On Thursday, August 9, 2007 traders in New York, London, and other financial centers around the world suddenly faced a dramatic change in conditions in the money markets where they buy and sell short-term securities. The interest rate on overnight loans between banks—the effective federal funds rate—jumped to unusually high levels compared with the Fed’s target for the federal funds rate. So did the rate on inter-bank term loans with maturities of a few weeks or more, even though no change in the Fed’s target interest rate was contemplated. Many traders, bankers, and central bankers found these developments strange and surprising after many years of comparative calm.

The turmoil did not disappear the next day. The overnight interest rate whipsawed sharply down on Friday as the New York Fed pumped liquidity into the market, with the rate overshooting the target on the down side by a large margin. Even more worrisome was that term inter-bank rates, those for loans lasting a month to several months, moved up further on Friday despite the increase in liquidity provided by central banks. Rates on term lending, such as the Libor one- and three-month rates, seemed to have become disconnected from the overnight rate and thereby from the Fed’s target for interest rates.

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1 We thank John Cogan, Darrel Duffie, Alan Greenspan, Jamie Paterson, Steve Malekian, and Josie Smith for helpful comments. The views expressed in this paper are solely those of the authors and should not be interpreted as reflecting the views of the management of the Federal Reserve Bank of San Francisco or the Board of Governors of the Federal Reserve System.
It was as if banks suddenly demanded more liquidity or had grown reluctant to lend to each other, perhaps because of fears about the location of newly disclosed losses on sub-prime mortgages. Perhaps some even thought, incorrectly in retrospect, that the Fed was going to increase the overnight interest rate in the near future and therefore bid up term rates immediately.

As we now know, that Thursday and Friday of August 2007 turned out to be just the start of a remarkably long episode of tumult in global money markets. The stress has spread beyond these markets and is by no means over. From the vantage point of more than a half year later, the episode looks even more unusual than it did at the start, and perhaps qualifies as one of those highly unusual “black swan” events that Taleb (2007) has recently written about.

This episode raises important questions for monetary theory and policy. At a minimum, the sharp changes in risk premia and liquidity premia provide new data to stress test our theories of the term structure of interest rates. Moreover, the money market represents the first stage of the monetary transmission channel, where monetary policy actions first come in contact with the rest of the financial system and with the entire economy. A poorly functioning money market jeopardizes the effectiveness of monetary policy. Term money market rates, such as 3-month Libor, affect the rates on loans and securities from home mortgages to business loans, so a large spread between Libor and Fed funds rate can itself interfere with how monetary policy affects the economy. For these reasons, the Federal Reserve has tried to find ways to reduce the spread between term fed funds and the overnight rate, including lowering the cost of borrowing by banks at the discount window, directly encouraging banks to borrow from
the window, and, most recently, introducing a new way for banks and other financial institutions to borrow from the Fed though the new Term Auction Facility (TAF).

We have several aims in analyzing this episode: first, to document the unusual developments in the money markets; second, to assess various explanations for these developments; and third, to evaluate the impact of various central bank policy measures. Though the episode is not over, we feel that enough time has passed and enough observations have accumulated to draw several conclusions that are of research interest and may be useful to policy makers going forward.

1. The August 9 Break Point: Target, Effective, and Term Fed Funds

Figure 1 focuses on three money market interest rates which nicely illustrate the changes in market conditions in August 2007—(1) the target for the federal funds interest rate as set by the Federal Open Market Committee, (2) the daily effective overnight federal funds rate in the market, and (3) the interest rate on 3-month Libor. The Libor interest rate in the London inter-bank market in dollars is essentially the same as the interest rate on term fed funds for comparable maturities, so we focus on the former in this study. (Nothing material would change if we focused on term fed funds directly.)

First, observe in Figure 1 that the volatility of the effective federal funds rate (the average rate at which overnight fed funds actually transact) relative to the target increased after August 9. During the period before August, the standard deviation of the difference between the effective funds rate and the target was only 3 basis points. Since August 9 the standard deviation has been 21 basis points. Note that the steadiness of the federal funds rate at 5.25 percent may be one of the reasons for the relatively small
misses in the earlier period, but if you include the years back to 2004 the volatility is 6 basis points, still much less than 21 basis points. There have been other periods where the effective funds rate was more volatile, particularly before the Fed became more transparent about its interest rate setting. See Taylor (2001) for a model that focuses on effective fed funds rate volatility.

Second, and this is the main focus of our paper, observe how the spread between 3-month Libor and the Fed’s overnight federal funds rate target increased dramatically starting in August and fluctuated erratically after that. During the year before August 2007 the 3-month Libor spread above target federal funds averaged only 11 basis with a standard deviation of only 1 basis point—a period of very low volatility. Similar changes in spreads between term rates and overnight rates are apparent for other Libor maturities and for several other countries, as we document below.

![Figure 1. Key money market rates from September 2006 to February 2008](image-url)
2. Potential Explanations

Ever since the turmoil began, traders, bankers, economists, and many others have offered explanations for the increase in the Libor spread. We think it is useful to categorize the many explanations into several types.

First, and perhaps the most commonly mentioned, is “counterparty risk,” which simply means banks became more reluctant to lend to other banks because of the perception that the risk of default on the loan had increased and/or the market price of taking on such risk had risen. Recall that inter-bank lending in the Libor market or term fed funds is unsecured.

Of course, this explanation has the virtue of reflecting the widely-reported reality that many banks were writing down securities that had either been downgraded or were backed by sub-prime mortgages that were becoming delinquent or going into foreclosure as housing prices stopped increasing and began to fall. Clearly the continuing decline in housing prices and the slowing economy could easily raise the chances of further bad debts on the banks balance sheets. Moreover, the realization of the risks in derivative securities based on sub-prime mortgages triggered doubts about many other aspects of the derivative market including the ability of credit default insurers to meet their obligations and the size and nature of the likely restructuring of the off balance sheet operations know as SIVs

Another explanation, which might be called “liquidity risk,” is that traders at one bank are reluctant to expose the trader’s bank’s funds during a period of time where those funds might be needed to cover the bank’s own shortfalls. Effectively, the trader may not
be given as much “balance sheet” to invest, which is perceived as a shortage of liquidity to the trader.

A third and closely related explanation was often heard during the period of November and January, It was that banks needed liquidity to make sure that their own balance sheets looked respectable in end-of-year financial reports, especially under the stress and scrutiny that many banks had been under.

The fourth explanation is due to expectations of future interest rate changes. Except for the very beginning of the turmoil period this explanation would tend to bring the spreads down because of expectations of future interest rate decline due to policy easing. Nevertheless it is essential to take account of this factor when assessing the other factors that could be moving the spread around. For example, if you look closely at Figure 1 you see that spread between Libor and the fed funds target comes down before cuts in the federal funds rate. Indeed, toward the end of our sample in mid February, the spread had narrowed significantly, but this could be due to expectations of future interest rate cuts. We therefore control for expectations of future interest rates in the analysis that follows.

3. A Model

In order to distinguish between these various explanations we need a model of money market interest rates through which we can interpret the risk, liquidity, and expectations factors that we have argued are important. It is essential to take out pure expectations effects, which always create differences between longer term interest rates
and overnight fed funds. Recall that Libor is a term rate (3 month in Figure 1) and fed funds are one-day maturity.

Early models of the money market used for monetary policy developed in the 1970s and 1980s (see Anderson and Rasche (1982) for a review) are not sufficient for this purpose because they neither account for forward-looking expectations nor risk premia. More recent finance models used by Ang and Piazzesi (2003) and McGough, Rudebusch and Williams (2005) are more useful for this purpose. Moreover the earlier models used estimated demand functions for securities, an approach that is not possible to implement in the current situation because available data is in the form of prices (in the form of interest rates), rather than quantities.

Our model focuses on three interest rates as defined below:

- \( i_t^{(n)} \) = libor rate with maturity \( n \) (with \( n = 1 \) defined to be the overnight federal funds rate)
- \( s_t^{(n)} \) = OIS with maturity \( n \) (with \( n = 1 \) also the overnight federal funds rate; that is \( s_t^{(1)} = i_t^{(1)} \))
- \( a_t^{(n)} \) = accepted bid on the term action facility (TAF) (\( n \) around 30 days)

The Overnight Indexed Swap (OIS) rate is closely connected to the average overnight interest rate expected to prevail over the next \( n \) days. An OIS is structured as follows: at maturity, the parties exchange the difference between the interest that would be accrued from repeatedly rolling over an investment in the overnight market and the interest that would be accrued at the agreed OIS fixed rate. The TAF is described in detail below.

Following the literature on arbitrage-free pricing of bonds, we write down term structure relations for the Libor (or fed funds) term structure interest rates. Let \( P_t^{(n)} \) denote the price of a zero-coupon loan with \( n \) periods until maturity. Equation 1 relates the yield on the loan, \( i_t^{(n)} \), to its price. The prices of zero-coupon loans follow the
recursion given in equation 2, where $m_{t+1}$ denotes the pricing kernel. As in Ang and Piazzesi (2003), we assume the pricing kernel takes the form shown in equation 3 and the market price of risk, $\lambda_t$, takes the linear form shown in equation 4, where $x_t$ is a vector of variables that affect the price of risk.

\begin{align*}
(1) \quad i_t^{(n)} &= n^{-1} \log(P_t^{(n)}) \\
(2) \quad P_t^{(n+1)} &= E_t[m_{t+1} P_{t+1}^{(n)}] \\
(3) \quad m_{t+1} &= \exp(-i_t^{(1)} - 0.5 \lambda_t^2 - \lambda_t e_{t+1}) \\
(4) \quad \lambda_t &= -\gamma_0 - \gamma_1 x_t
\end{align*}

Similar equations can be written down for the OIS and the TAF rates. In contrast to Libor loans, OIS transactions involve very little counterparty risk as no money changes hands until the maturity date. The only potential loss in case of default by the counterparty is the difference between the two interest rates on which the OIS is based. There exists some interest rate risk reflecting uncertainty regarding the future path of interest rates. However, given the short maturities of up to three months that we analyze in this paper, the market price of interest rate risk is likely very small, and as an approximation we assume that it is zero. Loans from the TAF are collateralized and therefore also carry relatively small risk. We therefore assume that the market price of risk associated with TAF loans is likewise zero.

Taken together, this assumption of a zero market price of risk for OIS and TAF rates implies that as part of the null hypothesis of an absence of liquidity effects in the
pricing of the various loans, we have: \( a_i^{(n)} = s_i^{(n)} \). Moreover, absent liquidity effects, we would not expect the \( \lambda_i \) for the inter-bank rates to be influenced by the TAF.

Under these assumptions, the OIS rate equals the average of the overnight night interest rates expected until maturity. By subtracting the appropriate OIS rate from the term Libor yield, we are able to cleanse expectations effects from the Libor yield. Under our null hypothesis of no liquidity effects, the resulting difference in rates, \( i_i^{(n)} - s_i^{(n)} \), reflects only the pricing of risk associated with Libor lending. Thus, in the next section, we use this difference in yields as a measure the effects of risk on yields. We will use several different measures of counterparty risk as explanatory variables in the price of risk, as explained below.

4. Focusing on the Libor OIS spread.

Figure 2 plots the spread between Libor and OIS during the same period as in Figure 1. It paints quite a different picture of the spread, and shows the value of removing expectations of future interest rates in analyzing term spreads. For example, looking at Figure 1 you might think the spread returned to normal by mid February. However, examination of Figure 2 shows that the spread is still quite large. In this chart and in the rest of our analysis we focus on 3 month Libor; similar results are found by looking at other maturities such as one-month Libor.

Figure 2 illustrates clearly how the spread between Libor and OIS jumped on August 9th. From December 4, 2001—the day when our OIS 3-month data begin—through 8 August 2007, the spread averaged 11 basis points with a standard deviation of 3.6 basis points. It jumped by 25 basis points above this average to 34 basis points on
August 9th, and since then it has fluctuated widely between a minimum of 30 basis points and a maximum of 106 basis points; it has averaged 65 basis points. On February 15, it was 53 basis points slightly less than the average since August 9, 2007—clearly not a return to a “normal” level. The peak was on December 6, 2007, and there was a big downward movement on December 12-14, 2007, and a more gradual decline began until another big jump down occurred on January 14-15, 2008.

![Graph showing 3-month LIBOR OIS Spread](image)

**Figure 2.** Taking out the pure expectations effects and leaving in the risk and liquidity effects.

Looking at spreads going back to December 2001 illustrates just how unusual this episode has been. Figure 3 plots the same data as in Figure 2, but starting in December 2001. As mentioned above, the spread on August 9 was 25 basis points above the pre-August 9, 2007 average. That is 7 times the standard deviation before August 9—more
than a 6-sigma event. The mean since then is 16 standard deviations above the old mean, which under normality would have been an extraordinarily improbable event.

Figure 3. A Black Swan in the Money Market?

Is it possible to get a longer perspective on the recent episodes of risk/liquidity premia on Libor? Thus far our comparison only goes back to late 2001, the time that OIS data started being collected. While the large spread observed since August is unusual compared with this recent period, the longer history of these yields should also be examined. Figure 4 is useful for this purpose. It shows the spread between unsecured inter-bank lending (Libor) and secured inter-bank Repo (Repurchase Agreements backed by Treasury securities) lending of the same maturity, in this case three months. Note that this measure of risk spreads using Repo rates to control for expectations effects shows the
same large increase in spreads after August 9. This measure of risk spreads experienced some episodes of short-lived spikes in the 1990s, indicating that the current episode is not as highly improbable as implied by the more recent evidence based on Libor-OIS spreads. Nonetheless, these past episodes were not nearly as large or persistent as that experienced in the past six months.

Figure 4. A Longer Perspective

5. Overnight Funds Volatility: Counterpart Risk or Increased Tolerance to Misses

Thus far we have shown how important it is to take out expectations effects in order to assess the increase in risk and liquidity premia in the interbank market. It is also possible to focus directly in the increase in volatility of the effective funds rate relative to
its target as set by the FOMC. Figure 5 shows the difference between the effective fed funds rate and the target fed funds rate.

There are several possible explanations for the increased volatility (or “misses” of the effective rate from the target). One is the same counterparty risk that is offered as an explanation for the spread seen in the term lending market. Fed funds trades are largely bilateral. Hence rates can differ from trade to trade even at the same point in time. If traders are more circumspect about some borrowers than others then this will show up in increased volatility of the effective rate, which is estimated from the bilateral trades. That volatility has increased in the overnight market is therefore corroborating evidence that counter party risk may be part of the explanation for the increased spread in the term market.

Another explanation, however, is that the underlying volatility in intraday trading in the fed funds market and the New York Fed’s trading desk has acted to prevent the rate from spiking on the up side. Indeed there is a noticeable downward bias in the misses in
the past six months.

![Graph showing Effective Federal Funds less Target]

**Figure 5.** Increased Volatility in the Overnight Federal Funds Market

6. **Measures and Indicators of Counterparty risk**

   In this section we consider a range of possible indicators of counterparty risk. To the extent that these are timed with the black swan event documented in Figure 2, they may offer evidence that such sources of risk, rather than more general liquidity concerns, have been the main reason for the increased spread in the Libor markets.

**Asset Backed Commercial Paper versus Dealer Placed Commercial Paper**

   Another market that has been under extreme stress during this period is the market that grew as a mechanism for financing the purchase of home mortgages in the process of assembling them into various derivative securities. Because the commercial
paper was backed by these mortgages or by the mortgage pools, they are called asset-backed commercial paper. They are a potential measure of the counterparty risk in commercial banks because banks held this paper either directly or indirectly through their SIV operations.

Figure 6 shows the spread between asset-backed commercial paper and dealer-placed commercial paper, which excludes the more risky asset-backed issues, letter-of-credit issues, and direct issues from firms. Clearly there was an increase in the spread about the same time as the Libor spreads increased. Interestingly the patterns of decline and the ups and downs also have similarities. To the extent that this is a good indicator of counterparty risk, this timing lends support for the counterparty risk explanation.
Figure 6. Asset Backed Commercial Paper Spreads Increased about the Same Time as Libor Spreads

Credit Default Swaps

Another measure of counter party risk is the probability that banks might default on their debt. These probabilities can be assessed using the premiums on credit default swaps that are like insurance policies for corporate bonds. The buyer of a credit default swap (CDS) pays a periodic fee to a seller in exchange for the promise of a payment, in the event of bankruptcy or default, of the difference between the par value and the market value of the corporate bond. Figure 7 shows the rates on five-year CDS for several major financial institutions in recent years. Note the increase starting in July of 2007. Figure 8 focuses on the three large commercial banks. Unlike the asset backed commercial paper
spread, there is no evidence of a decline in risk this year at the time that the Libor spreads declined.

**Figure 7.** Risk at Banks as measured by CDS rates increased in the summer of 2007
**Figure 8.** Risks as measure by CDS at three major banks continued increasing

*Developments in other Countries*

Yet another way to get at the risk in the inter-bank market is to look at Libor spreads in other currencies.

*Euro Libor and Pound Sterling Libor*  Figure 9 shows the Libor spreads for loans in Euro and Pound Sterling using the same OIS adjustment method we used above to calculate the U.S. dollar Libor spreads in Figure 2. We plot these other two spreads along with the dollar spread since 2004. All three spreads move closely together, indicating that whatever the source of these spreads, it is affecting money markets for all three currencies in the same way.
Figure 9. Libor spread increased in three major currencies in August 2007

Yen Libor and Tibor. Another useful indicator is a comparison of the Libor rate denominated in Yen to that of the Tibor, the rate on inter-bank loans between Japanese banks in the Tokyo markets. Figure 10 shows the two rates since the mid 1990s. Note that the chart shows the Libor yields themselves, not spreads. Japanese interest rates have been much lower than interest rates in the United States, Europe or the UK. Nonetheless, spreads can and do develop between different types of inter-bank lending and indicate risk factors in the banking sector. Indeed, in the late 1990s Japanese banks experienced sizable spreads on inter-bank lending comparable to what is being experienced in New York and London in this recent episode of stress. As explained by Peek and Rosengren (2001) and by Corvig, Low, and Melvin (2004), risks in the banking sector in Tokyo caused interest rates on inter-bank loans to rise in Tokyo compared with
London. In other words, Tibor rates rose relative to Libor rates, as shown in Figure 10 and Figure 11, which shows the Tibor-Libor spread for three-month loans.

Figure 10. Pattern of Tibor and Libor since 1990s

This pattern of Tibor-Libor spreads has reversed, with Tibor rates now lower than corresponding Libor rates. One interpretation is that the demand for liquidity has not risen as much for Japanese banks as for the major banks in these other markets. In our view, a more probable explanation is that the risks associated with inter-bank loans from American and European banks have increased relative to those for loans among Japanese banks. Accordingly, the “negative Japan premium” or Japan discount provides another measure of counterparty risk among banks in New York, London, and Frankfurt.
Figure 11. Unlike the Japan premium in the 1990s the Tibor-Libor spread turned negative fell when Libor spreads increased in the United States and Europe

**Swiss Libor.** Finally we look at Libor loans denominated in Swiss Francs. The Swiss National bank follows a different strategy for monetary operations than the Federal Reserve, the European Central Bank, or the Bank of England. The Swiss National Bank targets the three-month Libor rate and adjusts the amount of liquidity in the overnight market to hit its target. Hence, if there is an increase in the spread between three-month Libor and the overnight rate, then the SNB will take actions to reduce the overnight rate by providing extra liquidity to the market. (See Jordan Kugler (2004)). As a result, a very different pattern emerges in the overnight and term Libor rates. However, the same evidence of risk emerges if one looks at the spread between overnight and term rates.
These actions can be seen clearly in Figure 12. With a target for 3-month Libor of 2.75 percent, the overnight rate declined temporarily while the Libor rate remained steady. Hence, the spread between Libor and overnight was realized by a lowering of the overnight rate. The way this works is nicely illustrated in the period from August through February of 2008. The Swiss Libor rate first increased a bit in August and then was brought to target. Part of this initial increase was anticipation of an increase in the target, but part was evidently due to an increase in risk.

Figure 12. Term Libor spread in Switzerland resulted in a temporary decline in the overnight rate with current operating procedures at the SNB
7. The Term Auction Facility

In an effort to lower the unusual term lending spreads documented in Figure 2, the Federal Reserve has taken a number of actions. First it lowered the spread between the discount rate and the fed funds target directly and encouraged more discount window borrowing. But, banks did not increase their borrowing to any large degree. Second, in December 2007, the Federal Reserve established a new facility called the term auction facility (TAF) to provide liquidity directly to financial institutions at a longer duration, and thereby drive down the spread on term lending relative to overnight loans. According to the Federal Reserve Board, by injecting “term funds through a broader range of counterparties and against a broader range of collateral than open market operations, this facility could help ensure that liquidity provisions can be disseminated efficiently even when the unsecured interbank markets are under stress” (Board of Governors of the Federal Reserve, 2007).

The TAF was first announced on Dec 12. The TAF allows financial institutions to make bids for term borrowing from the Fed (with maturities typically of 28 days). So far, five TAF auctions have been held: December 17, December 20, January 14, January 20, and February 11 and more are scheduled to be held. Table 1 provides the key information about each of these auctions. Figure 13 shows the dates with vertical lines. TAF loans are collateralized following the procedures used for discount window borrowing. The Board of Governors sets the auction amount and the minimum interest rate bid, which is set equal to the OIS rate corresponding to the term of the loan. The interest rate on the loans is determined by an auction and is reported as the “stop-out” rate in Table 1. The spread between the auction stop-out rates and the OIS rate at the time
bids were taken averaged around 50 basis points for the first two auctions, but for the subsequent auctions this spread has been between 2 and 15 basis points.

Table 1. Term Auctions with TAF

<table>
<thead>
<tr>
<th>Bid Day</th>
<th>Settle Day</th>
<th>Term Days</th>
<th>Amt ($B)</th>
<th>Min Bid</th>
<th>Stop-out Bid</th>
<th>Spread</th>
<th>Bid/Cover</th>
<th># bidders</th>
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<tbody>
<tr>
<td>17-Dec</td>
<td>20-Dec</td>
<td>28</td>
<td>20</td>
<td>4.170</td>
<td>4.650</td>
<td>0.480</td>
<td>3.08</td>
<td>93</td>
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<tr>
<td>20-Dec</td>
<td>27-Dec</td>
<td>35</td>
<td>20</td>
<td>4.150</td>
<td>4.670</td>
<td>0.520</td>
<td>2.88</td>
<td>73</td>
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<tr>
<td>14-Jan</td>
<td>17-Jan</td>
<td>28</td>
<td>30</td>
<td>3.880</td>
<td>3.950</td>
<td>0.070</td>
<td>1.85</td>
<td>56</td>
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<tr>
<td>28-Jan</td>
<td>31-Jan</td>
<td>28</td>
<td>30</td>
<td>3.100</td>
<td>3.123</td>
<td>0.023</td>
<td>1.25</td>
<td>52</td>
</tr>
<tr>
<td>11-Feb</td>
<td>14-Feb</td>
<td>28</td>
<td>30</td>
<td>2.860</td>
<td>3.010</td>
<td>0.150</td>
<td>1.95</td>
<td>66</td>
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</tbody>
</table>

Figure 13. Timing of the TAF auctions
In assessing its effects, it is important to note that the TAF does not increase the amount of total liquidity in the money markets. Any increase in liquidity that comes from banks borrowing from the Fed using the TAF will be offset by open market sales of securities by the Fed to keep the total supply of reserves from falling rapidly. The actions are essentially automatic in the sense that the Fed must sell securities to keep the federal funds rate on target. Figure 14 shows that this is indeed what has happened under the TAF. The System Open Market Account reduced its outright holdings of securities (light blue area) by essentially the same amount as the TAF (dark blue area). This can also be seen in Figure 15: Note that TAF borrowings have increased dramatically only to be completely offset by a sharp declined in non-borrowed reserves leaving total bank reserves at the Fed largely unchanged.

**Figure 14** TAF did not increase the total amount of liquidity
Figure 15. As TAF borrowings from the Fed go up, non-borrowed reserves decline to offset the increase, keeping total reserves unchanged

8. Econometric Tests

In this section we endeavor to test whether the various risk variables can explain the Libor-OIS spread using the measures explored in previous sections. The test is performed with simple regressions. The null hypotheses are that (1) the risk factors do not significantly affect the spread and (2) the TAF does not significantly affect the spread. In each regression we use the daily data presented in the charts and look at the sample period from January 2, 2007 through February 15, 2008, a span of time that includes both the market turmoil period and a comparable period of time before the turmoil. The dependent variable in each case is the Libor3 – OIS3 spread. The independent variables are various indicators of counterparty risk as described in the title to each table and a TAF dummy (TAFD) which is one on each of the five TAF bid dates.
and zero elsewhere. There are four sets of regressions corresponding to different risk measures. For each of the risk measures, we report OLS regressions as well as regressions corrected for first-order serial correlation (AR(1)) with the estimated serial correlation coefficient $\rho$ reported.

Table 2  Asset Backed Commercial Paper Spread:

**OLS: $R^2 = .74$**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
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<tr>
<td>Constant</td>
<td>0.128805</td>
<td>0.012328</td>
<td>10.44793</td>
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<tr>
<td>SPREADABCP</td>
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<td>0.028335</td>
<td>27.50639</td>
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<td>TAFD</td>
<td>0.015851</td>
<td>0.072392</td>
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**AR(1): $\rho = .982$**

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<td>TAFD</td>
<td>0.009604</td>
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Table 3. Credit Default Swap on Citigroup:

**OLS: $R^2=.59$**

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<td>-0.012040</td>
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**AR(1): $\rho = .981$**

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<th>t-Statistic</th>
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<td>CCGI1U5</td>
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<td>TAFD</td>
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<td>0.313030</td>
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</table>
Table 4: Credit Default Swap on Bank of America:

**OLS: R^2 = .94**

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<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.020509</td>
<td>0.021995</td>
<td>0.932456</td>
</tr>
<tr>
<td>CBAC1U5</td>
<td>0.010274</td>
<td>0.000567</td>
<td>18.10748</td>
</tr>
<tr>
<td>TAFD</td>
<td>0.074080</td>
<td>0.121842</td>
<td>0.608001</td>
</tr>
</tbody>
</table>

**AR(1): ρ = .983**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.159746</td>
<td>0.150281</td>
<td>1.062981</td>
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<tr>
<td>CBAC1U5</td>
<td>0.006227</td>
<td>0.000909</td>
<td>6.850343</td>
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<tr>
<td>TAFD</td>
<td>0.005911</td>
<td>0.016379</td>
<td>0.360874</td>
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</tbody>
</table>

Table 5: Tibor-Libor Spread:

**OLS: R^2 = .61**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
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</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.095952</td>
<td>0.017103</td>
<td>5.610381</td>
</tr>
<tr>
<td>JAPANPREMIUM</td>
<td>-4.423828</td>
<td>0.220618</td>
<td>-20.05198</td>
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<tr>
<td>TAFD</td>
<td>0.180107</td>
<td>0.113209</td>
<td>1.590923</td>
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</table>

**AR(1): ρ = .987**

<table>
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<th>Coefficient</th>
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<th>t-Statistic</th>
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</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.548256</td>
<td>0.309707</td>
<td>1.770243</td>
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<tr>
<td>JAPANPREMIUM</td>
<td>-0.605535</td>
<td>0.243503</td>
<td>-2.486772</td>
</tr>
<tr>
<td>TAFD</td>
<td>0.012366</td>
<td>0.020045</td>
<td>0.616937</td>
</tr>
</tbody>
</table>

The common theme of all these results is that (1) one can easily reject the null hypothesis that the counterparty risk factors are not significant in the Libor OIS spread and (2) one cannot reject the null hypothesis that the TAF has no effect.
9. Conclusion

In this paper we documented the unusually large spread between term Libor and overnight interest rates in the United States and other money markets since August 2007. We also introduced a financial model to adjust for expectations effects and to test for various explanations that have been offered to explain this unusual development.

The model has two implications: first that counterparty risk could be a factor in explaining the spread between the Libor rate and the OIS rate, and second that the TAF should not have an effect on the spread. Since the TAF does not affect total liquidity, expectations of future overnight rates, or counterparty risk, the model implies that it will not affect the spread. Our simple econometric tests support both of those implications of our model.
References


McGough, Bruce, Glenn B. Rudebusch, and John C. Williams (2005), “Using a Long-Term Interest Rate as the Monetary Policy Instrument,” *Journal of Monetary Economics* (July), 52, 5, 855 – 879

