

The workings of liquidity lines between central banks*

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Abstract

Liquidity lines between central are a key part of the international financial safety net. In this handbook chapter, we summarize their history, describe their institutional features and draw lessons for future research, policymakers and practitioners.

Keywords: swap lines, FIMA, EUREP, financial stability, international currency, lender of last resort.

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1 Introduction

A liquidity line between two central banks is an agreement to provide a collateralized loan of the currency issued by the source central bank to the recipient central bank. They are often structured as a foreign exchange (FX) swap, and so are commonly referred to as central bank swap lines, even though they are only superficially related to the FX swaps seen in private markets. In this swap, while the recipient central bank receives the foreign currency it desires, the source central bank gets as collateral a deposit with the recipient central bank, which it will almost never use, and which has questionable value as security. More recently, the liquidity lines have been structured as repurchase agreements, which is symbolically more accurate of how they work and offers substantially more protection to the source central bank.

Historically, the proceeds of the loans were used in FX markets. More recently, they have been used to provide loans to banks in the jurisdiction of the recipient central bank. After a spectacular growth since the financial crisis of 2007-09, that was consolidated after the pandemic of 2020, today the liquidity lines are one of the foundations of the international financial system, potentially involving larger amounts than the IMF could ever lend. This article provides an entryway for readers interested in understanding how these liquidity lines work.

We start by briefly laying out their historical evolution since the 1960s. While liquidity lines predate this time, and their history could fill more than one long book, looking only at their use in the last 60 years already provides a rich picture of the diversity in their origins, goals, and uses. We then provide a thorough description of how the modern liquidity lines that are in operation in 2021 work. We provide descriptions of the relation between the two central banks, of the use of the funds by the recipient central banks, and of the steps needed to establish the line. Each involves many choices, and this has led to a very diverse set of arrangements in place today. The liquidity lines can perform three roles in the policy toolkit: to intervene in FX markets, to preserve financial stability, and to promote currency usage and trade credit. We describe each separately, as well as their interactions. Finally, we draw lessons for researchers, policymakers and financial market participants to keep in mind in their future usage of these liquidity lines.

Central bank liquidity lines are a pervasive tool with a rich history that have been used by multiple central banks for different purposes and that have played a key part in the policy response to recent financial crises. With this article, we hope they will also become less mysterious.

2 The evolution of the liquidity lines

Liquidity lines between central banks have a long history. For instance, Flandreau (1997) describes a loan of silver from the Bank of England to the Banque de France in 1847 following bad harvests in France. Moreover, the classic gold standard that dominated the international monetary system in the XIXth century required flows of specie back and forth across countries. These were smoothed out by bilateral credit between central banks that effectively pooled some of their gold reserves. The collapse of this form of cooperation between central banks was one of the contributors to the end of the regime after World War I (Eichengreen, 1996). While this is not the place to provide a detailed historical account of the liquidity lines, a brief historical review of the last few decades is useful to put the chapter into context.

The modern history of liquidity lines starts with the last decade of the **Bretton Woods era**. Many of the contractual arrangements between central banks that we see today originated in this period. In 1960, the Federal Reserve (Fed) began swapping USD for CNF with the Swiss National Bank. This was followed in 1962 by a more ambitious programme to establish bilateral swap lines with major counterparts in the rest of Europe, as well as Canada and Japan. These grew over the decade into a broader network, with the Bank for International Settlements (BIS) in a coordinating role. An important motivation for the liquidity lines was to preserve the fixed exchange rate regime, either by financing foreign exchange interventions, or by using swaps as a substitute for transfers of gold. As the United States ran large current account deficits during the decade, but was unwilling to transfer gold to other nations, it instead gave them USD through liquidity lines. Another important motivation of these lines was financial stability. The US Treasury had tight financial regulations, partly as a legacy of the Great Depression, and partly as a barrier to international capital flows that made it temporarily possible for the US to run large deficits and yet retain its central role in the system. This had led to the growth of offshore USD credit markets, most notably the eurodollar market. The Fed used USD swap lines, coordinated by the BIS, to intervene in these markets (McCauley and Schenk, 2020).

The usage of these USD liquidity lines peaked in 1974 at around \$240bn (2017 prices). This followed the financial instability driven by the USD going off gold in 1971, the sharp increase in oil prices in 1973, and the resulting sudden rise in interest rates and inflation. With Bretton Woods over, and in the aftermath of a USD crisis in 1978, the liquidity lines stopped playing an important role. They remained open, but rarely used, with constant nominal balances. The Fed formally ended them in 1998 (with the exception of lines to

Canada and Mexico under NAFTA).

Right at this time, elsewhere in the world, a second stage in the history of liquidity lines started with the **Chiang-Mai initiative**. In 1997, several South East Asian countries went through balance of payments crises. The desire to prevent future crises led many of the affected central banks to accumulate large reserves of assets denominated in USD (and other foreign currency). In order to boost the effectiveness of their reserves, 14 central banks in East Asia formed a network of liquidity lines in 2000 that would share these reserves if one country needed them to intervene in the foreign exchange market. Originally, the initiative was a network of bilateral swap lines, but in 2010, it became a multi-lateral swap line whereby participating central banks could swap their own currency for USD drawn from a pool generated from the combined reserves of the participants. While the goal of these lines was similar to those under Bretton Woods, the novelty was that the central bank of the currency being lent (the Fed) was not part of the network.

The year of 2001 saw the first of a different type of liquidity lines. They were not motivated by exchange rate stabilisation, and focused instead on providing **lender of last resort facilities to foreign commercial banks**. At the time, the global financial system was highly integrated with the USD as the dominant global currency. Banks outside the US had substantial USD denominated lending or holdings of USD securities (McGuire and von Peter, 2013, Aldasoro, Ehlers and Eren, 2019), relying on wholesale funding instead of having a significant USD deposit base. When the terrorist attacks of September 11th 2001 disrupted US money markets in the United States, banks outside the country faced difficulties borrowing the dollars they needed. Unlike US banks, they did not have easy access to the Fed's lending facilities. On September 12th the Fed opened a new swap line with the ECB, swapping USD for EUR; on the 13th, it expanded its dormant swap line with the Bank of Canada; and on the 14th it introduced a new swap line with the Bank of England. In total, \$90bn was made available for the recipient central banks to lend to commercial banks in their jurisdictions that had difficulty borrowing dollars, although only the ECB ended up making any drawings (Kos, 2001).

These 2001 swap lines were short-lived, expiring after 30 days, once the initial financial disruption brought about by the terrorist attacks was over. However, the situation repeated itself in 2007, as the global financial crisis again disrupted USD money markets. Unlike in 2001, the situation did not stabilise in a couple of weeks. Over the course of 2007-2008, the Fed opened up 14 new bilateral swap lines and at the peak lent \$583bn to foreign central banks in order to provide the dollars that could be lent on to commercial

banks in their jurisdictions (Obstfeld, Shambaugh and Taylor, 2009). These lines were, again, wound down as the crisis abated. By February 2010 they had all been discontinued. However, just three months later in May 2010 the financial market repercussions of the Euro sovereign debt crisis prompted the Fed to reactivate its swap lines with the ECB, Bank of Japan, Bank of England and the Swiss National Bank (SNB).

After years of institutional inactivity, the Fed had then found itself setting up liquidity lines to foreign central banks at relatively short notice for the third time in a decade. Repeated uses motivated a series of agreements over the course of 2010-2013 that culminated in a new stage of liquidity lines, that we refer to in this chapter as **the standing swap line network**: the four central banks that received swap lines in 2010 plus the Fed and the Bank of Canada agreed to a network of reciprocal, permanent, standing swap arrangements of unlimited amounts. This network among these six major central banks has been the source of the vast majority of lending through central bank liquidity lines since the global financial crisis. The pattern of a crisis reforming the Fed's liquidity line network repeated itself again when the Covid-19 pandemic again disrupted dollar money markets in 2020. The terms of the standing swap line network were eased, nine new temporary swap lines were established and the Fed lent \$449bn to counterparty central banks (Bahaj and Reis, 2020a, Aizenman, Ito and Pasricha, 2021).

The liquidity line network extends beyond the Fed. While the USD is dominant globally, other currencies have a regional role around a regional financial centre (Eichengreen and Lombardi, 2017). The central banks in these centres have created similar swap lines with their neighbouring central banks. In Central and Eastern Europe, many mortgages and other bank loans are denominated in EUR or CHF, which cause funding problems for their banks during a financial crisis. The Swiss National Bank created CHF and EUR denominated swap lines with the Polish National Bank, the Hungarian National Bank and the ECB at the time of the global financial crisis (Andries, Fischer and Yesin, 2017), and the ECB set up a network of bilateral liquidity lines with European central banks outside the Eurosystem during the Covid Pandemic (Albrizio et al., 2021). The Bank of Japan has established a small network of JPY denominated swap lines in the Asia-Pacific region for similar reasons.

A different type of network has its centre in China, and emerged in 2009 with the creation of the **RMB swap lines**. International trade is commonly invoiced in USD, inducing importers and exporters to get trade credit in USD as well (Bahaj and Reis, 2020b). The global financial crisis raised these borrowing costs (Bruno, Kim and Shin, 2018), moti-

vating Chinese policymakers to try to internationalise the RMB and insulate their trading firms from future shocks to USD funding (Zhou, 2009, 2017). One of the key planks of this initiative was the establishment of 38 bilateral swap arrangements by the People's Bank of China (PBoC) over the decade through to 2020 (Garcia-Herrero and Xia, 2015, Bahaj and Reis, 2020*b*). Rather than FX stabilisation, or to provide a lender of last resort facility to banks, these swap lines are designed to provide RMB offshore that can be used for the purpose of trade settlement. Currently, this is the widest network of bilateral liquidity lines among all central banks and the notional limit on drawings is comparable to the amounts drawn from the Fed's liquidity lines during the global financial crisis. Reported drawings, however, have been relatively limited at around \$10bn (Perks et al., 2021).

The final innovation of note came with the 2020 pandemic and the creation of a new set of **repo lines** by the ECB and the Fed. These repurchase agreements differ from other liquidity lines in how the loan is structured, but have similar purposes as the conventional foreign exchange swap lines. The Fed established its Foreign and International Monetary Authorities (FIMA) repo facility on March 31st 2020, which allows foreign central banks to borrow USD overnight against US treasuries so long as they are eligible for an account with the FRB New York. The ECB followed suit on June 25th 2020 with the Eurosystem repo facility for central banks (EUREP), which offers EUR loans to central banks against EUR denominated debt issued by euro area governments.

One important innovation with these repo facilities is that they are, in principle, available to a broader set of central banks than the more exclusive bilateral liquidity lines. They are arms-length relationships, open to any central bank that has the government securities to pledge as collateral, with standardised take-it-or-leave-it terms that are equal to all. The terms are worse compared to a bilateral line, a point that the ECB explicitly made when setting up the EUREP facility (ECB, 2020). On top of FIMA and EUREP, the ECB also established bilateral repo lines with six other European central banks in 2020, but it has not disclosed the terms of these arrangements.

To conclude, the network of agreements between central banks has evolved over the past half century, typically in response to crises in financial markets that affected offshore borrowing costs. The Asian financial crisis, the global financial crisis, the Euro sovereign debt crisis, and the pandemic recession all came and went. They left behind them a growing network of liquidity lines connecting most central banks. Figure 1 illustrates this evolution. The liquidity lines were near defunct during the 1990s, but they have grown in the XXIst century to become, today, one of the three pillars of the international financial

system (the other two being the IMF and regional financial agreements like the European Stability Mechanism). We now turn to how the lines are actually structured and operate before moving on to how they can be used to achieve their policy objectives.

3 The operation of the liquidity lines

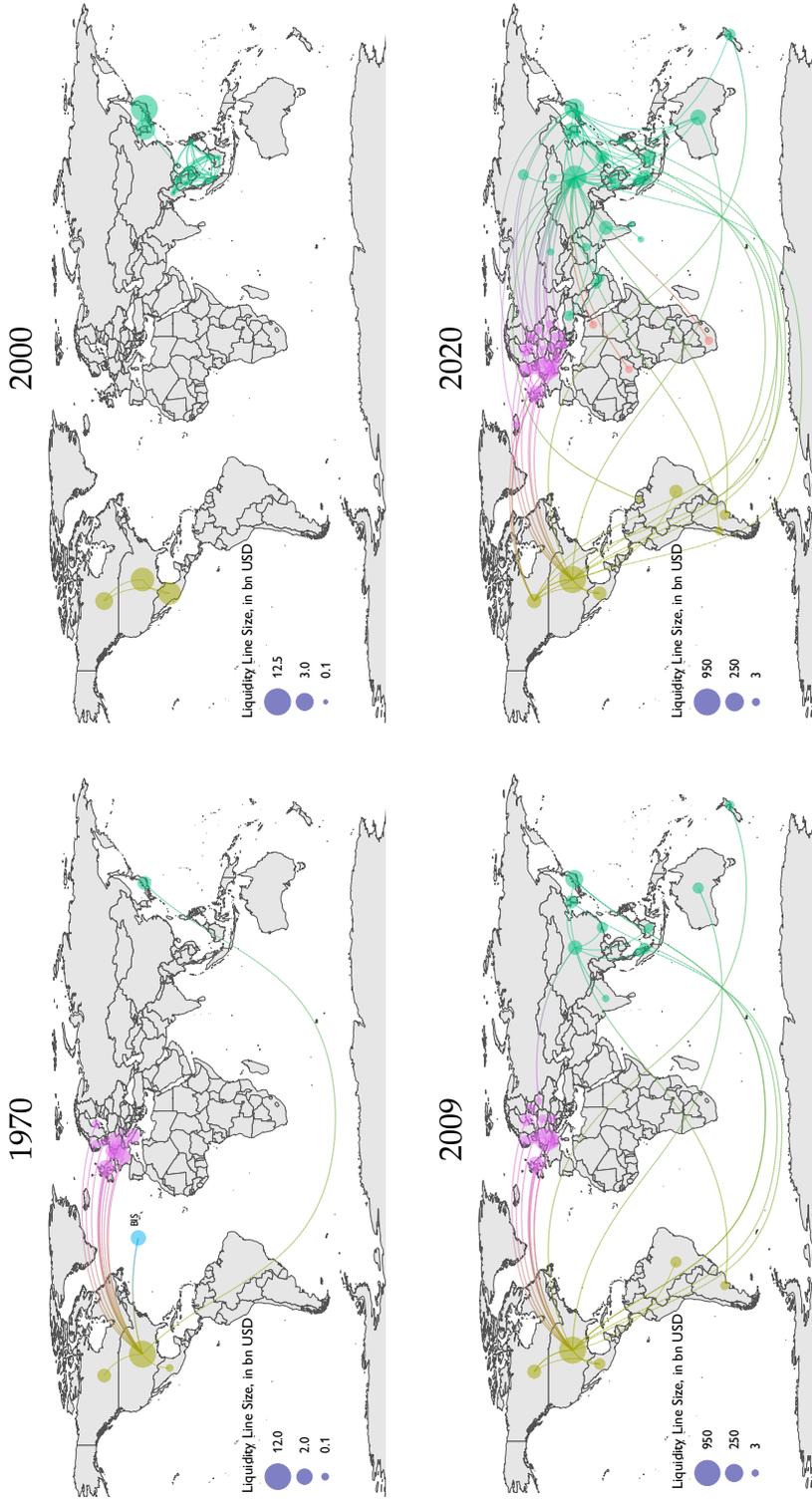
We focus on the arrangements that are currently in place. (For the agreements established during the Bretton Woods era, see the review in McCauley and Schenk (2020).) The transparency of the agreements greatly differs across source central banks. The Fed is perhaps the most transparent. It has published the contracts that underpin the standing swap line network, and it regularly reports the individual drawings from its lines at the central bank level.¹ The FOMC discussions during the 2008 and 2011 crises that led to setting up the liquidity line policies are publicly available in the meeting transcripts, and from those one can learn about the concerns and motivations behind these policies. The PBoC, which has the largest number of bilateral liquidity lines, only reveals the dates of the agreements, the quantities available to borrow, and aggregate borrowings as annual snapshots published in its monetary policy report. In between these two cases, other source central banks provide varying degrees of detail.

A complementary source of information comes from the recipient central banks. The liquidity lines are typically used to fund open market operations (OMOs) in source currency, and the details of these operations, including the amount lent, are often publicly disclosed. In most cases, the recipient just replicates the terms of the liquidity line when setting up its OMOs. When this is not the case, the terms of the OMO provide bounds, since a recipient central bank is unlikely to conduct an OMO at either a longer maturity or a lower interest rate than the liquidity line from the source central bank.

From an operational standpoint, there are two legs to a liquidity line. The first is the structure of the agreement between the two central banks. It determines the risk that the source central bank exposes itself to by lending to the recipient central bank. This is a sovereign credit risk. The second leg is how the recipient central bank goes about using the money that it is lent. This is often more important for the transmission of policy to the financial system. We discuss each in turn. Given these two legs, we then end the section with a summary of the process to set up a liquidity line.

¹See <https://www.newyorkfed.org/markets/international-market-operations/central-bank-swap-arrangements> (last accessed 30th December 2021).

Figure 1: The Evolution of the Global Liquidity Line Network



Notes: 1970 – Federal Reserve swap lines only, bubble size reflects outstanding drawings as of end-1970 per McCauley and Schenk (2020). 2000 – bubble size reflects the sum of the notional limits of all swap lines available to country per Denbee, Jung and Paterno (2016). 2009 – bubble size reflects the sum of either the notional limit of all swap lines available to country or, if the line is unlimited, the historical drawings per Perks et al. (2021). 2020 – as 2009 but augmented to include ECB's bilateral repo lines sourced from Albrizio et al. (2021).

Table 1: Terms and Conditions of Selected Liquidity Lines

Framework	Source	Recipient	Type	Max. Borrowable Amount (Source Currency mil.)	Max. Borrowed Amount (Source Currency mil.)	Interest Rate	Date of Agreement ¹	Date of First Drawing	Collateral	Maximum Maturity	Reciprocal
Swap Line Network	Federal Reserve	European Central Bank	Swap	∞	291,289	USD OIS + 25bp	10/05/2010	12/05/2010	EUR equivalent to USD borrowed	88 days (greater upon agreement)	Yes
Swap Line Network	Federal Reserve	Bank of Japan	Swap	∞	225,839	USD OIS + 25bp	10/05/2010	20/05/2010	JPY equivalent to USD borrowed	88 days (greater upon agreement)	Yes
Swap Line Network	European Central Bank	Bank of England	Swap	∞	10	ECB repo rate + 25bp	30/11/2011	13/03/2019	GBP equivalent to EUR borrowed	88 days (greater upon agreement)	Yes
Bilateral	People's Bank of China	Monetary Authority of Singapore	Swap	300,000	undisclosed	undisclosed	8/03/2013	undisclosed	SGD equivalent to RMB borrowed	3 months ²	Yes
Bilateral	Bank of Japan	Reserve Bank of Australia	Swap	1,600,000	0	undisclosed	18/03/2016	-	AUD equivalent to JPY borrowed	undisclosed	Yes
Bilateral	Federal Reserve	Norges Bank	Swap	30,000	5,400	USD OIS + 25bp	19/03/2020	30/03/2020	NoK equivalent to USD borrowed	3 months ²	No
FIMA	Federal Reserve	Hong Kong Monetary Authority	Repo	60,000 ³	1,400	Interest Excess Reserves + 25bp	31/03/2020 ⁴	05/14/2020	US treasuries, haircuts applied	overnight ⁵	No
Bilateral	European Central Bank	National Bank of Romania	Repo	4,500	0	undiscl.	5/06/2020	-	Euro area government debt, EUR denominated, haircuts undisclosed.	undisclosed	No

Notes: Terms accurate as of publication date. ¹Excludes prior agreements that have since lapsed. ²Maximum maturity of recipient central banks operations funded through the liquidity line. ³HKMA has committed to only draw up to \$10,000 million from the facility. ⁴HKMA announced it would start using the FIMA repo facility on 22/04/2020. ⁵ FIMA facility is stated as being limited to overnight maturity. HKMA operates one week dollar repos funded through FIMA, how this is reconciled is not disclosed.

3.1 The agreement between the two central banks

Table 1 provides a summary of the key features of selected liquidity lines that have been established over the past decade. This is not a comprehensive list but it is designed to give a set of examples of how different agreements are structured.

Activating the liquidity line. The process for drawing from a liquidity line is as follows. The recipient central bank initiates the transaction by making a request to obtain a certain amount of source currency at a particular date for a specific maturity from the source central bank.² The source central bank must then approve the request. If so, the relevant funds and collateral are then deposited at the agreed transaction date. All the central banks in the standing swap line network require at least one day's notice between initiation and the transaction taking place, with the exception of the Bank of Japan which requires two days due to the time difference.³ The request for activation must also align with the timing of the settlement cycle of operations funded through the liquidity line, which we will discuss below.

Collateral. The collateral that the recipient provides is the operational distinction between a swap line and a repo line. In a swap arrangement, the recipient central bank gives the source central bank a deposit of the recipient currency of the same value as the source currency borrowed. The spot exchange rate at initiation is typically used, so that the loan is structured as an FX swap. In a repo line, the recipient bank pledges as collateral securities denominated in source currency (although nothing prevents other denominations being used) subject to haircuts imposed by the source central bank. This raises the bar for access, as the recipient central bank cannot just issue the collateral that it needs.

Interest rates. The interest rate on the loan is *de jure* set by the source central bank, although in practice there will be a negotiation between institutions. Only the source central bank receives interest, as the recipient does not charge interest on any of the currency it provides as collateral (in the case of a swap). Typically, the interest rate is set as a spread

²Reserve sharing agreements, like the Chiang-Mai initiative, are different in that the currency lent is a reserve currency, typically USD, rather than the currency of the source central bank. The process still works in the same way except the source central bank would need to liquidate reserves to fund the transaction rather than just create the money being lent.

³Overnight swaps can be approved on the day so long as the request reaches the source central bank before 8am local time on the same day.

over a policy rate or a benchmark market interest rate in line with the standard Bagehot (1873) principle that a central bank should lend at a penalty rate. As of 2020, this spread is 25bp (down from 100bp in 2007) for the Fed's liquidity lines (and some other lines between major central banks). Anecdotes suggest that the PBoC charges higher spreads.

Maturity. For the swap line contracts that are in the public domain, upon mutual agreement, any maturity of loan is possible. In practice, the maximum duration seen in individual drawings is around 3 months, with maturities of overnight, one week and one month being common.⁴ The maturity of the transaction partly reflects the aims of the loan. For example, the Monetary Authority of Singapore (MAS) has an RMB facility whereby it borrows RMB via its PBoC swap line for one week or one month if the funds are to be used for the purposes of stabilizing the offshore RMB market in Singapore, and for three months if the RMB is to be used to finance international trade.

Reciprocity. With a swap line, a reciprocal arrangement means that either bank can be the source institution and the loan can go in either direction. There are occasions where reciprocity is relevant. One example is the bilateral swap line between the Bank of Korea and the PBoC where both have borrowed via the swap line to support local banks in supplying trade finance in RMB and KRW respectively. However, most swap lines are established with the tacit understanding that a specific central bank is likely to play the role as the source institution most, or all, of the time. For example, since the Fed established its reciprocal swap arrangements with five other central banks 2009, it has yet to indicate that it plans to use those facilities to borrow foreign currency. The FOMC transcripts suggest reciprocity was granted to signal a commitment to global financial stability. Since the mechanics of borrowing and lending via the swap line are near equivalent, having the arrangement be reciprocal has close to zero operational marginal cost.

Limits. In the standing swap line network the lending amounts are uncapped. Other existing agreements specify a limit to the total amount of loans. The recipient central bank then needs a system to ration access to source currency; typically, it uses variable priced operations (see the discussion below). In reciprocal arrangements there is a limit in each direction and the ratio between them need not match market exchange rates.

⁴The Fed's swap line contracts limit the maturity to 88 days unless both parties agree to relax this.

The financial flows. The funds are lent via the source central bank by crediting the recipient central bank's account within the financial system of the source country. In the case of the USD liquidity lines, recipient central banks have a correspondent account at the Federal Reserve Bank of New York with access to the US payment system. Similar correspondent accounts exist at central banks in other jurisdictions. The PBoC's liquidity lines are an exception in that the account will typically be at an offshore RMB clearing bank providing international RMB payment services, rather than onshore in China.

In the case of a swap line, the recipient central bank also creates a parallel correspondent account for the source central bank which is then credited with the amount to serve as collateral. The money held on account at the recipient central bank is not used during the life of the swap; indeed, some swap line contracts actively forbid the use of the account. In the case of a repo line, the recipient instead sells the securities that serve as collateral to the source central bank. For example, in the FIMA facility the recipient central bank sells treasuries to the Fed System's Open Market Account.

Upon maturity these transactions are reversed. All correspondent accounts are debited with the same values as at initiation plus interest, and any securities are sold back.

Default. To our knowledge, there has been no publicly-disclosed default on a central bank liquidity line. If a default were to occur, the basic assumption is that the source-central bank would liquidate the collateral, convert it back to source currency, and then pursue the recipient central bank for any residual amount including costs. The more likely outcome however is that, upon default, the loan would be rolled over while negotiations take place. Indeed, the contracts for the Fed's swap lines with the other major central bank have no explicit provision for withdrawing the deposit from the recipient central bank in the event of a missed payment. Instead, contractually, any balance not repaid is repeatedly rolled over using an overnight swap at the same exchange and interest rate until the balance is cleared. However, the contract does allow the Fed to offset any missed payments against other sums that the Fed may owe to the recipient central bank.

The recipient central bank will typically be lending the money it receives on to banks within its own jurisdiction in a collateralized operation. A default by the recipient central bank is likely, therefore, when it has been defaulted on by a commercial bank. The recipient central bank will need either to pursue the commercial bank, or to liquidate the collateral it is holding. Any residual losses would need to be covered through the country's foreign exchange reserves and accessing them would likely require political approval.

In the more extreme case where the recipient central bank is unable or unwilling to repay, the collateral available to the source central bank becomes relevant. In a repo line, the collateral is straightforward to access. With a swap line, the collateral is a deposit at an account of a central bank that is already in default. It is likely that a central bank that is unable to pay would be experiencing a balance of payments crisis. Therefore, the recipient currency would have depreciated sharply, diminishing the value of the collateral. Moreover, if the recipient central bank was unwilling to pay, it could unilaterally freeze the correspondent account. Of course, the reputational consequences of doing this would be severe, and it seems unlikely that a central bank would behave in this way. However, this does indicate that ultimately it is the central bank's reputation for having a stable currency and to honor commitments that serves as security in a swap operation.

3.2 The recipient central bank's use of the money

Once the recipient central bank has access to the source currency, it is free to make whatever payments it wishes. If it sets up domestic lending facilities, it can choose who to lend to, at what maturity, and against which collateral. Across some of these dimensions, there is great homogeneity, while across some others there are significant differences. Table 2 summarizes the terms for the USD facilities funded by the Fed's liquidity lines that were active in 2021, which we now discuss.

Purpose. Most liquidity lines are agreements between the two central banks for a specific purpose. If the recipient uses the money for a different purpose, it risks the source central bank in the future no longer authorizing any further drawings, or imposing new contractual terms.

One apparent case of misuse are various counterparties of the PBoC drawing RMB from the swap lines for the purpose of padding out official exchange reserves. For example, over the course of 2014 and 2015 the central bank of Argentina (BCRA) borrowed RMB to buy USD in order to bolster its reserves, although none of the USD appear to have been spent (McDowell, 2019). This goes against the typically stated goal of the PBoC's swap lines being for trade settlement (Georgiadis et al., 2021). However, the PBoC did not publicly protest the arrangement and some sources report that the BCRA's move had the PBoC's tacit approval (Tresor Economics, 2018). Given the opacity of the agreement (as with most other PBoC liquidity lines), it is difficult to say whether the contract has been revised, and so whether the BCRA and other counterparty central banks will be able

Table 2: Terms and Conditions of USD Operations funded through Federal Reserve liquidity lines (operational in 2021)

Lending Institution	Max. Allotted Amount (\$bn)	Tenor ¹	Frequency	Min. Bid Interest Rate	Eligible Collateral	Additional Haircuts
European Central Bank	∞	7 days	weekly	1 week OIS + 25bp	All assets within Eurosystem collateral framework; includes non-marketable credit claims and peripheral Euro Area government debt.	12%
Bank of Japan	∞	7 days	weekly	1 week OIS + 25bp	BoJ pooled collateral; includes debt securities rated either AA or A depending on type, some ABS, mortgage debt.	13% ; 25% for (terminated) operations of more than one month in maturity
Bank of England	∞	7 days	weekly	1 week OIS + 25bp	All assets under BoE's Sterling monetary collateral criteria; includes on balance sheet corporate loans, asset-backed securities and covered bonds.	For non USD collateral: 6%, +2% for YEN, AUD, NZD & RMB denominated collateral.
Swiss National Bank	∞	7 days	weekly	1 week OIS + 25bp	Same as for SNB CHF repos; debt securities rated at least AA-, no ABS.	Extra haircuts added if mismatch exceeds \$10bn.
Sveriges Riksbank	up to 60 ²	84 days	monthly	3 month OIS + 25bp	All assets under Riksbank collateral criteria; debt securities rated at least AA-, no ABS.	6%
Danish National Bank	up to 30 ²	84 days	suspended ³	3 month OIS + 25bp	Same as for Danish National Bank DKK credit facilities; Danish government debt securities and Danish covered bonds.	6%
Banco de Mexico	up to 60 ²	84 days	quarterly ⁴	3 month OIS + 25bp	Same as for Banco de Mexico credit facilities; public and corporate debt securities.	undisclosed.
Monetary Authority of Singapore	4 or 8 ^{**} (84)	7/28/84 days	weekly/ fortnightly / fortnightly	Tenor equivalent OIS + 25bp	SGD and G10 currency cash, debt securities and covered bonds rated at least BBB-. CNH cash.	undisclosed.
Hong Kong Monetary Authority	10	7 days	weekly	Interest on Excess Reserves + 25bp	HKMA Exchange Fund Bills and Notes	none

Sources: European Central Bank, Bank of Japan, Bank of England, Swiss National Bank, Sveriges Riksbank, Danish National Bank, Banco de Mexico, Monetary Authority of Singapore, Hong Kong Monetary Authority.

Notes: ¹ Tenor sometimes adjusted due to holidays. ² Limit on the swap line with the Federal Reserve. ³ Danish National Bank's last dollar operation matured on 12th March 2021. No further operations have taken place since then. ⁴ Banco de Mexico carries out two 84 day dollar repo operations one week apart every quarter. ⁵ \$4bn is the maximum allotted for 7 and 28 day operations. \$8bn is the maximum allotted on the 84 day operations.

The Bank of Korea and Norges Bank also carried out operations in 2020, these operations were not extended into 2021.

to do this again.

The Argentinian case is illustrative of a broader trend of using liquidity lines to window-dress official exchange reserves. Borrowing via a swap line generates a foreign liability in domestic currency but if the proceeds are in a reserve currency (or can be converted into one) then they count towards the country's gross foreign exchange reserves in official statistics. (Repo lines do not suffer from this problem as the country pledges securities from its reserves as collateral.) Such a transaction does nothing to improve the country's net financial position, and may even worsen it if the cost of borrowing from the swap line is onerous. Alongside Argentina, Pakistan, Egypt, and Turkey appear to have used their PBOC swap line in this manner. Egypt and Turkey have likewise drawn on swap lines they have with central banks in gulf states. These transactions have led to discussions regarding a revision of the technical definition of official reserves, in order to prevent a swap line being used for window dressing (IMF, 2017).

Setting aside misuse of the arrangement, the majority of modern lines that do not have an FX stabilization motive are meant to enable the recipient central bank to provide credit in source currency to banks in its jurisdiction. The loans could be a bespoke (often confidential) arrangement between the central bank and a private counterparty. However, recipient central banks typically set up formal facilities where they offer credit in the currency of the source central bank via a market operation. There are many examples of this. All of the drawings from the Fed's swap lines during the pandemic have been used for USD repo operations conducted by the recipient central banks, with a range of maturities up to three months. The Bank of England has used its swap line with the ECB within the standing swap line network to offer EUR-denominated one-week repos to UK banks. The Bank of Korea, the Monetary Authority of Singapore, and the Hong Kong Monetary Authority (HKMA) all have RMB lending facilities backed by their swap line with the PBoC. The HKMA also has a USD facility which provides one-week USD repos to banks in Hong Kong that is funded by the repo line with the Fed, the FIMA.

Settlement, frequency, tenor, and limits. The recipient central bank must coordinate the two legs of the swap line, so that both the drawing and the OMO can be completed. Typically, bids for the domestic operation are taken first. Knowing the demand for source currency, the recipient central bank can then initiate the drawing from the source central bank, so the funds are transferred to its account, and it can then settle the OMO.

For the frequency and tenor of the operations, the four central banks within the stand-

ing swap line network coordinate the timing and maturity of their USD operations in order to prevent arbitrage opportunities for global banks operating in multiple jurisdictions. But the other central banks with a USD facility funded by a swap line with the Fed make different choices. Another choice that is similar across central banks is the list of eligible counterparties within their banking system. Typically, these are the same set of banks that have access to domestic currency lending facilities.

In terms of amounts lent, the drawing limits imposed by the source central bank constrain the recipient's discretion over the total amount it can lend. The ECB can draw an unlimited amount of USD from its swap line with the Fed, hence it lends USD using a fixed price full allotment operation. In contrast, central banks with caps on drawings conduct operations of a fixed allotment size and a variable price (or, more precisely, an interest rate). Banks need to bid for the source currency, raising the cost of borrowing from the facility. Even so, in practice it is nearly always the case that the limit is non-binding and so the total quantity drawn from the liquidity line is still demand driven.

Collateral. The difference that stands out the most among institutions is the heterogeneity in the collateral that banks need to provide in order to access the lending facility. This is almost entirely a reflection of the heterogeneity in collateral regimes across central banks in general. Recipient central banks normally simply adopt the same eligibility criteria for their foreign currency operations as they do for the domestic currency ones. For instance, the HKMA limits collateral at its USD facility to Exchange Fund Bills and Notes. These are the HKD denominated debt securities that the HKMA itself issues to serve as security in domestic monetary policy operations. Another example is the ECB, which applies the broad Eurosystem collateral criteria, including non-marketable bank loans to Euro Area residents.

However, recipient central banks sometimes demand additional haircuts on collateral, reflecting the extra risk of a foreign currency loan. The BoJ demands 13% more collateral in value terms for a one-week USD loan compared to a one-week JPY loan of the same initial value. The Bank of England, Riksbank and Danish National Bank have extra haircuts starting at 6%. The SNB and the HKMA ask for no extra haircuts at all. It is the case, however, that these facilities all extend the criteria for eligible collateral relative to that for the Fed's own standing repo facility, which is limited to US treasuries and government sponsored agency securities.

A historical parallel. The current arrangements of the USD liquidity lines have an historical parallel in the early operations of the Federal Reserve system. When they provide loans, the regional reserve banks effectively borrow (uncollateralized) from the system as a whole, similarly to how European central banks use the TARGET II system today. But, in the 1920s and 1930s, the regional reserve banks individually determined the terms under which banks in their jurisdiction could access the lender of last resort facilities. This is just as what happens today with the recipient foreign central banks in the Fed's current swap line network. The USD liquidity lines turn the Fed into liquidity provider of last resort on the global scale, analogous to its founding mission at the national level.

The experience of the Fed shows that such heterogeneity in lender of last resort policies has economic consequences. Richardson and Troost (2009) show that during the great depression, banks located along the Mississippi in the more generous 6th Federal Reserve district had lower failure rates and were better able to maintain credit supply compared to those located in the non-interventionist 8th district. Whether heterogeneity in the lending facilities funded through liquidity lines has had similar economic effects is an open question for research. Differences among the recipient economies poses a severe challenge to identification.

3.3 Setting up a liquidity line

Because of the different layers involved in a liquidity line, there is a difference between two central banks reaching an agreement and the line actually being in operation.

There are three stages to setting up a liquidity line. First, the central banks agree in principle to engage in a lending relationship (reciprocal or not, swap or repo). Typically, the maximum amount that can be drawn will be specified and the relevant accounts required for the transactions will be set up. These agreements can lie dormant for months and years. In fact, most of the liquidity lines in Figure 1 are stuck at the end of this first stage.

The second stage is triggered by the recipient central bank telling the source central bank that it wants to start drawing on the line. They then agree on the terms, such as the maturity and frequency of drawings and the interest rate. Note that since every drawing requires authorization, nothing stops the source central bank from renegeing on the agreement and refusing the recipient's request to start using the line.

Once the terms are finalized, the third and final stage can take place. The recipient then sets up a lending facility in source currency, chooses its terms, and publicizes it to

market participants. The liquidity line is now ready to start operating.

In a crisis, these three steps can be completed relatively quickly, but the process is not always instantaneous. For example, during the Covid pandemic, the Fed announced that it would set up new swap lines with three Scandinavian central banks (among others) on March 19th 2020, but the three recipients took until the 26th to take bids on their first operations, and these were not settled until the 30th. These were the fastest among central banks that agreed new USD liquidity lines in March 2020. Others were slower to establish facilities, and others have still not done so, presumably because they anticipated little demand.

The fact that most liquidity lines are not fully operationalised does not mean they are ineffectual. The dormant lines still serve as insurance against future shocks to the supply of source currency credit to the banks in the recipient's jurisdiction. There are some signs in the data of a positive insurance value of merely having a liquidity line announced (Aizenman, Ito and Pasricha, 2021)). However, Bahaj and Reis (2022a, 2020a) have shown that actual drawings from the liquidity lines, even when their timing can be anticipated, have a large impact on asset prices in crisis times.

4 Economic consequences

The setup of the liquidity lines implies that the source central bank outsources the risk management of the loans to foreign commercial banks, while still extending the umbrella of its liquidity facilities. This division of tasks seems natural. The recipient is better placed to monitor the counterparties in its jurisdiction and the quality of the collateral. But the source central bank is better placed to provide the underlying loan, as it is the issuer of the currency.

The net effect is to provide source currency funds for banks in the recipient country. Why they need these funds in the first place is less well understood. In principle, banks could get the source currency from secured credit, unsecured loans, recipient-currency loans that are synthesized into source currency using foreign exchange swaps, or (for large banks) internal capital markets across subsidiaries and branches in different jurisdictions. During financial crises, these alternatives can either become unavailable, or are more expensive than the liquidity lines. Which one it is appears to depend on the line and the crisis. For instance, for the PBoC swap line, access to RMB may be hard given capital controls in China that prevent access to onshore RMB credit markets, and due to

volatility of borrowing costs in the offshore money market in Hong Kong. Avdjiev, Eren and McGuire (2020) argue that, during the Covid crisis, the USD swap lines replaced a large contraction in the unsecured portion of the market. Ultimately, research to answer this question will likely have to use bank-level data on drawings, which as of yet is not made available.

There are three primary policy aims behind providing the funds: financial stability, promoting international trade, and FX interventions. We discuss each in turn.

4.1 Liquidity lines as a financial stability tool

The top panel of figure 2 illustrates how a liquidity line, in this case a swap line, can be used to stabilize the financial system in the recipient central bank's jurisdiction, using the example of the ECB and the Fed. The figure shows the flows of funds and collateral that occur upon the ECB's drawing of the swap line and lending to a Eurozone bank via a USD-denominated market operation.

Initially, there must be a shock to USD denominated credit markets. When those markets are working normally, liquidity lines would be unused because they charge a penalty rate. Whether that shock hits the banks directly or some other parts of the financial system, it must create some profitable opportunity for the Euro area banks that prompts them to use the line.

The Euro area bank can then use these USD: (i) to cover withdrawals, (ii) to provide USD-denominated credit to clients (potentially via the FX swap market), or (iii) to purchase USD-denominated securities. In practice, there is evidence that all three usages are relevant. First, drawings from the Fed's swap lines have coincided with situations when USD money markets are withdrawing funds from foreign banks (Avdjiev, Eren and McGuire, 2020). Second, setting up the swap lines was correlated with lower deviations from covered interest parity (CIP), which measures the cost of borrowing foreign currency offshore via the swap market (Goldberg, Kennedy and Miu, 2011, Baba and Packer, 2009). Bahaj and Reis (2022a) show that changes in the terms and availability of the swap line causally lower CIP. Ivashina, Scharfstein and Stein (2015) and Eguren-Martin, Busch and Reinhardt (2019) find that a reduction in CIP deviations leads to banks lending more in foreign currency. The lending can also spill over to other jurisdictions; for example, Yun (2021) finds that the Korean branches of banks that had access to the Fed's swap line drew funding from their parents during the pandemic (relative to other branches and prior to the BOK activating its own USD swap line). Third, Bahaj and Reis (2022a) show that low-

ering the costs of the swap line leads recipient banks to purchase more USD denominated corporate bonds.

This can stabilize the financial system through a number of potential mechanisms. From the perspective of the ECB, the lines can prevent costly bank failures. The mere presence of a lender of last resort facility can even head off self-fulfilling runs. Either way, it lowers the cost of borrowing for commercial banks, boosts their profitability, and thus their capacity to engage in financial intermediation.

From the Fed's perspective, the liquidity prevents a fire-sale of USD-denominated assets by Euro area banks. It also potentially prevents spikes in key benchmark interest rates in wholesale USD funding markets driven by the spike in demand from Euro area banks (FOMC, 2007). Lastly, the provision of USD abroad may flow back to the domestic financial system, closing arbitrage opportunities and increasing the capacity of the financial system to intermediate between agents (Cetorelli and Goldberg, 2012).

On the other side of the scale is moral hazard. The net effect is to insure banks against some of the downside risks of having assets in source currency. This provides an implicit subsidy to Euro area banks having activities in USD. To the extent that an excessive amount of this activity poses financial stability risks, this poses a tradeoff for the policy. The tradeoff is especially complicated since the two central banks have different objectives, and different costs and benefits from the loans. Whether or not the facilities are designed optimally is still an open question in the literature.

All together, as noted by Bahaj and Reis (2022a), the liquidity lines are a lender of last resort facility justified by liquidity crises, preventing runs and reducing fire sales. Their benefits and costs align with those of standard central bank lending facilities that have been studied at least since Bagehot. Promoting financial stability was the stated goal of most central banks when establishing their modern liquidity lines.

4.2 Liquidity lines as a tool to encourage international trade and currency usage

The middle panel of figure 2 illustrates how a liquidity line can support international trade using the example of the Bank of Korea borrowing RMB from the PBoC for the purposes of trade finance. Most of the flows are similar to the top panel, with the added complication that Chinese capital controls require having an offshore RMB clearing bank to intermediate the transaction. In the figure, we have assumed for compactness that

both the Bank of Korea and the commercial bank use the same RMB clearing bank for their RMB payments but this does not need to be true in general. Now, the Korean bank that generates the drawing from the swap line lends the money on to a Korean importer to purchase products from a Chinese exporter. The liquidity line caps the wholesale cost of providing RMB trade finance for the Korean banks .

Since trade finance is just a specific form of financial intermediation, this could be seen as fitting within a broad financial stability objective. It is well known that instability in credit markets has a knock-on effect on international trade (Amiti and Weinstein, 2011). However, there are three reasons that lead us to separate trade finance from financial stability.

First, within the context of financial stability, subsidizing source-currency activity by recipient-currency banks is seen as an undesirable side effect of providing a lender of last resort facility, as we just discussed. The opposite is true in the case of a line for trade purposes. The goal is to promote trade between the two jurisdictions, and the associated trade credit. There is some evidence that reaching a swap agreement with the PBoC is associated with the country having stronger trade linkages with China (Zhang et al., 2017).

Second, the liquidity line can smooth frictions in the international payments system outside of crises. A typical cross-border payment, particularly in foreign currency, can pass through several different correspondent banks, leading to delays and transaction costs (BIS, 2021). The liquidity line plugs the Korean Bank directly into the RMB payment system, making transactions faster and cheaper, and lowering the cost of trade.

Third, and combining the previous two reasons, trade sales and trade credit require payments, which will happen using the RMB. This directly increases the international use of this currency. Additionally, if the importer is buying inputs for a product that it plans to export, it has an incentive to price exports in source currency too in order to align prices with marginal cost (Gopinath, Itskhoki and Rigobon, 2010). In turn, if a firm is pricing exports in a currency it has an incentive to get credit for working capital in that currency as well (Bahaj and Reis, 2020*b*). Empirically, Bahaj and Reis (2020*b*), Song and Xia (2020), Georgiadis et al. (2021) find that the PBoC's swap lines are associated with an increased use of the RMB for cross-border payments and for trade invoicing. Insofar as there are rewards of having an international currency, this provides a separate benefit of the liquidity lines.

4.3 Liquidity lines as a tool for FX interventions

Using a liquidity line to fund an FX intervention was the purpose of swap lines during the Bretton Woods era, and persists to today, perhaps most notably in the Chiang-Mai initiative. Some liquidity lines involving the major central banks would also potentially fall into this category. The swap line between the Banco de Mexico and the Fed was used to support the Peso during the 1982 Mexican crisis. The ECB has not indicated whether it would allow its swap lines to be used to defend the pegs of non-Euro Area central banks in the EU that peg to the EUR but there has been speculation that they could be used in this way too, even if the stated objective of the lines is them being a financial stability tool. As an example, the bottom panel of figure 2 shows an FX intervention by the Danish National Bank (DNB) funded through its swap line with the ECB. This is a hypothetical case, the DNB has not used the swap line in this way. Indeed, most of the FX interventions to defend its EUR peg in recent years have involved selling DKK, but the example is still illustrative.

The ECB provides the loan of EUR which the DNB then uses to buy its currency in the FX spot market.⁵ This would directly increase demand for the recipient currency and raise its exchange rate. Naturally, this usually happens when the recipient is defending a currency peg to the source currency. Of course, once the loan has to be repaid to the source currency, this would put pressure on the exchange rate in the opposite direction. The hope (often unfounded) is that the central bank can deftly use the liquidity line to intervene in a way that lowers the volatility of the exchange rate, and to deter any speculative attacks by increasing the time (and so cost) for speculators to sell the currency short.

The FX stabilizing aspect can be more subtle than in direct interventions. During the 1960s, the US ran a large and persistent current account deficit with European countries, which under the Bretton Woods rules would require a movement of gold from the US to Europe. As the US Treasury resisted this, the Fed instead provided USD, via the swap lines, to European central banks who would then hold them as reserves instead of drawing at the gold window. Since the swap contract would mature at some point, the Fed was offering the recipient central bank a guaranteed exchange rate for the duration of the swap, thus providing the incentive not to switch to gold (Bordo, Humpage and Schwartz, 2015). When the recipient needed to repay the swap line though, this could prompt a

⁵The timing of these transactions do not need to align precisely; for example the recipient central bank can sell source currency forward and tap the liquidity line only when the contract expires (McCauley and Schenk, 2020).

balance of payments crisis as happened in 1976, triggering an IMF program with the UK (McCauley and Schenk, 2020).

4.4 Intersections between the three tools

If the liquidity lines help to make the financial system more stable, then exporters can count on the supply of trade credit promoting international trade. Moreover, as the swap lines put a ceiling on CIP deviations to help prevent fire sales and bank runs, this effect on the forward FX market will naturally spill over to the FX spot market and affect the exchange rate. A stable exchange rate may contribute to reducing the prevalence of sudden stops in capital flows across borders, and is one of the factors that leads to more invoicing in a currency, which in turn boosts demand for trade credit in that currency. In short, all three tools have clear interactions and spillovers with each other.

The unifying thread, emphasized by Bahaj and Reis (2022a), is that all three uses of a liquidity line broadly fall under a lender of last resort function. The situations in which this backstop liquidity is more important is what distinguishes between the three. First, if there are large gross international investment positions denominated in source currency, the financial stability role dominates. In contrast, FX interventions typically arise from a negative net investment position. Finally, liquidity line for trade settlement purposes support gross trade flows. Countries can easily have very different positions on gross investment, net investment, and gross trade.

5 Lessons

We conclude with some lessons for three sets of potential readers of this article: researchers, policymakers, and market participants.

5.1 Three lessons for applied researchers

Drawings are not a policy choice. It is tempting to use liquidity line drawings, or allotments at an operation, as a measure of the size of the policy intervention. This is incorrect. Drawings are endogenous, partly determined by demand for credit in source currency, rather than solely by changes in policy that shift the supply. Worse, the central banks that have been the heaviest users of liquidity lines conduct fixed price, full allotment operations. Therefore, the supply curve of liquidity is perfectly elastic, and any variation in

quantities is completely driven by changes in demand from banks. Even for the other central banks, where there is a limit to the size of the liquidity lines, these limits have not been a binding constraint of the quantity lent. To measure policy shocks associated with the liquidity lines, researchers can instead look for changes in the terms of the agreement between central banks (including interest rate, the limit and the maturity) or in the terms of the recipient central banks' operations (including the frequency, the eligible collateral and any haircuts imposed).

Effects should be more noticeable during crises, measured by CIP deviations. Liquidity lines are instruments of last resort. Banks use them as an outside option, as the penalty rate makes operations funded through a liquidity line unappealing most of the time. Therefore, their effects should be more noticeable during crises. Since research has shown that the direct effect of a liquidity line is to put a ceiling on CIP deviations (Bahaj and Reis, 2022a), these crises can be identified as times when these observed CIP deviations are close to the ceiling. If CIP is close to holding, we should expect the liquidity lines to have effects that are too small to be detected. Alternatively, if CIP deviations are close to the ceiling, but not at it, the liquidity lines can exert a large effect on economic decisions. Even if the constraint placed by the swap line does not bind, being close to the constraint will lower the distribution of likely outcomes in the near future. This can significantly reduce the ex ante expected cost of borrowing in the source currency. A liquidity line can have large effects even it is never drawn on.

The liquidity lines are only one piece of the international financial architecture. The liquidity lines involve central banks, and through them give rise to capital flows of short maturities between banks across countries during times of stress in private money markets, with no direct link to other policies. The IMF instead is a multilateral organization that extends credit to sovereign nations that lasts for many months, during crisis involving balance of payments or sovereign debt, and conditional on a package of policy reforms. Further, today there are many regional financial agreements, including development banks like the Asian Infrastructure Investment Bank, and intergovernmental organizations like the European Stability Mechanism. These extend credit across borders that can take many different shapes, and are often more strongly tied to political goals and decisions. Together, these are three of the main legs of the current international financial system. Because they interact with each other (Gourinchas, Rey and Sauzet, 2019),

researchers have to be especially careful when trying to study one in isolation from the others. In times of crisis, all three will be active with many policy decisions that respond to economic outcomes as well as to what the others' policies may be. Identification of individual effects can therefore be tricky, and models that can take account these interactions may be essential.

5.2 Three lessons for policymakers

Specify the terms of the liquidity lines ahead of time. While there is evidence that just having an agreement for a liquidity line can affect economic outcomes, it is still the case that the terms of most agreements lack detail, especially on the terms at which the recipient central banks will lend the money on. Fischer (1999) provides some compelling reasons for why clearly laying out the terms of any lender of last resort facility in advance is advantageous: this lowers the likelihood of self-fulfilling runs, it enables prospective borrowers to take preemptive steps to access the facilities, and it serves as a commitment device for lenders that may be exposed to political pressure.

Consider setting up standing facilities. Most central banks operate a standing domestic currency lending facility (the discount window) where commercial banks can obtain an overnight loan at short notice. For central banks that have a liquidity line, very little stands in the way of offering a similar emergency overnight facility in the source currency (as opposed to only repo operations on a schedule and with weekly or monthly tenors). This is perhaps most relevant for central banks with a USD liquidity line with the Fed given the dominant role of the USD. Setting up a standing facility is possible since the Fed's swap line contracts allow for short notice drawings if the maturity is overnight. The virtue of doing so is that implementation lags of actually using liquidity lines could be decreased. Spikes in CIP deviations and interactions with reporting requirements in financial regulations could be avoided (Bahaj and Reis, 2022a). Central banks in the standing swap line network moved in this direction during the pandemic by offering daily repo operations but the frequency was dropped as the crisis abated.

Make collateral regimes consistent across central banks. Within the USD network, some central banks lend only against government securities, while others lend against a broad range of illiquid loans including household mortgages. Because there are many

global banks with operations in multiple jurisdictions, this presents opportunities to arbitrage different lending facilities. For example, the collateral criteria needed to access the ECB's dollar operations is much broader than to access the Fed's own standing repo facility, encouraging global banks to use the liquidity lines to obtain USD for their US branches (Cetorelli and Goldberg, 2012). Arguably, from a US perspective, this puts foreign global banks at an advantage compared to domestic banks. Working in the opposite direction, the interest rate charged in the USD swap lines is currently priced 25bp above the Fed's domestically focused repo facility.

5.3 Three lessons for financial market participants

A liquidity line agreement is only one step in the process. As we described, there are multiple steps involved in channeling the proceeds of a liquidity line to commercial banks. Many of the swap line agreements shown in figure 1 have not yet been operationalised. The experience of 2020 and the height of the pandemic is that this operationalisation can happen relatively quickly, although with significant differences across countries. This implies a system of liquidity lines that is in flux and does not provide the certainty that domestic lending of lines provide. Moreover, there are important differences between announcing an agreement (often at unspecified terms), announcing terms or changes of terms, and actually conducting operations (Bahaj and Reis, 2020a, Aizenman, Ito and Pasricha, 2021).

Details matter. Different liquidity lines differ in their purpose as well as in the details of their implementation. Many of these details may not matter for macroeconomic outcomes at quarterly frequencies. But for high frequency variations in prices they can be very important. An example comes from the settlement cycle of the operations. This cycle takes at least a day during which bids are taken, amounts are allotted, and then the money is transferred to the account of the bidding bank. This causes spikes in offshore funding costs concentrated in the window between bids being taken in an operation and the next operation being settled, and means that allotted amounts are independent of shocks that occur on the day that settlement occurs (Bahaj and Reis, 2022a, Syrstad and Viswanath-Natraj, 2020).

Identifying who is borrowing is hard. When the Fed provides a loan through its discount window, by law it has to soon reveal who was the recipient. This is often seen as

a pitfall of loans of last resort. If it isolates which banks needed the funds at the penalty rate, it can trigger runs on them by other banks. Such stigma may lead banks to avoid borrowing from the central bank in the first place, thus limiting the effectiveness of the lender of last resort. With the introduction of the USD liquidity lines with foreign central banks, identifying the borrowing banks is much harder. Many foreign central banks only make public which banks borrowed from them many years later. Even today, it is not known which European banks borrowed as much as \$285bn from the ECB at the peak of lending in 2008. Most large US banks can today obtain USD through their branches and subsidiaries abroad without making this known until much later, thus avoiding any stigma.

6 Conclusion

This article provided an overview of the history, terms, and mechanisms behind central bank liquidity lines, ending with lessons for researchers, policymakers, and financial market participants.

Research on this topic is still in its infancy, as the liquidity lines became much more prominent after the global financial crisis. After an initial wave of descriptive work, only recently have researchers written models that isolate the concrete channels through which the swap lines work, and used credible identification strategies to measure their causal effects. Today we can already move well beyond the initial, vague justification for liquidity lines as a tool to “alleviate funding pressures”.

Still, much work remains to be done. While we have highlighted some specific open questions in this chapter, in a companion paper, Bahaj and Reis (2022*b*), we lay out three broad sets of issues for future research. The first issue is how to write the contract that connects the two central banks, as well as the arrangement between the financial institutions and their domestic central bank. The current contracts were designed quickly, in crisis times. An optimal contract would have to balance the usual trade-offs in lender of last resort policies, together with the involvement of two central banks that may differ in incentives, objectives and constraints. A second issue is how the overall network should be structured. Should the international financial system combine different bilateral arrangements, with holes and indirect connections, or instead is a multilateral setup with broader coverage optimal? A third broad area of inquiry is the two-way interaction between a central bank providing a liquidity line, and its currency being used internation-

ally. Do the liquidity lines contribute towards a currency being used internationally or do they instead mitigate some of the financial frictions that cause the international financial system to gravitate to having one or a small number of dominant currencies?

These are important questions that require detailed theoretical and empirical analysis. Judging by how quickly central banks turned to the liquidity lines during the pandemic of 2020, the work is also urgent.

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