



VOL. 5, NO. 4
MAY 2010

Economic Letter



Insights from the
FEDERAL RESERVE BANK OF DALLAS

The Term Auction Facility's Effectiveness in the Financial Crisis of 2007–09

by Tao Wu

*The TAF and other
lending facilities
established during the
crisis were an
experiment that
proved effective in
addressing severe
financial turbulence.*

In the second half of 2007, financial turmoil swept over the U.S. and other major economies. Triggered by a subprime mortgage meltdown, the crisis quickly spread to other major financial markets and precipitated the worst economic downturn since the Great Depression. Although financial and economic conditions have improved substantially, the wrenching episode's effects are still with us.

During the crisis, financial markets experienced tremendous strains, and the cost of short-term funding rose sharply. The gap between the three-month unsecured London interbank offered rate (Libor) and the overnight indexed swap (OIS) rate is frequently used as a measure of tensions in interbank money markets. As the crisis began in early August, this spread jumped from less than 0.1 percentage point to almost 1 percentage point within a month. At the crisis's peak in September 2008—just after the collapse of Lehman Brothers



To find out whether the liquidity facilities have been working as intended, it's important to understand the nature of the heightened strains on interbank money markets.

and the rescue of American International Group—the gap soared to an unprecedented 3.7 percentage points.

The spikes in the Libor–OIS gap testify to the severity of a crisis that posed serious challenges to central banks around the world. In response, several of them created new lending facilities to quickly provide liquidity to the banking sector and improve market functioning. The list includes the European Central Bank, Bank of England, Bank of Canada and Swiss National Bank. On Dec. 12, 2007, the Federal Reserve established its version—the term auction facility (TAF).

Researchers have yet to reach a consensus on the effectiveness of such facilities. This *Economic Letter*, based on a recent study, provides an econometric evaluation of whether the TAF helped relieve strains in the U.S. money market.¹ The findings reveal that the TAF has reduced liquidity risk premiums paid by banks; however, it has been less effective in cutting counterparty risk premiums.

The Financial Crisis

The subprime mortgage market's growing problems began to draw attention in early 2007. However, it took several months for the financial crisis to spread to money markets. On Aug. 9, 2007, French investment bank BNP Paribas halted redemptions from three of its subsidiary mutual funds, and in response, overnight interest rates shot up in Europe and the U.S.

The interbank money market is the main gateway for commercial banks to quickly obtain funding to make loans. Deteriorating conditions greatly impaired the stability of this critical short-term funding and posed severe challenges to central banks' ability to provide ample liquidity through regular monetary policy channels.

Under normal circumstances, the Fed injects liquidity into the economy by two means—conducting open-market operations and lending at the discount window. However, the interbank

lending market's breakdown rendered those tools inadequate for addressing the unusual financial market pressures during this crisis.

Open-market operations are the Fed's most powerful and frequently used policy tool, providing overnight credits at the federal funds rate. Every day, the Fed trades on the open market with a select group of primary dealers, directly buying or selling Treasury or government agency securities or repurchase agreements against such securities.

In normal times, primary dealers distribute the liquidity increases to other financial institutions through the interbank money market, increasing the flow of credit to the overall economy. In turbulent times, however, financial institutions are reluctant to lend to each other, and the channel can clog.

The discount window gives the Fed an alternative means of adding liquidity. Depository institutions in sound condition can obtain fully collateralized overnight loans at an interest rate that's usually higher than the federal funds rate.

From 2003 to the summer of 2007, the discount rate had been 100 basis points above the federal funds target. After the initial jump in money-market interest rates, the Fed narrowed the discount rate premium to 50 basis points on Aug. 17, 2007, and to 25 basis points on March 17, 2008. The terms of discount window loans were extended to up to 30 days in August 2007 and later to 90 days. The Fed also made the loans renewable at the request of the borrowers.

These measures were taken to encourage banks to use the discount window, but the effects were modest due to the so-called stigma problem. During a financial crisis, banks may be reluctant to borrow from the discount window because of concerns that markets would interpret it as a sign of financial weakness. The stigma might damage their reputations, lower their market values and reduce their ability to borrow in the market.

As strains in money markets persisted and worsened in early December 2007, the Fed established a new lending alternative—the term auction facility. Through this facility, the Fed auctioned preannounced amounts of credit, twice a month, to eligible depository institutions in sound financial condition for a term of one month instead of overnight.² The TAF accepted the same kinds of collateral as the discount window.

The TAF was initially set at \$20 billion for each auction. It was gradually increased to \$150 billion in January 2009 before it was scaled back. The final auction was held March 8, 2010.

After the TAF's establishment, credit conditions in the interbank market improved significantly. The three-month Libor spread over the OIS rate dropped sharply from more than 1 percentage point in early December 2007 to less than 0.3 percentage point in late January 2008 (*Chart 1*). However, the spread widened again to about 0.8 percentage point in spring 2008.

As macroeconomic and financial market conditions worsened substantially in the second half of 2008, the spread jumped. The upswing and the later surge in Libor spreads raised doubts about the new liquidity facility's effectiveness.³

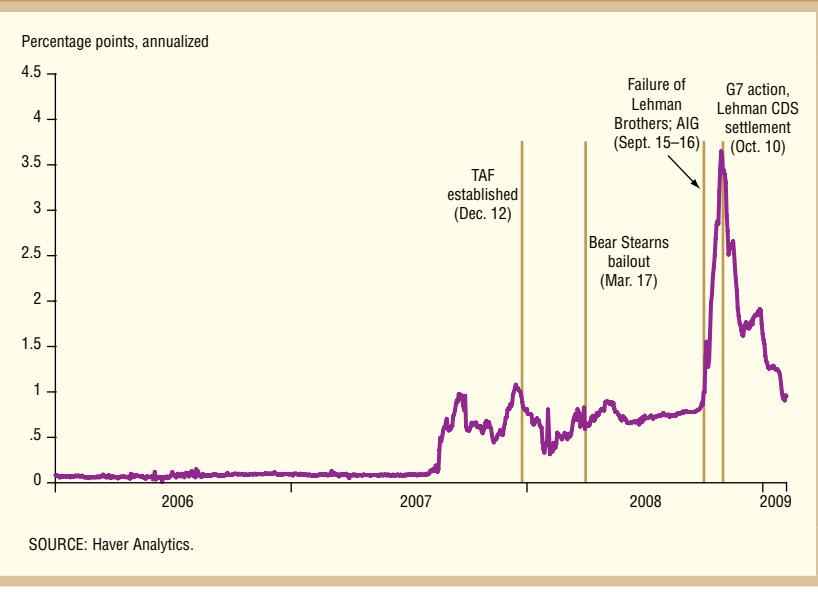
To find out whether a liquidity facility is working as intended, it's important to understand the nature of the heightened strains on interbank money markets. During financial stress, banks become increasingly reluctant to lend to each other for two reasons.

First, counterparty risk—the possibility that the institution on the other side of the transaction may default—increases with the uncertainty about banks' financial conditions.

Second, banks tend to build up precautionary liquidity to guard against mounting uncertainty about the market value of their assets—for instance, various structured credit products. In times of financial stress, funding to keep these assets on banks' balance

Chart 1

Libor–OIS Spread Widens in 2008, Raising Doubts About TAF



sheets is likely to become more costly and harder to obtain. Fund managers may also demand that extra liquidity be readily available to cover potential redemptions.⁴

Through lending facilities to provide credit to financial institutions in need, the Fed and other central banks sought to relieve financial strains through several channels.

The first and most direct channel involved providing additional funding to banks in immediate need of liquidity, lowering short-term borrowing costs.⁵

The second channel focused on reducing the pressure on banks to liquidate assets, helping counteract upward pressure on banks' funding costs from deterioration in money market conditions. All else equal, this may contribute to a decline in counterparty risk.

The third channel centered on strengthening confidence so that investors would demand less compensation for a given unit of risk—i.e., the price of risk may decline in the TAF's presence. The risk premium—the product

of the price per unit of risk and the perceived amount of risk—should also decline.

The final channel entailed offering other readily available funding sources to discourage banks from excessively hoarding liquidity purely out of individual precautionary concerns.

These channels provided reason to believe the TAF and other liquidity facilities might alleviate financial strains in the interbank money market.

Quantifying TAF's Effects

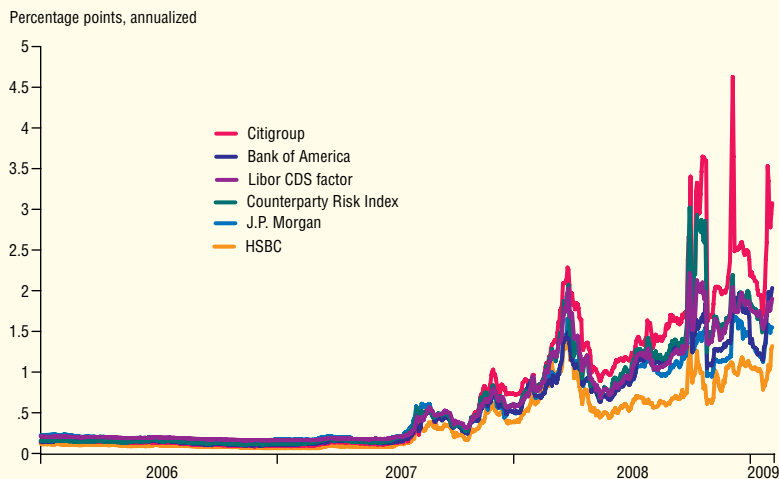
Money market strains come from both the larger demand for liquidity during a financial crisis and heightened counterparty risk. I first examine the TAF's effect by addressing these two concerns separately, and then quantify the TAF's overall effect.

Reducing liquidity premiums.

I focus on examining the TAF's effect in relieving banks' liquidity concerns by controlling for the variation in systematic counterparty risk premiums. Because measures of these premiums aren't readily available, I construct one based on the observed credit default



Chart 2
Credit Default Swap Premiums Gyrate During Crisis



NOTES: The Libor CDS factor summarizes the five-year rates for the 16 banks in the Libor U.S. dollar survey. The Counterparty Risk Index is based on the average credit spread of five-year credit default swap contracts traded by 15 major financial firms.
 SOURCES: Bloomberg; author's calculations.

dollar Libor survey and use it as a proxy for the major banks' systematic default risk premiums.

Chart 2 displays this systematic counterparty risk factor along with the individual CDS rates of several major banks included in the Libor survey. The constructed indicator captures the variations of individual CDS rates quite well, showing waves of volatility during the crisis.

I then regress the Libor spreads on the constructed systematic counterparty default risk factor and on a dummy variable that accounts for the TAF's creation on Dec. 12, 2007. Estimation results from the two regressions indicate that the TAF had effectively lowered major banks' liquidity concerns by decreasing the three-month Libor-OIS spread about 26 basis points (*Table 1*). This result is consistent with James McAndrews, Asani Sarkar and Zhenyu Wang's estimates of TAF effects using different model specification.⁶

Counterparty default risk premiums. Next, I evaluate the TAF's effect on reducing systematic counterparty default risk premiums. These premiums may depend on a variety of fundamental macroeconomic and financial variables—in particular, aggregate risks in the macroeconomy and financial markets. To capture this variable, I incorporate three measures of aggregate risk (*Chart 3*):

- Merrill Lynch's Merrill Option Volatility Estimate (MOVE) Index to track the implied volatility in the longer-term U.S. Treasury market
- The Chicago Board Options Exchange Volatility Index (VIX) measure of implied volatility from options on the S&P 500 index to gauge the uncertainty in the stock market
- The implied volatility from three-month Eurodollar futures options to measure uncertainty regarding the near-term path of monetary policy

Given the central role of subprime mortgages in the most recent financial crisis, it's necessary to control for their risks to more accurately determine the TAF's effect. However, there are few

Table 1
TAF Lowers Liquidity Premiums

	Three-month Libor-OIS spread	
	Regression 1	Regression 2
Counterparty default risk	1.0804** (8.9614)	.0677** (3.1736)
TAF dummy	-.2605** (-2.8216)	-.0448** (-3.5727)
Lag of Libor-OIS spread		.9697** (56.2749)
Adj. R ²	.6037	.9881

NOTES: *t*-statistics are displayed in parentheses (based on Newey-West standard errors). * (**) denotes statistical significance at the 5 percent (1 percent) level.

SOURCE: Author's estimates.

swap (CDS) rates of major financial firms.

A CDS is a contract insuring against the default risk of a specific company. The CDS buyer makes periodic payments to its seller, receiving full compensation for losses if the company defaults on its debt. The CDS rate can be viewed as an insur-

ance premium, and a higher CDS rate means the market perceives a higher risk of default for the company.

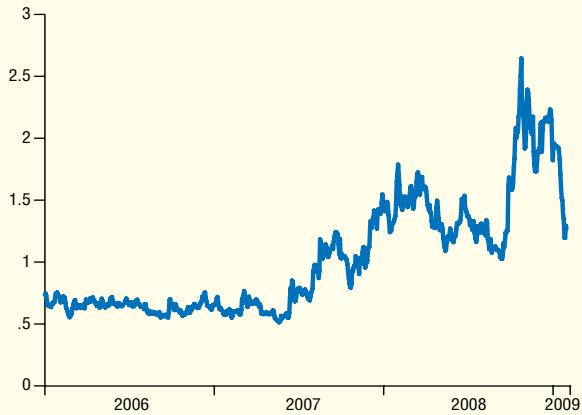
The CDS market quotes rates only for individual companies. To obtain a measure of overall or systematic counterparty risk, I extract the first principal component of the individual five-year CDS rates for all 16 banks in the U.S.

Chart 3

Evaluating Aggregate Risks in the Microeconomy and Financial Markets

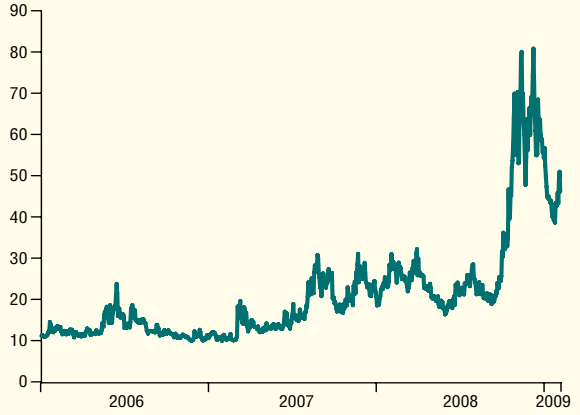
Implied Volatility on Longer-Term Treasury Securities (MOVE Index)

Percentage points, annualized



Implied Volatility on S&P 500 (VIX Index)

Percentage points, annualized



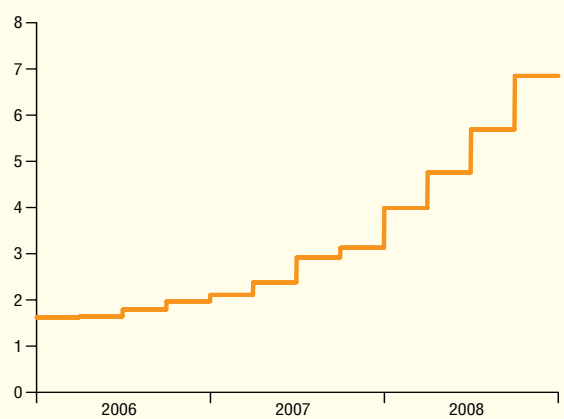
Implied Volatility on Three-Month-Ahead Eurodollar Futures Options

Percentage points, annualized



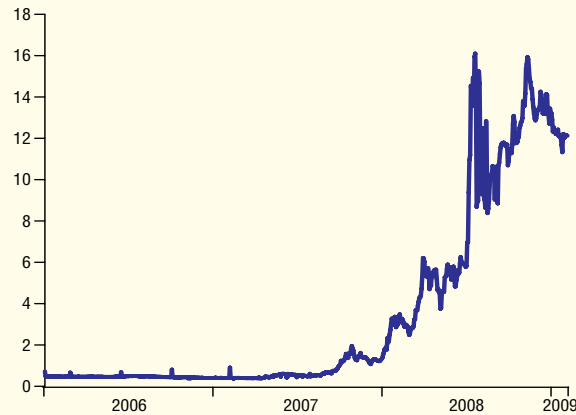
Average Delinquency Rate of Residential Mortgage Loans

Percentage points



Systematic CDS Factor Among Mortgage-Related Firms

Percentage points, annualized



SOURCES: Bloomberg; author's calculations.



The TAF was designed to alleviate liquidity premiums rather than address the insolvency risk that is reflected in credit default swap premiums.

readily available measures of these mortgage risks. For this reason, I use two alternative measures.

The first is the seasonally adjusted average delinquency rate of residential mortgage loans owned by the 100 largest U.S. commercial banks. This measures the portion of loans past due for 30 days or more on these banks' balance sheets. A substantial rise in the delinquency rate would endanger the banks' health and increase the probability of default.

The average delinquency rate had been below 2 percent until first quarter 2007, when it began to rise sharply, more than tripling to 6.9 percent in fourth quarter 2008. Since the onset of the financial crisis, a substantial rise in the delinquency rate has preceded almost every major spike in Libor–OIS spreads and counterparty default risk premiums, confirming that the worsening mortgage situation was a major driver in the crisis.

However, the delinquency rate is available only quarterly with a six- to seven-week lag. To model daily Libor

spreads, I construct a second mortgage default risk factor with a procedure similar to the one used for the variable that tracks systematic counterparty default risk.

This mortgage default risk factor is defined as the first principal component of individual CDS rates for a group of the largest subprime mortgage lenders, mortgage bond insurers and residential construction companies. These firms represent sectors most heavily exposed to subprime mortgage market turmoil but have no access to the TAF. Therefore, their CDS rates are an ideal measure of financial markets' perception of the underlying mortgage default risk.

Table 2 reports the TAF's impact on CDS spreads of banks active in the Libor market. Results from two regressions suggest that uncertainties reflected in the Treasury bond market and mortgage default risk premiums are closely related to financial strains in the Libor market. Uncertainties about the stock market and near-term monetary policy actions have far less effect on the counterparty default risk premiums.

At the same time, the TAF's effect on counterparty default risk premiums is negligible. This indicates that the facility has been unable to significantly reduce counterparty default risk premiums among major commercial banks.

The TAF, however, was designed to alleviate liquidity premiums rather than address the insolvency risk that is reflected in CDS premiums.

As McAndrews, Sarkar and Wang point out, "The TAF is not expected to exert large or immediate effects in reducing credit risks of banks. Credit risks are largely determined by banks' earnings and asset value. In the current situation, it is likely that changes in asset values are the driving force for the credit risk of banks.

"Much of the change in banks' asset values is determined by the valuation of mortgages and related financial products. Since the valua-

Table 2
TAF Offers Limited Relief from Counterparty Default Risk

	Systematic counterparty default risk factor	
	Regression 1	Regression 2
MOVE	.5600** (4.9254)	.4342** (3.4536)
VIX	-.0032 (-.9792)	-.0051 (-1.3582)
Eurodollar volatility	.1254 (.4651)	.5523* (2.3049)
Delinquency rate	.1638** (3.4940)	
Mortgage default risk factor		.0458** (3.4059)
TAF dummy	.0977 (0.9875)	.1637 (1.5500)
Adj. R ²	.8744	.8936

NOTES: *t*-statistics are displayed in parentheses (based on Newey–West standard errors). * (**) denotes statistical significance at the 5 percent (1 percent) level.

SOURCE: Author's estimates.



tion of mortgages is determined by the homeowners' long-term ability to pay for their debt, there is no reason to expect the TAF to affect the value of banks' mortgage and other assets."⁷

TAF's overall effect. Quantifying the TAF's broad impact on reducing money market strains combines the lowering of both liquidity and counterparty risk premiums. For this purpose, I regress the three-month Libor–OIS spread on the variables measuring macroeconomic and financial-market volatilities, the mortgage default risks and the TAF dummy.

The estimation's results show that the implied volatility of longer-term Treasury securities (MOVE) has a substantially positive and statistically significant effect on the Libor spreads (Table 3). A 1 percentage-point increase in the MOVE index tends to increase the three-month Libor–OIS spread by almost 1 percentage point.

Heightened mortgage risks have also contributed substantially to jumps in Libor spreads in the past two years. For instance, a 1 percentage-point rise in the delinquency rate tends to increase the three-month Libor spread by 24 basis points, and a 1 percentage-point rise in the CDS rates of mortgage firms increases the Libor spread by 6 basis points.

From mid-2007 to fourth quarter 2008, the delinquency rate rose about 4.5 percentage points, and mortgage CDS rates rose from less than 1 percent to a peak of 16 percent, both suggesting that heightened mortgage risk alone has increased the Libor spread by about 1 percentage point. Such an effect is significant at the 1 percent level.

The implied volatilities on the S&P 500 (VIX) and three-month Eurodollar futures options have much smaller influences on the Libor–OIS spread, and in most specifications, their coefficient estimates are statistically insignificant. This suggests that increased strains in the money mar-

ket can't be attributed to heightened uncertainty about the stock market or about the near-term course of monetary policy.

Finally, estimation results again reveal that the TAF has a substantial and statistically significant effect in narrowing the Libor–OIS spread. Controlled for various macroeconomic and financial volatility and risk measures, the results show that the presence of the TAF on average reduced the three-month Libor–OIS spread by 50 or 55 basis points, depending on the proxy of mortgage risks used in the regression.

The high adjusted R² values—85 percent even without including CDS rates or the lagged Libor spread in the regression—indicate that these volatility and risk measures along with the TAF dummy account for most of the variation in Libor spreads.

TAF in Retrospect

Facing potentially dire consequences from the financial crisis, several central banks established

Evidence indicates that the term auction facility was effective in reducing liquidity risk premiums paid by banks.

Table 3
Overall TAF Effects Significant

	Three-month Libor–OIS spread	
	Regression 1	Regression 2
MOVE	.9833** (5.3512)	.9904** (5.8595)
VIX	.0083 (1.3181)	.0109 (1.6506)
Eurodollar volatility	–.4092 (–1.1172)	–.2618 (–1.0616)
Delinquency rate	.2371** (5.2418)	
Mortgage default risk factor		.0559** (3.9497)
TAF dummy	–.5492** (–3.7547)	–.4879** (–3.4788)
Adj. R ²	.8501	.8477

NOTES: *t*-statistics are displayed in parentheses (based on Newey–West standard errors). * (**) denotes statistical significance at the 5 percent (1 percent) level.

SOURCE: Author's estimates.

liquidity facilities designed to reduce financial stresses on the interbank money market. The Fed's version was the term auction facility.

The TAF appears to have had only a limited effect in reducing counterparty risk premiums. However, evidence indicates that the facility was effective in reducing liquidity risk premiums paid by banks.

Estimates indicate that the presence of the TAF lowered the three-month Libor–OIS spread by 50 or 55 basis points during the crisis of 2007–09, mainly by addressing concerns about the banking sector's liquidity.

In 2010, the crisis has abated and financial markets are functioning normally. The TAF and other lending facilities established during the crisis were an experiment that proved effective in addressing severe financial turbulence, and similar facilities can be a useful part of the Federal Reserve's tool kit in the event of future crises.

Wu is a senior economist and advisor in the Research Department of the Federal Reserve Bank of Dallas.

Notes

¹ The study used is "The U.S. Money Market and the Term Auction Facility in the Financial Crisis of 2007–2009," by Tao Wu, *The Review of Economics and Statistics*, forthcoming.

² Occasionally, the Federal Reserve also conducts auctions in anticipation of special needs for liquidity. For instance, several forward auctions were conducted to ease year-end pressures on the demand for liquidity in late 2008. The maturity of the TAF loans in such cases can vary and is sometimes as long as 85 days.

³ See, for example, "A Black Swan in the Money Market," by John B. Taylor and John C. Williams, *American Economic Journal: Macroeconomics*, vol. 1, issue 1, 2009, pp. 58–83.

⁴ See note 1. These are concerns over funding liquidity; that is, the risk that an institution may be unable to raise cash to maintain its balance-sheet position. These are in contrast to concerns over trading liquidity, which refers to banks' difficulties executing transactions at the prevailing market price due to a temporary lack of appetite for the transactions by other traders on the market.

⁵ See note 1.

⁶ See "The Effect of the Term Auction Facility on the London Interbank Offered Rate," by James McAndrews, Asani Sarkar and Zhenyu Wang, Federal Reserve Bank of New York, Staff Report no. 335, July 2008.

⁷ See note 6.

EconomicLetter is published by the Federal Reserve Bank of Dallas. The views expressed are those of the authors and should not be attributed to the Federal Reserve Bank of Dallas or the Federal Reserve System.

Articles may be reprinted on the condition that the source is credited and a copy is provided to the Research Department of the Federal Reserve Bank of Dallas.

Economic Letter is available free of charge by writing the Public Affairs Department, Federal Reserve Bank of Dallas, P.O. Box 655906, Dallas, TX 75265-5906; by fax at 214-922-5268; or by telephone at 214-922-5254. This publication is available on the Dallas Fed website, www.dallasfed.org.



Richard W. Fisher
President and Chief Executive Officer

Helen E. Holcomb
First Vice President and Chief Operating Officer

Harvey Rosenblum
Executive Vice President and Director of Research

Robert D. Hankins
Executive Vice President, Banking Supervision

Director of Research Publications

Mine Yücel

Executive Editor

Jim Dolmas

Associate Editor

Kathy Thacker

Graphic Designer

Ellah Piña



FEDERAL RESERVE BANK OF DALLAS
2200 N. PEARL ST.
DALLAS, TX 75201