

Choi, Mark; Goldberg, Linda S.; Lerman, Robert Irving; Ravazzolo, Fabiola

Working Paper

The Fed's central bank swap lines and FIMA repo facility

Staff Reports, No. 983

Provided in Cooperation with:

Federal Reserve Bank of New York

Suggested Citation: Choi, Mark; Goldberg, Linda S.; Lerman, Robert Irving; Ravazzolo, Fabiola (2021):
The Fed's central bank swap lines and FIMA repo facility, Staff Reports, No. 983, Federal Reserve
Bank of New York, New York, NY

This Version is available at:

<https://hdl.handle.net/10419/247906>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

NO. 983
SEPTEMBER 2021

The Fed's Central Bank Swap Lines and FIMA Repo Facility

Mark Choi | Linda Goldberg | Robert Lerman | Fabiola Ravazzolo

The Fed's Central Bank Swap Lines and FIMA Repo Facility

Mark Choi, Linda Goldberg, Robert Lerman, and Fabiola Ravazzolo

Federal Reserve Bank of New York Staff Reports, no. 983

September 2021

JEL classification: F33, F34, G28

Abstract

Building on the facility design and application experience from the period of the global financial crisis, in March 2020 the Federal Reserve eased the terms on its standing swap lines in collaboration with other central banks, reactivated temporary swap agreements, and then introduced the new Foreign and International Monetary Authorities (FIMA) repo facility. While these facilities share similarities, they are different in their operations, breadth of counterparties and potential span of effects. This article provides key details on these facilities and evidence that the central bank swap lines and FIMA repo facility can reduce strains in global dollar funding markets and U.S. Treasury markets during extreme stress events.

Key words: swap line, dollar, liquidity, repo, Federal Reserve lending facilities

Choi, Goldberg, Lerman, Ravazzolo: Federal Reserve Bank of New York (emails: mark.choi@ny.frb.org, linda.goldberg@ny.frb.org, robert.berman@ny.frb.org, fabiola.ravazzolo@ny.frb.org). This paper was prepared for an upcoming issue of the *Economic Policy Review* and a related New York Fed conference, “Implications of Federal Reserve Actions in Response to the COVID-19 Pandemic.”

This paper presents preliminary findings and is being distributed to economists and other interested readers solely to stimulate discussion and elicit comments. The views expressed in this paper are those of the author(s) and do not necessarily reflect the position of the Federal Reserve Bank of New York or the Federal Reserve System. Any errors or omissions are the responsibility of the author(s).

To view the authors' disclosure statements, visit
https://www.newyorkfed.org/research/staff_reports/sr983.html.

1. Introduction

The severe global economic impact of the rapid spread of COVID-19 in early 2020 prompted a quick and broad policy response from fiscal authorities and central banks. This article focuses specifically on the policy actions taken by the Federal Open Market Committee (FOMC) in March 2020 that were primarily associated with pressures in offshore dollar funding markets and in part with U.S. Treasury market dislocation.¹ These actions included expanding and enhancing the central bank dollar liquidity swap line arrangements with selected foreign central banks (hereafter CB dollar swaps) and establishing a new repurchase operation (repo) facility to Foreign and International Monetary Authorities (FIMA) with accounts at the Federal Reserve (hereafter FIMA repo facility).

This article provides details on the conditions that spurred creation or use of these facilities, the operational elements of the facilities, and some evidence of effects on strains in offshore dollar funding markets and credit provision. We begin with a review of developments in the supply and demand for offshore dollar funding and how it affected broader markets, such as the U.S. Treasury and foreign exchange swap market. We then discuss the details of the Federal Reserve's CB dollar swaps and FIMA repo facility actions to enhance the provision of U.S. dollar liquidity internationally to address strained market conditions and support credit provision abroad and in the United States. The CB dollar swaps historically have been an effective tool to help facilitate the flow of dollars through foreign central banks to financial institutions in their respective jurisdictions. The new FIMA repo facility provides broader access to a dollar liquidity backstop compared to the CB dollar swaps, offering foreign official institutions an ability to temporarily exchange their own U.S. Treasury holdings held in custody at the Federal Reserve for short-term dollar liquidity.

The article also provides perspective on the efficacy of these backstop facilities. The settlement of dollars through these facilities helped to support the stabilization of financial markets and sustain the flow of credit to borrowers, thus containing the amplification effects that could have worsened the economic outcomes from the pandemic shock. The new FIMA repo facility, not yet broadly utilized by the time of this publication, should likewise provide stabilizing effects in the event of future turmoil idiosyncratic to countries or in broader funding markets. The article concludes by highlighting some lessons learned around the design aspect of the facilities. Operational readiness, agility, and the groundwork of strong central banking relationships continue to be important features given the ever-changing dollar funding landscape.

2. Global U.S. Dollar Funding Markets

Offshore dollar funding markets are one element of the extensive global use of the U.S. dollar in international trade and financial transactions (Goldberg and Lerman 2019). A large amount of dollar funding flows through different types of financial intermediaries and a variety of market instruments.²

¹ It is worth noting that to support market function and address dislocations in the U.S. Treasury market, the FOMC took other and more relevant direct actions [refer and link to other relevant EPRs].

² Intermediaries that might provide U.S. dollar through one instrument, for example a loan, also need to fund that asset by borrowing U.S. dollars, for example a U.S. dollar deposit. Intertwined in this process is the need to hedge

The interconnectedness of markets worldwide can quickly transmit both favorable conditions and strains across financial markets and institutions, impacting financial conditions, credit provision, and monetary policy transmission in the United States and globally.³

Under normal conditions, the broad participation and high volume of activity in U.S. dollar funding markets means that borrowers incur relatively low funding rates. International capital flows and global dollar liquidity respond relatively smoothly to changes in risk and returns across markets, without excessive price impact. When conditions are stressed, price dispersion occurs, as gaps widen between the cost of funds for some market participants and the price other market participants are willing to pay. Global liquidity flows, the more volatile part of international capital flows, can retrench and redirect, particularly as global banks and financial institutions realign and redeploy scarce funds via their internal capital markets.

In the decade following the global financial crisis (GFC), the U.S. dollar funding landscape had undergone significant structural changes. Largely attributed to post-GFC regulatory reforms on banks, changes included reduced currency mismatches, smaller global footprints of weaker banks, and shifted business models and the geographic reach of different intermediaries (BIS CGFS 2020). Dollar funding flows shifted somewhat from a concentration in Europe toward institutions in Japan and some emerging market economies (EMEs).⁴ Moreover, the capacity of banks to engage in market-making activity appears to have become more constrained due to changes in the regulatory environment, helping drive an increase in participation by non-banks as providers and users of U.S. dollar funding (BIS CGFS 2021). Strong global risk appetite and historically low levels of U.S. Treasury yields supported cross-border U.S. dollar investment flows to emerging market economies (EMEs) and increased the demand for dollar-denominated borrowing in those countries. During this period, foreign central banks, particularly those in many EMEs, increased the size of their foreign exchange (FX) reserves, including U.S. dollars, to better manage local dollar funding needs in the event of sizable capital outflows.

In March 2020, extreme uncertainty amid virus-related lockdowns and expectations of a severe global economic downturn led to simultaneous supply and demand shocks in global U.S. dollar funding markets. Greater risk aversion and a desire to hold precautionary cash balances led banks and non-bank financial institutions (NFBIs) to reduce dollar intermediation in funding markets. Corporations, faced with tightened access to U.S. dollar funding markets and facing uncertain economic outlooks, drew heavily on their committed credit lines with banks. Some of these committed credit line draws were concentrated in the U.S. branches of foreign banking organizations (FBOs), resulting in significant increases in bank loans and new dollar funding needs. Some non-U.S. banks and corporations sought to build extra liquid dollar balances. Non-U.S. asset managers with sizable U.S. securities holdings, particularly Japanese insurance companies, increased hedging demand for U.S. dollars given the

risks, including those related to exchange rate, interest rate and maturity, for which certain instruments, such as FX forward and swaps, tend to be used. For a list of instruments and their characteristics see Table 1, in BIS CGFS (2020), [US dollar funding: an international perspective](#).

³ See interactive mapping of U.S. dollar funding flows, [here](#), explained in Afonso, Ravazzolo and Zori (2019), [From policy rates to market rates: untangling the U.S. dollar funding market](#).

⁴ For example, banks headquartered in Japan, the United Kingdom, France, Switzerland, and Canada engage in significant dollar lending, especially to other advanced foreign economies (AFEs). Chinese and some other banks of East Asia's emerging economies are significant suppliers of dollar-denominated credit, especially to other emerging market economies as noted in EMEAP (2020).

significant volatility in the FX market and some U.S. financial markets, especially U.S. Treasury and agency MBS markets.⁵ Some EMEs experienced capital outflows as international investors decreased holdings of local currency and dollar-denominated EME assets (FSB 2020), and sold U.S. dollar-denominated assets out of their foreign exchange reserves (Goldberg and Krogstrup 2021).

One standard metric that reflects the gap in the cost of funds is the foreign exchange swap basis spread (sometimes referred to as the basis), constructed by comparing the implied cost of U.S. dollar funding from a FX swap transaction of a specific tenor to a direct U.S. dollar interest rate. A positive FX swap basis spread reflects a premium to borrow U.S. dollars in the FX swap market, meaning that borrowers pay a higher cost for obtaining funds than the relevant U.S. dollar unsecured rates would suggest.⁶

At the onset of the pandemic in March 2020, the strains initially were most pronounced in shorter-term funding markets, generally with tenors under three months across both advanced economies and EMEs. Conditions had started to deteriorate at the end of February and became particularly strained around mid-March for short tenor transactions (Figures 1a and 1b). The premium to obtain U.S. dollar funding in the FX swap market increased to levels last seen in 2008, particularly in the dollar-yen currency pair, reflecting the recent growth in dollar activity of Japanese banks and in holdings of U.S. assets among Japanese non-bank financial entities (BIS CGFS 2020). Across EM currency pairs, the premium to obtain U.S. dollar in the FX swap market also significantly increased in March 2020. However, basis spreads of EM currency pairs remained narrower than peaks reached during the GFC, reflecting a decline in vulnerabilities associated with dollar funding activity of banks in these countries following banking sector reforms undertaken after the GFC (EMEAP 2020).

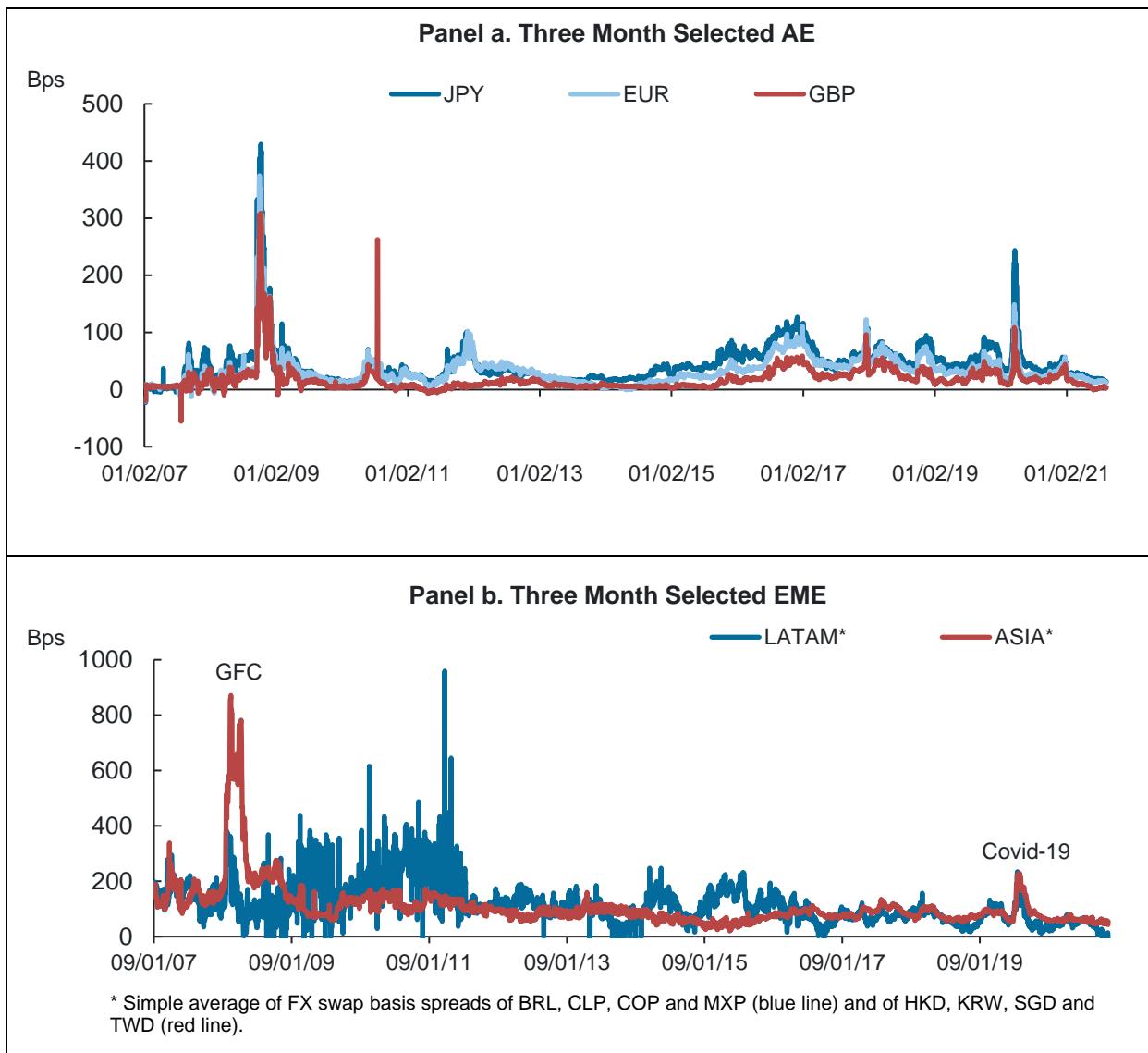
⁵ [Liao and Zhang \(2020\)](#) show that there was a larger rise in the cost of dollar funding through FX swaps for currencies whose home jurisdictions have more positive net international investment positions (that is, their investment in foreign assets is larger than their foreign debts), corresponding to more demand for hedging of dollar investments.

⁶ The relevant U.S. dollar unsecured rates in this paper are Overnight Indexed Swap (OIS) rates. The formula below provides an example based on the cost of borrowing euros in unsecured markets and converting them to U.S. dollars via the FX swap market and then comparing that with the rate paid to borrow U.S. dollars directly in the unsecured market:

$$EURUSD \text{ Swap Basis Spread} = \left[\frac{360}{\text{tenor}} \left(\left(\frac{\text{forward(tenor)}}{\text{spot}} \right) \left(1 + \text{EuroOIS(tenor)} \frac{\text{tenor}}{360} \right) \right) - 1 \right] - \text{US OIS(tenor)}$$

where *spot* is the foreign exchange spot rate at time *t*, *forward (tenor)* is the foreign exchange forward rate contracted at time *t* for delivery at time *t+tenor*, and *EUROOIS(t, tenor)* (or *USDOIS(t, tenor)*) is the uncollateralized euro (dollar) interest rate from time *t* to time *t+tenor*, which in this case is the overnight interest swap rate.

Figure 1 FX Swap Basis for Selected Currencies against the U.S. Dollar



Source: Bloomberg, L.P., authors' calculation.

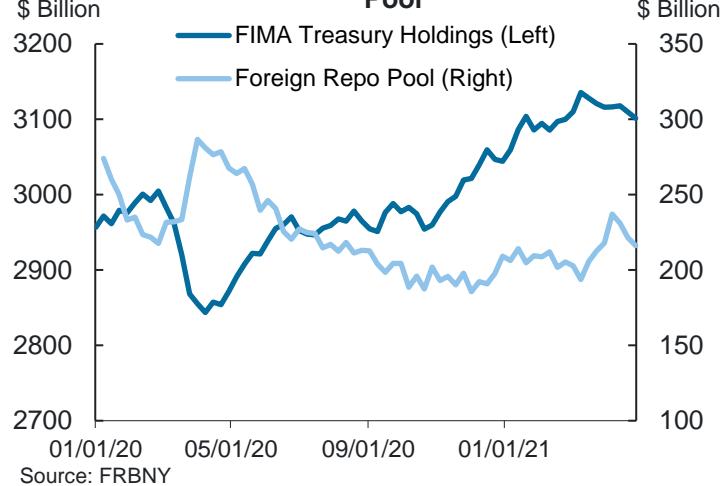
Note: As of 11 a.m., London time. Based on overnight unsecured funding rates (OIS) along with bilateral spot and forward exchange rates. A positive number reflects a premium to borrow or hedge U.S. dollars.

These strains also can show up in volumes of funding flows across borders. Within banking organizations, the flow of funds between the branches of foreign banking organizations (FBOs) operating in the United States and their foreign parent organizations responded quickly in response to the pattern of funding needs both within the United States and in foreign markets. The U.S. branches of foreign banking organizations received greater net internal capital flows from their parent banks (or reduced outflows went from the US branches to the parent organizations). Cetorelli, Goldberg and Ravazzolo (2020b) show that this adjustment corresponded to the combination of loan demand increase and funding supply contraction in March, with a stabilized position after the CB dollar swaps and Federal Reserve corporate credit and funding facilities were used. This directional flow differed from that which occurred in the early stages of the GFC, when European banking organizations were particularly strained

and obtained dollar funding from their US branches through internal capital market transfers (Goldberg and Skeie 2011, and Cetorelli and Goldberg 2011).

A sudden shift in global risk sentiment triggered, in an environment of tighter conditions in dollar funding markets, significant capital outflows from some EMEs reflecting reducing investor interest in holding EM currencies and facing EM counterparties. Some foreign official investors sold U.S. Treasuries, held as part of their official foreign currency reserves, to raise dollar liquidity to build precautionary buffers, support dollar funding needs of local institutions, and for foreign exchange intervention. The significant volume of these foreign official sales was widely seen as exacerbating strained liquidity conditions in the U.S. Treasury market. Foreign official holdings of Treasury securities declined nearly \$150 billion in March 2020 and another \$70 billion in April 2020 (Figure 2). Consistent with the precautionary liquidation motive, cash balances held by foreign official investors at the Federal Reserve and invested overnight in the foreign repo pool spiked by nearly \$70 billion in March to a near record high of approximately \$300 billion.

Figure 2: FIMA Treasury Holdings & Foreign Repo Pool



Source: FRBNY

3. Central Bank Dollar Swaps and FIMA Repo

The March 2020 strains were met with important Federal Reserve facility changes. Before detailing these, below we begin by noting the long history of central bank operations in markets for dollar liquidity, highlighting changes over time in institutional features and objectives. We then explain and compare the features, operational aspects and relevant usage of the CB dollar swaps and complementary FIMA repo facility from the vantage point of developments since March 2020.

3.1 The central bank U.S. dollar liquidity providing swap arrangements

Swap agreements were established in the early 1960s between the Federal Reserve and a number of other central banks. The primary purpose of CB dollar swaps was to fund foreign exchange interventions, but they were also used to help some central banks in Europe to manage shocks on the Eurodollar market by providing temporary liquidity funding in dollars (McCauley and Schenk 2020). The nominal value of the swap lines limits increased in 1973 when the Bretton Woods system ended, and again in 1978 after the dollar exchange rate crisis. However, the facility was seldom used after the early

1980s and eliminated in 1998 in anticipation of the adoption of the euro. The FOMC maintained swap lines with Canada and Mexico. As discussed by Bordo, Humpage and Schwartz (2014) and Truman (2016), many FOMC participants instead favored a mechanism capable of providing emergency dollar liquidity in the event of a payments-system meltdown.

CB dollar swaps were re-deployed in late 2007, providing US dollar liquidity to help smooth strains in global U.S. dollar funding markets (Goldberg, Kennedy and Miu 2011). These swaps were solely intended to provide U.S. dollar liquidity on a temporary basis and not to fund foreign exchange intervention as had been the case in the past. The Federal Reserve initially entered into U.S. dollar liquidity swap arrangements with the European Central Bank (ECB) and Swiss National Bank (SNB), further expanding agreements during 2008 to include a total of 14 central banks.⁷ As the GFC subsided, the CB dollar swaps for all counterparties were briefly discontinued in early 2010. In the wake of the euro-area sovereign and banking crisis, swap arrangements were reintroduced in May 2010 between the Federal Reserve and five other central banks with large dollar financial centers outside the U.S. (Bank of Japan, European Central Bank, Bank of England, Swiss National Bank and Bank of Canada). These arrangements are also reciprocal between central banks of this network [since November 2011](#), meaning any central bank of the network can draw local currency liquidity from another, as there could be funding disruptions in any of the participating currencies. The swap lines among the network of standing swap line central banks (SSCBs) initially were implemented on a temporary basis but, given their effectiveness as a backstop liquidity facility to stabilize offshore dollar funding markets, were subsequently converted into “standing facilities” in October 2013.⁸

3.1.1 Main Developments in CB Dollar Swaps during COVID-19 outbreak

In mid-March 2020, as funding conditions deteriorated globally, the network of SSCBs enhanced access to the swap lines by lowering the price to a spread of overnight indexed swaps plus 25 basis points from a spread of 50 basis points (March 15), adding an operation for 84-day term funding (March 15) to its existing weekly operation for 7-day funds, and increasing the frequency of the operations for 7-day funds from weekly to daily (March 20). The FOMC granted temporary swap lines to nine other central bank counterparties, all of whom had previously received dollar swap lines during the GFC (March 19). Originally authorized until September 30, 2020, these lines to temporary swap central banks (TSCBs) were extended twice for six months each and then for another three months, with planned expiration on December 31, 2021.

Swap usage peaked at \$449 billion in late May 2020 compared to \$598 billion drawn during the GFC. The aggregate BOJ and ECB usage accounted for about 82 percent of the total peak. The Bank of England and the Swiss National Bank had lower usage compared with the GFC (Figure 3), while the Bank of Canada did not draw on its swap line.⁹ In 2020, aggregate usage by TSCBs peaked at less than \$50 billion, compared to a peak of \$96 billion during the GFC. This lower usage reflected a decline in

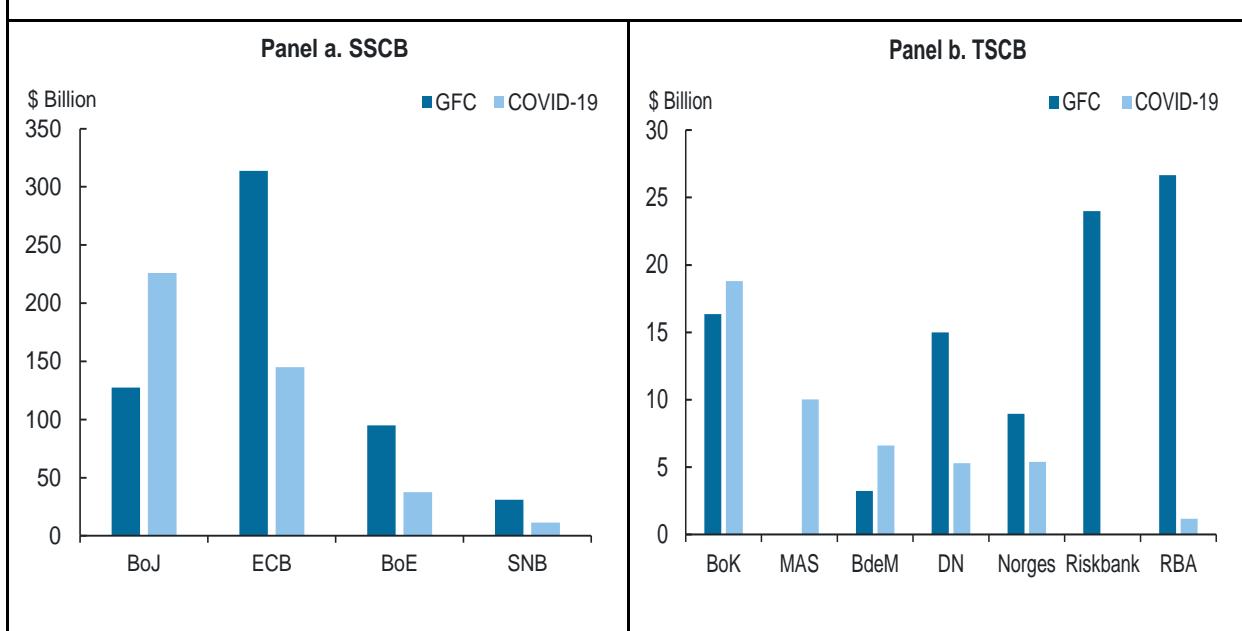
⁷ See Goldberg, Kennedy and Miu (2011) for details about central bank counterparties of standing and temporary swap arrangements in the global financial crisis period. Baba and Packer (2009) provide initial insights into smoothed strains in U.S. dollar funding markets. In addition to the Bank of Japan, European Central Bank, Bank of England, Swiss National Bank and Bank of Canada, the counterparties to the nine temporary swap lines are the central banks of Australia, Brazil, Denmark, Korea, Mexico, New Zealand, Norway, Singapore, and Sweden.

⁸ This network is comprised of the Federal Reserve, Bank of Japan, Bank of Canada, Swiss National Bank, European Central Bank and the Bank of England.

⁹ The Bank of Canada has never drawn on its swap line with the Federal Reserve.

vulnerabilities associated with dollar funding activity of banks in these countries following banking sector reforms undertaken after the GFC (EMEAP 2020). Looking at country level usage of TSCBs, there was no usage by the Central Bank of Brazil, the Riksbank and Reserve Bank of New Zealand, and relatively small usage by the Reserve Bank of Australia and other Scandinavian central banks.¹⁰ This time, the Monetary Authorities of Singapore used the facility, while it did not during the GFC, reflecting an increased role of Singapore as a dollar financial intermediation center in Asia (EMEAP 2020). Among the TSCBs, the Bank of Korea had the largest usage and Banco de Mexico's use exceeded GFC levels, reflecting increase dollar hedging activity of U.S. dollar-denominated investment and trade financing by non-financial entities in these countries.

Figure 3: Peak USD Swap Outstanding during 2020 and during the Global Financial Crisis



Source: FRBNY.

Note: The Bank of Canada, Central Bank of Brazil and Reserve Bank of New Zealand never used the facility.

3.1.2 What are the operational mechanics of the CB dollar swaps?

The Federal Reserve's CB dollar liquidity swaps network is designed to contain deterioration in dollar funding markets by providing foreign central banks with U.S. dollar liquidity, which they can supply to financial institutions in their respective jurisdictions. By providing dollar liquidity directly to the foreign central bank, the CB swaps are structured to help limit credit risk to the Federal Reserve. The Federal Reserve transacts directly only with the foreign central bank, which then distributes dollar liquidity to counterparties that are eligible for access to the facilities. The CB swaps are also priced as a "backstop"

¹⁰ Gislen, Hansson, and Melander (2021) argue that lower usage of ECB and Scandinavian central banks' dollar operations is most likely due to higher initial liquidity, higher capital, and lower dollar exposures of European and Scandinavian banks than during the global financial crisis.

facility to help ensure that they are used largely in times of acute stress, and not a replacement for private markets in normal times.

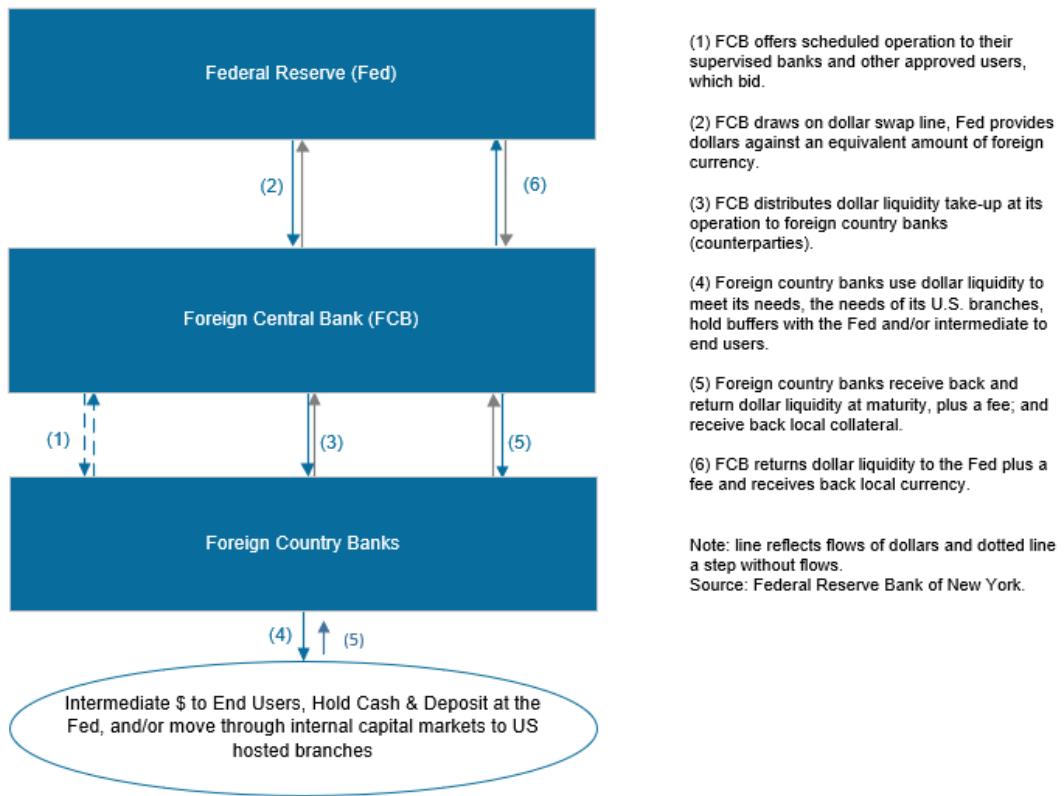
When a foreign central bank draws on its CB dollar swaps, dollar liquidity is typically distributed by the drawing central bank to financial institutions through a local dollar operation. Figure 4 illustrates the flow of liquidity with an authorized central bank through several steps. First, the foreign central bank holds a dollar operation on a schedule pre-approved with the Federal Reserve, typically in the format of repurchase agreement (or repo) where dollars are exchanged for local-currency collateral (1). Eligible counterparties at the foreign central bank's dollar operation are typically the same as those who participate in regular local currency operations. When the operation of the foreign central bank concludes, the central bank makes a request to draw dollars from the Federal Reserve through the swap line arrangement (2) and both formally agree to a draw.

The foreign central bank swaps an equivalent amount of local currency for dollars at the tenor of the operation (for example, 7 days or 84 days), and then provides those dollars to local institutions who bid at the offered operation (3). The Federal Reserve charges a fee to the foreign central banks based on the relevant U.S. dollar OIS plus a spread, which is currently 25 basis points.¹¹ The foreign central bank passes that fee on to its counterparties, though it is not required to do so. Local institutions who bid at the dollar auction can use proceeds (4) to meet their own liquidity needs or those of their overseas branches, provide dollar intermediation to end users and/or build precautionary liquidity buffers (generally deposited at the Federal Reserve).¹² At maturity, local institutions return dollars to the foreign central bank and receive back securities originally purchased (5). The foreign central bank then returns drawn dollars plus the aforementioned fee to the Federal Reserve and receives back its local currency (6). The Federal Reserve does not bear FX risk given that the same amount of dollars is exchanged at the settlement and maturity of the swap transaction with the foreign central bank.

¹¹ Before being reduced on March 15, 2020, the pricing of CB dollar swaps had been at U.S. dollar OIS plus 50 basis points since [November 30, 2011](#), when during the euro-area financing turmoil it was reduced from U.S. dollar OIS plus 100 basis points.

¹² See step 2 in the stylized balance sheet mechanics of central bank swap lines, Graph 2 in Aldasoro, Cabanilla, Disyatat, Ehlers, McGuire and von Peter (2020).

Figure 4: The steps in liquidity flows through central bank swap lines



3.2 The temporary FIMA repo facility

Another key facility development was the establishment by the Federal Reserve of a new FIMA repo facility on March 31, 2020. Originally authorized until September 30, 2020, the facility was twice extended for six months and was converted to a standing facility on July 28, 2021. In the event that dollar liquidity becomes scarce, this facility serves as a backstop that helps support the smooth functioning of the U.S. Treasury market by providing reassurance to FIMA account holders of their ability to secure dollar liquidity through repo transactions with the Federal Reserve in times of unusual market stress, rather than through selling their Treasury securities or financing Treasury securities in the private repo market. The facility, complementing the CB dollar swaps in helping to ease strains in global dollar funding markets, provides temporary dollar liquidity to a much broader range of foreign official institutions (FIMA account holders) at a backstop interest rate. The span of central bank access to dollar liquidity had been a point of debate around the structure of the international monetary system given the extensive international role of the dollar.

The announcement of the FIMA Repo Facility was welcomed by market participants as part of a broader set of measures implemented by the Federal Reserve. The facility eased pressures for foreign official institutions to sell Treasury securities for precautionary reasons, but actual usage was minimal in the period soon after introduction and has remained so in 2021.¹³ Nevertheless, central banks' increased confidence in their ability to raise dollar liquidity through the facility likely contributed to a strong return to Treasury investments by the second week of April 2020 and a drawdown of the large accumulations of precautionary cash balances seen in the Federal Reserve's foreign repo pool (Figure 2).

3.2.1 The steps in liquidity flows through the FIMA repo facility.

The FIMA repo facility allows foreign official institutions to temporarily raise dollars by selling U.S. Treasuries to the Federal Reserve's System Open Market Account (SOMA) and agreeing to buy them back at the maturity of the repurchase agreement. The term of the agreement at the time of the facility's establishment and subsequent renewals is overnight with an option for account holders to roll over as needed. Transactions are conducted at a rate designed to generally be above market repo rates when the Treasury market is functioning well, therefore positioning the facility as a backstop.¹⁴ Most FIMA account holders, which consist of foreign central banks (FCB) and other foreign monetary authorities with custodial accounts at the Federal Reserve of New York, are eligible to apply to use the facility but applications for usage of the facility must be approved by the Federal Reserve.¹⁵

After a FIMA account holder receives the approval to use the facility, it can draw on the facility at any time. The operational process and flow of liquidity illustrated in steps (1) to (8) in Figure 5 begins with a FIMA account holder sending a trade request to the Federal Reserve (1), which, if the terms of the requested trade are within facility parameters, sends back trade confirmations (2).¹⁶ Then, the FCB temporarily sells U.S. Treasury securities to the Federal Reserve (3), which involves the movement of U.S. Treasury holdings in an amount equivalent to the value of the repo agreement (minus a haircut) from the FCB's main custody account to another specially-designated custody account under its control first and then finally to a SOMA custody account (an account at the Federal Reserve). Once the FCB's holdings of U.S. Treasuries are in the Federal Reserve's custody account, the Federal Reserve sends the cash value of the repo to the FCB's specially designated custody account (4). The FCB decides how to remit the dollar proceeds of the repo, which is generally expected to result in transfer of dollars to local institutions with funding needs and/or fund FX spot interventions (5) and (6)¹⁷. Should the duration of the FCB's dollar liquidity need extend beyond one day, the FCB has the option to roll over the repo. In this event, the U.S. Treasuries held in custody by the Federal Reserve's account as part of the repo are revalued (i.e., repriced and re-haircutted), the amount of Treasuries held as collateral are adjusted

¹³ Aggregate volumes are reported on the weekly [H.4.1 data](#) release on the Federal Reserve's balance sheet under the repo line item ("foreign official").

¹⁴ For the temporary facility, the rate was set at interest on excess reserves plus 25 basis points. When converted into a standing facility on July 28 2021 the rate was set at 25 basis points.

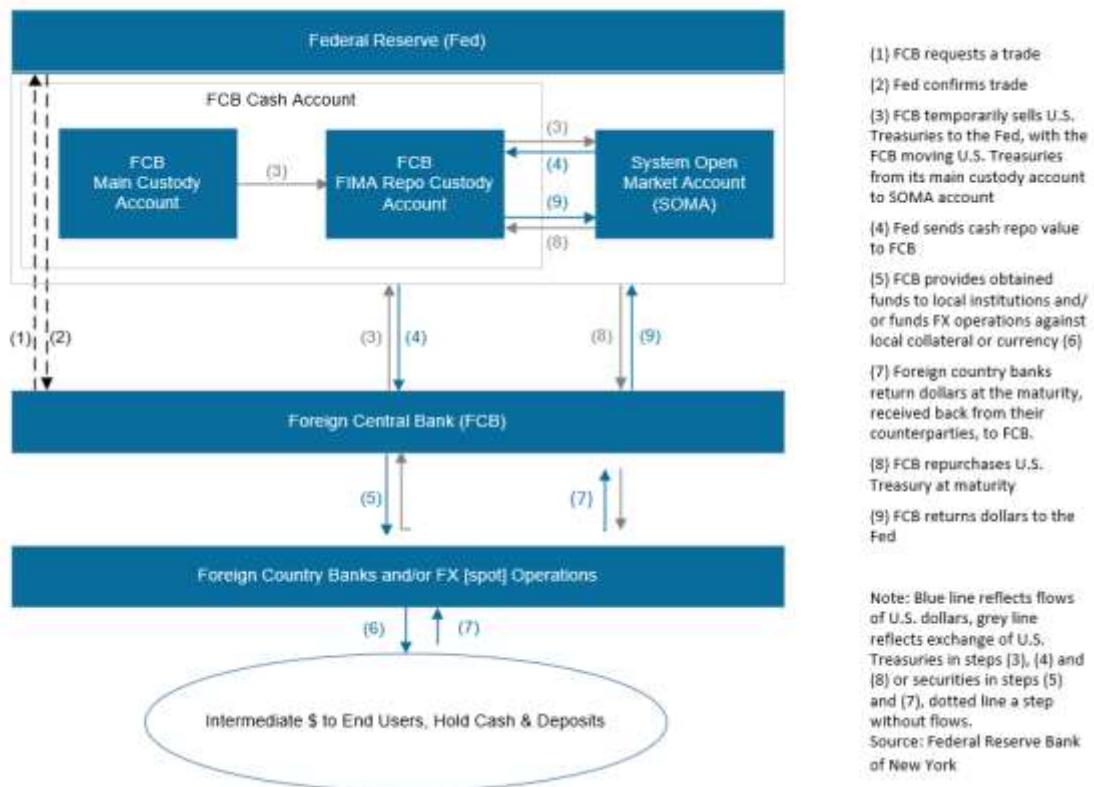
¹⁵ See Choi, Nemeth, Potter on central bank services in BJORHEIM (2020). The Federal Reserve Bank of New York maintains cash and custody accounts for nearly every central bank in the world and the FIMA repo facility is in addition to a suite of dollar-based correspondent banking and custody services that the Federal Reserve.

¹⁶ For example, within transaction size limits and priced at the correct facility pricing.

¹⁷ FX intervention funded in this way would only be in the direction of currency sales to strengthen the domestic currency vis-à-vis the U.S. dollar.

accordingly.¹⁸ At the maturity, the foreign central bank repurchases its U.S. Treasury securities (7) and returns the dollars to the Federal Reserve (8).

Figure 5: The stylized flow of liquidity through the FIMA repo facility



The Federal Reserve is responsible for all aspects of post-trade clearing, settlement, and collateral management, in contrast with commercial tri-party repo arrangements where these activities are performed by the clearing agent. This reliance on the Federal Reserve's back-office infrastructure for FIMA repos has had important implications for operational readiness to be discussed later.

3.2.3 Similarities and differences with the Fed's CB swaps

There are similarities and differences across the dollar facilities (Table 1). These span objectives, counterparties, and operational constraints.

The FIMA repo facility is offered to a broader range of foreign official institutions compared to the narrower set of swap central bank counterparties and offers a lower level of credit risk to the Federal Reserve. For example, in the event that a counterparty fails to return the dollars to the Federal Reserve,

¹⁸ That is, should the value of the purchased Treasuries fall below the outstanding FIMA repo, additional Treasuries are moved from the FIMA repo custody account to the SOMA, and vice versa if the marked-to-market valuation (minus haircut) exceeds the amount of the outstanding FIMA repo.

the Federal Reserve is left with U.S. Treasuries. In the event dollars are not repaid in a swap transaction, the Federal Reserve would be left holding the local currency of the foreign jurisdiction which may entail a higher risk of value loss.¹⁹

The new FIMA repo facility filled a gap in many foreign central banks' dollar liquidity management toolkits by providing a way to obtain dollar liquidity temporarily during periods of acute market stress without having to liquidate U.S. dollar asset holdings. By being able to temporarily exchange securities originally purchased instead of selling assets, central banks with access to the FIMA repo facility could avoid fire sales of U.S. dollar assets that may otherwise be required to generate dollar liquidity.

The amount of available dollar liquidity via the FIMA repo facility for any FIMA account holder is limited to the smaller of the U.S. Treasuries held at the Federal Reserve by the FIMA account holder or the counterparty limit set bilaterally. In comparison, the standing swap lines have no specific limits, while the temporary swap lines are capped at \$30 or \$60 billion depending on the central bank.²⁰ Another difference is that, unlike FIMA repo, in a CB swap transaction the reserve assets of the foreign central bank are unencumbered.

The CB swap and FIMA repo facilities also differ in the tenor of dollar liquidity that is provided. Dollar funding through FIMA repo can only be obtained on an overnight basis. In comparison, the swap lines currently offer funding for up to 88 days or such other time as the parties may agree, though the current scheduled operations for the standing swap lines is 7 days. Although the FIMA repo facility does not offer additional longer-term funding, its existence provides reassurance of access to overnight liquidity, which can be rolled over, that could dampen precautionary asset sales and have cross-market amplification effects.

¹⁹ Absent default neither party in the swap transaction faces market risk as the spot and forward legs of the transaction are at the same exchange rate and the same dollar amount for the FIMA repo transaction.

²⁰ The [temporary CB dollar swaps facilities](#) support the provision of U.S. dollar liquidity in amounts up to \$60 billion each for the Reserve Bank of Australia, the Banco Central do Brasil, the Bank of Korea, the Banco de Mexico, the Monetary Authority of Singapore, and the Sveriges Riksbank and \$30 billion each for the Danmarks Nationalbank, the Norges Bank, and the Reserve Bank of New Zealand.

Table 1: The key features of the FIMA repo facility and CB dollar swaps

Features	FIMA Repo Facility	CB Dollar Swaps
<i>Backstop tool</i>	Yes	Yes
<i>Objective(s)</i>	Dollar liquidity provision and U.S. Treasury market function support	Dollar liquidity provision
<i>Federal Reserve Counterparty</i>	Foreign and International Monetary Authority (FIMA) account holders at the Federal Reserve/New York Fed (e.g., foreign central banks)	Selected foreign central banks
<i>Asset Exchanged for US Dollars</i>	U.S. Treasuries	Foreign currency
<i>Custodian of exchanged asset</i>	Federal Reserve	Foreign central banks
<i>Format</i>	Standing	Five standing and 9 temporary
<i>Transaction request</i>	Ad hoc at the request of approved FIMA account holders	Pre-approved schedules of operations
<i>Transactions Maturity</i>	Overnight	Up to 88 days
<i>Maximum Position Size</i>	U.S. Treasury holdings at the New York Fed, subject to internal counterparty limits communicated bilaterally to applicants	Unlimited (standing) and \$30 or \$60 billion capped (temporary)
<i>Pricing</i>	For the temporary facility, the offering rate was the Fed's IOER plus a spread. For the standing facility the rate was set at 25 basis points (the top range of the Fed's effective funds target rate).	Term USD OIS plus a spread, (currently 25 bps)

Source: Federal Reserve Bank of New York.

Note: *Format* means the time duration of the facility, *Term* is a transaction with a maturity longer than one day, *USD OIS* is a U.S. dollar overnight indexed swap, *IOER* is the interest rate paid on excess reserves, and *intermediation* refers to the entity proving U.S. dollars to a private market counterparty. All central bank transaction instructions associated with usage of both facilities sent to the Federal Reserve (and Federal Reserve Bank of New York) are screened for sanctions compliance.

4. The effects of the central bank dollar swaps and the FIMA repo facility

The effectiveness of CB dollar swaps specifically works through a number of channels to mitigate market strains. The dollars provided through swap central bank counterparties allow foreign commercial banks to access U.S. dollar liquidity at lower costs than in the stressed private market, obviating the need to bid up rates excessively in the market. Moreover, these more favorable dollar liquidity terms allow foreign commercial banks to maintain the provision of private credit at times of market strains. This credit provision spans direct lending via their U.S. branches as well as within their own economies, including to nonbank financial intermediaries and other private borrowers. Having adequate access to dollar liquidity also allow foreign banking organizations (FBOs) to meet precautionary funding needs.

The FIMA repo facility allows central banks without swap lines to gain access to backstop dollar liquidity, thus reducing the need of other foreign official institutions to sell their U.S. dollar reserve assets, helping limit amplification of stress in US credit and other financial markets.

Research conducted around the introduction and expansion of CB dollar swaps during the GFC had shown that these facilities significantly reduced strains in U.S. dollar funding markets, as demonstrated by comparing FX swap basis spreads for directly covered currencies versus other currencies after CB dollar swaps were employed in late 2007 and expanded during 2008 (for example, Baba and Packer 2009, Goldberg et al 2011, and Bahaj and Reis (forthcoming)). The reduced funding strains occurred for the currencies and terms that were associated with dollar provisions, but then extended to broader dollar funding markets.

Newer research shows that the suite of policy actions taken by the FOMC in 2020, including those related to the swap lines and the FIMA repo facility, helped stabilize U.S. dollar funding markets and supported the continued flow of credit to the U.S. economy and abroad. These types of conclusions are drawn from applying different methods to understand the effects of each facility-related announcement and associated settlement of dollar flows, and of shifts in risk sentiments.

One method is the feedback from market observers. According to market participants, in mid-March banks became less interested in intermediating dollar flows to nonbanks, especially for term funding, given lingering uncertainty over the path and duration of the virus. It was only until after banks had cumulated sizable excess dollar balances from the availability of funds through take-up at dollar operations of central banks of the swap lines network that they began to intermediate dollars to other regional banks and non-banks. Market participants overall provided positive commentary on the effects of the access to dollars through central bank swap facilities and later positive feedback on the FIMA facility introduction.

Quantitative evidence is based on examining indicators of strains in dollar funding markets, international Treasury holdings, cross-border global liquidity flows, and exchange market pressure. The actual settlement of dollars through the facilities as key, replacing the need for banks to secure dollar funds in already stressed private markets. These funds were partially being used to support continued credit provision both in the U.S. and abroad, helping to contain contractions in credit supply in response to the March 2020 pandemic events. International capital flows largely reverted toward pre-pandemic levels, as did exchange market pressures, after markets stabilized. Regardless of the data explored, it is challenging to isolate the effects of particular facilities, especially when market conditions and sentiment rapidly evolved and multiple official interventions occurred during similar time frames. Subject to this caveat, below we provide key lessons based on the analytics.

- 1) *Settlement of dollars through CB swap operations calmed funding strains, even more than the announcement of facility-related announcements.*

Cetorelli, Goldberg, and Ravazzolo (2020a) analyze changes in selected FX basis spreads around key facility announcement dates and around auction settlement dates: (1) the announcement for the SSCBs on March 15, (2) the March 19 announcement for TSCBs, (3) the announcement of daily 7-day auctions for the SSCBs, and (4) the announcement of the FIMA repo facility. The announcement window includes the day of, and, in some cases, the day following the announcement. The FX swap basis spread changes

over this window are compared with the average spread during the two days prior to the announcement.

On average across currencies, the TSCBs activation, the daily SSCB auction analyses, and FIMA repo announcements correspond to average reductions on FX swap basis spreads, especially outside of the major currency pairs taken vis-à-vis the dollar. Relative to other currencies, those currencies with announcements related to SSCBs and TSCBs did not have significantly narrower FX swap basis spreads on and after announcement dates. By contrast, the announcement of the increased frequency of 7-day U.S. dollar operations lowered the rate of increase in the FX swap basis spreads for currency pairs of countries with SSCBs, as compared to the changes observed in FX swap basis spreads of other currency pairs. If it were to be given a causal interpretation, this announcement improved market conditions on the announcement day, relative to conditions over the prior two days. However, we caution that these results have no other controls in place to benchmark what the respective changes in FX swap basis spreads would have been absent the announcements.

The actual settlement of funds from U.S. dollar operations has materially different effects on the FX swap basis spreads of currency pairs of the standing swap central banks versus those of all other currencies. After controlling for the effects of concurrent equity market volatility, the settlements of daily 7-day auctions on one-week FX swap basis spreads improved market conditions. In contrast, settlements of 7- and 84-day operations were not associated with significant improvements in three-month swap basis spreads. Our interpretation is that initially the term liquidity obtained by banks was only partially channeled beyond the banking system and the relief provided to broader markets was delayed.

2) Over longer horizons, strains in dollar funding markets were reduced by access to CB swaps and later to the FIMA repo facility. Risk sensitivity also declined.

Goldberg and Ravazzolo (2021) conduct further analysis of how CB swaps and the FIMA repo facility influence FX swap basis spreads over longer time horizons. This analysis uses daily data on FX swap basis spreads for 21 currencies for January 02, 2020 through June 30, 2020. Three periods are compared: *Period 1* covers from February 1, 2020, through March 10, 2020; *period 2* covers from March 19, 2020, through April 4, 2020; and *period 3* covers from May 21, 2020 through June 30, 2020. While all types of currencies on average exhibited an increase in FX swap basis spreads in the initial stress period (2) in comparison with the pre-pandemic period (1), those currencies with access to CB swaps had significantly lower strains. In the latter period, after their activation of the FIMA repo facility, those currencies had significantly greater declines in FX swap basis spreads compared with the pandemic stress period. On net and on average, all of these FX swap basis spreads returned to pre-pandemic levels by the third period.

Related regression analytics over the daily data shows that, while both groups of currencies exhibited increased risk sensitivity from period (1) to period (2), the increased in sensitivity was significantly lower for the currencies with access to swap lines. Comparing period (3) with period (2), the currencies that instead were associated with FIMA repo accounts experienced significantly larger reductions in the sensitivity of FX swap basis spreads to daily changes in risk sentiment as proxied by the VIX (Chicago Board of Exchange volatility index, or volatility of an equity index).

Complementary evidence comes from comparing exchange market pressure indices, which capture the incipient pressures on currencies as reflected in actual depreciation against the US dollar plus the official foreign currency intervention and policy rate changes that might be applied to offset these pressures. Both groups of currencies tended to depreciate against the dollar in the early part of the pandemic, and to recover value or even appreciate by the end of June 2020 (Goldberg, Hamerling and Krogstrup 2021).

3) *Credit provision in the US and abroad is supported by dollars settled through CB swap lines and potentially FIMA repo.*

The COVID-19 shock had a significant impact on U.S. FBO branch balance sheets beginning in late February 2020. Cetorelli, Goldberg and Ravazzolo (2020b) show that, as funding strains became evident, deposits began to decline and the net funding that U.S. FBOs received from parent organizations rose, as did other borrowings, including those secured through the fed funds market, the repo market, and the Federal Reserve's discount window.

More sizable changes occurred in the third week of March, when FBO branch balance sheets registered a combined sharp decline in deposits, a marked increase in lending, further increase in other borrowing, and a substantial jump in funding received on net from their parent organizations. The sharp increase in lending was likely due to large customer draws on the sizable credit commitments in place with the branches rather than reflecting new loan extensions. The freezing up of the corporate credit market led customers to draw on those lines, resulting—all else equal—in U.S. FBOs facing an increase in funding needs to match the increased amount of loans on their balance sheet. U.S. branches of FBOs with access to dollar liquidity through the dollar operations of SSCBs borrowed more internally from their parent organizations.

The share of net internal borrowing among U.S. branches of FBOs, after the changes in dollar availability through the standing swap lines, increased by significantly more for U.S. branches with larger needs for such funding, if they had access to these dollars. The swap dollars supported flow of funds back to the United States, where hosted branches of foreign banks met needs generated by committed credit lines demands when corporate funding markets were strained. U.S. branches of FBOs also held precautionary liquidity demanded by their banking organizations. The response to the shock through the activation of an internal funding channel within these banking organizations was more than sufficient to support the balance sheet needs of FBO branches and continue the flow of credit to borrowers in the United States. The fact that the increase in internal borrowing was even larger than what was immediately needed seems to suggest that dollars obtained from parent companies were also used to boost overall precautionary liquidity, or to support some of the liquidity needs of related [intermediate holding companies](#) (IHC).

Goldberg and Ravazzolo (2021) provide additional insights through analysis of Treasury TIC data and BIS Locational Banking Statistics. In the initial stage of the pandemic, U.S. Treasury Holdings by Foreign Entities declined broadly. These declines, sometimes described as part of the dash for cash, on average initially were not proportionately larger for the countries without swap lines. Some of the dollars were placed in the Federal Reserve's foreign repo pool. On average, the individual countries that set up FIMA repo accounts further reduced Treasury holdings through May 2020 and thereafter rebuilt Treasury holdings, eventually surpassing pre-pandemic values.

International capital flows, captured through the asset and liability data reported in BIS Locational Banking Statistics, show that banking systems with access to swap lines continued to provide credit in the early part of the pandemic, including to banking sector borrowers abroad, at a higher rate than other groups of countries. The credit provision mainly slowed later, by groups of countries both with and without access to swap lines and later with access to the FIMA repo facility. However, the countries with access to swap lines ended up with more robust overall inflows on net during the first half of 2020.

5. Policy Considerations

During the GFC and the COVID-19 period the Federal Reserve demonstrated a commitment to well-functioning U.S. dollar funding and credit markets. The dollar liquidity made available helped calm global dollar funding markets, support the provision of credit, and limit disruptive financial amplification effects of the worldwide pandemic shock. Operational readiness, agility, and the groundwork of strong central banking relationships were demonstrated as the frequency of dollar operations was adjusted, auctions of longer tenors of funding were added, and additional central banks received temporary swap lines. The Federal Reserve's swift introduction of a new FIMA repo facility built on expertise previously developed within the U.S. and across some foreign central banks.

However, despite operational readiness around the CB dollar swaps, the immediate announcement of facilities did not eliminate all funding strains. The costs of dollar funding, for example three-month FX swap basis spreads, remained relatively elevated for some time despite sizable usage of CB dollar swaps. In some cases, market segmentation and intermediation frictions may have prevented U.S. dollar liquidity from reaching entities in need of liquidity, particularly the non-bank financial intermediaries and corporations without access to dollar operations of swap central banks. For example, foreign banks appear to have met their own institutional needs, including for liquidity buffers, before passing funds through to other end-users. This raises a policy question about how to reduce the potential for funding market strains *ex ante* and then how to best respond to the range of institutional needs.

Indeed, some new vulnerabilities of the post-GFC dollar funding landscape were related to the increased role played by NBFIs, a point discussed in BIS CGFS (2021). Non-banks have access to a narrower range of U.S. dollar funding sources, including central bank backstop facilities. The large footprint of non-bank financial institutions in some markets also increases the risk of possible fire sales of dollar assets in cases of stress that could amplify any market volatility. Some of these dynamics in March 2020 raised questions about reducing such vulnerabilities and the span of availability of dollar liquidity from backstop tools at local central banks.

Additionally, history informs us that not all crises unfold in similar ways. Compared with the GFC, an interesting novelty around March 2020 take-up at swap central banks' dollar operations is that foreign banks (parents) helped cover new dollar funding needs of their U.S. branches. Some of the dollar liquidity provided through the swap lines made its way back to the United States, instead of remaining in offshore funding markets. This type of dynamic arises, in part through the structure of regulation, and also through the design of the swap agreements. As U.S. branches of foreign banks, it is the foreign central banks which ensure through their supervision that their local banks meet local capital and

liquidity requirements.²¹ The CB swaps are structured in a way that exposes foreign central banks to the credit risk of their local institutions and leverages foreign central bank expertise in distributing dollar liquidity. This design built into the structure of regulation and central bank swaps allowed liquidity flows from swap lines to the most stressed parts of institutions and helped to limit the consequences for the rest of the organization in Spring 2020.

Finally, the COVID-19 experience highlighted that while more FX reserves held by central banks after the GFC provided insulation to some central banks, there were still potential amplification effects in a coordinated shock that gave rise to concentrated liquification. The deployment of the FIMA repo facility in late March should help address such strains if they arise in a future crisis, by at least partially attenuating the need of reserve managers to sell U.S. Treasury holdings. Despite the minimal use of the FIMA repo facility through 2021, its introduction provided the availability of a backstop that offers entities with accounts at the New York Fed the capacity to convert U.S. Treasury holdings for cash overnight if needed. This may reduce precautionary (contingency) selling of U.S. Treasuries and make U.S. Treasury assets more attractive to reserve managers by reducing their holding costs (reflected in a reduction of liquidity premium or convenience yield).

Overall, the CB swaps and the new FIMA repo facility are important parts of the toolkit around global dollar funding markets and are consistent with U.S. financial stability and economic objectives.

²¹ U.S. branches are subject to certain liquidity requirements (see e.g., [12 C.F.R. 252.157\(c\)](#)). Depending on their organizational form, they may also be subject to certain capital requirements.

6. References

Aldasoro, Inaki, Christian Cabanilla, Piti Disyatat, Torsten Ehlers, Patrick McGuire and Goetz von Peter, 2020. "Central Bank Swap Lines and Cross-Border Bank Flows", BIS Bulletin No 34, Bank for International Settlements, December.

Afonso, Gara, Fabiola Ravazzolo and Alessandro Zori, 2019. From Policy Rates to Market Rates—Untangling the U.S. Dollar Funding Market *Federal Reserve Bank of New York Liberty Street Economics* July 8, 2019.

Aizenman, Joshua, Hiro Ito and Gurnain Kaur Pasricha, 2021. "Central Bank Swap Arrangements in the COVID-19 Crisis", NBER Working Paper 28585. <https://voxeu.org/article/central-bank-swaps-age-covid-19>

Aldasoro, Inaki, Christian Cabanilla, Piti Disyatat, Torsten Ehlers, Patrick McGuire and Goetz von Peter, 2020. "Central bank swap lines and cross-border bank flows", BIS Bulletin, no.34, Bank for International Settlements.

Aldasoro, Inaki, Egemen Eren, Wenqian, Huang, 2020. "Dollar funding of non-US banks through COVID-19", BIS Quarterly Review, March 2021, Bank for International Settlements.

Avdjev, Stefan, Egemen Eren and Patrick McGuire, 2020. Dollar funding costs during the Covid-19 crisis through the lenses of the FX swap market" BIS Bulletin no 1 Bank for International Settlements.

Avdjev, Stefan, Leonardo Gambacorta, Linda Goldberg and Stefano Schiaffi. 2020. The Shifting Drivers of International Capital Flows. *Journal of International Economics*.

Baba, Naohiko and Frank Packer, 2009. From turmoil to crisis: dislocations in the FX swap market before and after the failure of Lehman Brothers, *Journal of International Money and Finance*, vol 28, no 8, December 2009, pp 1350-74.

Bahaj, Saleem and Ricardo Reis (forthcoming) Central Bank Swap Lines: Evidence on the Effects of the Lender of Last Resort. *Review of Economic Studies*.

BIS CGSF, 2020. "US dollar funding: an international perspective", [BIS CGSF Paper No 65, Bank for International Settlement](#).

BIS CGFS, 2021. "Changing patterns of capital flows", [BIS CGSF Paper No 66](#), Bank for International Settlement.

Boissay, F, N Patel and Hyun Song Shin, 2020. "Trade credit, trade finance, and the Covid-19 Crisis", *BIS Bulletin* 24, 19 June.

Bordo, Michael, Owen Humpage, and Anna Schwartz, 2014. "The evolution of the Federal Reserve Swap Lines since 1962", NBER working paper 20755, December.

Cetorelli, Nicola and Linda Goldberg, 2011. Global Banks and Their Internal Capital Markets during the Crisis *Federal Reserve Bank of New York Liberty Street Economics*, July 11, 2011.

Cetorelli, Nicola, Linda Goldberg and Fabiola Ravazzolo, 2020a. Have the Fed Swap Lines Reduced Dollar Funding Strains during the COVID-19 Outbreak? *Federal Reserve Bank of New York Liberty Street Economics* May 22 2020.

Cetorelli, Nicola, Linda Goldberg and Fabiola Ravazzolo, 2020b. How Fed Swap Lines Supported the U.S. Corporate Credit Market amid COVID-19 Strains *Federal Reserve Bank of New York Liberty Street Economics* June 12 2020.

Eguren-Martin, Fernando, 2020. Dollar shortages and central bank swap lines, Staff working paper no 879 Bank of England.

Eren, Egemen, Andreas Schrimpf and Vladyslav Sushko, 2020b. 'US dollar funding markets during the Covid-19 crisis – the international dimension', BIS Bulletin, no. 15, Bank for International Settlements.

EMEAP, 2020. "Study on US dollar Liquidity and Funding Dynamics in the EMEAP Region", [EMEAP Working Group on Financial Markets](#).

Financial Stability Board, 2020. "Holistic Review of the March Market Turmoil", Issue 2020/11, [Report to the G20](#).

Gislén, Marushia, Ida Hansson and Ola Melander, 2021. Dollar liquidity from the Federal Reserve to other central banks 27 *Sveriges Riksbank Economic Review* 2021:1 [Economic Review 1, 2021](#)

Goldberg, Linda, Craig Kennedy, and Jason Miu, 2011. Central Bank Dollar Swap Lines and Overseas Dollar Funding Costs *Federal Reserve Bank of New York Economic Policy Review* vol. 17 no.1 pp. 3-20 (May).

Goldberg, Linda, Sarah Hamerling and Signe Krogstrup, 2021. International Capital Flow Pressures: the GFC and Pandemic Period Compared. manuscript.

Goldberg, Linda and Robert Lerman, 2019. The US Dollar's Global Roles: Where Do Things Stand? *Federal Reserve Bank of New York Liberty Street Economics*. February 11 2019.

Goldberg, Linda and Fabiola Ravazzolo, 2021. Currency strains and dollar funding facilities: Evidence from 2020. Manuscript.

Goldberg, Linda and David R. Skeie, 2011. Why Did U.S. Branches of Foreign Banks Borrow at the Discount Window during the Crisis? *Federal Reserve Bank of New York Liberty Street Economics*, April 13, 2011.

Liao, Gordon and Tony, Zhang, 2020. "The Hedging Channel of Exchange Rate Determination", [International Finance Discussion Papers Number 1283](#), Board of Governors of the Federal Reserve System.

McCauley, Robert N. and Catherine R. Schenk, 2020. "Central bank swaps then and now: swaps and dollar liquidity in the 1960s", [BIS Working Papers No 851](#).

Persi, Gianluca, 2020. US dollar funding tensions and central bank swap lines during the COVID-19 crisis. ECB Economic Bulletin, Issue 5/2020 [US dollar funding tensions and central bank swap lines during the COVID-19 crisis \(europa.eu\)](#)

Rose, Andrew and Mark Spiegel, 2012. "Dollar illiquidity and central bank swap arrangements during the global financial crisis", *Journal of International Economics* 88(2): 326-340.

Truman, Edwin, 2016. "The Federal Reserve Engages the World (1970-2000): An Insider's Narrative of the Transition to Managed Floating and Financial Turbulence, in editors Michael Bordo and Mark Wynne *The Federal Reserve's Role in the Global Economy*, Cambridge University Press.