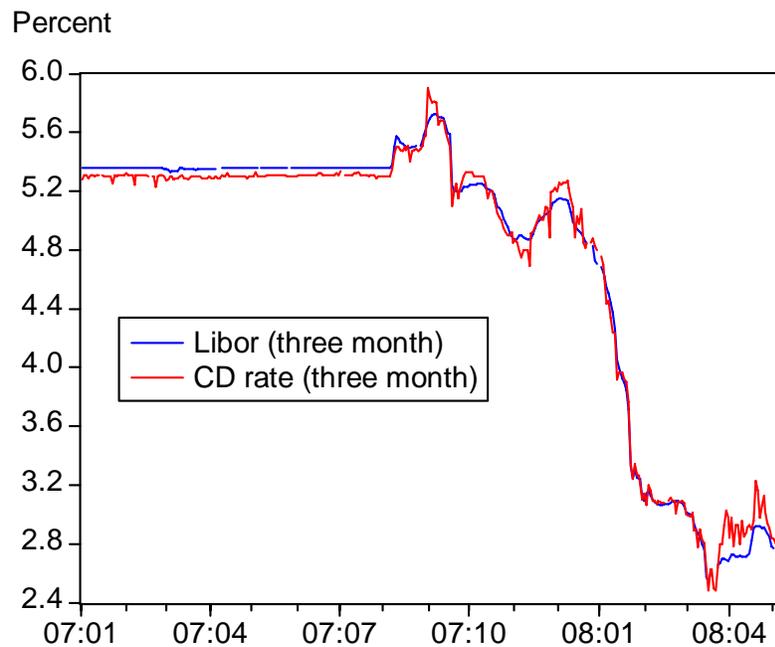
Figure1. Cross-checking Libor with CD Rate: Three-Month Maturity

Figure 1 shows three-month Libor and rate on three-month certificates of deposit (CD) through May 9, 2008. Observe that the major ups and downs in these two series during the past nine months track each other quite closely. That said, a gap between the two series has appeared at times. Particularly noticeable is the persistent gap between the two series since late March 2008, with the CD rate consistently above the Libor rate. Two other measures of term lending rates, on three-month term fed funds and on term Eurodollar, have also deviated from the Libor at times and have been higher than the Libor on average since late March 2008. The discrepancies between one-month rates are smaller than for the corresponding three-month rates, as seen in Figure 2, which compares the one-month Libor and CD rates.
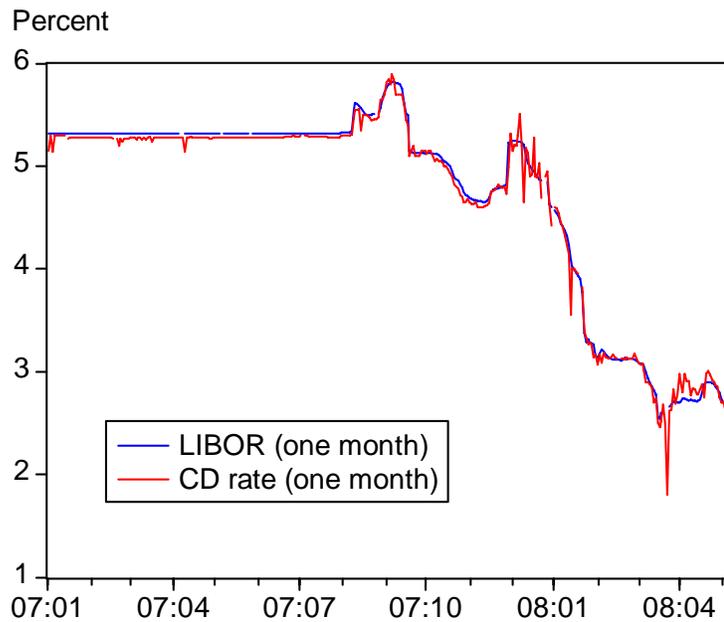
Figure2. Cross-checking Libor with CD Rate: One-Month Maturity

In light of the discrepancies between the various lending rates and the uncertainty about their sources, we reexamine the empirical evidence on Libor spreads using four alternative series on term lending rates: Libor, CDs, term fed funds, and term Eurodollar.

2. Risk versus Liquidity

One of the most common reactions to our earlier paper has come from analysts and others who argue that the increased spread between Libor and OIS has been due to shortages of liquidity rather than to increased risk, as we had concluded. In this section, we briefly revisit the issue of liquidity vs. counterparty risk.

In our previous paper, we offered the high correlation between the Libor-government Repo spread and the Libor-OIS spread as evidence for our conclusion. Although the Repo rate is subject to more noise than OIS, for the reasons discussed in our earlier paper, we argued that the Libor-Repo spread is a very good measure of inter-bank risk because it is the difference in rates between secured and unsecured lending between banks at the same maturity.
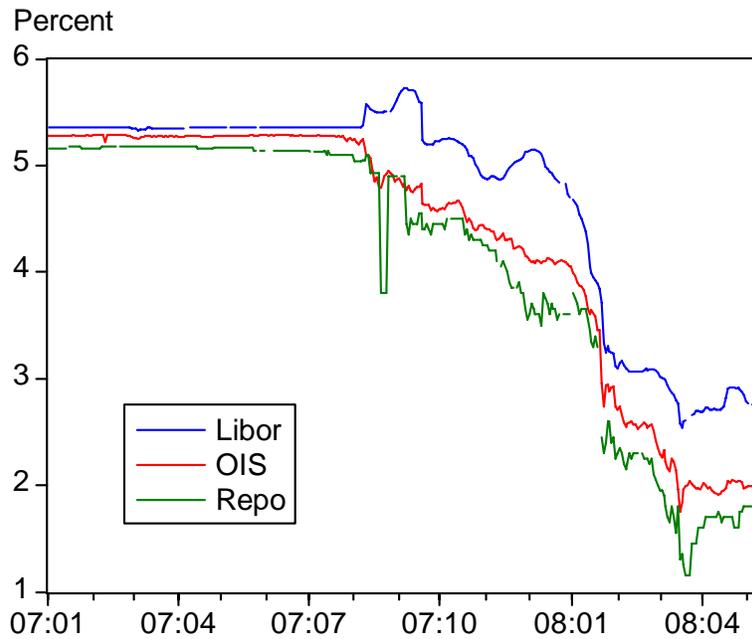
Figure 3. Three-month Libor, OIS, and Repo rates

Here we take a closer look at the relation between Libor-Repo and Libor-OIS spreads, focusing on the time series pattern of this correlation. Figure 3 plots the three-month Libor, OIS, and Repo rates. As seen in the figure, Repo rates have tracked the downward trajectory in OIS rates over the past nine months reasonably well. In contrast, the spread between the Libor rate and the OIS has widened dramatically since early August 2007.

To illustrate the close connection between the Libor-OIS spread and the Libor-Repo spread, we regressed the Libor-OIS spread on a constant and the Libor-Repo spread. Figure 4 shows the actual and fitted values from this regression for the three-month maturity case. The regression coefficient is .684 with a standard error of .035. The R^2 of the regression is .885. Observe how the three major fluctuations in the Libor-OIS spread can be explained by the Libor-Repo spread variable. The Libor-OIS spread

increased in August and September and then came down a bit in October. It rose again in November and then declined in December and January. The spreads started to increase again in March and April. In each of these cases the Libor-Repo spread followed a very similar pattern.

We also show the results of an analogous regression for the one-month maturity in Figure 5. The regression coefficient on the Libor-Repo spread is .610 and the standard error is .061. The R^2 is .786, so the fit is not quite as good as for the three-month regression. High correlations are also found using spreads based on term fed funds, Eurodollar, and CD rates.

Percentage points
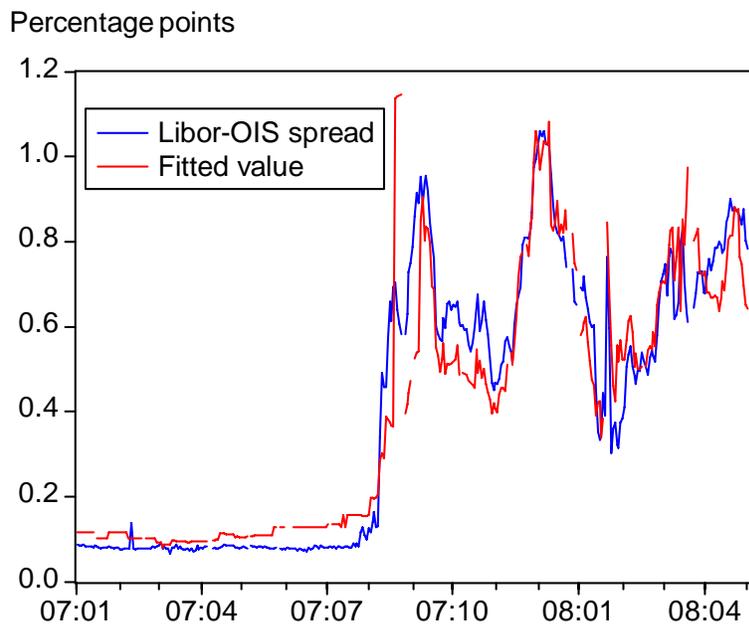
Figure 4. Actual and fitted spread from a regression of three-month Libor-OIS spread on the spread between three-month Libor and three-month Repo.
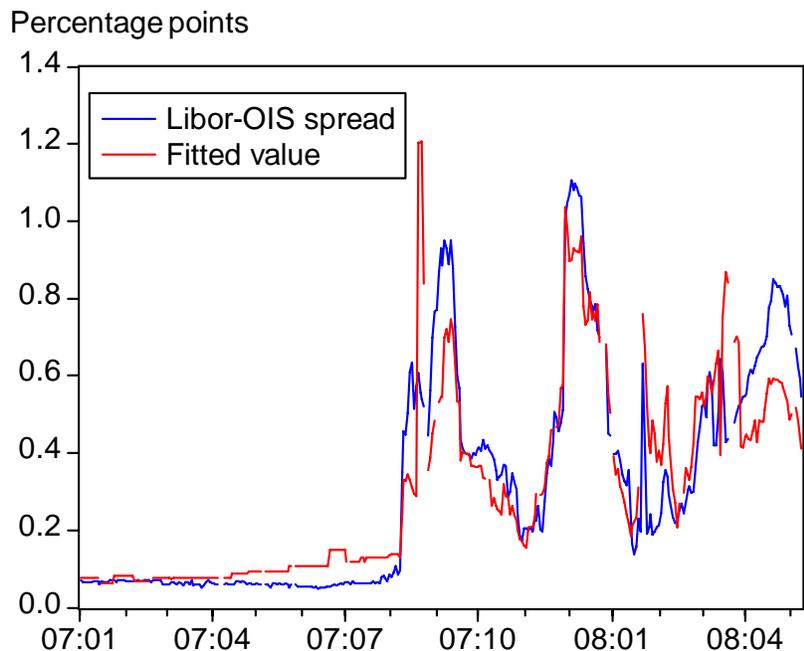
Figure 5. Actual and fitted spreads from a regression of one-month Libor-OIS spread on one-month Libor-Repo spread.

While Figures 4 and 5 provide evidence that counterparty risk is a key factor in the movements in the term lending spreads, they do not rule out that liquidity has been reduced by the increase in counterparty risk, a possibility that has been raised with us by traders in the markets and others since the crisis began. The argument is that banks are reluctant to lend funds in the inter-bank market because of uncertainty about their own future need for funds, perhaps because of concerns about risk in their own balance sheet. We referred to this phenomenon as "liquidity risk" in our earlier paper.

One way to discriminate between liquidity risk and counterparty risk is to look at rates paid when parties other than banks lend to banks, as in the market for certificates of deposit. As long as lenders exist who are not constrained by liquidity concerns, banks who seek to hoard liquidity can borrow from these lenders in the CD market.

Competition will lead to the equalization of borrowing rates across instruments for borrowers of the same credit quality. As discussed above, CD rates have tracked Libor and other inter-bank term lending rates closely during the crisis, except for a few notable episodes, suggesting that liquidity risk is not a significant separate factor driving term lending rates.

4. Alternative Statistical Tests of the Impact of the TAF

In our original paper, we tested the impact of the TAF on the Libor-OIS spread by including dummy variables for the TAF bid dates in Libor-OIS regressions along with various measures of risk, including asset-backed commercial paper spreads, credit default swaps for banks, the Tibor-Libor spread, and the Libor-Repo spread. The idea underlying these regressions is that the basic no-arbitrage model of the term structure of interest rates predicts that there would be no effect of the TAF on the spread. But, in an unspecified alternative model, perhaps with imperfect substitutability across instruments, the influx of funds from the TAF could affect spreads. Economic theory does not provide clear guidance on how the TAF auctions should enter into our empirical model, and subsequent to our writing the paper, a number of alternative specifications have been proposed.[4] In this section, we revisit the empirical analysis, considering several specifications.

We first consider an alternative specification of the timing of the effects of TAF auctions on term lending spreads in our empirical specification. If the TAF interventions are similar to sterilized interventions in the foreign exchange market, then the influx of

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[4] See, for example, William Dudley (2008), "May You Live in Interesting Times: The Sequel," Federal Reserve Bank of New York, May 15.

funds from the TAF might temporarily lower rates for term interbank loans made around the time of the auction.   Thus, a reasonable alternative specification is where the TAF auction has effects on spreads for several days, starting with the date of bidding and including the days when the auction results are announced and the loans are made, rather than just on the day that bids are collected, as in our previous paper. To examine this possibility, we included a variable equaling the sum of the TAF auction bid dummy variable (the one we used in our previous paper) over the current and previous four days.

We also consider an alternative measure of counterparty risk that uses credit default swap (CDS) rates from a set of banks in the Libor survey. In our previous paper we used the CDS rates from two major U.S. banks, Bank of America and Citigroup. Two recent papers, McAndrews, Sarkar, and Wang (2008)—hereafter MSW— and Wu (2008), used measures of CDS rates based on a larger set of banks.[5] To see if estimation results are sensitive to using a broad base of bank CDS rates, we include as a measure of counterparty risk the median CDS rate from the seven banks in the Libor survey for which we have data with no missing values.[6] By excluding banks for which there are missing data in constructing this measure, we reduce the effects of composition changes over time as individual banks drop in and out of the sample. All of our results using this measure are close to what we obtain if we include the median of all available CDS data on a given day from banks in the Libor survey. For reasons of space, we drop the specification using the Citigroup CDS rate.

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[5] See James McAndrews, Asani Sarkar, and Zhenyu Wang, "The Effects of the Term Auction Facility on the London Inter-bank Offered Rate," Federal Reserve Bank of New York, May 19, 2008; and Tao Wu, "On the Effectiveness of the Federal Reserve's New Liquidity Facilities," Federal Reserve Bank of Dallas, April 2008.
[6] The seven banks used to compute the median are: Barclays Bank, Credit Suisse, Deutsche Bank, Lloyds TSB Bank, Rabobank, The Royal Bank of Scotland Group, and UBS.

The basic results regarding the effect of TAF on Libor-OIS spreads using this specification are the same as in our previous paper: we find no evidence of a significant impact of the TAF. Table 1 reports the results for the alternative specification of the TAF effects on spreads, where the dependent variable is the three-month Libor-OIS spread.[7] (All regressions reported in this paper include a constant, but the estimated constants are not reported to save on space.) The sample is January 1, 2007 to May 9, 2008 for this and all other regressions reported in the tables in this paper. The estimated coefficients lie between -7 basis points and +17 basis points and in no case is a negative coefficient on the TAF variable statistically significant at the 5 percent level (although in one case a positive estimated coefficient is statistically significant). The results using the median CDS rate are qualitatively similar to those using the Bank of America CDS rate. (Precise comparisons of fit between these two regressions are complicated by the fact that the Bank of America CDS data has some missing observations.)

We ran the same regressions using the spreads between the CD, term fed funds, and Eurodollar rates and the OIS rate as the dependent variables. The results, reported in Tables 2, 3, and 4, are consistent with those using the Libor-OIS spread. Again, we do not find evidence of a significant negative effect of the TAF on term lending spreads using this specification.

A second alternative approach, followed by Wu (2008), avoids the issue of the precise timing of TAF effects altogether, by simply asking whether Libor-OIS spreads

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[7] In all of regressions and for those in this paper, we follow MSW (2008) and shift the timing of the Libor rate back one day, reflecting the timing of the collection of the Libor data, as is discussed further in the text below. In addition, for the regressions using the Eurodollar rate, we lag TAF dummy variables that measure "news" (bid, result, and announcement days) by one day, reflecting the fact that Eurodollar data are collected at around 9:30am, before the release of TAF information on that day. The estimation results that use the level of the term lending spreads are generally relatively insensitive to this timing issue, while the results using the specification of MSW (2008) are more sensitive.

have been lower on average since the introduction of the TAF compared to before, controlling for measures of counterparty risk. The effect of the TAF is measured using a dummy variable set equal to 0 before December 12, 2007 (the day of the announcement of the TAF) and 1 thereafter. Wu (2008) finds a significant negative coefficient on the TAF variable using the three-month Libor-OIS spread as the dependent variable. One potential problem with this approach is that it implicitly assigns to the TAF all changes in spreads since December 12, 2007 that are not accounted for by the included measures of counterparty risk. Thus, mismeasurement of counterparty risk and changes in liquidity risk unconnected to the TAF will contaminate the estimates.

Table 5 reports the results of such a specification for the four measures of three-month term lending rates and the Bank of American and median CDS rates. The estimated coefficients on the CDS rates are all positive and highly statistically significant. The estimated coefficients on the TAF variable range from -18 basis points to +12 basis points; none are statistically significant.[8] Perhaps not surprisingly, the estimated TAF coefficient is lower (more negative) for the Libor-OIS spread than for any of other three measures of term lending spreads. If we drop Libor-OIS regressions from the set of regressions due to concerns about underreporting in Libor, the coefficient on the TAF ranges from -11 basis points to +12 basis points.

The results for one-month term lending spreads, reported in Table 6, are very similar to those for the three-month spreads. The coefficients on the CDS rates are highly

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[8] Our results differ from those of Wu (2008) due to our sample including more recent data and to the choice of the measure of counterparty risk. Wu (2008) uses the principal component of CDS rates for four banks as a measure of counterparty risk. He included in his sample two banks, Wachovia and Washington Mutual, neither of which are part of the Libor panel. Moreover, Washington Mutual's CDS rates are extreme outliers relative to the Libor bank panel during this period, making this particular choice problematic for the analysis of Libor rates.

significant. The estimated TAF coefficients range between -13 basis points and +13 basis points and these estimates are all statistically insignificant.

The estimates of TAF effects are consistently larger (more positive) using the median CDS rate than using the Bank of America CDS rate. For all three term lending series excluding Libor, the estimated TAF coefficient is positive when using the median CDS as a measure of counterparty risk. This difference in results reflects in part the effects of missing data in the Bank of American CDS series and illustrates the sensitivity of the results using this specification to modest changes in specification and sample.

The strategy of using a single TAF dummy variable ignores the time variation in the TAF program, which could potentially help identify effects of the TAF. The outstanding balance of TAF loans, including those from the Fed, the European Central Bank (ECB), and the Swiss National Bank (SNB), has varied considerably over time, as shown in Figure 6 (where the balance is measured in units of 100 billion dollars). The decline in outstanding loans in early 2008 reflected the temporary cessation of TAF loans by the ECB and SNB. The chart also shows one-month Libor-OIS spreads, which declined after the introduction of the TAF and then rose again after the ECB and SNB stopped participating in auctions. This negative correlation caused some observers to infer that the TAF was having sizable negative effects on spreads.
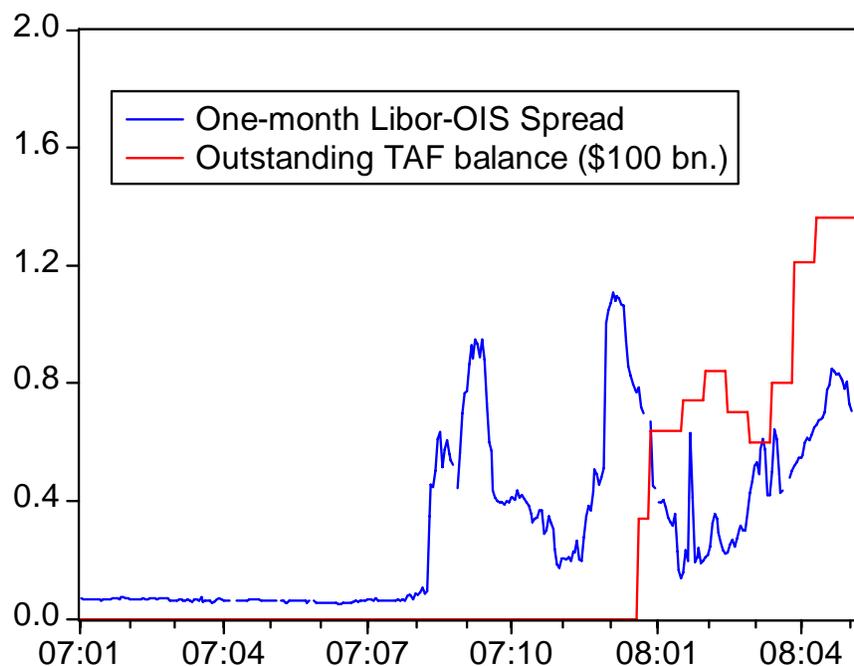
Figure 6. One-month Libor-OIS spread versus the total outstanding balances of dollar-denominated TAF loans from the Fed, the ECB, and the Swiss National Bank, in units of 100 billion dollars.

We now examine whether the effects of the volume of TAF funds on term lending spreads.[9] Table 7 reports the results for three-month term lending spreads. The TAF variable is the outstanding loan balance divided by 100 billion, so the coefficient measures the effect of a $100 billion balance. These results confirm those using the single TAF dummy variable. The coefficient estimates range from -.14 to + .14 and none are statistically significant. The estimated effects are larger (more positive) for the other three measures of term lending rates than for Libor, with these estimates ranging between -.04 and + .14. The results for one-month spreads, shown in Table 8, are similar to those for three-month spreads.

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[9] Brian Sack and Laurence Meyer discuss a similar approach in "TAF and Liquidity Policies: Keeping Libor Down," Macroeconomic Advisers, May 15, 2008.

These approaches to estimating the effects of the TAF using a single dummy variable or the outstanding balance of TAF loans are open to a number of criticisms. First, they treat the TAF intervention(s) as exogenous events, but in fact they were endogenous reactions to events. Second, because they rely on a small number of changes in the TAF, the results can be very sensitive to the sample. This sensitivity is illustrated by examining regressions estimated only through the end of February 2008. For the three-month Libor-OIS spread, the estimated coefficient on the post Dec-11 dummy is –0.30 with a standard error of .14. The corresponding estimated effect of the TAF balance (per $100 billion) is -.70 with a standard error of .15. However, this evidence supporting large, statistically significant effects of the TAF was undermined by subsequent data, demonstrating the fragility of these results and serving as a warning about their reliability.

The final specification that we consider is based on that proposed by MSW that looks at changes in three-month Libor-OIS spreads on days in which a TAF event takes place, controlling for changes in measures of counterparty risk. They find a statistically significant decline of about 2 basis points in Libor-OIS spreads on TAF event days, which they define to be days on which TAF announcements are made, auctions are conducted, or auction results are revealed. The greatest effect occurs on days of major TAF announcements. One advantage of their approach of using first differences is that it isolates the high-frequency response of spreads to the TAF and thereby is less likely to confound the effects of the TAF with other influences on spreads, as in the cases of using the post-Dec 11 dummy variable and the outstanding TAF balance as TAF indicators.

A potential disadvantage of the MSW approach is that it relies on getting the timing of the various variables correctly aligned. Relative to the other specifications where the variables are highly serially correlated, first differences of these data series have little serial correlation, making the timing critical for the analysis. This is a particular problem for the Libor data (collected to 11:00am London time), which, as MSW point out, occurs before the TAF events and the news that drive the CDS and OIS data of the same "day." MSW therefore shift the Libor data back one day, so that a Wednesday Libor data point is aligned with Tuesday's TAF, OIS, and CDS data, and we follow the same approach in this paper. Although this adjustment is sensible, the resulting data still suffer from misalignment of timing. It therefore is important to reexamine their results using the other measures of term lending rates, for which this timing problems are smaller. In addition, concerns about the accuracy of the Libor provide another argument for such a robustness analysis.

The first two columns of Table 9 report the results for a specification very similar to that of the basic specification of MSW where the Bank of America CDS rate is a proxy of counterparty risk. MSW used a proprietary data series for average CDS rates that we were not able to obtain; we consider the median CDS rate below. (The equation also includes a constant and the first lag of the term lending spread; to save on space, these estimated coefficients are not reported.) As reported in the first column of the table, we find about a -2 basis point effect of TAF events and this coefficient is statistically significant, consistent with MSW. We also find, like MSW, that TAF announcements have large negative effects on Libor-OIS spreads, while actual TAF operations have smaller, and in our results, statistically insignificant negative effects (column 2 of the

table). These results provide some support for a significant negative effect of the TAF on Libor-OIS spreads.

The effects of the overall TAF variable are smaller and statistically insignificant when using any of the other three measures of term lending rates. For example, for the CD-OIS spread, when counterparty risk is measured by the Bank of American CDS rate, the coefficient on the TAF dummy is slightly positive. If we break out the announcement effects from the other TAF events, the announcements have significant negative effects, but the operations have offsetting positive effects on CD-OIS spreads. The estimated TAF coefficients using the other two spreads lie between those for the Libor and the CD rates.[10] The results for one-month spreads, reported in Table 10 are similar to those for three-month spreads.

Table 11 reports the results when counterparty risk is measured by the median CDS rate. Qualitatively, the results are similar to those using the Bank of American CDS rate. In the case of the CD-OIS rate, the estimated effect of the overall TAF variable is less than half as large as compared to the Libor-OIS regression. The estimated overall TAF coefficient is statistically insignificant for all three measures of term lending rates besides Libor. The results for one-month spreads are similar and are reported in Table 12. Taking all these results together, the estimated coefficient on the overall TAF variable on three-month spreads ranges from -2.6 basis points to +0.8 basis point, and that for one-month spreads ranges from -2.2 basis points to +3.2 basis points.

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[10] The proper timing of the TAF variable for the term fed funds rate equation is not clear as for the other three measures of term lending rates. The tables report the case where the contemporaneous TAF variable is included. When we instead include the lagged TAF variable, the results are similar to those for the Eurodollar-OIS spreads. The regressions with the CD-OIS spreads prefer the contemporaneous TAF variable, which is used in the results reported in the table. Results using the CD data are not very sensitive to this timing issue.

One concern in analyzing the effects of the TAF using dummy variables is the sensitivity of results to the particular choice of TAF events. We therefore consider an alternative specification that allows for effects of the TAF on the day the auction is settled. Arguably, the actual distribution of funds affects liquidity in money markets. Table 13 reports the results for three-month rates, where counterparty risk is measured by the median CDS rate, and we add a dummy variable for TAF settlement days. The estimated coefficient on the expanded TAF variable (equal to the TAF event dummy + the TAF settlement day dummy) falls by about half and is statistically insignificant. When we allow for separate coefficients on the MSW TAF events and the settlement days, there is a negative effect on TAF event days and a positive effect on settlement days.

When settlement days are included in the TAF dummy variable, the TAF effects vanish for all three measures of term lending rates excluding Libor. When MSW TAF events area separated from settlement days, there are large increases in spreads on settlement days and smaller negative responses on the MSW TAF event days. Similar results obtain using one-month rates, as shown in Table 14. The one exception is one-month CD-OIS spreads, which rise in response to both TAF events and on settlement days.

One interpretation of these results is that market participants put some probability that the introduction and expansion of the TAF would help reduce spreads, but during the actual operation of the TAF auctions, including settlement days, spreads have tended to rise back up (after taking account of the effects of changes in counterparty risk). This

finding also demonstrates that accumulating the effects of TAF events on spreads, but ignoring the reverse movements on settlement days, as in MSW, may be misleading.

5. Conclusion

This extension of our previous work shows that our original results are robust. Counterparty risk still appears to be the key variable driving spreads on term lending rates, a finding that is robust to many different measures of the spread and the risks. Indeed, a number of researchers have confirmed our earlier results that measures of counterparty risk, such as credit default swaps, have a significant impact on the spreads. In contrast, we do not find a comparably robust significant impact of the TAF on the spreads. While other researchers have found significant TAF effects by altering the specification of the empirical equation that we originally proposed, these results are sensitive to small changes in specification, measures of the spread, or measures of risk.

We believe this area continues to be ripe for research. The turbulence in the money markets is clearly not over and as more data come in, estimates and tests should be updated and reassessed. In addition, it would be valuable to collect and provide data on the volume of trade in term inter-bank lending markets. Finally, as the amount of available data has grown, it is important to move beyond reduced-form equations toward structural estimates of the no-arbitrage models of the term structure of bank lending rates.

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Table 1
Three-Month Libor-OIS Spread

	1	2	3	4	5	6	7	8	9	10
CP Spread	.758	-.002								
	(.102)	(.059)								
CDS-BOA			.007	.002						
			(.001)	(.001)						
CDS-Median					.006	.002				
					(.001)	(.001)				
Tibor-Libor Spread							-4.551	-.552		
							(.427)	(.264)		
Libor-Repo Spread									.703	.170
									(.036)	(.082)
TAF Bid (t-4:t)	.097	-.005	-.073	-.003	-.023	.007	.169	-.002	-.044	-.003
	(.062)	(.012)	(.086)	(.019)	(.076)	(.015)	(.040)	(.018)	(.028)	(.010)
AR(1)		.989		.980		.988		.994		.983
		(.009)		(.013)		(.011)		(.009)		(.012)
R^2	.622	.979	.512	.980	.431	.980	.635	.984	.885	.982

Notes: Newey-West standard errors are reported under coefficient estimates. The TAF variable is the sum of the current and four lags of the TAF Bid dates.

Table 2
Three-Month CD-OIS Spread

	1	2	3	4	5	6	7	8	9	10
CP Spread	.840	.058								
	(.115)	(.073)								
CDS-BOA			.008	.004						
			(.001)	(.002)						
CDS-Median					.007	.002				
					(.001)	(.001)				
Tibor-Libor Spread							-5.180	-.729		
							(.494)	(.352)		
Libor-Repo Spread									.787	.081
									(.053)	(.091)
TAF Bid (t-4:t)	.158	.003	-.029	.019	.033	.000	.251	.028	.011	.004
	(.085)	(.030)	(.090)	(.038)	(.084)	(.027)	(.056)	(.031)	(.045)	(.033)
AR(1)		.975		.968		.973		.974		.972
		(.010)		(.014)		(.011)		(.011)		(.011)
R^2	.590	.961	.521	.961	.432	.958	.617	.958	.858	.961

Notes: Newey-West standard errors are reported under coefficient estimates. The TAF variable is the sum of the current and four lags of the TAF Bid dates.

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Table 3
Three-Month Term Fed Funds-OIS Spread

	1	2	3	4	5	6	7	8	9	10
CP Spread	.776	-.028								
	(.068)	(.050)								
CDS-BOA			.008	.003						
			(.001)	(.001)						
CDS-Median					.006	.001				
					(.001)	(.001)				
Tibor-Libor Spread							-4.560	-.792		
							(.470)	(.368)		
Libor-Repo Spread									.712	.037
									(.043)	(.038)
TAF Bid (t-4:t)	.175	.012	.003	.036	.062	.012	.254	.017	.040	.011
	(.092)	(.014)	(.094)	(.016)	(.086)	(.013)	(.047)	(.015)	(.007)	(.014)
AR(1)		.989		.978		.988		.990		.988
		(.008)		(.013)		(.009)		(.008)		(.009)
R^2	.627	.976	.553	.977	.470	.977	.612	.981	.872	.976

Notes: Newey-West standard errors are reported under coefficient estimates. The TAF variable is the sum of the current and four lags of the TAF Bid dates.

Table 4
Three-Month Eurodollar-OIS Spread

	1	2	3	4	5	6	7	8	9	10
CP Spread	.891	-.100								
	(.081)	(.053)								
CDS-BOA			.008	.004						
			(.001)	(.001)						
CDS-Median					.007	.001				
					(.001)	(.001)				
Tibor-Libor Spread							-5.200	-.753		
							(.541)	(.367)		
Libor-Repo Spread									.803	.066
									(.052)	(.052)
TAF Bid (t-4:t)	.153	-.003	-.043	-.001	.060	-.011	.280	-.024	.020	-.024
	(.080)	(.018)	(.109)	(.027)	(.098)	(.020)	(.054)	(.020)	(.043)	(.017)
AR(1)		.989		.974		.986		.988		.985
		(.008)		(.014)		(.009)		(.008)		(.009)
R^2	.629	.977	.513	.977	.428	.976	.620	.980	.865	.976

Notes: Newey-West standard errors are reported under coefficient estimates. The TAF variable is the sum of the current and four lags of the TAF Bid dates.

Table 5
Post-December 11 TAF Dummy
Three-month Rates

	Libor - OIS		CD – OIS		Term Fed Funds – OIS		Eurodollar – OIS	
	1	2	3	4	5	6	7	8
CDS-BOA	.009		.009		.008		.009	
	(.002)		(.002)		(.002)		(.002)	
CDS-Median		.006		.006		.005		.006
		(.002)		(.002)		(.002)		(.002)
TAF Dummy	-.178	-.056	-.107	.064	-.037	.123	-.108	.083
	(.125)	(.126)	(.141)	(.138)	(.138)	(.134)	(.164)	(.157)
R^2	.531	.433	.526	.434	.554	.477	.518	.429

Note: Newey-West standard errors are reported under coefficient estimates.

Table 6
Post-December 11 TAF Dummy
One-month Rates

	Libor – OIS		CD – OIS		Term Fed Funds – OIS		Eurodollar – OIS	
	1	2	3	4	5	6	7	8
CDS-BOA	.006		.006		.006		.007	
	(.002)		(.002)		(.002)		(.002)	
CDS-Median		.004		.003		.003		.004
		(.002)		(.002)		(.002)		(.002)
TAF Dummy	-.126	-.013	-.025	.099	-.010	.126	-.084	.090
	(.142)	(.134)	(.151)	(.139)	(.148)	(.135)	(.185)	(.168)
R^2	.351	.264	.345	.276	.393	.531	.354	.281

Note: Newey-West standard errors are reported under coefficient estimates.

Table 7
TAF Loan Balance: Three-month Rates

	Libor - OIS		CD - OIS		Term Fed Funds – OIS		Eurodollar – OIS	
	1	2	3	4	5	6	7	8
CDS-BOA	.008		.008		.008		.009	
	(.002)		(.002)		(.002)		(.002)	
CDS-Median		.006		.006		.005		.006
		(.001)		(.002)		(.001)		(.002)
TAF Balance/100	-.135	.004	-.015	.137	-.002	.141	-.035	.130
	(.121)	(.112)	(.132)	(.116)	(.119)	(.105)	(.137)	(.120)
R^2	.521	.430	.520	.445	.553	.484	.513	.437

Note: Newey-West standard errors are reported under coefficient estimates.

Table 8
TAF Loan Balance: One-month Rates

	Libor - OIS		CD – OIS		Term Fed Funds – OIS		Eurodollar – OIS	
	1	2	3	4	5	6	7	8
CDS-BOA	.006		.005		.005		.006	
	(.002)		(.002)		(.002)		(.002)	
CDS-Median		.004		.003		.003		.004
		(.001)		(.001)		(.001)		(.001)
TAF Balance/100	-.074	.050	.016	.133	.031	.150	-.004	.142
	(.135)	(.118)	(.126)	(.109)	(.125)	(.105)	(.151)	(.125)
R^2	.342	.267	.345	.286	.394	.342	.349	.293

Note: Newey-West standard errors are reported under coefficient estimates.

Table 9
First-Difference Specification: Three-month Rates

	Libor - OIS		CD – OIS		Term Fed Funds – OIS		Eurodollar – OIS	
	1	2	3	4	5	6	7	8
CDS-BOA	.002	.002	.003	.003	.002	.002	.004	.004
	(.001)	(.001)	(.002)	(.002)	(.001)	(.001)	(.001)	(.001)
TAF Dummies (all)	-.023		.008		.003		-.014	
	(.010)		(.022)		(.011)		(.018)	
TAF Dummies excl. announcements		-.016		.030		.013		-.007
		(.011)		(.026)		(.012)		(.021)
TAF Announcements		-.047		-.058		-.026		-.049
		(.012)		(.018)		(.014)		(.031)
R^2	.042	.048	.028	.048	.019	.028	.055	.060

Note: Newey-West standard errors are reported under coefficient estimates.

Table 10
First-Difference Specification: One-month Rates

	Libor - OIS		CD – OIS		Term Fed Funds – OIS		Eurodollar – OIS	
	1	2	3	4	5	6	7	8
CDS-BOA	.000	.000	.000	.000	.001	.002	.003	.003
	(.001)	(.001)	(.002)	(.002)	(.001)	(.001)	(.001)	(.001)
TAF Dummies (all)	-.017		.032		-.014		-.011	
	(.010)		(.034)		(.015)		(.017)	
TAF Dummies excl. announcements		-.010		.000		.006		-.006
		(.010)		(.039)		(.017)		(.019)
TAF Announcements		-.040		.127		-.065		-.033
		(.017)		(.082)		(.026)		(.024)
R^2	.012	.016	.039	.058	.019	.040	.027	.029

Note: Newey-West standard errors are reported under coefficient estimates.

Table 11
First-Difference Specification: Three-month Rates

	Libor - OIS		CD – OIS		Term Fed Funds – OIS		Eurodollar – OIS	
	1	2	3	4	5	6	7	8
CDS-Median	.002	.002	.002	.002	.000	.000	.000	.000
	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)
TAF Dummies (all)	-.026		-.011		-.012		-.021	
	(.009)		(.018)		(.012)		(.015)	
TAF Dummies excl. announcements		-.016		.009		-.004		-.017
		(.009)		(.019)		(.013)		(.019)
TAF Announcements		-.065		-.082		-.039		-.037
		(.016)		(.032)		(.018)		(.017)
R^2	.057	.073	.024	.045	.010	.017	.019	.021

Note: Newey-West standard errors are reported under coefficient estimates.

Table 12
First-Difference Specification: One-month Rates

	Libor – OIS		CD - OIS		Term Fed Funds – OIS		Eurodollar – OIS	
	1	2	3	4	5	6	7	8
CDS-Median	.001	.001	.000	.000	.001	.001	.001	.001
	(.001)	(.001)	(.002)	(.002)	(.001)	(.001)	(.001)	(.001)
TAF Dummies (all)	-.022		.024		-.018		-.017	
	(.009)		(.028)		(.012)		(.014)	
TAF Dummies excl. announcements		-.012		.003		-.006		-.016
		(.009)		(.029)		(.014)		(.017)
TAF Announcements		-.061		.097		-.063		-.019
		(.015)		(.079)		(.024)		(.015)
R^2	.025	.037	.045	.055	.021	.037	.017	.017

Note: Newey-West standard errors are reported under coefficient estimates.

Table 13
First-Difference Specification: Three-month Rates

	Libor – OIS		CD – OIS		Term Fed Funds – OIS		Eurodollar – OIS	
	1	2	3	4	5	6	7	8
CDS-Median	.002	.002	.002	.002	.000	.000	.001	.000
	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)
MSW TAF Dummies + TAF Settlement	-.014		-.002		.005		-.002	
	(.009)		(.018)		(.010)		(.013)	
MSW TAF Dummies		-.026		-.011		-.010		-.020
		(.009)		(.019)		(.012)		(.015)
TAF Settlement		.015		.024		.044		.049
		(.019)		(.027)		(.023)		(.024)
R^2	.042	.061	.022	.026	.007	.031	.009	.041

Note: Newey-West standard errors are reported under coefficient estimates.

Table 14
First-Difference Specification: One-month Rates

	Libor – OIS		CD - OIS		Term Fed Funds – OIS		Eurodollar – OIS	
	1	2	3	4	5	6	7	8
CDS-Median	.001	.001	.000	.000	.001	.000	.001	.000
	(.001)	(.001)	(.002)	(.002)	(.001)	(.001)	(.001)	(.001)
MSW TAF Dummies + TAF Settlement	-.015		.037		-.003		-.003	
	(.009)		(.024)		(.011)		(.012)	
MSW TAF Dummies		-.022		.024		-.017		-.016
		(.009)		(.028)		(.012)		(.015)
TAF Settlement		.004		.073		.036		.033
		(.026)		(.027)		(.019)		(.016)
R^2	.020	.025	.053	.057	.014	.034	.013	.024

Note: Newey-West standard errors are reported under coefficient estimates.