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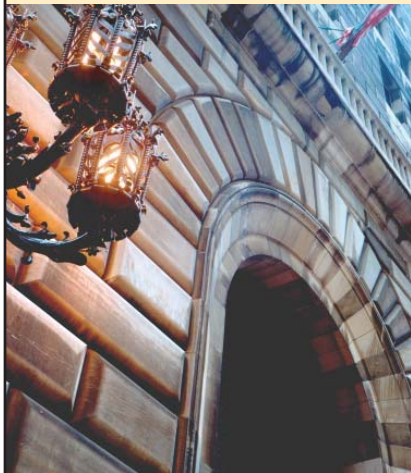
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## The Federal Reserve's Foreign Exchange Swap Lines

Michael J. Fleming and Nicholas J. Klagge

*The financial crisis that began in August 2007 disrupted U.S. dollar funding markets not only in the United States but also overseas. To address funding pressures internationally, the Federal Reserve introduced a system of reciprocal currency arrangements, or “swap lines,” with other central banks. The swap line program, which ended early this year, enhanced the ability of these central banks to provide U.S. dollar funding to financial institutions in their jurisdictions.*

The onset of the financial crisis in August 2007 had disruptive effects worldwide. Concerns about credit risk and higher demand for liquidity placed extraordinary strains on the global market for interbank funding in U.S. dollars.<sup>1</sup> Interbank interest rates denominated in dollars increased sharply, and market participants reported little or no interbank lending at maturities longer than overnight.

In response to these market disruptions, the Federal Reserve in December 2007 established the Term Auction Facility (TAF) to provide funding to U.S. banks through its role as lender of last resort. While the TAF addressed domestic dollar funding pressures, the Fed recognized that the new facility was unlikely to alleviate dollar funding pressures overseas, since interbank lending was effectively frozen.<sup>2</sup>

Accordingly, the Fed simultaneously announced the establishment of reciprocal currency arrangements, or “swap lines,” with the European Central Bank and the Swiss National Bank. The swap lines increased the capacity of these central banks to deliver dollar funding directly to financial institutions in their jurisdictions, reducing funding pressures on those institutions and potentially improving conditions in the global funding and credit markets more generally.

This edition of *Current Issues* provides an overview of the U.S. dollar swap line program.<sup>3</sup> We describe the disruptions to dollar funding markets worldwide in 2007 and 2008, the initial structure of the swap line program, and the revision of that structure as the financial crisis evolved. We also present results from several dollar funding operations carried out through the swap lines and examine how indicators of funding pressures performed over the program's two-year course.

<sup>1</sup> The term “dollars” in this article refers to U.S. dollars.

<sup>2</sup> U.S. branches and agencies of foreign banks that held reserves were eligible to borrow from the TAF, but in general, foreign institutions needed to borrow in the jurisdictions where they had their collateral.

<sup>3</sup> On April 6, 2009, the Federal Reserve opened foreign currency swap lines with the European Central Bank, the Swiss National Bank, the Bank of England, and the Bank of Japan. These lines mirrored the U.S. dollar swap lines in that they enabled the Fed to provide liquidity in foreign currencies to U.S. financial institutions if the need arose. The Fed did not draw on these swap lines, which expired at the same time as the dollar swap lines on February 1, 2010.

### Disruptions to Dollar Funding Markets

The market for interbank funding in U.S. dollars is global. Many banks in Europe, Japan, and elsewhere have some dollar-denominated assets and liabilities, and thus have occasion to borrow and lend in dollars.<sup>4</sup> Under normal circumstances, these borrowers can access dollar funding at the same schedule of interest rates as U.S. banks, conditional on their level of credit risk.

Beginning in August 2007, however, signs of problems in the interbank lending market emerged. On August 9, the French bank BNP Paribas announced that, because of illiquid markets, it was unable to determine net asset values for three of its credit-focused hedge funds and would suspend redemptions from those funds.<sup>5</sup> The announcement caused financial institutions to reassess their counterparty credit risk, particularly given concerns over the credit quality of U.S. subprime mortgages and banks' increased demand for liquidity.

The disruptions in the interbank lending market in August 2007 were reflected in the spread between the London interbank offered rate (Libor), an unsecured lending rate, and the overnight indexed swap (OIS) rate, a measure of average expected overnight rates. The Libor-OIS spread captures the additional cost of "term" (longer than overnight) borrowing relative to rolling overnight borrowing, and reflects the risk that a lender may not renew an overnight contract. Thus, the sharp rise in the spread at the onset of the crisis was a sign that interbank lending at longer maturities was regarded as particularly risky. The spread remained elevated until the bankruptcy of Lehman Brothers in September 2008, when it spiked to unprecedented levels before moderating somewhat (Chart 1).

A factor that exacerbated the funding pressures faced by banks during this period was the need to provide backstop financing for structured investment vehicles (SIVs).<sup>6</sup> Many SIVs had funded themselves by issuing asset-backed commercial paper, a practice that led to a rapid increase in commercial paper outstanding during 2005 and 2006 (Chart 2). With the onset of the financial crisis, concerns mounted about the quality of SIV assets, causing investor appetite for asset-backed commercial paper issued by SIVs to plummet. As a result, banks were forced to find alternative financing for the assets.

Although both U.S. and foreign banks held some assets of questionable credit quality, the severely reduced supply of wholesale dollar funding was especially detrimental for foreign banks. U.S. banks tend to have large deposit bases denominated in dollars, enabling them to fund their dollar-denominated assets and making them natural net lenders in the dollar interbank funding markets. Foreign banks, by contrast, generally lack significant deposit bases in dollars

<sup>4</sup> For information on structural differences between the balance sheets of U.S. and non-U.S. banks, see McGuire and von Peter (2008, 2009). Although it is not necessary to match the currency composition of assets and liabilities, most financial institutions prefer not to take on the exchange rate risk inherent in a currency mismatch.

<sup>5</sup> See, for example, Boyd (2007).

<sup>6</sup> Typically held off balance sheet, an SIV is a pool of investment assets that is designed to profit from spreads between short-term debt and long-term structured finance products such as asset-backed securities.

Chart 1

### Three-Month Dollar LIBOR-OIS Spread



Source: Authors' calculations, based on data from Bloomberg L.P.

and must therefore rely heavily on the interbank market and other sources to fund their dollar-denominated assets.

### The Introduction of Reciprocal Currency Arrangements

On December 12, 2007, the Federal Reserve announced the establishment of foreign exchange swap lines with the European Central Bank and the Swiss National Bank. In its press release, the Fed indicated that the swap lines, like the Term Auction Facility created at the same time, were intended "to address elevated pressures in short-term funding markets."<sup>7</sup>

#### How the Swap Lines Worked

The swaps involved two transactions. At initiation, when a foreign central bank drew on its swap line, it sold a specified quantity of its currency to the Fed in exchange for dollars at the prevailing market exchange rate. At the same time, the Fed and the foreign central bank entered into an agreement that obligated the foreign central bank to buy back its currency at a future date at the same exchange rate. Because the exchange rate for the second transaction was set at the time of the first, there was no exchange rate risk associated with the swaps.

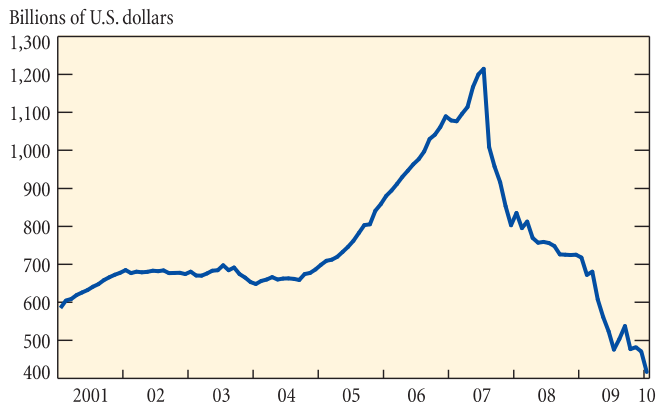
The foreign central bank lent the borrowed dollars to institutions in its jurisdiction through a variety of methods, including variable-rate and fixed-rate auctions. In every case, the arrangement was between the foreign central bank and the institution receiving funds. The foreign central bank determined the eligibility of institutions and the acceptability of their collateral. And the foreign central bank remained obligated to return the dollars to the Fed and bore the credit risk for the loans it made.

At the conclusion of the swap, the foreign central bank paid the Fed an amount of interest on the dollars borrowed that was equal to the amount the central bank earned on its dollar lending operations. In contrast, the Fed did not pay interest on the foreign currency it

<sup>7</sup> For additional detail on the TAF, see Armantier, Krieger, and McAndrews (2008).

Chart 2

## Asset-Backed Commercial Paper Outstanding



Source: Board of Governors of the Federal Reserve System.

acquired in the swap transaction, but committed to holding the currency at the foreign central bank instead of lending it or investing it. This arrangement avoided the reserve-management difficulties that might arise at foreign central banks if the Fed were to invest its foreign currency holdings in the market.

### Expected Effects of the Swaps

The provision of dollar funding to foreign financial institutions through swap lines with central banks was expected to reduce the institutions' funding rollover risk and increase the predictability of funding costs—much the same functions that the TAF performed for U.S. banks. These effects, in turn, could reduce pressures on funding markets in the United States. Moreover, by reducing the need to sell dollar assets at a time of stress, the swaps could lead to improved conditions in U.S. and foreign financial markets more generally.

Although such broader beneficial effects were possible, the direct purpose of the swaps was limited to addressing overseas pressures in dollar funding markets. The swaps were not structured to provide credit to distressed banks, to mitigate losses banks were facing, or to bolster the capital positions of banks. Rather, the swaps were intended to provide foreign central banks with the capacity to deliver dollar funding to institutions in their jurisdictions during times of market stress.

### The Federal Reserve's Role

In principle, foreign central banks could have provided dollar funding to banks in their jurisdictions without the involvement of the Fed. They could have obtained dollars from their own foreign exchange reserves or from the open market. However, the foreign exchange reserves of many central banks at the onset of the crisis were smaller than the amounts they subsequently borrowed under the swap lines, so these reserves alone would not have been sufficient.<sup>8</sup> Furthermore, if foreign central banks had been forced to sell

<sup>8</sup> See Obstfeld, Shambaugh, and Taylor (2009).

## Swap Lines Opened with Central Banks

Date	Central Bank
December 12, 2007	European Central Bank, Swiss National Bank
September 18, 2008	Bank of Japan, Bank of England, Bank of Canada
September 24, 2008	Reserve Bank of Australia, Sveriges Riksbank, Norges Bank, Danmarks Nationalbank
October 28, 2008	Reserve Bank of New Zealand
October 29, 2008	Banco Central do Brasil, Banco de México, Bank of Korea, Monetary Authority of Singapore

their own currencies to buy dollars in the open market, the transaction itself would likely have crowded out private transactions to some degree, making foreign commercial banks even less capable of securing dollar funding without government assistance.

The Federal Reserve was thus in a unique position to mitigate pressures in dollar funding markets. Initially, the Fed funded the dollar swap lines by reducing its holdings of Treasury securities, particularly Treasury bills. Later, as the swap lines and other liquidity facilities expanded in size, the Fed increased its liabilities commensurately, taking on the proceeds from the sale of a special series of Treasury bills and boosting incentives for depository institutions to hold reserves at the Fed. No other institution was in a position to undertake these efforts in support of dollar funding markets.

The Fed's establishment of swap lines with other central banks was not unprecedented. In the days following the terrorist attacks of September 11, 2001, the Fed had instituted a similar system of swap lines to ensure the continued functioning of global financial markets.<sup>9</sup> The 2001 swap lines, however, were more temporary than those established in 2007. In 2001, the swap lines all expired after thirty days, whereas the 2007 swap lines were initially established for up to six months and were renewed to run until February 1, 2010.

### The Evolution of Reciprocal Currency Arrangements

The Federal Reserve's program of foreign exchange swap lines (see table) passed through three broad structural phases. In each phase, the Fed expanded the scope and potential size of the program.

#### Phase 1: December 12, 2007, to September 17, 2008

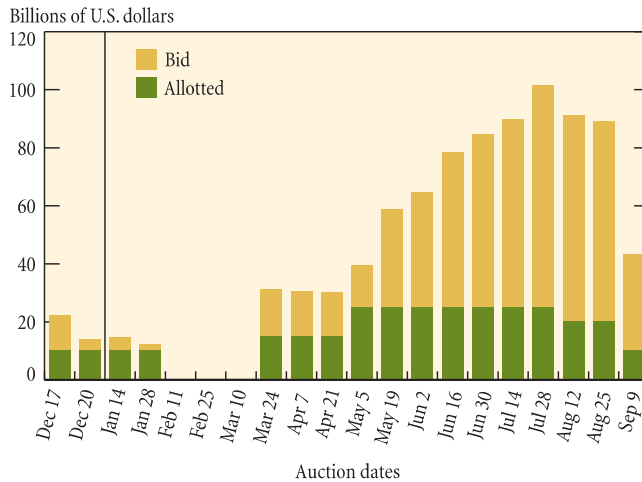
From the program's inception in December 2007 through September 17, 2008, the swap lines acted largely as an overseas extension of the Term Auction Facility. The European Central Bank executed one-month, and later three-month, fixed-rate tenders at the "stop-out rates," or lowest rates at which bids were accepted, for the most recent TAF auctions. Variable-rate auctions for much smaller amounts were conducted by the Swiss National Bank. For a period in February and March 2008, the European Central Bank and the Swiss

<sup>9</sup> See Kos (2001). In addition, from the 1960s through 1998, the Fed had standing FX swap lines with several central banks, but their purpose was to provide currency for FX market intervention rather than to provide money market liquidity. Most of these older swap lines were phased out by mutual agreement in 1998, although Canada and Mexico retained small swap lines under the auspices of the North American Free Trade Agreement.



Chart 3

### Demand for Dollar Funding in the European Central Bank's One-Month Auctions December 17, 2007–September 9, 2008



Source: European Central Bank.

National Bank stopped conducting dollar operations as pressures in dollar funding markets eased, then reinstated them at the end of March following the collapse of Bear Stearns.

Despite the resumption of auctions by the European Central Bank and Swiss National Bank, excess demand for dollar funding among European banks was once again evident. While the Fed had sharply increased amounts available under the TAF, the amounts available in the auctions of the European Central Bank and Swiss National Bank were limited by the caps on their swap lines, leading to high bid-to-cover ratios in these auctions and significant unmet demand for dollar funding from European banks (Chart 3).<sup>10</sup>

#### Phase 2: September 18, 2008, to October 12, 2008

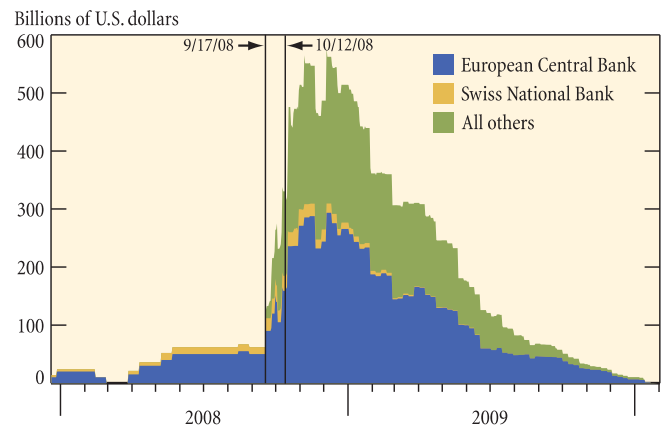
As market conditions deteriorated worldwide following the bankruptcy of Lehman Brothers on September 15, 2008, the Federal Reserve undertook a rapid expansion of its FX swap line program. It extended swap lines to three additional central banks on September 18 and four more on September 24.

Besides opening new swap lines, the Fed aggressively expanded the total quantity of dollars made available to central banks in the program. Over the second phase, the Fed boosted the available amount by nearly a factor of ten, to \$620 billion from \$67 billion. This expansion allowed a significant increase in the quantity of dollars actually lent by central banks under the swap agreements (Chart 4). By the end of the second phase, on October 12, more than \$330 billion in dollar loans was outstanding under the program.

<sup>10</sup> The bid-to-cover ratio measures the quantity of funds requested relative to the quantity of funds offered.

Chart 4

### Foreign Exchange Swap Line Amounts Outstanding, by Foreign Central Bank



Source: Authors' calculations, based on data from Bloomberg L.P. and foreign central banks.

As foreign central banks expanded the quantity of their dollar loans during the second phase, they also broadened the terms of their lending, auctioning funds at a wider range of maturities. On September 18, the European Central Bank, the Swiss National Bank, and the Bank of England supplemented the existing one- and three-month tenders with lending in overnight and one-week tenors (Chart 5). These shorter-term loans were all conducted as variable-rate operations with lending rates set by auction. With these operations, the central banks were able to adjust dollar liquidity to mitigate pressures associated with the end of the quarter, as well as to expand dollar liquidity to address the generally increased pressures in funding markets.

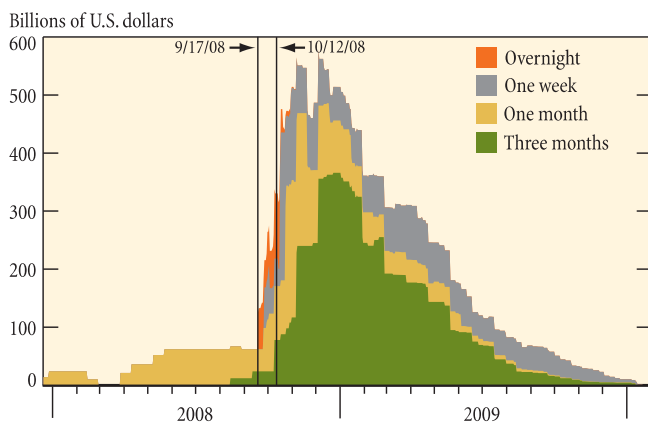
#### Phase 3: October 13, 2008, to February 1, 2010

As financial market conditions continued to deteriorate, the Federal Reserve began a third phase of its FX swap line program, expanding it aggressively once again. On October 13-14, 2008, the Fed announced that it would remove the caps from its swap lines with the European Central Bank, the Bank of England, the Swiss National Bank, and the Bank of Japan.

In line with this announcement, these four central banks again altered the mechanism through which they provided dollar liquidity to private sector banks. They continued to provide a small amount of overnight funding through fixed-amount variable-rate auctions for a time, but they also replaced their limited-amount tenders at one- and three-month maturities with fixed-rate tenders for uncapped amounts at one-week, one-month, and three-month maturities. In that way, eligible institutions could borrow any amount they wished against the appropriate collateral. The rates for these operations, rather than being drawn from the Fed's TAF program, were set by the participating central banks. The Fed also opened swap lines with five more central banks during this phase.

Chart 5

## Foreign Exchange Swap Line Amounts Outstanding, by Loan Term



Source: Authors' calculations, based on data from Bloomberg L.P. and foreign central banks.

Note: A small share of swap line loan terms were somewhat shorter or longer than the most common terms. We group loans of up to four days as overnight, 5-16 days as one week, 17-45 days as one month, and more than 45 days as three months.

As foreign central banks made greater dollar liquidity available, actual lending outstanding under the swap lines again jumped significantly (Charts 4 and 5). At the program's peak, in the week ending December 10, 2008, swaps outstanding totaled more than \$580 billion, accounting for over 25 percent of the Fed's total assets.

During 2009, foreign demand for dollar liquidity through the swap lines diminished steadily as funding market conditions improved. Foreign central banks' practice of offering funds at a penalty rate—that is, a rate somewhat above the cost of funds for most banks under normal conditions—cut the program's use as banks secured funds elsewhere at lower costs. Consistent with the improved market conditions and reduced swap line use, the Fed ended the program February 1, 2010. The last outstanding loan under the program matured February 12, 2010.

### Measures of Overseas Dollar Funding Pressures

To see how dollar funding pressures in overseas markets evolved over the course of the swap line program, we track the performance of three measures: 1) the overseas-U.S. Libor spread, 2) the dollar basis, and 3) the lending rates from overnight U.S. dollar auctions conducted by foreign central banks. We also draw some inferences about the effectiveness of the swap line program in improving market conditions, but our assessment is necessarily preliminary.

#### *The Overseas-U.S. Libor Spread*

Because foreign banks secure much of their dollar funding through interbank loans, they can expect to face greater funding pressures during times of market stress. One way to measure such pressures involves examining the individual borrowing rates of the sixteen banks that make up the Libor

Chart 6

## Spread between Foreign Banks' and U.S. Banks' Three-Month Dollar Libor Quotes



Source: Authors' calculations, based on data from Bloomberg L.P.

Note: The spread is calculated as the difference between the average borrowing rate of the thirteen non-U.S. banks on the Libor panel and the average borrowing rate of the three U.S. banks on the panel.

survey "panel."<sup>11</sup> The difference between the average borrowing rate of the panel's thirteen non-U.S. banks and the average borrowing rate of its three U.S. banks provides a rough proxy for the increased difficulty foreign banks face in trying to borrow dollars (Chart 6).

The overseas-U.S. Libor spread was essentially zero from January 2007 through the beginning of August 2007. After the market turmoil began, the spread rose, generally remaining elevated through the beginning of December 2007. Following the announcement of the swap lines and the first U.S. dollar auctions by the European Central Bank and the Swiss National Bank in late December, the spread returned to a level close to zero for several months.<sup>12</sup>

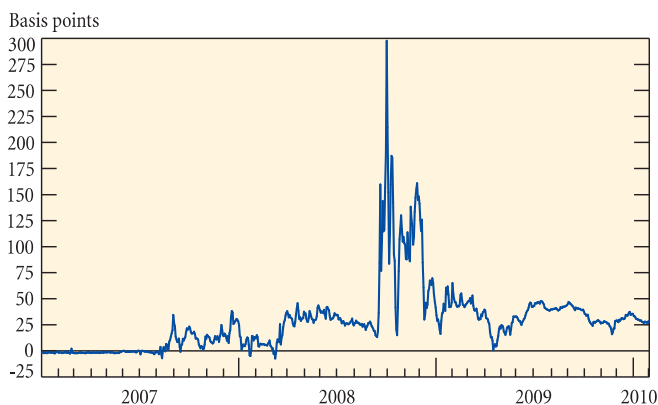
Beginning in April 2008, the spread widened again, remaining so throughout the summer as European demand for dollar funding rose while the amounts made available by the European Central Bank and Swiss National Bank were constrained by the swap line caps (Chart 3). Following the announcement of Lehman Brothers' bankruptcy on September 15, 2008, the spread widened to unprecedented levels.

The announcement that caps would be removed on four swap lines in mid-October 2008 had little apparent effect on the spread, but as the new uncapped-quantity auctions were executed and the actual quantity of dollar lending under the swap lines rose in early

<sup>11</sup> U.S. dollar Libor is set on a daily basis through a survey that asks the sixteen banks what borrowing rates they face in the interbank market. The published rate is a trimmed average of the banks' individual rates.

<sup>12</sup> McAndrews, Sarkar, and Wang (2008) show statistically that swap line announcements, as well as TAF announcements, narrowed Libor-OIS spreads over the early stages of the programs. Although they do not specifically examine the overseas-U.S. Libor spread, it is highly correlated with the Libor-OIS spread, as can be seen by comparing Charts 1 and 6.

Chart 7

**Three-Month Dollar Basis**

Sources: Bloomberg L.P.; Federal Reserve Bank of New York; Tullet.

Note: The dollar basis measures the cost of indirect borrowing in dollars using euro/dollar FX swaps less the cost of direct borrowing in dollars.

November 2008, the spread began to ease. By late January 2009, the spread had stabilized in a range of 2 to 6 basis points, where it stayed through January 2010, despite the drop in swaps outstanding.

**The Dollar Basis**

European banks having difficulty borrowing dollars in the interbank market also have the ability to acquire dollar funding by borrowing euros in the interbank market, then executing a foreign exchange swap for U.S. dollars with a private counterparty. Economic intuition, formalized in the principle of covered interest parity, suggests that the total cost of this action, combining the cost of borrowing in euros and the cost of executing the FX swap, should be approximately the same as the cost of direct borrowing. We use a daily estimate of the spread between the cost of indirect borrowing in dollars using euro/U.S. dollar FX swaps and the cost of direct borrowing in dollars. This spread, known as the dollar basis, provides a measure of the relative stresses on overseas borrowers of U.S. dollars (Chart 7).<sup>13</sup>

The dollar basis followed much the same pattern as the overseas-U.S. Libor spread: essentially zero through early August 2007, elevated through December 2007, close to zero again through March 2008, higher through the summer, up to unprecedented levels following Lehman's bankruptcy, and then down slightly in late 2008. The basis subsequently remained at moderately high levels through January 2010. The movements of the dollar basis provide some support for the notion that the swap line operations helped ease dollar funding strains on foreign banks. Moreover, they are consistent with Coffey, Hrungrung, and Sarkar's (2009) statistical findings that swap line announcements and operations were effective in reducing the basis.

Interestingly, however, while the overseas-U.S. Libor spread and the dollar basis generally moved together, the basis rose to much higher levels during the crisis. One reason for the difference is that

<sup>13</sup> Coffey, Hrungrung, Nguyen, and Sarkar (2009) describe the dollar basis and its behavior during the financial crisis.

the Libor panel includes only large banks, whereas the level of the basis can be influenced by the market activity of smaller and riskier banks. If anything, the basis probably underestimates the dollar funding pressures faced by many European banks, given that riskier institutions were likely unable to borrow euros at Libor rates.

Despite allegations that some Libor panel banks were underreporting borrowing costs in early 2008,<sup>14</sup> we do not believe that any such underreporting significantly biases our findings for either the overseas-U.S. Libor spread or the dollar basis. First, the sharp movements in these two measures began before the alleged period of underreporting. Second, there is independent evidence of severely impaired liquidity in the euro/U.S. dollar FX swap market from September 2007 through January 2008, consistent with the hypothesis of a massive rise in demand for U.S. dollars from European banks.<sup>15</sup>

**Lending Rates in Foreign Central Banks' Overnight Dollar Operations**

The European Central Bank, the Swiss National Bank, and the Bank of England all conducted overnight variable-rate auctions for U.S. dollars during the swap line program's second and third phases. The rates bid for dollars in these auctions provide some insight into pressures in overseas U.S. dollar funding markets over this period.

Specifically, the stop-out rates from these auctions (Chart 8) reveal elevated funding pressures at the end of September 2008, with especially high demand for funds over the quarter-end. Funding pressures again rose on October 7 and 8, particularly in Europe. Funding pressures then appear to have relaxed during the program's third phase, starting in mid-October, suggesting that the aggressive expansion of dollar lending by foreign central banks had beneficial effects. The European Central Bank stopped overnight auctions in mid-October after a series of low stop-out rates, while the Swiss National Bank and the Bank of England discontinued the overnight auctions in early November after a series of undersubscribed auctions.

Overall, our look at the evolution of funding pressures during the crisis suggests that swap line program announcements and operations were effective at easing strains in dollar funding markets. Moreover, our descriptive findings are supported by a number of more rigorous studies employing statistical analyses.<sup>16</sup>

**Conclusion**

During the second half of 2007, the functioning of U.S. dollar funding markets became impaired as credit and liquidity concerns increased. The scarcity of interbank lending made it particularly difficult for non-U.S. banks to fund the dollar-denominated assets on their balance sheets, even as they were taking on additional dollar assets through backstop financing to structured investment vehicles.

Through direct lending, the Federal Reserve had a channel to reduce funding pressures for U.S. banks. With interbank lending

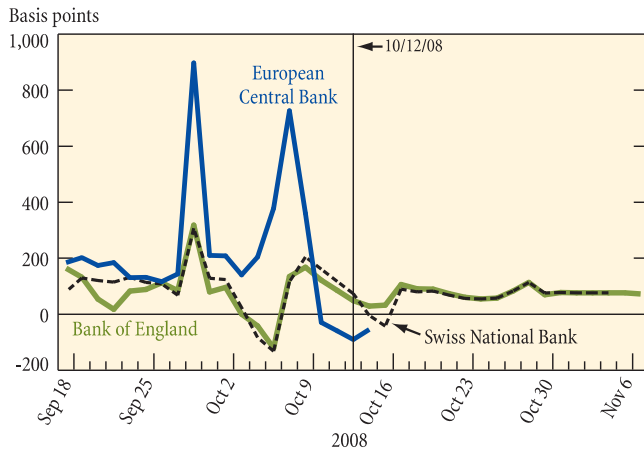
<sup>14</sup> See, for example, Mollenkamp (2008) and Mollenkamp and Whitehouse (2008).

<sup>15</sup> See Baba, Packer, and Nagano (2008).

<sup>16</sup> Goldberg, Kennedy, and Miu (2010) review the econometric evidence on the effects of the TAF and the swap line program.

Chart 8

## Spread between Foreign Central Banks' Overnight Dollar Auction Stop-Out Rates and the Effective Federal Funds Rate



Source: Authors' calculations, based on data from the Federal Reserve Bank of New York and foreign central banks.

Note: The effective federal funds rate is a volume-weighted average of rates on federal funds trades arranged by major brokers.

effectively frozen, however, it was unclear if steps to mitigate dollar funding pressures domestically would also ease dollar funding pressures overseas. As a result, the Fed established a system of foreign exchange swap lines with other central banks. This move allowed those central banks to provide lender-of-last-resort liquidity in U.S. dollars without being forced to draw down dollar holdings of foreign exchange reserves or to transact directly in the open market.

The Fed greatly expanded this system of swap lines in size and scope during the fall of 2008. By December 10, 2008, swaps outstanding had risen to more than \$580 billion, accounting for over 25 percent of the Fed's total assets. During 2009, financial strains abated and demand for the swaps diminished steadily, leading to the program's termination in early 2010.

Early evidence suggests that the swap lines were successful in smoothing disruptions in overseas dollar funding markets. Swap line announcements and operations were associated with improved

conditions in these markets: Although measures of dollar funding pressures remained high throughout the crisis period, they tended to moderate following large increases in dollars lent under the swap line program. Moreover, the sharp decline in swap line usage as the crisis ebbed suggests that the pricing of funds offered through swap lines gave institutions an incentive to return to private sources of funding as market conditions improved.

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