

The Federal Reserve's Financial Crisis Response C: PROVIDING US DOLLARS TO FOREIGN CENTRAL BANKS¹

Rosalind Z. Wiggins²
Andrew Metrick³

ABSTRACT

The financial crisis that began in late 2007 with the decline in the United States (U.S.) subprime mortgage markets, quickly spread to other markets and eventually disrupted the interbank funding markets in the U.S. as well as overseas. To address the strain in the U.S. dollar (USD) funding markets, the Federal Reserve worked with foreign central banks around the world to provide USD liquidity to affected overseas markets by entering into currency swap agreements. Following the bankruptcy of Lehman Brothers in September 2008, and the resulting further destabilization of the world's financial systems, the size and utilization of these swaps expanded significantly. Ultimately the Federal Reserve would enter into currency swap agreements with central banks in 14 major economies and lend an unprecedented total of \$10 trillion pursuant to them. In terms of commitment and usage, the currency swaps were one of the most significant efforts by the Federal Reserve to combat the crisis. These extraordinary actions succeeded in maintaining the availability of USD liquidity internationally and helped to moderate the stresses in the financial markets.

¹ This case study is one of five Yale Program on Financial Stability case modules considering the Federal Reserve's credit and lending responses to the global financial crisis:

- The Federal Reserve's Financial Crisis Response A: Lending & Credit Programs for Depository Institutions
- The Federal Reserve's Financial Crisis Response B: Lending & Credit Programs for Primary Dealers
- The Federal Reserve's Financial Crisis Response D: Commercial Paper Market Facilities
- The Federal Reserve's Financial Crisis Response E: The Term Asset-Backed Securities Loan Facility.

Cases are available at the YPFS website, <http://som.yale.edu/ypfs>, or may be downloaded from the Social Science Research Network.

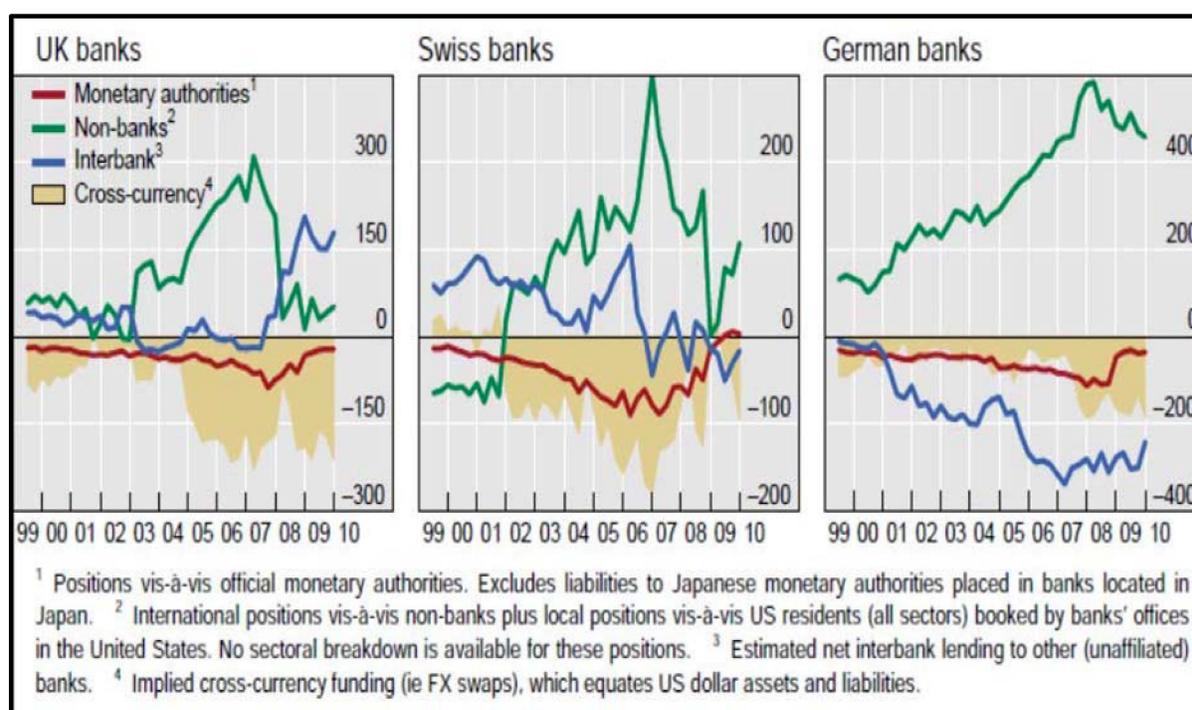
² Project Editor, Case Study and Research, YPFS, Yale School of Management.

³ Michael H. Jordan Professor of Finance and Management, and YPFS Program Director, Yale School of Management

1. INTRODUCTION

The crisis in U.S. dollar (USD) funding outside the U.S. during 2007-2009 can be attributed to a combination of circumstances that developed during the prior decade. Beginning in 2000, trends such as the global saving glut, the buildup of institutional cash pools, and the desire for safe assets, combined with roaring U.S. real estate and mortgage markets⁴, to spur investment in U.S. assets. Holdings of US-denominated asset by non-US financial institutions swelled, as can be seen in Figure 1. By 2007 the global financial system had grown to be highly interconnected and incorporated many new types of financial products and markets. Many of these products, such as derivatives and collateralized debt obligations⁵, were highly complex and purported to distribute risks across vast markets, but were untested in an economic downturn.

Figure 1: Net US dollar-denominated positions, by counterparty (In billions of US dollars)



Source: BIS consolidated statistics (immediate borrower basis); BIS locational statistics by nationality; author's calculations (McGuire and von Peter, 2009, 55). (Also see McGuire and von Peter 2009 for similar data for other countries.)

Additionally, while banks still primarily looked to deposits for funding and to their own central banks as their lenders of last resort, they borrowed an increasing portion of needed funds from non-bank sources, such as the wholesale interbank funding markets. This funding largely consisted of commercial paper (usually 30-days of less) and overnight funding such as repos. The result was that many long-term assets

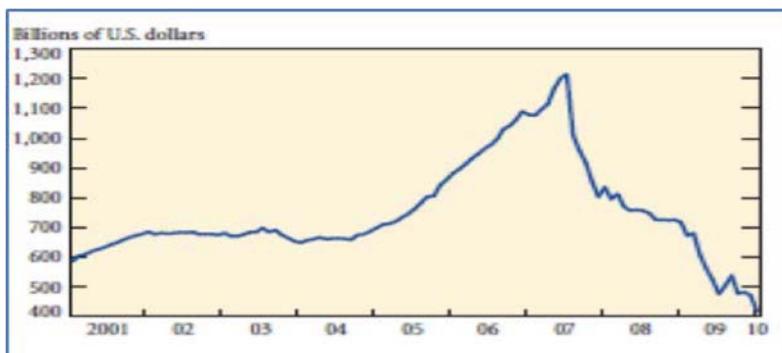
⁴ See Gorton and Metrick 2012 for discussion of these developments.

⁵ See Wiggins and Metrick 2014, for a discussion of how these new derivative instruments contributed to the financial crisis.

held by non-U.S. financial institutions were supported by short-term funding requiring frequent rollovers, to the tune of billions of dollars. Further, the growth of new such financial firms, such as hedge funds, also relied on the wholesale funding markets. (McGuire and von Peter 2009, 49).

In August 2007, the decline in the U.S. subprime mortgage market began to spill over and infect the interbank markets. Haircuts on repo collateral began to rise and asset-backed commercial paper (ABCP) issuers had trouble rolling over their outstanding paper. Outstanding U.S. ABCP would drop almost \$200 billion during the month. (See Figure 2.) These events are usually cited as the beginning of the downturn that would develop into the worst financial crisis since the Great Depression of the 1930s.

Figure 2: Asset-backed Commercial Paper Outstanding



Source: Board of Governors of the Federal Reserve System

The strains in the wholesale funding market that began in the U.S. were soon felt outside the country as USD funding became scarce and expensive. The problem quickly developed into a systemic risk as the gap between the amount of USD liquidity needed by foreign banks and financial companies severely outstripped the amount that could be accessed through the interbank markets. According to Bank for International Settlements (BIS) estimates, by mid-2007, the estimated USD funding gap for Dutch, German, Swiss and UK banks was an estimated \$1 trillion. (ECB August 2014).

Beginning in December 2007, the Federal Reserve and the central banks of other major economies acted to provide USD liquidity to impacted markets and maintain the overall stability of the global financial system. They also sought to prevent a disorderly deleveraging and to limit the disruptive effects of funding tensions on real economic activity. (Fleming and Klagge 2009). The first reciprocal foreign currency swap agreements (FCSAs) entered into by the Federal Reserve were with the European Central Bank (ECB) and the Swiss National Bank (SNB) for the relatively modest amounts of \$24 and \$6 billion, respectively.

As 2008 dawned and the financial crisis worsened, the number of countries with which the Federal Reserve had swaps would grow to 14, and the amount extended under those swaps would expand to unprecedented levels. The one day maximum amount outstanding would reach \$583 billion in December 2008. In total, the Federal Reserve would lend \$10.057 trillion under the swaps, the most expended under any single facility adopted to combat the crisis. (Felkerson 2011, 11).

Notably, the FCSAs were just one part of an ongoing coordinated effort among the central banks of the world's major economies to combat the crisis and prevent the total collapse of the world's financial system. Though not without their critics, the swaps were largely seen as a success. However, the magnitude of the strain in USD funding can only truly be appreciated when it is considered that many U.S. subsidiaries of foreign banks also borrowed billions of dollars under other Federal Reserve facilities

such as the Primary Dealer Credit Facility⁶ and the Commercial Paper Funding Facility⁷. The FCSAs and other Fed programs enabled the Federal Reserve to maintain the flow of USD in foreign markets and thereby moderate the negative effects that a lack of USD liquidity would have had on those markets and on the U.S. financial system and economy.

In this case, we review in depth the FCSAs program and its impact. Section 2 provides an overview of the Federal Reserve's authority to enter into the swaps; Section 3 discusses certain circumstances in the global financial system prior to the disruption in the USD markets that created the need for the swaps; Section 4 examines how the swaps worked and how they were coordinated with the counterparty central banks; Section 5 discusses the period after the Lehman bankruptcy when the swaps were significantly expanded, while Section 6 examines the Federal Reserve's unprecedented action, in October 2008, of committing to provide unlimited USD liquidity to the central banks in four major economies. Lastly, in Section 7 we evaluate the impact and effectiveness of the swap program.

QUESTIONS

1. What were the forces that contributed to the imbalance of USD funding outside the U.S.?
2. The central banks chose to enter into swaps directly with the Federal Reserve and funnel the USDs to the banks in their jurisdictions. Was this an efficient design for the swaps? What were the benefits to the central banks? To the Federal Reserve?
3. The Federal Reserve could have provided dollars to foreign banks by lending to their U.S. subsidiaries. What would have been the pros and cons of this design?
4. Foreign central banks used a variety of fixed and varied auctions, at differing maturities, to lend out the USDs. Why do you think this was and what purpose were these variations designed to serve?
5. The USDs loaned under the swaps and the foreign currency given to the Federal Reserve as security was maintained in the Federal Reserve and the counterparty central bank, respectively. Why was this handled this way? What were the benefits of the arrangement?

2. APPLICABLE LEGAL AUTHORITY

The Federal Reserve has standing authority to provide USDs to foreign countries under Section 14 (Monetary Policy) of the Federal Reserve Act and policies established by the Federal Open Markets Committee (FOMC)⁸. Such provisions have in the past been implemented as temporary arrangements in response to a stress in the markets. In at least two recent occasions, the Federal Reserve has taken preparations in anticipation of unusual shortages. In 1999 there was concern that the change to computer systems might result in glitches as a result of Y2K failures. In order to respond to any such shortages, the Federal Reserve entered into swaps with nine central banks, not to exceed an aggregate of \$25 billion. (FOMC Mins Feb. 1-2, 2000).

⁶ See Wiggins and Metrick 2016B for a discussion of the Primary Dealer Credit Facility.

⁷ See Wiggins and Metrick 2016D for a discussion of the Commercial Paper Funding Facility.

⁸ Section 14(2)(b)(2) of the Federal Reserve Act provides— “[Every Federal reserve bank shall have power] To buy and sell in the open market, under the direction and regulations of the Federal Open Market Committee, any obligation which is a direct obligation of, or fully guaranteed as to principal and interest by, any agency of the United States. 12 U.S.C. 355, as amended.

Another circumstance where the Federal Reserve took extraordinary action to maintain the flow of USD was after the September 11th terrorists' attacks and the resulting 4 day market closing.⁹ On September 13, the Federal Reserve put in place a similar series of swaps with the ECB, the Bank of England and the Central Bank of Canada for \$50 billion, \$30 billion and \$10 billion respectively. These swaps expired after 30 days. (Bd of Gov. Sept. 13, 2001; Fed. Res. Sept. 13, 2001; Fed. Res. Sept. 2001A).

In taking its action in December 2007 to institute the swaps, the FOMC was faced with impaired USD funding markets that if not checked could develop into worse:

The upward pressure in term funding markets and the uncertainty about forward LIBOR rates have caused impairment of the foreign exchange swap market—a market used by many European banks to obtain dollar funding. In this market, bid-asked spreads have widened, transaction sizes have dropped, and some dealers have stopped making markets. As noted earlier, some of the upward pressure on term funding markets represents balance sheet adjustments for the year-end. Currently, the cost of the two-day year-end turn is about 11 percent. . . , the year-end premium has moved irregularly higher over the past six weeks to more than 600 basis points. . . , this is much greater than what typically has occurred in other years. However, it is much less than what was evident in 1999, when Y2K put significant upward pressure on implied forward rates over the year-end turn. (FOMC Dec. 6, 2007, 4).

Three factors were identified by the Federal Reserve staff as driving the pressures in the funding markets: (1) the year-end, (2) balance sheet pressures, and (3) worries about counterparty risks. (Ibid.). Notably, European banks were facing balance sheet pressures from two sides. As asset values dropped they were experiencing mark-to-market losses and required higher loan-loss provisions, as losses were expected to continue. At the same time, they were unable to securitize subprime mortgages or to sell off leveraged loan commitments and assets that had formerly been held off balance sheet in structured investment vehicles.

Fundamentally, the FOMC considered that it was addressing not just a liquidity issue but also one of credit quality and valuation. (Ibid, 11). However, the withdrawal from the interbank markets by banks and money market funds had quickly made term funding very difficult and expensive. By providing liquidity, the Federal Reserve hoped to moderate the need for banks to engage in “fire sales with knock-on effects in the rest of the system.” (Ibid.).

3. DISLOCATION IN THE US DOLLAR FUNDING MARKETS

PRELUDE TO A CRISIS

Between 2000 and 2007, the internationalization and interconnectedness of the world's banking and financial systems grew rapidly. The foreign positions (i.e., assets that are denominated in a foreign currency), of banks reporting to the BIS, grew from \$11 trillion at the end of 2000 to \$31 trillion by mid-2007. This development was fueled by the explosion in structured finance instruments such as derivatives, the emergence of the hedge fund industry, and the spread of “universal banking” which combined commercial and investment banking and proprietary trading activities. (McGuire and von Peter 2009, 49). In the U.S. this was made permissible by the repeal of the Glass-Steagall Act in 1999.

During this period, European banks in particular, acquired significant foreign assets including as shown on Figure 1 significant USD-denominated assets. For example, in 2000, Swiss banks' foreign claims

⁹ In anticipation of panic selling and a huge meltdown of the market, the New York Stock Exchange and the Nasdaq did not open for business on Tuesday September 11th and remained closed until the following Monday, September 17th, the longest closure since 1933. See also note 17.

were roughly five times Swiss GDP. This total had jumped to eight times GDP by mid-2007 (Ibid.). In aggregate, growth in USD-denominated assets accounted for over half of the increase in foreign assets acquired by European banks during this period. Japanese and Canadian banking industries also experienced robust growth of USD-denominated assets, although at lower volumes. (Ibid., 49-50). Sales of new complex financial instruments such as collateral debt obligations, many based on U.S. subprime mortgages, sold to investors worldwide helped to fuel these increases at non-U.S. banks and also at financial institutions, such as hedge funds.

Because of the size and depth of the U.S. financial markets, many foreign banks made commitments and investments in USDs and some even did this expecting to swap USDs for a third currency. (Ibid.). Most foreign banks maintained long¹⁰ positions in foreign currency including USD. For example, as of mid-2007, U.K. banks held USD positions in excess of \$300 billion, on an estimated \$2 trillion in gross USD claims. (Ibid., 50). The same is true of German and Swiss banks which each held net USD positions of \$300 billion by mid-2007, while that of the Dutch banks exceeded \$150 billion. (Ibid, 50-51).

Much of this growth was financed by short-term borrowing even though the assets funded were long-term and or relatively illiquid. The need to refinance their funding created rollover or funding risk for the banks. If they could not rollover their funding they might be faced with having to sell assets sooner than anticipated, perhaps at a loss.

According to BIS estimates, by mid-2007, the major European banks had a USD funding gap of between \$1.1 to 1.3 trillion, which they funded through the interbank market (\$400 billion), borrowing from their central banks (\$380 billion), and through FX swaps (\$800 billion).¹¹ (Ibid., 54). When in August 2007, strains in the interbank funding markets lead to a constriction in USD availability, the problem quickly developed into a systemic risk as the gap between the amounts of USDs needed by foreign banks severely outweighed the amount of the currency that could be accessed through the interbank markets.

THE PANIC BEGINS

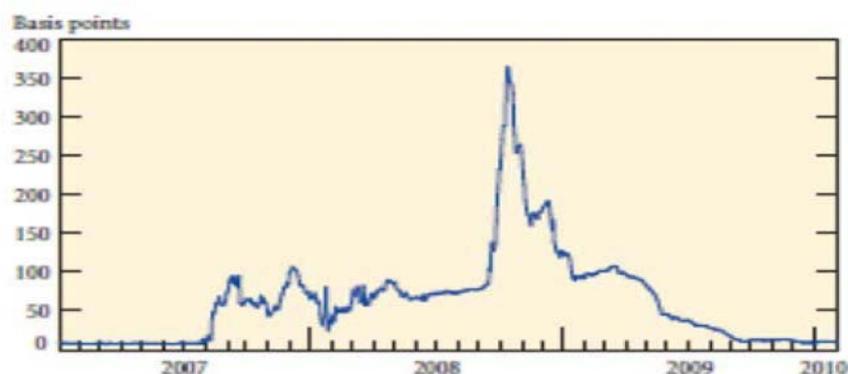
On August 9, 2007 the French bank BNP Paribas announced that it was suspending redemptions in three of its hedge funds that had invested in sub-prime mortgages. The announcement sent a tremor through the interbank lending markets and prompted banks to reassess their counterparty risk and liquidity needs. The news also caused the spread between the London interbank offered rate (LIBOR), an unsecured lending rate, and the overnight indexed swap rate (OIS), a measure of average overnight rate, to increase, reflecting that the market perceived an increase risk to longer maturity lending. (Fleming and Klagge 2010, 2).

As shown in Figure 3, the LIBOR-OIS spread remained elevated and was further aggravated by such factors as the contraction in the commercial paper market and the increasing need for financial institutions to fund special purpose vehicles that were experiencing valuation pressures due to the problems in the subprime markets. Things only tightened when, on December 15, 2007, Citibank announced that it would take its seven structured investment vehicles (with a value of \$49 billion) onto its balance sheet.

¹⁰ A “long” position denotes a positive while a “short” position denotes a negative net position.

¹¹ In the BIS locational banking statistics, several countries (e.g. Germany, Japan and the United States, do not report liabilities (in forging currency) vis-a-vis domestic official monetary authorities, which makes it difficult to identify precisely total liabilities to the counterparties. (McGuire and Von Peter, 54, Fn 13).

Figure 3: Three-Month Dollar LIBOR-OIS Spread



Source: Fleming and Klagge 2010

In response, U.S. financial institutions began hoarding USDs and the Federal Reserve, in December 2007, established the Term Auction Facility (TAF)¹² to provide additional funding to U.S. banks, there was little evidence that it served to relieve the pressure for USD liquidity on foreign markets. To the contrary, to support their parent entities, European subsidiaries of U.S. banks, lent USDs to their parent entities, sending USDs back into the U.S. (Bertaut and Pounder 2009, 159).

However, some U.S. banks did lend to Europe. . From August 2007 to September 2008, many U.S.-based banks of different sizes lent to European banks, where usually only large banks did. This activity generated an outflow of more than \$450 billion. Most of this new lending represented loans from the U.S. subsidiaries of European banks to their European affiliates; more than two-thirds of banks' cross-border positions were intercompany lending to affiliated banking offices abroad. (Ibid., 158). The U.S. offices of 30 banks, 22 of them with European parents, each lent over \$10 billion overseas. (Ibid., 158). And since U.S. subsidiaries of European banks are eligible to borrow from the Federal Reserve Discount Window and other facilities, some of these funds, were lent on. Circumstances that would later create quite a bit of controversy once disclosed. (See Grim 2009.)

Although the strains in the interbank funding markets impacted both U.S. and foreign financial institutions, the impact on foreign institutions was worse than on the U.S. institutions. U.S. banks have large reserves in their deposits that are denominated in USD. They also have the ability to borrow from the Federal Reserve's Discount Window when needed. Neither of these sources of funds was available to foreign banks, except as discussed above, indirectly through their U.S. subsidiaries. Thus, the collapse of the interbank markets severely limited foreign banks' access to USD liquidity.

In an effort to relieve these pressures, in December 2007, the European Central Bank (ECB) and the Swiss National Bank (SNB) sought currency swaps with the Federal Reserve to provide access to USD to Eurozone and Swiss financial institutions, respectively.

The central banks could have funded USD liquidity from their own reserves; however the banks may not have had sufficient funds. In some cases, the amounts ultimately lent to some central banks by the Federal Reserve exceeded the amount of their reserves. (Ibid., 3). Another possibility would have been for the

¹² The Term Auction Facility was enacted to provide funding to U.S. depository banks. See Wiggins and Metrick 2016A.

central banks to raise USD by selling assets. However, this would have been subject to market pressures and might even have exaggerated the market. Liquidity provided by the Federal Reserve was not subject to the market stresses and the Federal Reserve was in a unique position to mitigate market stresses as it could provide unlimited supply.

4. THE INITIAL CURRENCY SWAP LINES - DECEMBER 2007 TO SEPTEMBER 2008

On December 12, 2007, the Federal Reserve announced that it had entered into temporary reciprocal foreign currency swap agreements (FCSAs) with the ECB and the Swiss National Bank (SNB) to “address elevated pressures in short-term funding markets¹³ and permit the central banks to provide USD liquidity to European financial institutions in their respective jurisdictions. The original swap with the ECB provided for a line up to \$20 billion. The agreement with the SNB allowed for up to \$4 billion. (Fed. Res. December 12, 2007). The lines were originally approved for a period of up to six months, but would repeatedly be extended and augmented.

The announcements were one of several during the crisis that the Federal Reserve would coordinate with other central banks. Although the original swap agreements were only between the Federal Reserve and ECB and the SNB, the Bank of Canada and the Bank of England simultaneously announced expansions of their long-term repo operations. (Bank of Canada 2007) (Bank of England 2007). In addition, the Bank of Japan and Sveriges Riksbank (Sweden) issued statements in support of the actions that indicated that they were closely monitoring their currency situations. (Bank of Japan 2007) (Sveriges Riksbank 2007).

Foreign banks normally accessed USD through interbank lending such as repo and commercial paper. As U.S. financial institutions began to hoard USD, foreign entities experienced difficulties in meeting their needs for the currency. Pressures increased in March 2008 as markets were further aggravated by the near failure of Bear Stearns. The disruptions in the interbank lending for USD mirrored those in the U.S. lending markets generally and were evidenced by an increase in rates and a decrease in lending maturities. It did not take long for there to be little or no interbank lending at maturities longer than overnight. Given these increased pressures, the central banks requested an extension and increase in the swap lines. The lines were expanded through September 2009 and increased to \$30 billion for the ECB, and \$6 billion for the SNB. (Fed. Res. March 11, 2008).

HOW THE SWAPS AND DISTRIBUTIONS WORKED

The swaps were affected by the foreign central bank entering into a FCSA¹⁴ with the Federal Reserve Bank of New York (FRBNY) on behalf of the FOMC providing for a stated maximum amount of funding when needed during the term of the FCSA, as determined by the foreign central bank. When the foreign central bank drew on the FCSA, it would sell to the Federal Reserve a quantity of its currency in exchange for USD at the prevailing market exchange rate. At the same time, the central bank entered into an agreement to buy back its currency from the Federal Reserve in the future at the same exchange rate. (Fleming and Klagge 2010, 2). The foreign central bank would hold its currency in an account for the benefit of the Federal Reserve.

¹³ On April 6 2009 the Federal Reserve also established foreign currency swap lines with the ECB, the SNB, the Bank of England, and the Bank of Japan that permitted it to provide liquidity to U.S. banks in the foreign currencies if needed. However, the Federal Reserve did not draw on these lines and they expired on February 1, 2010 at the same time as the USD swap lines. (Fleming and Klagge, 1, Fn 3).

¹⁴ As an example of a FCSA see the examples of agreements between the Federal Reserve and central banks, available at https://www.newyorkfed.org/markets/liquidity_swap.html.

Simultaneously, the FRBNY would transfer the USDs drawn under the FCSA into an account that it maintained for the benefit of the foreign central bank. Following an auction by a foreign central bank the FRBNY would transfer the USD liquidity directly into an account maintained at the FRBNY by the foreign financial institution to clear its USD trades. There would be no direct agreement between the FRBNY (or any other Federal Reserve entity) and the foreign financial institution, and the foreign central bank would be liable for the loan. At the end of the swap, the central bank would pay interest to the FRBNY equal to the amount that the central bank had earned on its USD loans. (Fleming and Klagge, 2).

The FCSAs were enacted at the same time as the TAF and, with some exceptions, were originally administered by the foreign central banks as an extension of the TAF program. By funneling the USD liquidity through the central banks, the Federal Reserve did not have to create a distribution network or manage counterparty risk with respect to the borrowing foreign banks.

Establishment of this liquidity swap line, along with the TAF, could have positive confidence effects. Moreover, given the strong financial position of the ECB, the swap line would involve virtually no credit risk to the Federal Reserve. By providing dollars to the ECB to use in its efforts to address term funding problems in Europe, we would assist credit markets without ourselves providing funding to banks overseas. (FOMC Trans. December 6, 2007).

Thus, the Federal Reserve looked to the central banks, which utilized their standing facilities, to distribute the USDs to those of their banks that satisfied the eligibility criteria that the foreign central banks had established and which could produce the necessary collateral to secure the loan.

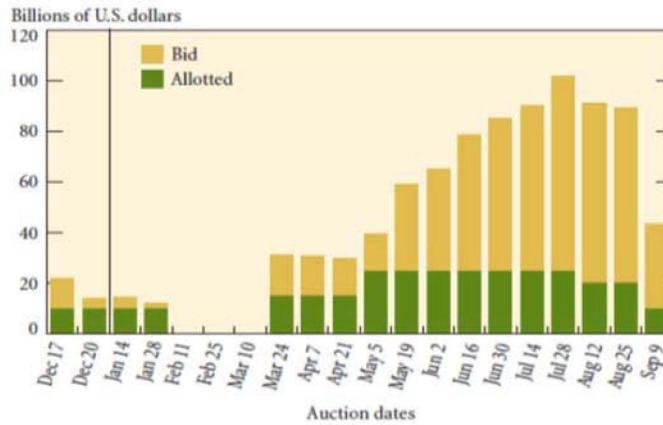
During the initial period of the FCSAs, prior to September 2008, the terms of the lendings to financial institutions by foreign central banks closely mirrored those imposed by the Federal Reserve under the TAF. The central banks utilized both variable and fixed rate auctions. They determined the maturities offered, the eligible collateral that would be accepted, and how much to lend to any one institution. Prior to September 2008, the auctions run by the central banks utilized the same rate charged under the TAF.

For example, the ECB press release of December 12, 2007 announcing the provision of USD liquidity pursuant to the FCSA stated that such was being done “in connection with the US dollar Term Auction Facility.” The ECB set maturities at 28 and 35 days, as the Federal Reserve did under the TAF, and charged the same rate as the TAF, but accepted ECB-eligible collateral. (ECB December 12, 2007).

As shown in Figure 4, Demand for USDs slacked in early 2008 and the ECB ceased conducting the auctions. The ECB then resumed the auctions in March following the tumult over Bear Stearns. From March through September 2008, the market stresses continued to block the availability of USD liquidity through the interbank markets resulting in continued high demand. However, the total amount of USD liquidity available for the auctions was limited by the amount of the FCSA and so as demand increased, the auctions were oversubscribed as shown in Figure 4, leading to high bid-to-cover rates and unmet demand. (Fleming and Klagge 2010, 4).

At the end of the swap the central bank would pay to the Federal Reserve interests in an amount equal to the amount earned by the central bank on its lending operations. The Federal Reserve on the other hand did not pay interest on the foreign currency it received in the swap, which it held rather than investing it in the market. (Fleming and Klagge 2010, 3).

Figure 4: Demand for Dollar Funding in the European Central Bank’s One-Month Auctions December 17, 2007—September 9, 2008

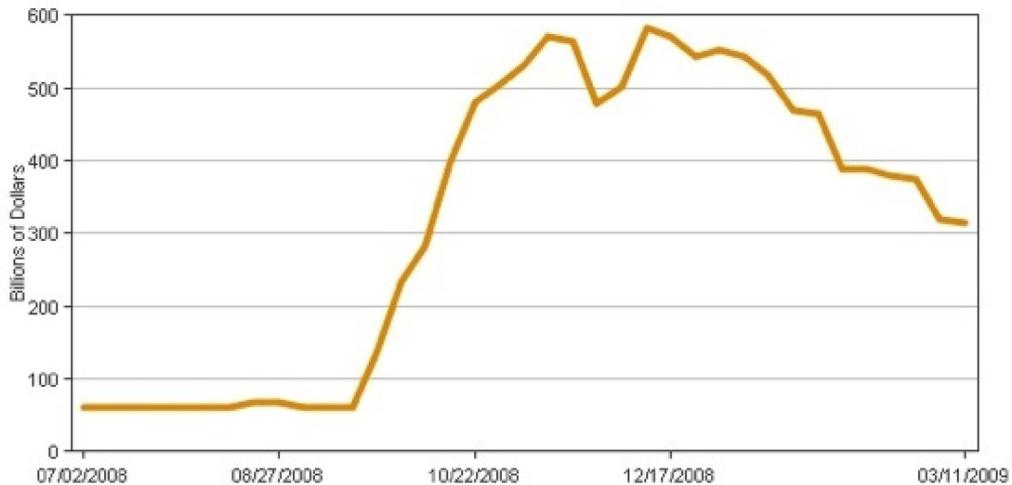


Source: European Central Bank (Fleming and Klagge, 2010, 4)

5. SIGNIFICANT EXPANSION OF SWAPS - SEPTEMBER 18 TO OCTOBER 12, 2008

On September 16, 2008, following the disruption in the markets after the announced Lehman Brothers’ bankruptcy and the “sever stresses in the dollar funding markets” the FOMC authorized its Foreign Currency Subcommittee to direct the NYFED as needed to expand existing swap arrangements and to enter into new swap arrangements to address the strains in the funding markets. The authorization sought to “provide the flexibility necessary to respond promptly to requests from foreign central banks to engage in temporary reciprocal currency (“swap”) arrangements to be used in supporting dollar liquidity in their jurisdictions.” (FOMC Mins September 16, 2008, 2).

Figure 5: Amounts Outstanding Pursuant to the USD Swaps, July 2, 2008—March 1, 2009



Source: Huffington Post

On September 18, the Federal Reserve announced that it was doubling the USDs allotted under the swap with the ECB from \$ 55 billion to \$110 billion, and increasing the allotment to the SNB from \$12 billion to \$27 billion. On that same day it also announced new FCSAs with the Bank of Japan, the Bank of England and the Bank of Canada for up to \$60 billion, \$40 billion and \$10 billion, respectively. (Fed. Res. September 18, 2008). This brought the total committed to \$ 247 billion.

Despite this aggressive move, continued rapid deterioration in the credit markets shortly compelled the Federal Reserve to take additional steps to maintain the USD liquidity around the world. On September 24, 2008, the Federal Reserve announced that it had put in place four additional FCSAs with the Reserve Bank of Australia, Svergis Riksbank (Sweden), Norges Bank (Norway), and Danmarks National Bank (Denmark). The maximum amount committed under each agreement was \$10 billion with respect to Australia and Sweden, and \$5 billion each with respect to Denmark and Norway, bringing the total committed under the nine outstanding FCSAs to \$277 billion.

On September 29th U.K. officials nationalized mortgage lender Bradford and Bingley, the Dutch-Belgian bank Fortis had to be bailed out, and Iceland took control of the country's third largest bank in an effort to prevent its entire banking system from collapsing.¹⁵ In the midst of this turmoil, European bank equity stocks dropped sharply and the funding markets only went from bad to worse experiencing continued seizure and a dire lack of USD funding, especially at maturities longer than overnight.

Notwithstanding the Federal Reserve's unprecedented expansion of the FCSAs just a few days earlier, the staff recommended that the FOMC again take even further dramatic action and again greatly expand the swap lines. It is interesting to note that although the expansions were requested by the central banks, their decisions were made "with some encouragement from the Federal Reserve" (FOMC September 29, 2009, 4). As indicated in the meeting transcript, the Federal Reserve saw the expanded authority as serving two purposes, (1) providing funding and (2) reassuring and calming the markets:

The actual draws on these lines may turn out to be considerably less, and the amounts that are actually drawn are likely to depend on market conditions. The large increase in authorization should be considered as insurance in case market conditions continue to deteriorate and as reassurance to market participants that the world's major central banks are determined to respond in force to mitigate dollar funding pressures. . . Adding up all this would result in an increase in our swap line authorization to \$620 billion from \$290 billion previously. I think that these decisions have been made in response to the increasing turmoil evident in interbank markets, especially for dollar funding; and by increasing the size of the authorization significantly, the intention is to reassure market participants that sufficient dollar funding will be available well into 2009. (Ibid.).

¹⁵ The next day it would guarantee all bank deposits for two years and, within days, it would take its three largest banks into receivership. Zeissler, Ikeda and Metrick, 2014.

Figure 6: Federal Reserve Swap Lines with Central Banks 2007-2010

Date	Central Bank	Maximum Amount Available
December 12, 2007	European Central Bank	\$240 billion*
	Swiss National Bank	\$60 billion*
September 18, 2008	Bank of Japan	\$120 billion*
	Bank of England	\$80 billion*
	Bank of Canada	\$30 billion
September 24, 2008	Reserve Bank of Australia	\$30 billion
	Sveriges Riksbank	\$30 billion
	Norges Bank	\$15 billion
	Danmarks Nationalbank (Denmark)	\$15 billion
Subtotal	9	\$620 billion
October 28, 2008	Reserve Bank of New Zealand	\$15 billion
October 29, 2008	Banco Central do Brasil	\$30 billion
	Banco de Mexico	\$30 billion
	Bank of Korea	\$30 billion
	Monetary Authority of Singapore	\$30 billion
Total	14	\$755 billion*

*As of October 13-14, 2008, the Federal Reserve removed the caps on the FCSAs with these banks and announced that it would provide unlimited USD liquidity to them as needed.

Sources: Fleming and Klagge 2010, Federal Reserve Website.

On September 29, 2008 the Federal Reserve announced that it was more than doubling the total amount committed under all outstanding swap agreements¹⁶ increasing committed amounts by \$330 billion to \$620 billion from the previous \$290 billion.¹⁷ It stated the following reasons for its dramatic move:

Dollar funding rates abroad have been elevated relative to dollar funding rates available in the United States, reflecting a structural dollar funding shortfall outside of the United States. The increase in the amount of foreign exchange swap authorization limits will enable many central banks to increase the amount of dollar funding that they can provide in their home markets. This should help to improve the distribution of dollar liquidity around the globe.

¹⁶ Authorization under swap agreements with the Bank of Canada, Bank of England, Bank of Japan, Danmarks Nationalbank (National Bank of Denmark), European Central Bank (ECB), Norges Bank (Bank of Norway), Reserve Bank of Australia, Sveriges Riksbank (Bank of Sweden), and the Swiss National Bank. (Fed. Res. Sept. 29, 2008).

¹⁷ On September 26, 2008 the Federal Reserve also announced a \$10 billion increase in its temporary swap facility with the ECB and a \$3 billion increase in its facility with the SNB intended to address particular funding pressures occurring over quarter-end. These expansions brought the Federal Reserve's commitments to provide USD liquidity up to \$120 billion with respect to the ECB, up to \$30 billion with respect to the SNB, and its total under all FCSAs to \$290 billion. (Fed. Res. Sept. 26, 2008).

(Fed. Res. Sept. 29, 2008). The maximum committed amounts identified by the respective central bank are shown in Figure 5. The FCSAs were authorized through April 30, 2009. However, in its announcement, the Federal Reserve made a further commitment to the world's markets—“We will continue to adapt these liquidity facilities as necessary and *will keep them in place as long as circumstances require.*” (Emphasis added.) (Ibid.).

These greatly expanded amounts provided significantly increased capacity for the foreign central banks to meet the unmet demand for USD funding. The ECB, which was now authorized for up to \$110 b its FCSA, quickly moved to add an overnight maturity to its lending operations and to increase the amounts lent under its term auction facility (28- and 84- days). (ECB 18 Sept. 2008.) Echoing the Federal Reserve's announcement and the central banks' coordinated efforts, the ECB announcement stated that— “[I]t is intended to continue the provision of US dollar liquidity *for as long as needed* in view of the prevailing market conditions.” (Emphasis added.) (Ibid.).

THE EXTREME TURMOIL IN THE MARKETS

The actions of the central banks must be viewed in light of the extreme and dire stresses that were battering the global financial system at the time. During the month following Lehman Brothers' announcement of its bankruptcy, the credit markets all but froze and there was real fear that the entire global financial system, a system that had shown itself to have pockets of unquantifiable risk, and to be highly interconnected, might collapse.

On September 15, the Dow Jones fell 504.49 points (4.4%), its worst percentage decline since reopening after the September 11th terrorists' attacks. London's FTSE 100 Index fared no better, closing down 291.80 points (3.9 %) ¹⁸. The Federal Reserve began its bail out of the insurance giant AIG acquiring a 79.9% equity stake for \$85 billion to keep it solvent. The money market fund, the Reserve Primary Fund, “broke the buck” causing a run on money market funds that required nothing less than the U.S Treasury to step in with an unprecedented guarantee of all funds to halt it.

Things were no better outside the U.S. During September 2008, major banks and financial institutions failed in Belgium (Fortis), the Netherlands (Dexia), Iceland (Glitnir), the U.K. (Bradford and Bingley) and the entire Irish banking system was nationalized. In addition to providing USD liquidity to financial institutions within their jurisdictions, the other central banks also scrambled to maintain liquidity in their host currencies. For example, on September 15th, the ECB and the Bank of England injected €30 billion, and £5 billion, respectively, into their economies. Further, on September 18th, the Federal Reserve coordinated with the Bank of England, the ECB, the Bank of Japan, and the SNB to inject an additional \$184 billion into the world's banking systems to compensate for the lack of active lending.

The Federal Reserve's actions to provide USD liquidity outside the U.S. were in tandem with its extraordinary efforts to provide liquidity in the U.S. markets via the TAF, the Primary Dealer Credit Facility, the Commercial Paper Funding Facility and the several other facilities that it had scrambled to put in place. And it should also be noted that many U.S. subsidiaries of foreign banks also borrowed under these facilities. (See other YPFS papers.) Eventually, the Federal Reserve would interject more than \$10 trillion dollars into the U.S. financial system to combat the crisis. (Federal Reserve Website, Felkerson 2011).

¹⁸ The dive was even worse on September 29, 2008, when the U.S. House of Representatives refused to approve the Bush Administration's \$700 billion bailout plan triggering the biggest one-day point drop in the history of the Dow Jones, 778 points (7.0%). The FTSE 100 also dropped 418.80 points (5.30%).

6. PROVIDING UNLIMITED SUPPLY - OCTOBER 13, 2008 TO FEBRUARY 10, 2010.

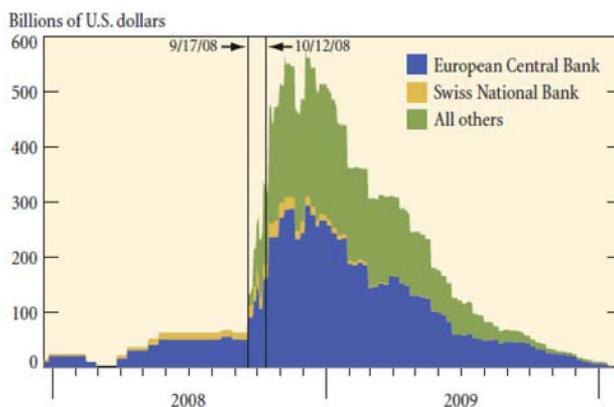
Notwithstanding the unprecedented nature and volume of the various efforts undertaken by the central banks of the world’s major economies to calm the crisis, including the announcement by the U.S. government on October 8th of the \$700 billion Troubled Asset Relief Program, the credit markets did not immediately respond. Days later, on October 13, 2008, the Federal Reserve further announced that it was removing the cap from the swap lines with three major central banks—the ECB, the Bank of England, and the SNB, to permit them to provide USD liquidity in whatever amounts their economies demanded:

The BoE, ECB, and SNB will conduct tenders of U.S. dollar funding at 7-day, 28-day, and 84-day maturities at fixed interest rates for full allotment. Funds will be provided at a fixed interest rate, set in advance of each operation. Counterparties in these operations will be able to borrow any amount they wish against the appropriate collateral in each jurisdiction. Accordingly, sizes of the reciprocal currency arrangements (swap lines) between the Federal Reserve and the BoE, the ECB, and the SNB will be increased to accommodate whatever quantity of U.S. dollar funding is demanded. The Bank of Japan will be considering the introduction of similar measures.

(Fed. Res. Oct. 13, 2008). A day later, a similar announcement was made with respect to the Bank of Japan. Basically, the Federal Reserve agreed to provide unlimited USD funding to these major economies through April 2009.

As shown in Figure 7, the Federal Reserve’s dramatic expansion in availability allowed for a significant increase in the quantity of USD liquidity lent by central banks into their jurisdictions. At one point during the crisis, December 10, 2008, there was a high of \$580 billion outstanding under the swaps, more than 25% of the Federal Reserve’s total assets. (Fleming and Klagge 2009, 5).

Figure 7: Foreign Exchange Swap Line Amounts Outstanding, by Foreign Central Bank



Source: Fleming and Klagge 2010, 4. Authors’ calculations based on data from Bloomberg L.P. and foreign central banks.

In line with the October 2008 announcements, the four major foreign central banks altered the mechanisms through which they provided USD 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 full allotment amounts at one-week, one-month, and three-month maturities. These longer term maturities were intended to mitigate the risk of nonrenewal and to provide some comfort to the

markets that USD funding could be sustained. Eligible institutions were permitted to borrow any amount of USDs that they wished, provided that they could supply the required collateral. The full allotment offerings also addressed the large over subscriptions that had been occurring.

Another change in practice after the October 2008 announcements was that the central banks individually set the rates for these later auctions, rather than just adopt the rate established by the Federal Reserve for the TAF. For example, the ECB charged a fixed rate of 100 basis points above the corresponding OIS rate, thus implying a premium over the Federal Reserve rate. (ECB August 2014, 71). This was also intended to dissuade banks from continuing to use the facility when other cheaper avenues of funding became available. This strategy mirrored the changes that the ECB had undertaken with respect to the provision of Euros.

In the final days of October 2008, the Federal Reserve opened swap lines with five more central banks as shown in Figure 5 bringing its total number of FCSAs to 14. Thus, at September 24, 2009, the Federal Reserve had committed \$620 billion to nine central banks. By October 29, 2008, 14 central banks agreements provided for a minimum aggregate lending of up to \$755 billion, with a commitment of unlimited allotments to the ECB, Bank of England, the Bank of Japan, and the SNB. Figure 7 shows the total borrowing by each central bank. In October 2008, lending reached its monthly peak at \$2.887 trillion and the peak outstanding of \$583.13 billion was reached in December 2008. Over the tenure of the FCSAs the Fed would provide loans totaling \$10.056 trillion. (Felkerson 2011, 11).

Figure 8: CBLS Borrowing by Foreign Central Bank, in USD (billions)

Borrower	Total
European Central Bank	8,011.37
Bank of England	918.83
Swiss National Bank	465.812
Bank of Japan	387.467
Danmarks Nationalbank (Denmark)	72.788
Sveriges Riksbank(Sweden)	67.2
Reserve Bank of Australia	53.175
Bank of Korea (South Korea)	41.4
Norges Bank (Norway)	29.7
Bank de Mexico	9.663

SOURCE: FEDERAL RESERVE

7. THE IMPACT OF THE USD LIQUIDITY PROGRAM

Research on the FCSA program concludes that the program was effective in providing funding where the seizure of the interbank markets had created a gap and in easing market pressures. The three measures described below particularly indicate that the Federal Reserve’s aggressive expansion of full allotment funding beginning in October 2008, addressed market circumstances that had become extremely strained

and where costs had risen to unprecedented levels. (For more statistical analysis of the FCSA program see Goldberg, Kennedy and Miu 2010.)

The LIBOR Spread. Prior to the beginning of the crisis in August 2007, the rate that non-U.S. banks paid for USD funding closely mirrored that paid by U.S. banks. This can be seen in Figure 8, which shows the average borrowing rates of the thirteen non-U.S. banks in the LIBOR survey panel as compared to the rates paid by the three U.S. banks. Prior to August 2007, the spread was essentially zero. Beginning with the market turmoil in August 2007, the spread increased. It then subsided in December 2007, when the first USD currency swaps were put in place by the Federal Reserve, the ECB and SNB. Rates once again increased after the Bear Sterns near-failure in March and then escalated to unprecedented levels after the Lehman Bankruptcy. This is as would be expected as U.S. banks began to hoard funds in response to the contraction in the interbank wholesale funding markets. With the introduction of full allotment funding in October 2008, there was gradual easing of the rates. (Fleming and Klagge, 2010, 5-6).

Figure 9: Spread between Foreign Bank's and U.S. Bank's Three-Month Dollar Libor Quotes



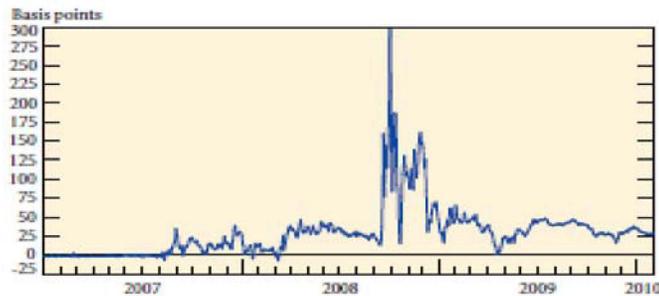
Note: The spread is calculated as the difference between the average borrowing rate of the thirteen non-U.S. banks on the Libor panel and the average borrowing rate of the three U.S. banks on the panel.

Source: Fleming and Klagge, 2010, 5. Author's calculations based on data from Bloomberg L.P.

The Dollar Basis

The banks in the LIBOR panel are large banks and while their data is instructive, it is also useful to note that the *dollar basis*, a measure relating to the cost of funding for a wider range of banks, followed a similar pattern as shown in Figure 9. The dollar basis is the spread between the cost of borrowing USDs directly in the interbank markets, and the cost of borrowing euros and then entering into a foreign currency swap for USDs. Ideally, the cost of the two transactions should be the same, but in strained markets, the spread increases as it did in August 2007. From then on, the dollar basis followed an exchanging pattern similar to that of the overseas-U.S. LIBOR spread, increasing as the markets experienced additional shocks and easing as more USD were made available through the swaps program. (Ibid., 6).

Figure 10: Three-Month Dollar Basis



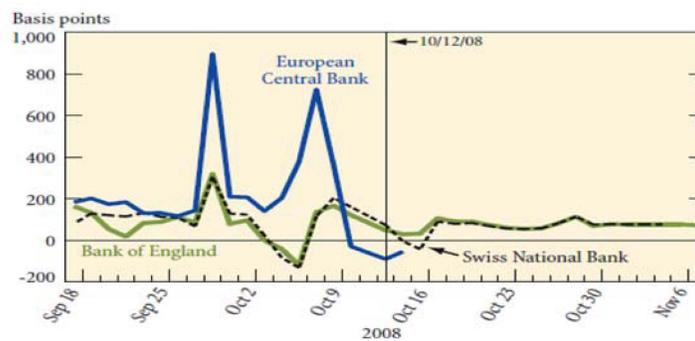
Note: The dollar basis measures the costs of individual borrowing in dollars using Eurodollar FX swaps less the cost of direct borrowing in dollars.

Source: Fleming and Klagge, 2010, 6. Bloomberg, L.P.; Federal Reserve Bank of New York; Tullet.

Central Bank Auction Stop-out Rates

One additional measure of the impact of the FCSA program is the changes in the stop-out rates achieved in the central bank auctions of USD. In periods of extreme constraint, the stop-out rates climbed, as shown in Figure 10. The provision of USDs via the FCSAs increased the supply and correspondingly decreased the rates bid in the auctions to secure funding. When bidding is tight, bidders will bid high to improve their chances at a scarce commodity. When funding pressures wane, such as after the Federal Reserve committed unlimited USD capacity to four major central banks, bidding eased and stop-out rates lowered.

Figure 11: Spread between Foreign Central Banks' Overnight Dollar Auction Stop-Out Rates and the Effective Federal Funds Rate



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

Source: Fleming and Klagge 2010, 7. Authors' calculations, based on data from the Federal Reserve Bank of New York and foreign central banks.

AFTERMATH

In May 2010, in response to stress resulting from the European sovereign debt crisis and the re-emergence of strains in short-term U.S. dollar funding markets, the FOMC announced that it had again authorized unlimited dollar liquidity swap lines with the Bank of England, the ECB, the Bank of Japan,

and the SNB.¹⁹ Further analysis of the effects of the temporary FCSAs utilized during the crisis proved to be favorable, and in October 2013, the Federal Reserve and these central banks announced that their existing temporary liquidity swap arrangements, including the dollar liquidity swap lines, would be converted to standing arrangements that will remain in place until further notice:

The conversion of these liquidity lines with pre-set expiration dates to standing lines further supports financial stability by reducing uncertainties among market participants as to whether and when these arrangements would be renewed. This action results from the ongoing cooperation among these central banks to help maintain financial stability and confidence in global funding markets. (Federal Reserve. Res. Website).

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