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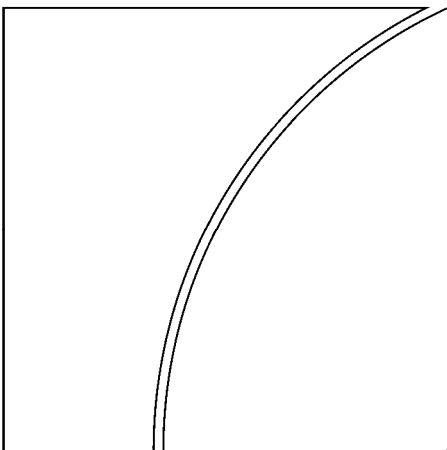
No 310

# Central bank co-operation and international liquidity in the financial crisis of 2008-9

by William A Allen and Richhild Moessner

Monetary and Economic Department

May 2010



JEL classification: E58, G01, F31

Keywords: Central bank cooperation, central bank swap lines,  
FX swaps, international liquidity, lender of last resort

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ISSN 1020-0959 (print)

ISBN 1682-7678 (online)

# Central bank co-operation and international liquidity in the financial crisis of 2008-9<sup>1</sup>

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May 2010

Abstract

The financial crisis that began in August 2007 has blurred the sharp distinction between monetary and financial stability. It has also led to a revival of practical central bank co-operation. This paper explains how things have changed. The main innovation in central bank cooperation during this crisis was the emergency provision of international liquidity through bilateral central bank swap facilities, which have evolved to form interconnected swap networks. We discuss the reasons for establishing swap facilities, relate the probability of a country receiving a swap line in a currency to a measure of currency-specific liquidity shortages based on the BIS international banking statistics, and find a significant relationship in the case of the US dollar, the euro, the yen and the Swiss franc. We also discuss the role and effectiveness of swap lines in relieving currency-specific liquidity shortages, the risks that central banks run in extending swap lines and the limitations to their utility in relieving liquidity pressures. We conclude that the credit crisis is likely to have a lasting effect on the international liquidity policies of governments and central banks.

JEL classification: E58, G01, F31.

Key words: Central bank cooperation, central bank swap lines, FX swaps, international liquidity, lender of last resort.

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<sup>1</sup> The views expressed are those of the authors and should not be taken to reflect those of the BIS. We would like to thank Naohiko Baba, Henning Dalgaard, Petra Gerlach, Corrinne Ho, Toshio Idesawa, Harold James, Anders Jørgensen, Istvan Mak, Bob McCauley, Patrick McGuire, Dubravko Mihajjek, Shinobu Nakagawa, Jacek Osinski, Judit Pales, Jong Seok Park, Camilo Tovar, Philip Turner, Lorant Varga, Jae Hyun Chio, Jong Seok Park and other officials of the Bank of Korea, and participants in seminars at the BIS Monetary and Economic Department, Cass Business School and the London School of Economics for helpful comments. We would also like to thank Bilyana Bogdanova, Homero Goncalves, Swapan Pradhan and Gert Schnabel for excellent research assistance. Any remaining errors are the responsibility of the authors. The authors' e-mail addresses are [bill@allen-economics.com](mailto:bill@allen-economics.com) and [richhild.moessner@bis.org](mailto:richhild.moessner@bis.org).

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## 1. Introduction.

Central banks co-operate naturally when they are committed to maintaining exchange rate relationships among their currencies, as was the case for example under Bretton Woods and in the European Exchange Rate Mechanism (which is still in operation for some countries)<sup>2</sup>. This is because maintaining an exchange rate relationship requires domestic monetary policy objectives to be subordinated in some degree, so that a degree of co-ordination of monetary policy is unavoidable. Financial supervisors from different countries also co-operate naturally, because many of the private financial companies that they supervise operate in many different countries; and many central banks, though not all, have financial supervision among their functions.

In recent years, exchange rate commitments short of full monetary union have gone out of fashion, even if they have not disappeared completely. In the past 20 years, many countries have shifted their monetary policy strategies towards one or other of two positions: (a) monetary union (eg as in the euro area), and (b) inflation targeting with a floating exchange rate. Both positions appeared sustainable, unlike the position of 'fixed but adjustable' exchange rates, which prevailed throughout the Bretton Woods era, but which, in the light of more recent experience, appeared unstable. Thus Economic and Monetary Union has been created in Europe, with 16 member countries at the time of writing; while inflation targeting with a floating exchange rate, which was invented as a monetary policy technique in New Zealand in the late 1980s, has now been adopted by 29 countries<sup>3</sup>.

Monetary union requires not only co-operation among the participating central banks, but also common subordination to central management (such as is provided in the euro area by the European Central Bank). Until recently, it seemed that the other sustainable position, inflation targeting, required no more than exchange of information among central banks, if that. If one country made a policy error, the consequences would be largely confined to that country<sup>4</sup>.

While supervisory co-operation has continued, co-operation on monetary policy seemed, at least until recently, to have become less intense. That process has been described succinctly by Borio and Toniolo (2006):

*In the post-Bretton Woods years, the aims of central bank cooperation progressively shifted from monetary to financial stability, and new tools were introduced. The experience of the Great Inflation of the 1970s convinced central banks that domestic monetary stability, their overriding responsibility, could be*

<sup>2</sup> See for example Toniolo (2005).

<sup>3</sup> See International Monetary Fund (2009a, appendix table II.9), available at <http://www.imf.org/external/pubs/ft/ar/2009/eng/pdf/a2.pdf>.

<sup>4</sup> This has been characterised as the 'house in order doctrine' by Padoa-Schioppa (2006).

*pursued primarily by domestic policy. After some disappointing attempts in the 1970s, cooperation on exchange rates became largely subordinated to the pursuit of that objective. ...At the global level, cooperation on monetary issues became less feasible once the more inflation-conscious countries or currency areas saw it as not entirely consistent with domestic price stability.*<sup>5</sup>

The advent of the credit crunch in August 2007, and its subsequent intensification, have largely eroded the hitherto apparently sharp distinction between monetary and financial stability; and led to a revival of central bank co-operation. Section 2 of the paper describes the onset of the credit crisis, and its sudden intensification after the failure of Lehman Brothers in September 2008. It explains how money and swap markets were affected by the credit crisis and identifies indicators of market stress. The following two sections discuss official policy reactions: section 3 discusses monetary policy and section 4 describes the ways in which governments and central banks supported banks financially during the crisis. In section 5 we define the concept of currency-specific liquidity shortages and introduce a proxy measure of them, using the BIS international banking statistics. Section 6 reviews the behaviour of the market stress indicators during the crisis.

Central banks responded to the sudden drying-up of liquidity in international financial markets by opening up inter-central-bank swap facilities. Section 7 describes the four swap networks that were established during the crisis, and the objectives of the central banks which established them. In section 8 we examine econometrically the characteristics of countries which received swap lines during the crisis, and find, among other things, that the proxy measure of currency-specific liquidity shortages that we introduced in section 5 plays a significant role. The risks run by the central banks of countries which provided swap lines were of course important in the selection of recipient countries, and these are discussed in section 9, while section 10 discusses the objectives of the countries which received swap lines. The working of the swap network in practice is described country by country for a selection of countries in sections 11 and 12, from the viewpoints of the swap providers and the swap recipients separately. It is clear that the financial stability problems faced by several of the recipient countries would have been much more severe had the swap facilities not been made available.

In the light of our analysis, we conclude that the experience of the credit crisis is likely to have a lasting effect on the behaviour of governments and central banks, not only as regards financial regulation but also as regards policies related to international liquidity. In the concluding section, we also assess the effectiveness of the swap networks and draw inferences about the likely future direction of international liquidity policies and their possible effects on the world economy<sup>6</sup>.

<sup>5</sup> See Borio and Toniolo (2006), page 25.

<sup>6</sup> The Basel Committee on the Global Financial System (CGFS) has published its own report on the official response to the crisis. See Committee on the Global Financial System (2010).

## 2. Effect of the credit crisis on money and swap markets.

The credit crisis was initiated by a widespread, though not uniform or complete, loss of confidence in the creditworthiness of banks. It began suddenly in August 2007, and varied in intensity throughout the following year. Perceived counterparty credit risks increased sharply, owing to uncertainty about other banks' credit exposures and the size of potential losses, and banks started hoarding liquidity. U.S. banks in particular withdrew liquidity on a massive scale from their affiliates in other countries. Spreads between LIBOR rates and Overnight Index Swap rates (OIS) widened and became highly volatile. The credit crisis damaged the functioning of all financial markets, including the wholesale deposit and foreign exchange swap markets. The crisis became much more acute after the failure of Lehman Brothers in September 2008, which destroyed the widespread belief in financial markets that governments would not allow any systemically-important financial institution to fail, and thereby dramatically heightened perceptions of credit risk among trading counterparties in financial markets.

In many countries, banks had made loans in foreign currencies, particularly those currencies in which interest rates had been relatively low, notably the US dollar, the yen and the Swiss franc. They had financed those loans partly by taking deposits in the currency of the loan, typically in the international wholesale deposit market, and partly by taking deposits in their home currencies, and using the foreign exchange swap market to eliminate foreign exchange risk. For example, a Hungarian bank with a Swiss franc asset, such as a mortgage, to finance might take forint deposits and then swap the forints into Swiss francs. Specifically, the bank would sell the forints received from the depositors spot for Swiss francs, to be delivered to the borrower. The bank would simultaneously arrange to sell Swiss francs, at a specified forward date and a specified exchange rate, so as to hedge its foreign exchange risk. Typically, as is generally the case in banking, the loans were of longer maturity than the deposits. Therefore the financing needed to be renewed periodically.

When the credit crisis struck, it became much more difficult, or in some cases impossible, for many banks to secure foreign currency deposits in the wholesale markets. Even in domestic currency markets, the available range of maturities became much shorter. Many banks were forced to use the lending facilities of their home central banks to finance themselves. Such facilities were in normal times typically confined to their domestic currency and to short maturities. Therefore, banks had to replace relatively long-maturity foreign currency financing of foreign currency assets with relatively short-maturity domestic currency financing.

These financial market stresses had several consequences for financial market prices, which make it possible to identify market stress indicators, as described below. The consequences included the following:



- a. Because many banks no longer had access to markets for foreign currency loans and deposits, particularly at longer maturities, quoted prices in those markets became irrelevant for them.
- b. There was increased demand to borrow at longer maturities in domestic-currency deposit markets, but with domestic depositors also becoming uneasy about bank creditworthiness, and banks hoarding liquidity, rates tended to rise<sup>7</sup>.
- c. As foreign currency financing of foreign currency assets was replaced by domestic currency financing, banks sold the domestic currency received from the new lender spot for foreign currency, in order to repay the original depositor, and bought it forward so that the currency composition of its assets and liabilities would be matched<sup>8</sup>. Thus the forward price of the domestic currency tended to rise relative to the spot price, particularly at the short maturities at which commercial banks were borrowing from their central banks. In addition, in many countries, foreign investors had purchased domestic-currency government securities on a currency hedged basis. In other words, they had bought the domestic currency spot, to pay for the government securities, and sold it forward in order to hedge the foreign exchange risk. When the credit crunch struck, many of them unwound the investment, and as a consequence sold the domestic currency spot and bought it forward. This then was an additional influence driving up the forward price of the domestic currency relative to its spot price.
- d. In the stressed market conditions that prevailed during the credit crisis, the cost of raising dollar funding by means of swaps went up as the dollar deposit market became inaccessible to all but a few banks and the demand for swap-related funding rose. In normal conditions, covered interest rate differentials were close to zero (interest parity). During the crisis, they increased sharply as measured, reflecting both upward pressure on interest rates in the currencies in which banks were able to raise deposits, and increasing forward premia on those currencies as banks bought them forward to cover their foreign exchange exposures. At the same time, liquidity in the commercial swap market was impaired, probably mainly because of anxiety about counterparty credit risk. Some banks that had previously been able to use swap markets to obtain dollar funding were unable to do so any longer, while others were able to use swap markets only at a restricted range of short maturities. This aggravated the measured changes in covered interest differentials<sup>9</sup>. Covered interest differentials are thus a good market stress indicator.
- e. Likewise, as foreign currency financing of foreign currency assets had to be replaced by domestic currency financing, banks could adjust their hedging by

<sup>7</sup> See for example ECB (2009), pages 12-13, Ejerskov (2009), pages 45-47.

<sup>8</sup> See Mak and Pales (2009), pages 31-32; National Bank of Poland (2009b), pages 23-24.

<sup>9</sup> See Baba et al. (2008), Baba and Packer (2009), Bank of Korea (2009c), page 43.



means of cross-currency basis swaps, in which banks agreed to pay floating-rate interest in foreign currency and receive it in domestic currency over the life of the swap. Accordingly, the cost of undertaking such swaps increased. In normal conditions, the cost of swapping floating-rate interest at LIBOR into floating-rate interest at LIBOR in any other currency is very small, ie a few basis points, but in several currency pairs the spreads became very wide during the crisis.<sup>10</sup> Cross-currency basis swap spreads are therefore our second market stress indicator.

- f. In some cases, borrowers with foreign currency debts to repay, and who were unable to refinance them, simply bought the needed foreign currency outright spot or forward. Banks were inhibited from doing so by regulatory limits on their open foreign exchange positions, but non-bank borrowers were generally not thus inhibited, and some of them will in any case have been short of the currency in question. Outright purchases of foreign currencies by those who had borrowed them created pressure for the currencies which had been most widely used as borrowing vehicles to appreciate. Our third market stress indicator is therefore spot exchange rates. Of course liquidity pressures were not the only influence on spot exchange rates at the time, but in some cases their behaviour suggests that liquidity pressures were a very important influence on them for a period.

To summarise, our three market stress indicators are covered interest differentials, cross-currency basis swap spreads and spot exchange rates.

In some countries, the central bank was willing to lend foreign currency to domestic commercial banks which had lost foreign currency deposit financing of foreign currency assets. In countries where the central bank provided foreign currency in this way, the pressure for the forward price of the home currency to appreciate relative to the spot price was weaker or absent altogether. The central bank's ability to lend foreign currency obviously depended on its own access to foreign currency resources, and the main function of the swap lines set up during the crisis was to augment central banks' foreign currency resources.

Not all central banks lent foreign currency to domestic commercial banks. For example, in some countries where the banks' foreign currency liquidity needs were only moderate, or where most of the banks had foreign parent companies which were able to supply the needed liquidity, the central bank could accept whatever pressure spot purchases of foreign currency might put on the exchange rate, and preferred not to relieve the pressure on the foreign parents of the commercial banks to provide them with liquidity.

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<sup>10</sup> See Baba et al. (2008).

### 3. Shift in balance of risks for monetary policy.

Before the credit crisis began, many central banks, particularly in countries with large banking industries, conducted monetary policy in pursuit of the objective of low but positive inflation, using the level of official interest rates as their sole policy instrument. Indeed, prior to the financial crisis, the main risk perceived by many central banks was higher inflation, mainly owing to the sharp rise in commodity prices which had continued until mid-2008. For example, oil prices had risen by 470% between the start of 2000 and mid-2008. Higher commodity prices contributed to higher inflation, which doubled from about 2% several years ago to 4% in mid-2008 in advanced economies, and from about 4% to 8% in emerging economies<sup>11</sup>.

The onset and development of the crisis changed the balance of risks. The objective of monetary policy was unchanged. However, commodity prices fell precipitously and the severe damage done to financial markets by the crisis meant that, suddenly, the economic outlook deteriorated massively and the downside risks to inflation became much greater. The threat of deflation was a real one. In these circumstances, interest rates in many countries were reduced to historically very low levels, but interest rate management on its own was inadequate. In some countries it was supplemented by unconventional monetary policy measures, including 'credit easing' and 'quantitative easing', in which central banks bought assets in order to support liquidity in financial markets and increase the 'monetary base'. Such unconventional monetary policy measures contributed to an enormous increase in the balance sheets of major central banks (see Graph 2 in Appendix 1)<sup>12</sup>. In addition, governments and central banks provided direct support to the banking system through provision of capital and liquidity.

### 4. Official support for banks during the crisis.

#### I. Capital support and guarantees

In order to keep the banking system functioning and to prevent bank failures, governments (and some central banks) have recapitalised banks that would otherwise have failed or been forced to shrink their balance sheets massively. A review and assessment of financial sector rescue programmes is provided in Panetta et al. (2009).

<sup>11</sup> See Cecchetti and Moessler (2008).

<sup>12</sup> See also BIS (2009), 79th Annual Report, Chapter VI, Graph VI.4.

## II. Domestic liquidity support

Since the onset of the credit crunch, central bank balance sheets have expanded enormously, and the range of assets that central banks accept as collateral for loans has in some cases been greatly widened<sup>13</sup>. These changes have been the result of national decisions, though the decisions have been driven by a common cause. For a discussion of the issues surrounding expanded liquidity support by central banks, see Turner (2010).

There were coordinated announcements by major central banks of special measures for enhanced liquidity provision in the central bank's own domestic currencies during the crisis, including in the provision of term funding.<sup>14</sup> There is likely to have been some discussion among central banks about what kind of collateral they would take for loans after August 2007 (eg mortgage-backed securities), and perhaps also about the amount of liquidity they would provide to their banking systems. The decisions were purely national although the central banks were no doubt influenced by each other's behaviour. As stated by Vice Chairman of the Federal Reserve D. Kohn (2009), "Beginning in late 2007, central banks generally reacted to funding problems and incipient runs with similar expansion of their liquidity facilities. They lengthened lending maturities, in many cases broadened acceptable collateral (...). Central banks were in constant contact throughout this period, although they arrived at many of these actions separately". Other instances of coordination include a joint assessment by central banks of measures taken in response to the financial turmoil up to April 2008 (see CGFS (2008)), and a coordinated attempt to inform market participants about how central banks operate in a period of uncertainty by publishing a compendium on central bank operating frameworks (see Markets Committee (2008)).

## III. Swap networks

Swap facilities can be used as a means of making the provision of central bank liquidity more effective by extending its geographical scope. Typically, central bank lending to domestic commercial banks is denominated in domestic currency; but if the commercial banks need foreign currency liquidity, then something more is required if the central bank wants to address this need. Swap facilities enable a central bank to provide liquidity to domestic banks in foreign currency.<sup>15</sup>

The mechanics of an inter-central bank swap are very simple. Central bank A credits the account of central bank B in its own books with A's currency; in return, central bank B credits the account of central bank A in its books with an equivalent amount of B's

<sup>13</sup> See BIS (2009), 79th Annual Report, Chapter VI, Graphs VI.4 and VI.5.

<sup>14</sup> For example on 12 December 2007, see <http://www.bankofengland.co.uk/publications/news/2007/158.htm>

<sup>15</sup> Alternatively, the central bank could use some of its own foreign exchange reserves for that purpose, converting them into the required currency if necessary by means of market transactions.

currency. Thus A lends its currency to B and B lends its currency to A; each loan is collateral for the other. There may be a provision for the amounts of the loans to be adjusted as exchange rates change. In principle, both A and B may use the foreign currency which the swap has put at their disposal, but in practice, only one party normally uses the swap proceeds; the other party simply holds them on deposit as collateral for the loan.

Central bank swaps have been used frequently in the past to help address a wide variety of problems. While the broad nature of the instrument is well-established, the details of swap agreements can differ from case to case, and the documentation which sets the details out is not usually made public.

## **5. Incidence of currency-specific liquidity shortages – evidence from the BIS international banking statistics.**

In normal market conditions, commercial banks can readily convert liquidity from one currency into another using foreign exchange swap markets. Thus a bank which is in need of foreign currency liquidity but can get only domestic currency liquidity can swap the domestic currency into foreign currency using the commercial swap market, selling the domestic currency spot and buying it forward. However, commercial swap market liquidity was seriously impaired during the credit crisis, partly by concerns about settlement risk, and currency-specific liquidity shortages developed in many countries. The Continuous Linked Settlement Bank (CLSB), introduced in 2002, greatly reduces credit risk in foreign exchange settlements. The CLSB acts as a central counterparty, which takes one side of all market trades between its members. It is described in Sawyer (2004). The effects of the credit crisis would have been very much worse in the absence of the CLSB. One reason why covered interest differentials involving the Hungarian forint and the Polish zloty have remained very wide (see sections 6 and 12) may be that transactions in neither currency can be settled through the CLSB.

Currency-specific liquidity shortages occurred when commercial banks needed to replace foreign currency deposits (including deposits taken in wholesale markets) which had been withdrawn, but were not able to do so. It is useful to consider what were the characteristics of the currencies in which liquidity shortages were experienced, and what were the characteristics of the countries in which the shortages were located.

### **I. Which currencies were in short supply?**

It follows from the analysis of the origin of the liquidity shortages that the currencies in which the shortages were experienced had two characteristics:

- i. They were currencies in which banks outside their home country had denominated large volumes of assets which could not be liquidated quickly; and
- ii. Some of the banks concerned were experiencing problems in raising new deposits in the currency in question, or were experiencing the withdrawal of funding previously provided by their head offices.

It is not possible to identify from any available banking statistics precisely which currencies displayed these two characteristics in late 2008. However the BIS locational international banking statistics contain some suggestive information. Table 5D in the BIS release gives information about reporting banks' domestic assets denominated in foreign currency, classified by currency. The data are summarised in table 5.1 below.

Currency	vis-à-vis all sectors	vis-à-vis non-banks
All	4,067.2	2,084.5
US dollar	1,927.5	1,015.1
Euro	1,093.7	603.4
Yen	156.5	99.3
Pound sterling	123.3	60.3
Swiss franc	251.5	166.0
Other	216.5	129.0
Unallocated	298.2	11.3

Source: BIS locational international banking statistics (Annex Table 5D).

These data show that the US dollar was the currency most widely used to denominate local foreign-currency loans, followed by the euro and the Swiss franc in that order. Therefore it would not have been surprising if those had been the three currencies in shortest supply during the credit crisis.

In the event, the shortages of US dollars, euros, Swiss francs and yen were all serious enough to warrant the provision of swap facilities by their home central banks. It seems plausible that shortages of US dollars, Swiss francs and yen were related to the earlier use of those currencies as borrowing vehicles for so-called 'carry trades', on account of their relatively low interest rates in the years preceding the credit crunch. The euro and the Swiss franc were used for mortgage borrowing by households in some emerging European economies, owing to their lower interest rates compared with domestic interest rates.

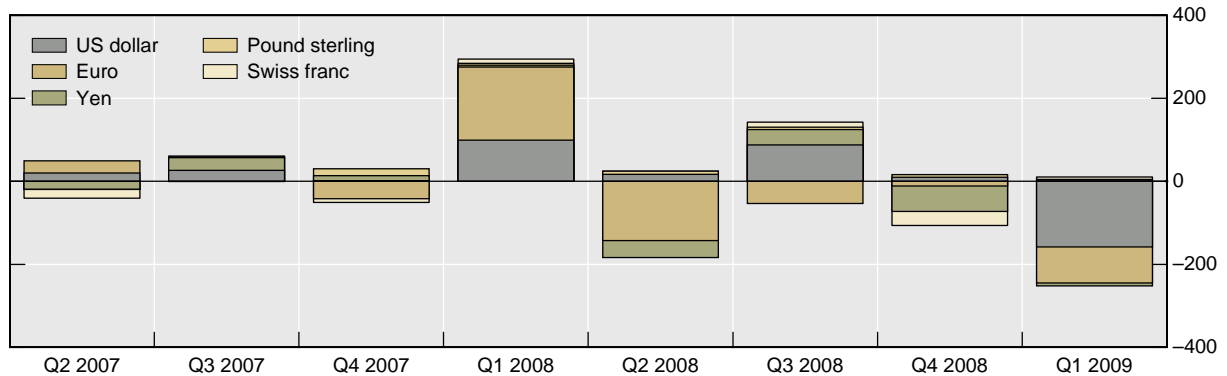
The BIS statistics show both local foreign currency assets and liabilities of banks located in individual countries, and their cross-border assets and liabilities. Graph 5.1 shows that

local foreign-currency loans in the US dollar increased or were relatively stable up to December 2008, and started falling only in 2009Q1, which might provide some support for the notion that they could not be liquidated quickly after the Lehman failure. In 2008Q4, the largest decreases were in yen and Swiss francs (see Graph 5.1). In 2009Q1, the largest decreases were in US dollars and euros, in that order. Local foreign-currency loans in the pound sterling were little changed in either quarter.

Graph 5.1

### BIS reporting banks' local claims in foreign currencies vis-à-vis all sectors

Estimated exchange-rate adjusted changes<sup>1</sup>



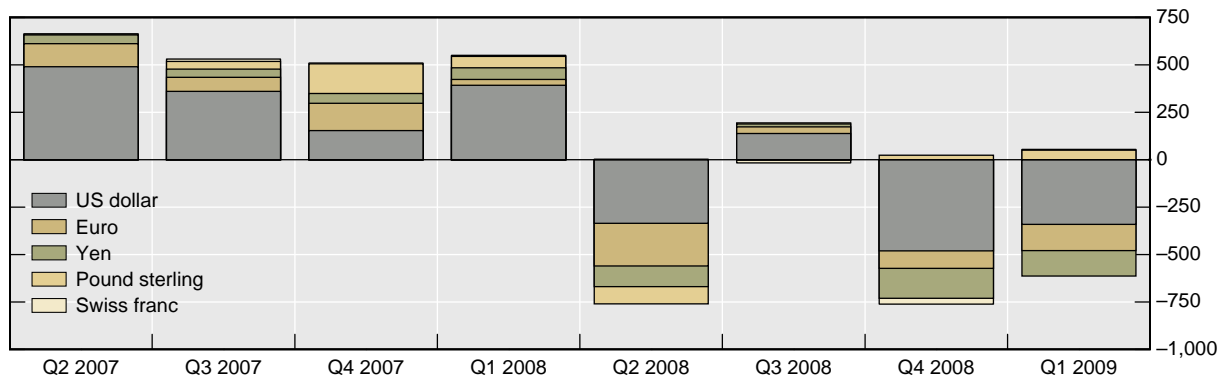
<sup>1</sup> In billions of US dollars.

Source: BIS locational international banking statistics (Annex Table 5D).

Graph 5.2

### BIS reporting banks' cross-border claims in foreign currencies vis-à-vis all sectors

Estimated exchange-rate adjusted changes<sup>1</sup>



<sup>1</sup> In billions of US dollars.

Source: BIS locational international banking statistics (Annex Table 5A).

By contrast, BIS reporting banks' cross-border assets in foreign currency<sup>16</sup> in the US dollar decreased very strongly in 2008Q4, with the second largest fall occurring in the

<sup>16</sup> We consider BIS reporting banks' cross-border assets in foreign currency, rather than domestic currency, for comparability between currencies of individual countries and of several countries in a monetary union.

yen, followed by the euro and Swiss franc, probably partly reflecting the banks' deleveraging in those currencies, and suggesting possible shortages of them (see Graph 5.2). Cross-border assets in foreign currency in the pound sterling increased slightly in 2008Q4 and 2009Q1, suggesting no strong deleveraging or shortages in sterling.

## II. Which countries experienced foreign currency shortages?

A number of advanced and emerging economies experienced currency-specific shortages as the financial crisis intensified.<sup>17</sup> In principle, the size of the currency-specific liquidity shortage in any country is equal to the following:

- i. Banks' total liabilities in the currency in question *minus*
- ii. Banks' total illiquid liabilities in that currency *minus*
- iii. The total funds in that currency that banks can raise from depositors, from their affiliates or from other providers, including central banks, or by means of asset sales.

Item (i) minus item (ii) are the banks' liabilities that need to be refinanced, and item (iii) is the funding that can be raised for this refinancing. The difference between the two, [(i)-(ii)]-(iii), is therefore the currency-specific liquidity shortage. In practice, none of these components is available in published statistics. The sizes of currency-specific liquidity shortages have to be estimated using such proxy data as are available.

As a proxy measure of US dollar-specific shortages, Graph 5.3 shows the net outstanding US dollar cross-border claims on BIS reporting banks by the economies shown, defined as cross-border total liabilities minus claims (in both foreign and domestic currency) of all BIS reporting banks vis-à-vis banks and non-banks located in the countries shown.<sup>18</sup> The corresponding proxy measure of euro-specific liquidity shortages is shown in Graph 5.4, and the corresponding measures for the yen, the pound sterling and the Swiss franc are shown in Graphs 5.5 to 5.7.

On this measure, the largest currency-specific liquidity shortage was of US dollars in the euro area (around \$400 billion). The next largest were the shortage of yen in the United Kingdom (\$90 billion equivalent), that of euros in the United States (about \$70 billion equivalent), and that of Swiss francs in the euro area (about \$30 billion equivalent). There were only small shortages of pound sterling (with the largest being around \$6 billion equivalent for Norway).

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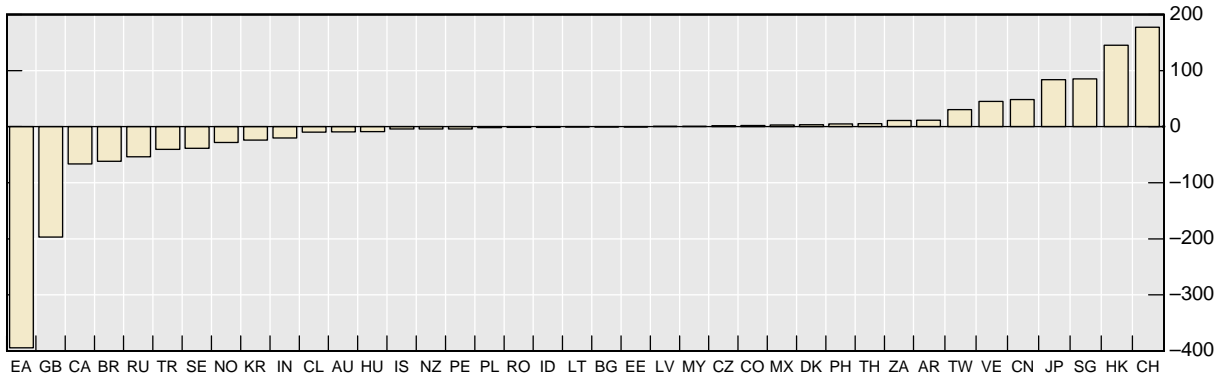
For the euro, BIS reporting banks' cross-border assets in domestic currency would include cross-border euro positions between countries belonging to the euro-area.

<sup>17</sup> US dollar shortages have been analysed in McGuire and von Peter (2009a and 2009b).

<sup>18</sup> This measure of currency shortages includes BIS reporting banks' liabilities vis-à-vis monetary authorities in the country. This measure includes cross-border total liabilities minus claims of BIS reporting banks (but not of banks or non-banks in non-BIS reporting countries or of non-banks in BIS reporting countries) vis-à-vis banks and non-banks located in the countries shown.

Graph 5.3

**Net outstanding US dollar cross-border claims on BIS reporting banks by economies shown<sup>1</sup>**  
 In billions of US dollars, December 2008

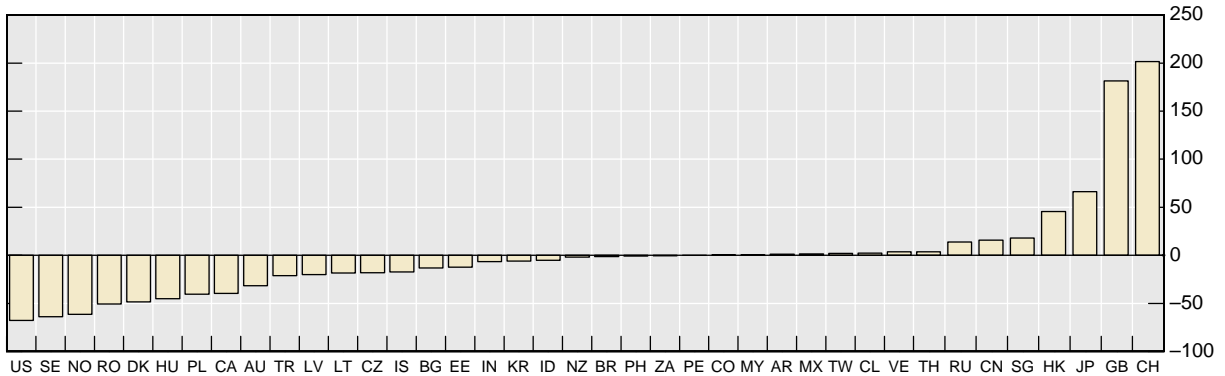


<sup>1</sup> AR=Argentina, AU=Australia, BR=Brazil, BG=Bulgaria, CA=Canada, CL=Chile, CN=China, TW=Chinese Taipei, CO=Colombia, CZ=Czech Republic, EE=Estonia, EA=Euro area, DK=Denmark, HK=Hong Kong SAR, HU=Hungary, IS=Iceland, IN=India, ID=Indonesia, JP=Japan, LV=Latvia, LT=Lithuania, MY=Malaysia, MX=Mexico, PE=Peru, NZ=New Zealand, NO=Norway, PH=Philippines, PL=Poland, RO=Romania, RU=Russia, SG=Singapore, ZA=South Africa, KR=South Korea, SE=Sweden, CH=Switzerland, TH=Thailand, TR=Turkey, GB=United Kingdom, US=United States, VE=Venezuela.

Sources: BIS locational international banking statistics, authors' calculations.

Graph 5.4

**Net outstanding euro cross-border claims on BIS reporting banks by economies shown<sup>1</sup>**  
 In billions of US dollars, December 2008



<sup>1</sup> See Graph 5.3 for a list of abbreviations of economies.

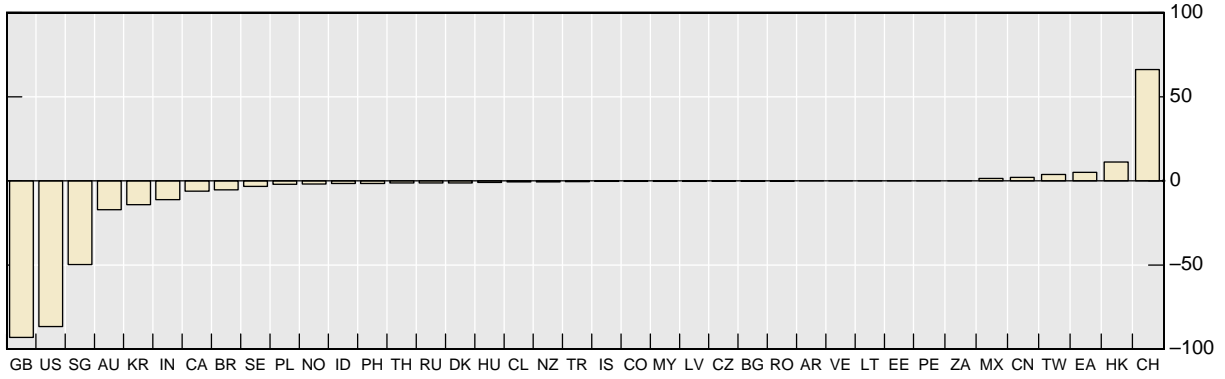
Sources: BIS locational international banking statistics, authors' calculations.



Graph 5.5

**Net outstanding Japanese yen cross-border claims on BIS reporting banks by economies shown<sup>1</sup>**

In billions of US dollars, December 2008



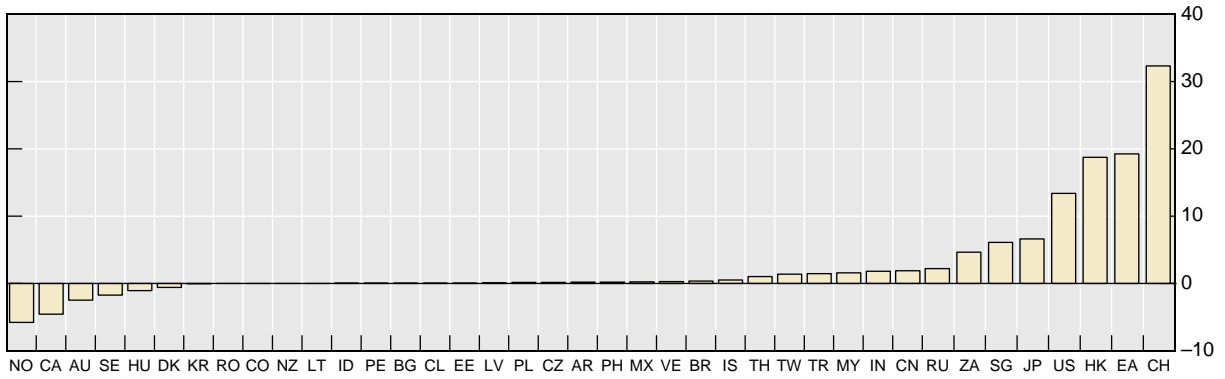
<sup>1</sup> See Graph 5.3 for a list of abbreviations of economies.

Sources: BIS locational international banking statistics, authors' calculations.

Graph 5.6

**Net outstanding pound sterling cross-border claims on BIS reporting banks by economies shown<sup>1</sup>**

In billions of US dollars, December 2008



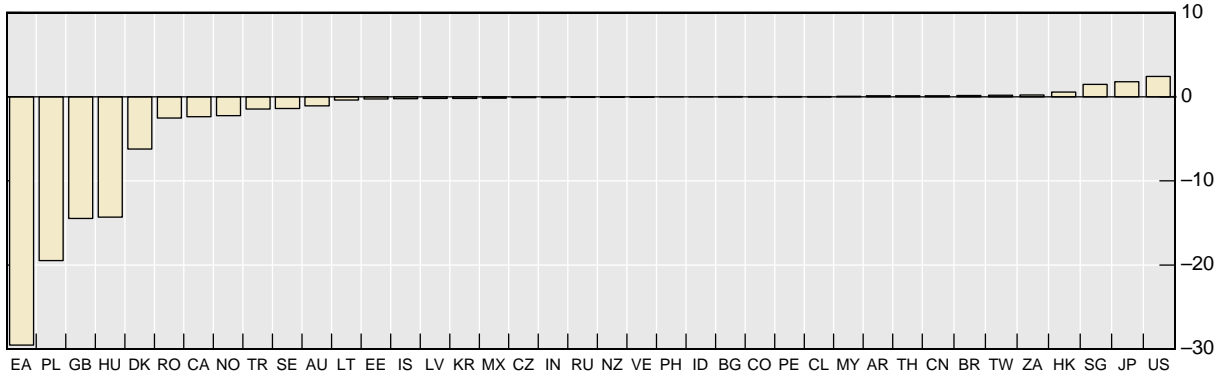
<sup>1</sup> See Graph 5.3 for a list of abbreviations of economies.

Sources: BIS locational international banking statistics, authors' calculations.

Graph 5.7

**Net outstanding Swiss franc cross-border claims on BIS reporting banks by economies shown<sup>1</sup>**

In billions of US dollars, December 2008



<sup>1</sup> See Graph 5.3 for a list of abbreviations of economies.

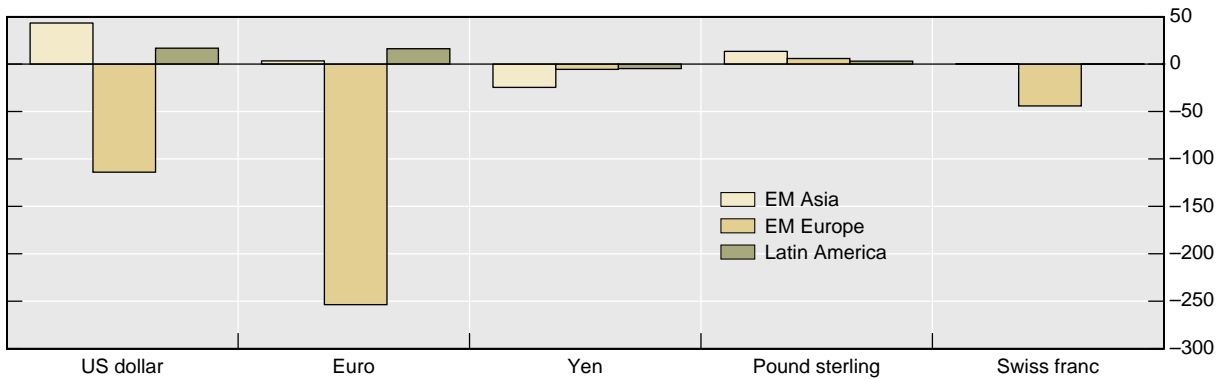
Sources: BIS locational international banking statistics, authors' calculations.

Graph 5.8 shows the total cross-border liabilities minus claims of BIS reporting banks vis-à-vis banks and non-banks located in emerging economies as at the end of December 2008. We can see that the group of emerging European economies had largest shortages on this measure in euros, followed by US dollars and Swiss francs. The group of emerging Asian economies had some shortages in yen, but not in the US dollar, euro or Swiss franc. The group of Latin American economies had a small shortage in yen, but surpluses in the US dollar and the euro. None of the three groups of emerging economies had shortages in the pound sterling.

Graph 5.8

**Net outstanding cross-border claims on BIS reporting banks by groups of emerging economies**

In billions of US dollars, December 2008



Sources: BIS locational international banking statistics, authors' calculations.

Breakdowns for total cross-border liabilities minus claims of BIS reporting banks by currency vis-à-vis individual emerging economies are shown in Graphs 1a to 1c in Appendix 1.

The measure used in Graphs 5.3 to 5.7 is based on the BIS locational international banking statistics by residence of counterparty. The BIS locational international banking statistics record the aggregate international claims and liabilities of all banks resident in the BIS reporting countries broken down by instrument, currency, sector, country of residence of counterparty, and nationality of reporting banks. Both domestic and foreign-owned banking offices in the reporting countries report their positions gross (except for derivative contracts for which a master netting agreement is in place) and on an unconsolidated basis, ie including banks' positions vis-à-vis their own affiliates<sup>19</sup>.

Another set of BIS statistics, the consolidated international banking statistics, provide information on the country risk exposures of the major banking groups of various countries vis-à-vis the rest of the world. The consolidated banking statistics report banks' on-balance sheet financial claims (ie contractual lending) vis-à-vis the rest of the world and provide a measure of the risk exposures of lenders' national banking systems. The data cover contractual (immediate borrower) and ultimate risk lending by the head office and all its branches and subsidiaries on a worldwide consolidated basis, net of inter-office accounts. Reporting of lending in this way allows the allocation of claims to the bank entity that would bear the losses in the event of default by borrowers (see BIS (2009)).<sup>20</sup>

The main reason why our particular measure of currency-specific shortages is based on the BIS locational international banking statistics by residence of counterparty is that in a financial crisis gross positions can matter, including of banks vis-à-vis their branches and subsidiaries, rather than just net positions, and they did matter in the recent crisis. Head offices may be unable or unwilling to provide their branches and subsidiaries with necessary liquidity during a crisis, either for reasons of balance sheet management or just because of time zone differences; and they may even withdraw liquidity from them.

According to Committee on the Global Financial System (2010), more host country regulation of bank liquidity is not unlikely. This could force global banking groups to decentralise important aspects of their liquidity management, hold more liquid assets in more locations, and reduce currency and maturity mismatches, as well as their reliance on intragroup funding (CGFS (2010)). The Basel Committee on Banking Supervision tried to reach agreement on liquidity risk management in the 1980s, at the same time as it was addressing capital adequacy issues for the main international commercial banks (Goodhart (2007)). However, it failed to reach any agreement on liquidity risk

<sup>19</sup> This is consistent with the principles of national accounts, money and banking, balance of payments and external debt statistics (see BIS (2008)).

<sup>20</sup> See McGuire and von Peter (2009a, 2009b) for currency-specific net foreign positions of banks by nationality of head office based on the BIS locational international banking statistics by nationality of head office and the BIS consolidated international banking statistics.

management;<sup>21</sup> consequently, while the earlier downward trend in banks' capital ratios was reversed by agreement on Basel I, the downward trend in liquidity ratios was not (Goodhart (2007)). Some issues regarding the supervision of liquidity are discussed in Davies and Green (2010, pages 97-106).

It is true, as noted in section 2 above, that in some countries where the foreign bank presence is relatively large, the central bank was able to take no action on foreign currency liquidity during the recent crisis, leaving it to parent banks to provide any needed funds. However it is clear that location was important during the crisis. Foreign-related institutions in the United States drained liquidity from their foreign affiliates in large amounts in the last four months of 2008 in order to build up dollar liquidity in the United States, even though they were very short of dollar liquidity elsewhere: they increased their net debt to related foreign offices by \$410.2 billion between 3 September 2008 and the end of that year<sup>22</sup>. Domestically chartered banks in the United States also drained liquidity from their foreign affiliates, increasing their net debt to related foreign offices by \$165.0 billion between 3 September 2008 and the end of 2008. If commercial banks had been able and willing to transfer liquidity as needed between their head offices and their foreign affiliates, then the locational banking statistics would not provide a useful proxy indicator of shortages in countries with a large foreign banking presence, but in our judgment that was not generally the case during the recent financial crisis.

### III. Currency mismatches

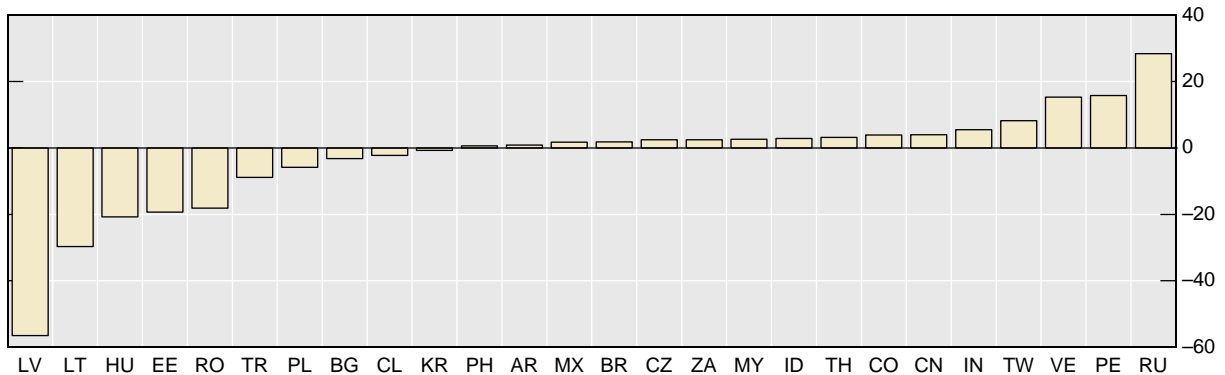
A measure of aggregate effective currency mismatches (AECM) for emerging economies is shown in Graph 5.9. The measure shown is an update of the AECM in Table 4.5 of Goldstein and Turner (2004), which assumes a zero foreign-currency share of domestic debt. It is a proxy measure for the vulnerability of the domestic economy to a depreciation of the local currency (see Goldstein and Turner (2004)), with a more negative value generally indicating greater vulnerability. Among the economies shown, some emerging European economies had the largest negative currency mismatches.

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<sup>21</sup> Although 'guidance' was issued by the Basel Committee in 2000 (Davies and Green (2010)). Since the crisis, the Basel Committee issued a set of 'principles for sound liquidity risk management and supervision' (BCBS (2008)), and some proposed minimum liquidity ratios (BCBS (2009)).

<sup>22</sup> See Federal Reserve table H8, 'net due to related foreign offices'.

Graph 5.9

**Aggregate effective currency mismatch (AECM)<sup>1</sup> in 2008**

<sup>1</sup> The AECM is the product of the country's net foreign currency asset position (as a percentage of GDP) and the simple mismatch ratio (ie the foreign currency share of aggregate debt relative to the export/GDP ratio); it is assumed that domestic credit is entirely in domestic currency.

Sources: IMF; BIS; national data; BIS calculations, update of table 4.5 of Goldstein and Turner (2004).

## 6. Incidence of currency-specific liquidity shortages – evidence from market indicators.

The analysis of the market effects of the credit crisis implies that the symptoms of currency-specific liquidity shortages include increases in covered interest differentials (FX swap spreads) and a widening of cross-currency basis swap spreads (see Baba and Packer (2009), Baba et al. (2008)), as well as sharply depreciating spot exchange rates in some countries.

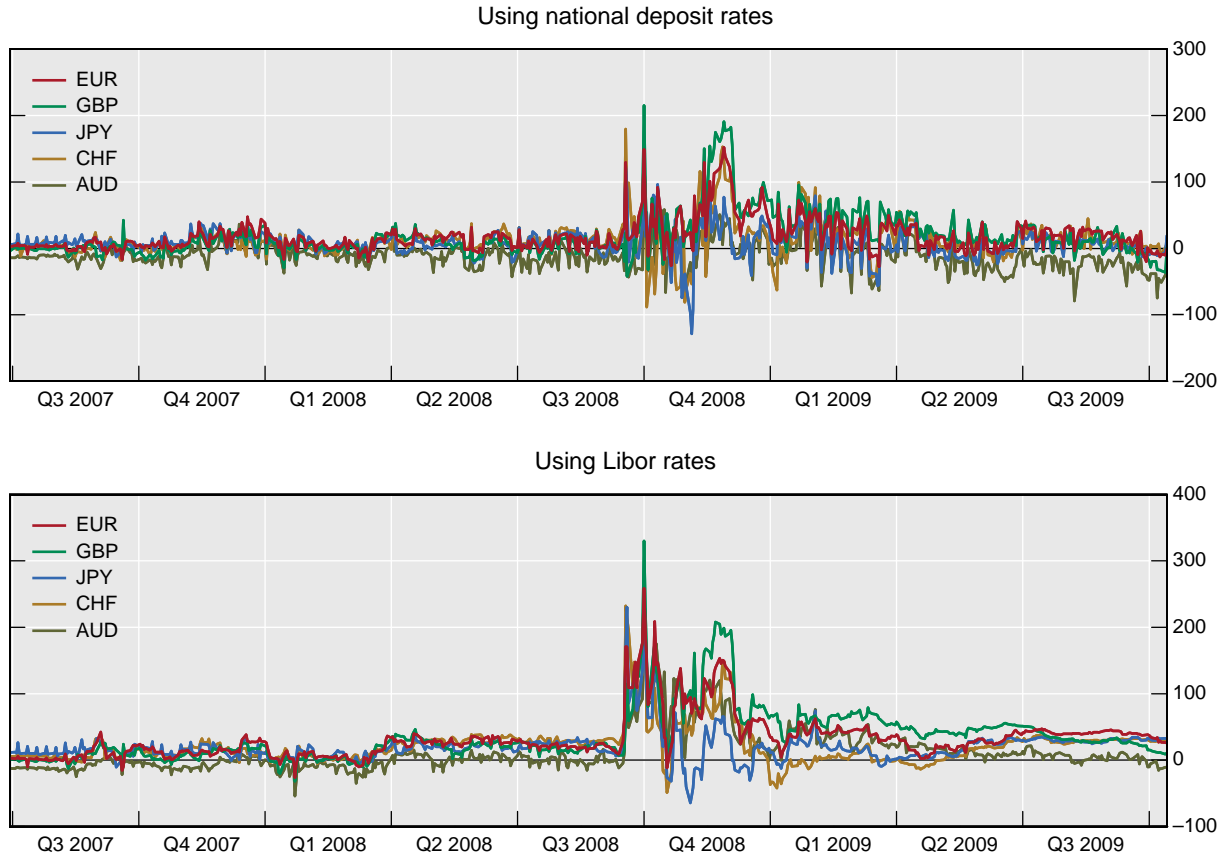
### I. Covered interest differentials

In market conditions which, before the credit crisis, were regarded as normal, commercial banks outside the United States could typically borrow in the wholesale deposit market in their domestic currency. They would be able to swap the domestic currency borrowed in that way for dollars in the commercial swap market, and the cost of borrowing dollars indirectly by swapping domestic currency would not be significantly different from the cost of borrowing dollars directly in the eurodollar deposit market. So-called covered interest rate differentials, which measure the difference between the cost of borrowing dollars indirectly, by swapping borrowed foreign currencies into dollars, and the cost of borrowing dollars directly, were accordingly close to zero in normal market conditions.

As described in section 2 above, in the stressed conditions that prevailed during the credit crisis, covered interest rate differentials diverged substantially from their normal low levels under pressure from the strong demand from banks which could get access

only to domestic currency funding and needed to swap it into the foreign currencies in which the assets that they needed to finance were denominated.

Graph 6.1  
Covered interest differentials against the US dollar, 3-month maturity<sup>1</sup>



<sup>1</sup> In basis points.

Sources: Bloomberg; authors' calculations.

Graph 6.1 provides evidence of stressed FX swap market conditions. It shows covered interest differentials against US dollars at the 3-month maturity for five currencies – the euro, the pound sterling, the Swiss franc, the yen and the Australian dollar. In late September 2008, following the intensification of the financial crisis in the wake of the collapse of the investment bank Lehman Brothers on 15 September, the differentials became much more volatile and much larger in absolute value. At times, the cost of borrowing dollars by swapping borrowed Swiss francs and yen was lower than the cost of borrowing dollars directly, but the cost of borrowing dollars by swapping euros and pounds increased sharply in relation to the cost of borrowing dollars directly. Table 6.1 shows average covered interest differentials over the period after the Lehman failure.

Table 6.1

**Average covered interest differentials versus US dollar: 16/09/2008 – 02/01/ 2009<sup>1</sup>**

Using deposit rates					
Maturity	EUR	GBP	JPY	CHF	AUD
1 month	69	58	46	40	3
3 months	54	64	17	25	4
6 months	38	50	-5	11	6
12 months	20	33	-30	-3	-21
Using Libor rates					
Maturity	EUR	GBP	JPY	CHF	AUD
1 month	105	106	75	72	75
3 months	95	111	38	66	71
6 months	84	103	7	43	78
12 months	93	118	-2	43	75

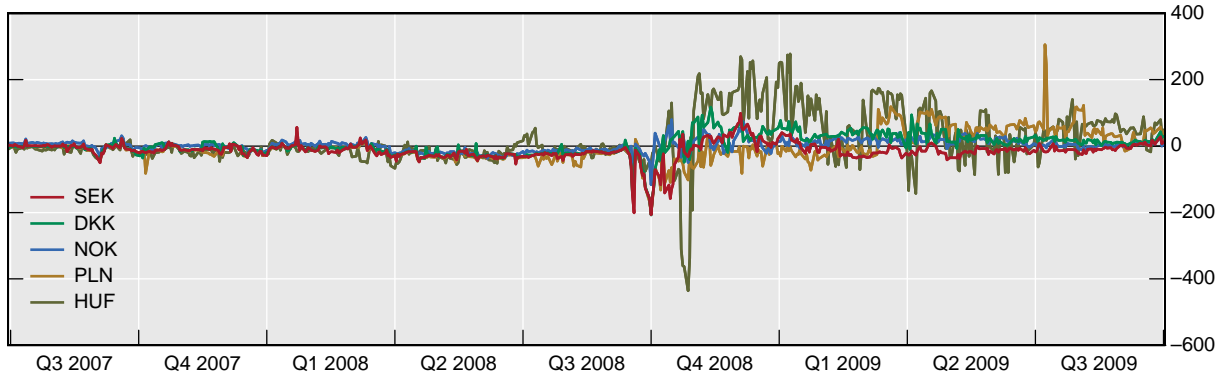
<sup>1</sup> In basis points.

Sources: Bloomberg, BIS calculations.

The evidence is consistent with the hypothesis that commercial banks needed to get access to dollars, and, at longer maturities, to yen and Swiss francs, presumably to repay debts, and that banks that were unable to borrow those currencies directly for reasons of perceived creditworthiness had to borrow other currencies such as euros and pounds, and swap them into the needed currency, thus putting pressure on covered interest differentials.

Curiously, the 3-month covered interest differentials of the currencies of Denmark, Norway and Sweden against the euro initially became negative – ie it was cheaper to borrow euros indirectly, by borrowing the domestic currency of any of the three domestic currencies and swapping them into euros, than to borrow euros directly (Graph 6.2). In fact the Swedish krona's covered interest differential against the euro remained persistently negative.

Graph 6.2

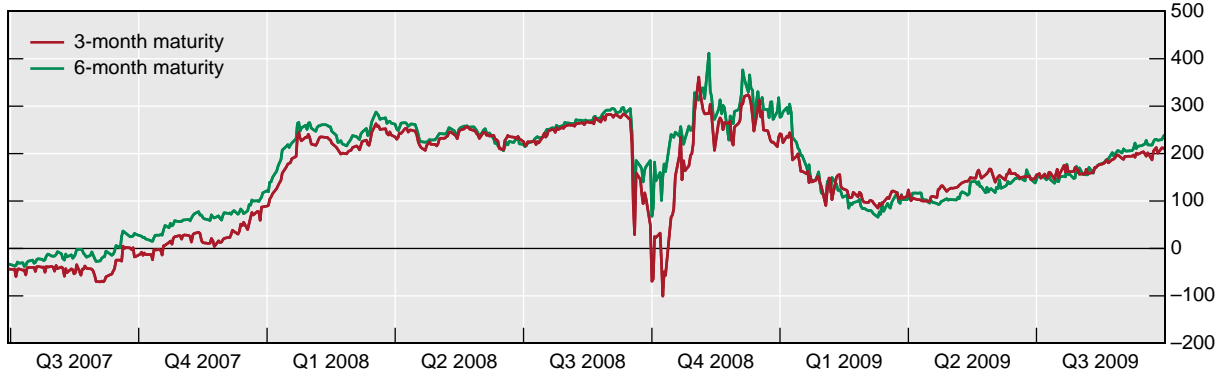
**Covered interest differentials against the euro, 3-month maturity<sup>1</sup>**

<sup>1</sup> In basis points.

Sources: Bloomberg, Datastream; authors' calculations.

In Asia, covered interest rate differentials of the Korean won against the yen turned positive, as Korean banks which were unable to get foreign currency funding turned to the swap market to convert won borrowing into foreign currencies (see Graph 6.3). The profile of Korean covered interest rate differentials against the dollar was very similar.

Graph 6.3

**KRW covered interest differential against the Japanese yen<sup>1</sup>**

<sup>1</sup> In basis points.

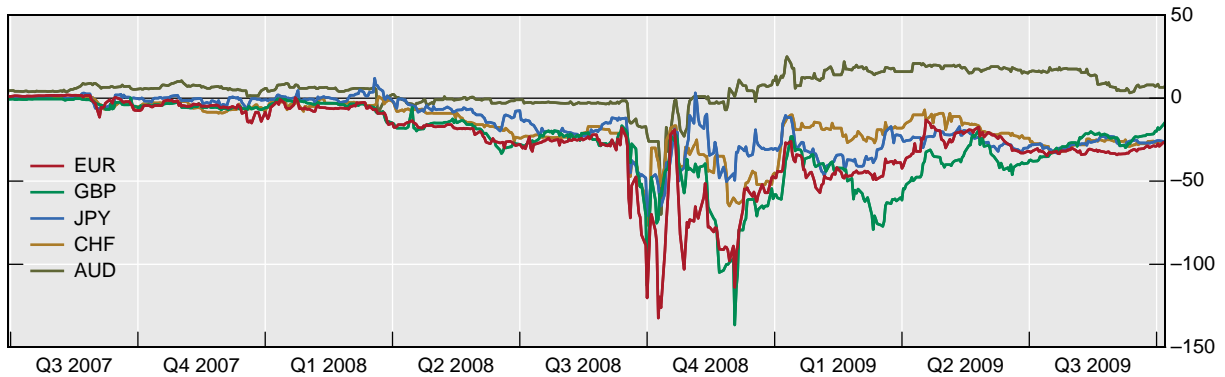
Sources: Bloomberg; authors' calculations.

## II. Cross-currency basis swap spreads

As described in section 2 above, the credit crisis led to market stresses which drove cross-currency basis swap spreads away from their normal very low levels. Chart 6.4 below shows cross-currency basis swap spreads of the euro, the pound sterling, the yen and the Swiss franc against the dollar. They show stresses developing in summer 2007, increasing in spring 2008 and becoming much more acute after the Lehman failure. This is consistent with the indications from covered interest differentials.



Graph 6.4

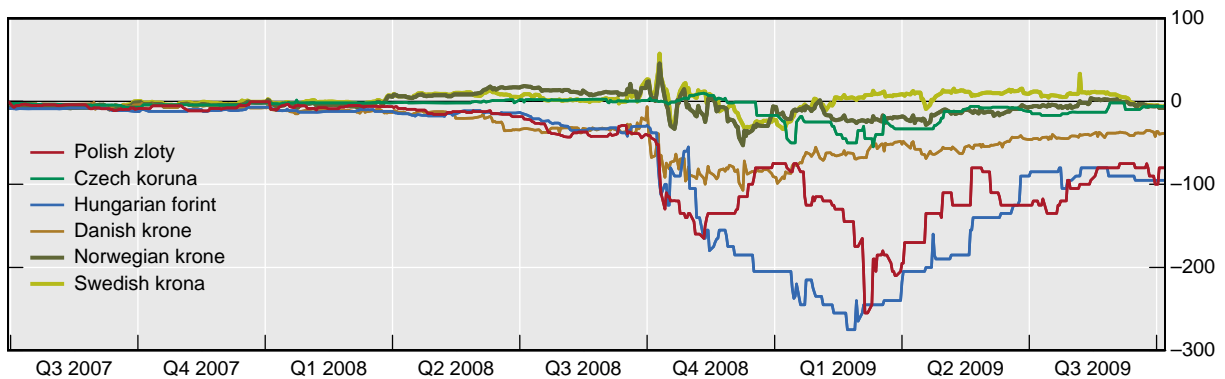
**Cross currency basis swap spreads against the US dollar, 1 year maturity<sup>1</sup>**

<sup>1</sup> In basis points.

Source: Bloomberg.

Cross-currency basis swap spreads against the euro of the currencies of some European economies outside the euro area widened in late 2008, in particular in Hungary and Poland, but also in Denmark, suggesting a shortage of euros in those economies (see Graph 6.5). Cross-currency basis swap spreads against the euro of the Czech koruna, the Swedish krona and the Norwegian krone also increased in late 2008, but much less strongly.

Graph 6.5

**Cross currency basis swap spreads against the euro, 1-year maturity<sup>1</sup>**

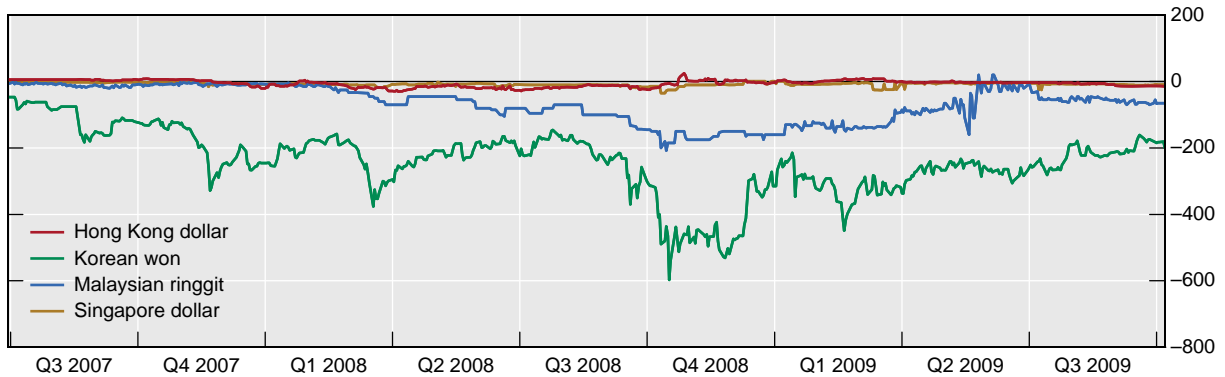
<sup>1</sup> In basis points.

Source: Bloomberg.

Cross-currency basis swap spreads of some Asian currencies against the US dollar increased in late 2008 (see Graph 6.6), in particular the Korean won, consistent with Korea having the largest US dollar shortage among Asian countries on the measure shown in Graph 5.3. By contrast, cross-currency basis swap spreads of the Hong Kong dollar and the Singapore dollar against the US dollar were little changed, consistent with those two countries having US dollar surpluses on the measure shown in Graph 5.3.

Graph 6.6

### Cross currency basis swap spreads against the US dollar, 1-year maturity<sup>1</sup>



<sup>1</sup> In basis points.

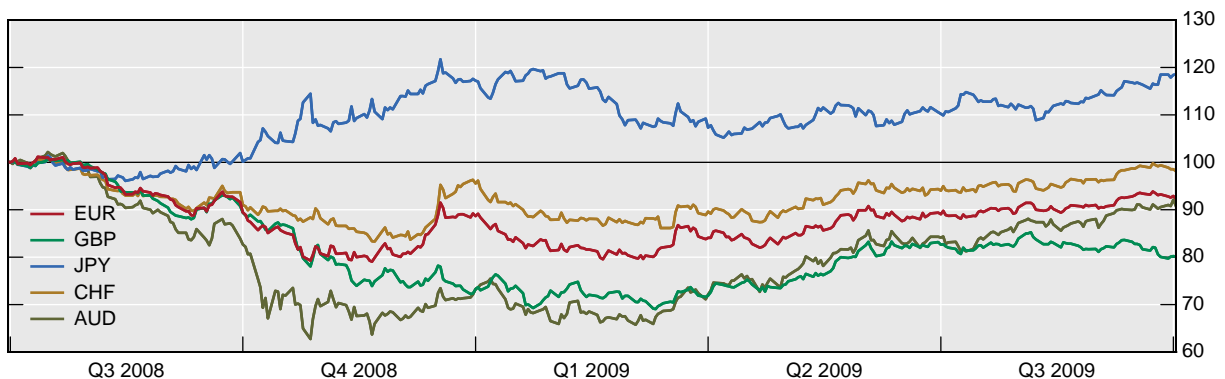
Source: Bloomberg.

### III. Spot exchange rates

As described in section 2 above, one of the symptoms of market stress in the period immediately after Lehman Brothers collapsed was sharp exchange rate movements as some market participants were forced to buy foreign currencies in order to repay debts. As Graph 6.7 shows, the dollar appreciated against the euro and the pound sterling after the Lehman failure. It was little changed against the Swiss franc, but the yen appreciated very sharply against even the dollar, suggesting that deleveraging pressures were particularly intense in yen.

Graph 6.7

### Exchange rates against the US dollar



<sup>1</sup> An increase represents an appreciation against the US dollar; 30 June 2008=100.

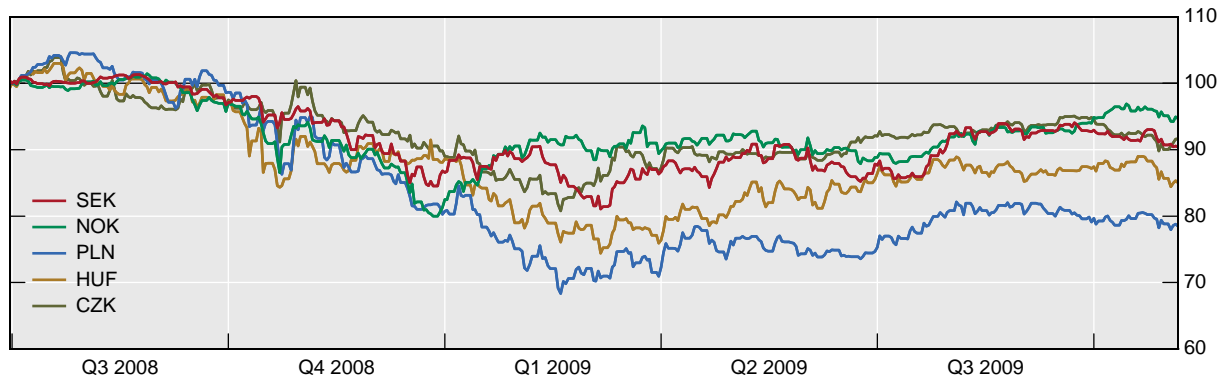
Sources: Bloomberg; authors' calculations.

Within Europe, the Hungarian forint and the Polish zloty depreciated sharply against the euro after the Lehmans collapse (see Graph 6.8). The Norwegian krone, the Swedish krona and the Czech koruna depreciated, too, though more modestly. The Swiss franc

appreciated moderately against the euro, and sharply against the forint and the zloty (see Graph 6.9).

Graph 6.8

### Exchange rates against the euro

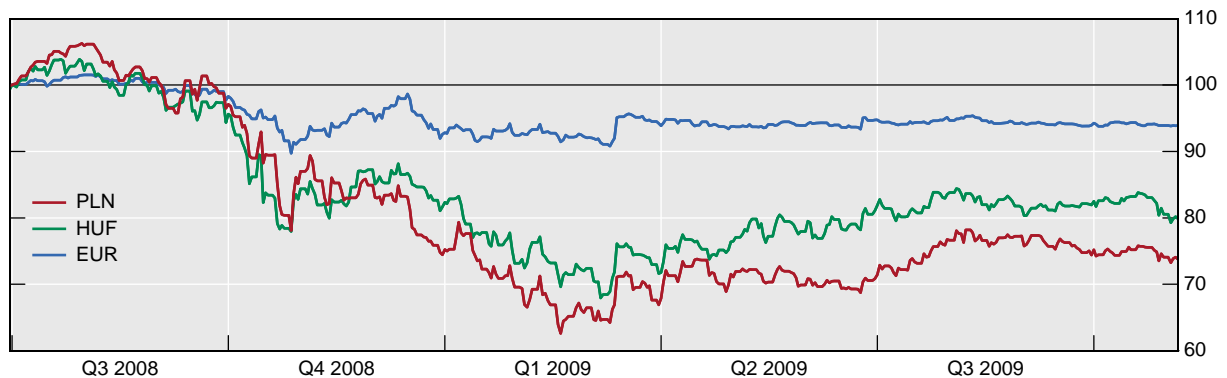


<sup>1</sup> An increase represents an appreciation against the euro; 30 June 2008=100.

Source: Bloomberg; authors' calculations.

Graph 6.9

### Exchange rates against the Swiss franc

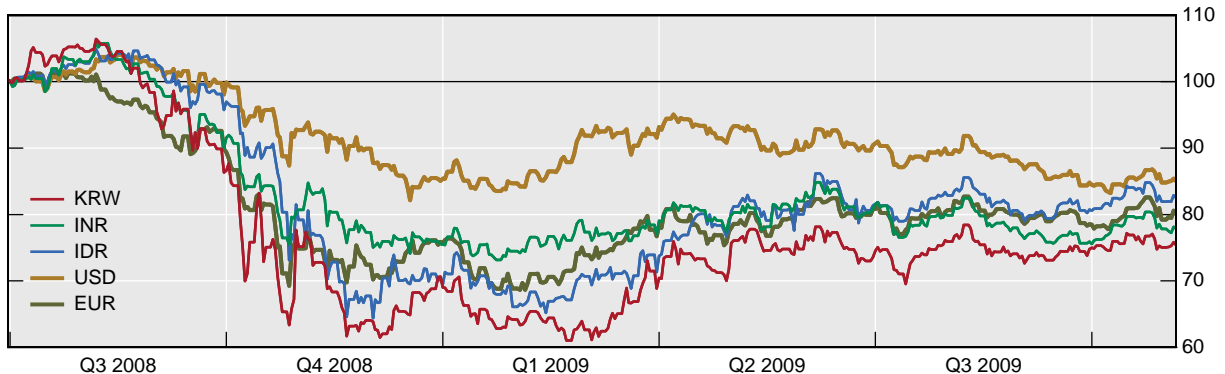


<sup>1</sup> An increase represents an appreciation against the Swiss franc; 30 June 2008=100.

Source: Bloomberg; authors' calculations.

In East Asia, the main exchange rate developments were that the Chinese yuan remained effectively pegged against the dollar as from late July 2008, the earlier gradual appreciation which had been in progress since July 2005 having been brought to an end; and that the yen appreciated very sharply indeed against a wide range of currencies (Graph 6.10).

Graph 6.10

**Exchange rates against the Japanese yen**

<sup>1</sup> An increase represents an appreciation against the yen; 30 June 2008=100.

Sources: Bloomberg; authors' calculations.

## 7. Central bank swap networks.

The central banks' response to currency-specific liquidity shortages was to set up swap facilities so that the home central bank of the currencies in short supply could provide those currencies to the commercial banks outside the home country that needed them. They did so indirectly, using as intermediaries the central banks of the commercial banks that were short of liquidity. In effect, they used foreign central banks to extend the geographical scope of their liquidity-providing operations<sup>23</sup>.

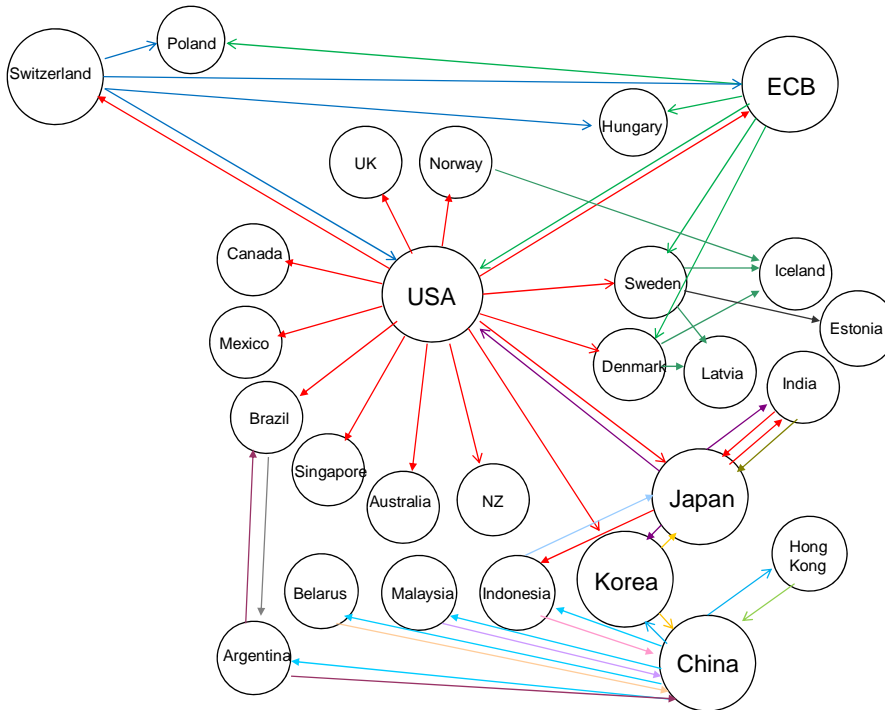
In total, four overlapping swap networks were established:

- I. The Fed network, set up to supply dollars (the Fed also set up swap facilities with certain foreign central banks under which it could obtain foreign currencies from them).
- II. The euro network, under which the ECB supplied euros. There were also what we regard as extensions to the euro network enabling Danmarks Nationalbank, the Norges Bank and the Sveriges Riksbank provided euros to other central banks.
- III. The Swiss franc network.
- IV. The Asian and Latin American network.

The entire network of swap facilities is illustrated in see Graph 7.1, and the swap lines set up are listed in Table A2 in Appendix 2.

<sup>23</sup> By doing so, they avoided the credit risk of lending directly to foreign commercial banks. That risk was taken by the intermediary central banks (see section 9 below).

Graph 7.1



### I. The Fed network

The Federal Reserve was the first in the field. It set up its first swap lines in December 2007, and the number and size of its swap lines increased steadily in the following months. In reporting the initial phase of the extension of swap facilities in December 2007, the Federal Reserve Bank of New York commented as follows:

*From mid-November to year-end, trading liquidity in the foreign exchange swaps market was severely impaired. The re-emergence of funding pressures in term dollar, euro, and pound sterling money markets caused by balance sheet constraints and typical year-end funding pressures made it difficult to identify the appropriate interest rates at which to price forward transactions. These factors were exacerbated by increased demand for dollar funding by offshore banks that are typically structurally short U.S. dollars and that use the foreign exchange swaps market to obtain such funding. As a result, trading volumes in the foreign exchange swaps market diminished considerably, trade sizes contracted, and bid-ask spreads on transactions became much wider than normal. Additionally, concerns about counterparty credit risk prompted some market makers to temporarily withdraw from the market. Credit tiering also became evident, with counterparties viewed as less creditworthy finding it more difficult and costly to enter into transactions than counterparties perceived to be more creditworthy.*

*Despite the impairment to the swaps market, spot foreign exchange market liquidity for major currencies was generally healthy during the quarter.<sup>24</sup>*

The swap network was part of a broader programme of facilities that the Fed established to provide liquidity to financial markets. Access to other Federal Reserve liquidity facilities is confined to banks and primary securities dealers in the United States<sup>25</sup>, so that banks outside the United States needing to raise dollars did not have access to them. The swap lines established by the Federal Reserve also had the aim of reducing US dollar funding market pressure in the United States, as the following statements make clear:

*“However, we did explicitly coordinate to address problems in dollar funding markets. The Federal Reserve entered into foreign exchange swaps with a number of other central banks to make dollar funding available to foreign banks in their own countries. By doing so, we reduced the pressure on dollar funding markets here at home.” (see Kohn 2009).*

*“During this period, foreign commercial banks were a source of heavy demand for U.S. dollar funding, thereby putting additional strain on global bank funding markets, including U.S. markets, and further squeezing credit availability in the United States. To address this problem, the Federal Reserve expanded the temporary swap lines that had been established earlier with the European Central Bank (ECB) and the Swiss National Bank, and established new temporary swap lines with seven other central banks in September and five more in late October, including four in emerging market economies” (see Bernanke 2009a).*

There is a relatively large Eurodollar market, ie a market for deposits denominated in US dollars outside the United States, and there is some evidence that Eurodollar interest rates could affect domestic US short-term interest rates (see Hartman 1984). This would be one channel through which US dollar funding problems of foreign banks could affect domestic US dollar funding markets.

The minutes of the conference call held by the Federal Open Market Committee on 6 December 2007, at which it was decided to establish the first of the swap lines, records that the swap proposal was ‘aimed at improving market functioning’. The extension of swap lines by the Federal Reserve took place in four main phases, as market liquidity deteriorated. The first swap lines were set up in December 2007, and they were

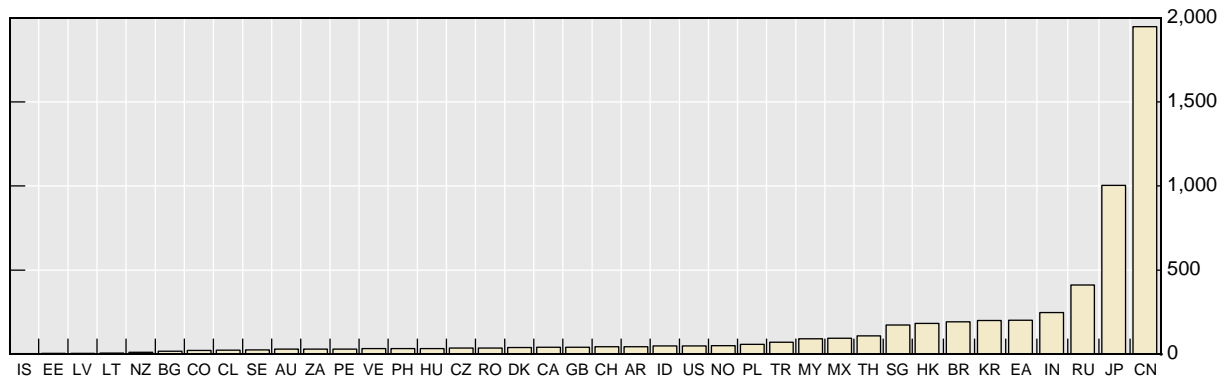
<sup>24</sup> See Federal Reserve Bank of New York, ‘Treasury and Federal Reserve Foreign Exchange Operations: October – December 2007’, <http://www.newyorkfed.org/newsevents/news/markets/2008/fxq407.pdf> .

<sup>25</sup> For information about access to the discount window, see The Federal Reserve System: Purposes and Functions, published by the Board of Governors of the Federal Reserve System, 2005, [http://www.federalreserve.gov/pf/pdf/pf\\_complete.pdf](http://www.federalreserve.gov/pf/pdf/pf_complete.pdf) . For information about access to the Term Auction Facility and the primary dealer credit facility, see <http://www.federalreserve.gov/newsevents/press/monetary/20071212a.htm> and <http://www.federalreserve.gov/newsevents/press/monetary/20080316a.htm> respectively.

extended, both in size and in geographical spread, in March 2008, May 2008, and September/October 2008. The last phase of extensions was by far the largest. It followed the failure of Lehman Brothers on 15<sup>th</sup> September. In response to the ensuing deterioration in market conditions, it was announced that foreign central banks (the ECB and the central banks of Japan, Switzerland and the U.K.) would auction term and forward dollar funding, in parallel with the Fed's domestic Term Auction Facility. To facilitate these auctions, the upper limits on the amounts of the Fed's swap lines with these central banks were removed entirely.

The four economies with the largest US dollar shortages according to the measure shown in Graph 5.3, namely the euro area, the United Kingdom, Canada and Brazil, all received swap lines from the Fed. Among the fifteen economies with the largest US dollar shortages according to the measure shown in Graph 5.3, all received US dollar swap lines from the Fed except for Russia, Turkey, India, Chile, Hungary and Iceland (see Graph 7.1). Of these countries, Russia had substantial foreign currency reserves (see Graph 7.2), India received a US dollar swap line from the Bank of Japan, and Hungary and Iceland received IMF stand-by arrangements.

Graph 7.2

**Foreign exchange reserves at end-2008<sup>1</sup>**

<sup>1</sup> In billions of US dollars.

Source: IMF.

In addition, Switzerland, Japan and Singapore received US dollar swap lines from the Fed, despite their US dollar surpluses on the measure shown in Graph 5.3. Mexico and Denmark, which had small US dollar surpluses on this measure, also received US dollar swap lines from the Fed.

In April 2009, the Fed announced that, as a precautionary measure, it had established swap lines to receive foreign currency from the ECB and the central banks of Switzerland, the U.K. and Japan, so that it would have the means to relieve shortages of

foreign currencies in the United States should they arise<sup>26</sup>. These swap lines were not used. All of the Fed swap lines expired on 1<sup>st</sup> February 2010<sup>27</sup>.

On 9<sup>th</sup> May 2010, amid the market stresses related to the crisis in Greek public finances, the Fed reestablished temporary swap lines with the Bank of Canada, the Bank of England, the ECB, and the Swiss National Bank. Due to liquidity pressures in international financial markets and their possible impact on liquidity in the Yen money market, the Fed swap line with the Bank of Japan was reestablished on 10<sup>th</sup> May 2010. These swap lines are due to expire in January 2011.<sup>28</sup>

## II. The Euro network

As noted above, the euro is less widely used than the US dollar to denominate foreign currency loans by banks outside its home territory. Moreover, its external use in trade in goods is concentrated in those parts of Europe outside the euro area (see Bertuch-Samuels and Ramlogan 2007). Evidence on the international role of the euro is provided in ECB (2008) and Bertuch-Samuels and Ramlogan (2007).<sup>29</sup> At the end of September 2006, euro-denominated reserves comprised one-fourth of total world holdings of official foreign exchange reserves for which the currency composition is known, while dollar-denominated foreign exchange reserves comprised almost two-thirds (Bertuch-Samuels and Ramlogan 2007); at the same time, the euro surpassed the dollar as the most important currency of issue for international bonds and notes - defined as foreign-currency issues and domestic-currency issues targeted at nonresidents (Bertuch-Samuels and Ramlogan 2007). In international banking, 39 percent of all loans and 28 percent of all deposits were denominated in euros at end-June 2006, compared with 41 percent and 48 percent, respectively, that were denominated in dollars (Bertuch-Samuels and Ramlogan 2007). In foreign exchange markets, the euro was the second most widely traded currency after the dollar in April 2007 (see BIS 2007).

Therefore financial trading in euros is probably largely concentrated in time zones close to those of the euro area, so that there is much less risk of stresses emerging in euro

<sup>26</sup> In each case, it already had in place a swap line under which it could supply dollars to the foreign central bank in question.

<sup>27</sup> See FOMC press release of 27<sup>th</sup> January 2010

<http://www.federalreserve.gov/newsevents/press/monetary/20100127a.htm> .

<sup>28</sup> The swap lines with the the Bank of England, the Bank of Japan, the ECB, and the Swiss National Bank allow tenders of US dollars at fixed rate for full allotment, while the swap line with the Bank of Canada allows drawings up to \$30 billion, as had been the case previously. See FOMC press releases of 9<sup>th</sup> May 2010 and of 10<sup>th</sup> May 2010, <http://www.federalreserve.gov/newsevents/press/monetary/20100509a.htm> and <http://www.federalreserve.gov/newsevents/press/monetary/20100510a.htm> , and Bank of Japan press release of 10<sup>th</sup> May 2010, <http://www.boj.or.jp/en/type/release/adhoc10/mok1005a.pdf> . The Fed explained the reopening of the swap lines with the Bank of Canada, the Bank of England, the ECB and the Swiss National Bank as being 'in response to the re-emergence of strains in U.S dollar funding markets in Europe'. The Bank of Japan explained that its swap line had been reopened 'in view of recent liquidity pressures in the international financial markets and the possible impact of those on liquidity in the Yen money market'.

<sup>29</sup> See also Galati and Wooldridge (2006) on the role of the euro as a reserve currency, and McGuire and Tarashev (2007) on its role in international banking.



money markets at a time when normal central bank liquidity facilities are not available than there is in the case of the dollar.

Nevertheless, euro-specific liquidity shortages developed in several European countries outside the euro area; the market symptoms were noted in section 5c above. The ECB set up facilities with the Danish, Hungarian, Polish and Swedish central banks to assist commercial banks in those countries in getting access to euro liquidity and thereby relieving localized shortages. In Hungary and Poland, commercial banks had made extensive domestic mortgage loans in foreign currencies, financing themselves in wholesale markets which became much less liquid as the credit crisis intensified<sup>30</sup>.

Among the seven economies with the largest euro shortages according to the measure shown in Graph 5.4, all received euro swap lines from the ECB except for Norway and Romania (see Graph 7.1)<sup>31</sup>. Norway had substantial foreign exchange reserves (see Graph 7.2 and discussion in section 12 below), but it nevertheless received a swap line from the Fed. Romania received an IMF stand-by arrangement.

In addition to the swap lines provided by the ECB, further swap lines were provided indirectly to a certain other European countries in an extended euro swap network (see Graph 7.1), via central banks in countries with which the ECB had established swap lines (Sweden and Denmark), as well as separately by Norway, which has no swap line with the ECB.

The Czech Republic, Lithuania, Bulgaria and Turkey also had euro shortages on the measure shown in Graph 5.4, but did not receive euro swap lines.

### III. The Swiss franc network

The euro area, Poland and Hungary were among the 4 economies with the largest Swiss franc shortages according to the measure shown in Graph 5.7, consistent with their receiving Swiss franc swap lines from the Swiss National Bank (see Graph 7.1). The United Kingdom also had a large Swiss franc shortage (see Graph 5.7), but did not receive a Swiss franc swap line. Under the SNB's swap lines with Hungary and Poland, Swiss francs were provided against euro collateral, not against the national currency of the counterparty central bank.

The SNB's purpose in providing these swap facilities was to enable foreign central banks to provide their commercial banks with Swiss franc liquidity and thereby satisfy the

<sup>30</sup> See for example the 2007 IMF Article 4 reports on Hungary and Poland (<http://www.imf.org/external/pubs/ft/scr/2007/cr07250.pdf> and <http://www.imf.org/external/pubs/ft/scr/2008/cr08130.pdf>). See also the NBP's Financial Stability Report, October 2008 ([http://www.nbp.pl/en/SystemFinansowy/Financial\\_Stability\\_October2008.pdf](http://www.nbp.pl/en/SystemFinansowy/Financial_Stability_October2008.pdf)).

<sup>31</sup> The swap facility under which the ECB could supply dollars to the Fed was however set up only in April 2009.

strong demand for Swiss francs<sup>32</sup>. The SNB implements its monetary policy by fixing a target range for the three-month Swiss franc LIBOR rate. The SNB reduced the upper bound of its target range from above 3% to 0.75% in the course of the financial crisis, and sought to bring down the LIBOR rate within this target range. However, the efforts of foreign banks to obtain the Swiss franc funding that they needed put upward pressure on the LIBOR rate. Easing the Swiss franc funding problems of foreign banks by providing swap lines was therefore expected to help bring down the SNB's policy rate within the target range, thereby aiding in achieving the SNB's monetary policy objectives. Regarding the extension of the EUR/CHF foreign exchange swaps with the ECB, National Bank of Poland and Magyar Nemzeti Bank on 25 June 2009, the SNB's stated in its Monetary Policy Report that "The aim of this measure is to further ease the situation on the short-term Swiss franc money market."<sup>33</sup> The provision of the swap facilities probably also partly reflected the SNB's concern about the appreciation of the Swiss franc, as well as its concern about conditions in credit markets. Indeed, on 12<sup>th</sup> March 2009, the SNB announced that it would act 'to prevent a further appreciation of the Swiss franc against the euro', including by purchasing foreign currency on the foreign exchange markets<sup>34</sup>. It therefore seems highly likely that the provision of Swiss franc swap facilities to the ECB and to the central banks of Hungary and Poland was partly motivated by the same concern.

#### IV. The Asian and Latin American network

Before the credit crisis began, there was already an extensive network of inter-central bank swap lines in East Asia, created since 2000 under the Chiang Mai initiative<sup>35</sup>. These facilities were set up after the Asian financial crisis of 1997-98 in order to enable East Asian central banks to provide mutual financial support in the event of a future crisis, and they are part of a larger programme of economic integration in East Asia, as Kawai (2007) describes. The provisions of the swap facilities are fairly conservative, in that only the first 20% of the committed amount is available in the absence of IMF conditionality. The remainder is provided in association with an IMF programme. To the authors' knowledge, no drawings were made under this network during 2007-09. The Chiang Mai network needed to be supplemented to address the pressures created by the credit crisis<sup>36</sup>.

During the crisis, the Bank of Japan established yen swap lines with the United States and Korea (see Graph 7.1), which were among the six economies with the largest yen shortages according to the measure shown in Graph 5.5. In addition, in June 2008, the

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<sup>32</sup> See Roth (2009).

<sup>33</sup> See SNB (2009b), p. 26.

<sup>34</sup> See [http://www.snb.ch/en/mmr/reference/pre\\_20090312/source](http://www.snb.ch/en/mmr/reference/pre_20090312/source).

<sup>35</sup> See Kawai (2007).

<sup>36</sup> In late 2009, the Chiang Mai network of bilateral facilities was multilateralised. Each member country was assigned a 'contribution amount' and a 'purchasing multiplier', and is able to draw US dollars up to the product of its contribution amount and purchasing multiplier. See for example <http://www.pbc.gov.cn/english/detail.asp?col=6400&id=1451>.

Bank of Japan, acting as agent for the Ministry of Finance established a US dollar swap line with India.

The People's Bank of China was active in establishing new swap lines during the crisis. It appears to have had two separate objectives; first, to help in dealing with financial stress, and second, to promote bilateral trade and investment in the partner countries' own currencies, with a view to establishing these currencies as international trading and investment vehicles in the longer term. It is reasonable to believe that the PBOC's pursuit of both these objectives was motivated by the financial crisis. The need for liquidity was obvious. And the desire to promote non-dollar currencies as trading and investment vehicles is consistent with the views on international monetary reform expressed by the Governor of the PBOC in a speech on 23<sup>rd</sup> March 2009<sup>37</sup>.

These objectives were set out in the English-language versions of the PBOC's announcements of the establishment of the various swap lines, as Table 7.1 shows.

Date	Counterparty	Short-term liquidity?	Bilateral trade?
12 Dec 2008	Bank of Korea	Yes	Yes
20 January 2009	Hong Kong Monetary Authority	Yes	Yes <sup>1</sup>
8 February 2009	Bank Negara Malaysia	No	Yes <sup>2</sup>
11 March 2009	National Bank of Belarus	No	Yes <sup>2</sup>
23 March 2009	Bank Indonesia	Yes	Yes <sup>3</sup>
2 April 2009	Central Bank of Argentina	No	No

<sup>1</sup> This will bolster investor confidence in Hong Kong's financial stability, promote regional financial stability and the development of yuan-denominated trade settlement between Hong Kong and the mainland.' <sup>2</sup> Announcement refers to 'bilateral trade and investment'. <sup>3</sup> Announcement refers to 'bilateral trade and direct investment.'

Sources: English-language versions on PBOC internet site.

The PBOC's second objective, of promoting bilateral trade in the trading partner countries' own currencies, with a view to establishing their own currencies as international trading vehicles, is by its nature a longer-term project, and this is reflected in the fact that the PBOC's swaps all have three-year terms, much longer than the terms of the swaps set up by other central banks purely to address market liquidity strains. Hong Kong SAR had substantial surpluses in the US dollar, euro, yen and pound sterling on the measure shown in Graphs 5.3 – 5.7, and so had no obvious need for swap lines for providing liquidity in these foreign currencies; Malaysia had small surpluses, and Indonesia small shortages (see Graph 1b in the appendix).

<sup>37</sup> See Zhou (2009).

Only few economies had shortages in the pound sterling according to the measure shown in Graph 5.6, while many economies were close to balance in the pound sterling or had surpluses. This is consistent with the absence of any swap lines in the pound sterling.

Graph 7.1 shows how the four central bank swap networks overlap.

## 8. Relationship between currency shortages and probability of receiving a swap line.

In this section we study the relationship between the level of a country's currency-specific shortages based on the BIS locational international banking statistics by residence of counterparty as shown in Graphs 5.3 to 5.7, and whether the country received a swap line in that currency. We do so by considering a probit regression model of the dependent variable,  $y_i^c$ , which equals 1 if the country received a swap line in the currency,  $c$ , under consideration and 0 otherwise, on the level of countries' currency-specific shortages<sup>38</sup>,  $s_i^c$ , as well as on a constant term. The sample of countries consists of those included in Graphs 5.3 to 5.7. We define the vector of explanatory variables as  $x_i^c = (1, s_i^c)$ . The probit model models the probability that a country  $i$  receives a swap line in currency  $c$ ,  $y_i^c = 1$ , as a function of the explanatory variables, in our case a constant term and the currency-specific shortage,  $s_i^c$ , according to

$$P(y_i^c = 1 | x_i^c) = \Phi(x_i^c \beta) \quad (1)$$

where  $\Phi(\cdot)$  is the standard normal cumulative distribution function, the vector of coefficients is  $\beta = (\beta_1, \beta_2)$ ,  $c$  denotes the currency considered, ie the US dollar, euro, yen or the Swiss franc, and  $s_i^c$  is the measure of the shortage in that currency (where a shortage is defined as positive in the regressions), in billions of US dollars or US dollar equivalent.<sup>39</sup> The estimated coefficients in the regression in equation (1) are shown in Table 8.1. We find that the probability of a country receiving a swap line in the euro, yen and the Swiss franc depends significantly on the measures of currency-specific shortage in the currency considered. The relationship is significant at the 1% level for the euro and Swiss franc, and at the 5% level for the yen. The coefficient  $\beta_2$  on the estimated currency-specific shortage is largest for the Swiss franc, followed by the euro and the yen. Consistent with this, the goodness-of-fit of the probit model, as measured by the McFadden  $R^2$  measure, is largest for the Swiss franc (at 0.44), followed by the euro (at 0.41) and the yen (at 0.19).

<sup>38</sup> A country's currency-specific shortage is defined as in Graphs 5.3-5.7 in section 5, but here we take shortages to have positive sign.

<sup>39</sup> We do not consider sterling since no swap lines were granted in that currency, with the single exception of the swap line provided by the Bank of England to the Fed in April 2009.

The marginal effect of the currency shortage on the probability of receiving a swap line in that currency is given by<sup>40</sup>

$$\partial\Phi(x_i^c; \beta)/\partial s_i^c = \phi(x_i^c; \beta) * \beta_2 \quad (2)$$

where  $\phi(\cdot)$  denotes the standard normal density function. This marginal effect depends on the value of the shortage. For the values of the shortages in our sample of countries, it ranges from close to zero to around 0.05 for the Swiss franc, to around 0.02 for the euro, and to around 0.01 for the yen.

	US dollar		Euro		Yen		Swiss franc	
	Eq. 1	Eq. 3	Eq. 1	Eq. 3	Eq. 1	Eq. 3	Eq. 1	Eq. 3
Constant, $\beta_1$	-0.25 (0.21)	-0.41 (0.34)	-1.87** (0.50)	-3.17** (0.95)	-1.73** (0.38)	-3.04** (0.80)	-1.85** (0.40)	-3.53** (0.99)
Currency-specific shortage, $\beta_2$	0.004 (0.003)	0.006 (0.005)	0.043** (0.014)	0.073** (0.025)	0.021* (0.01)	0.036* (0.018)	0.130** (0.048)	0.252** (0.097)
McFadden R <sup>2</sup>	0.04	0.04	0.41	0.39	0.19	0.18	0.44	0.46
Number of observations	39		39		39		39	

\*\* and \* denote significance at the 1% and 5% level, respectively; standard errors are given in brackets.

Next we estimate the probability that a country  $i$  receives a swap line in currency  $c$ ,  $y_i^c = 1$ , as a function of the explanatory variables, a constant term and the estimated currency-specific shortage,  $s_i^c$ , using the logit model, which is an alternative binary choice model to the probit model where the standard normal probability distribution function is replaced by a logistic probability distribution function,

$$P(y_i^c = 1 | x_i^c) = F(x_i^c; \beta) \quad (3)$$

Here,  $F(\cdot)$  is the standard logistic distribution function,  $F(w) = \exp(w)/(1 + \exp(w))$ .

In the logit model, the marginal effect of the estimated currency shortage on the probability of receiving a swap line in that currency is given by<sup>41</sup>

$$\partial F(x_i^c; \beta) / \partial s_i^c = \exp(x_i^c; \beta) / (1 + \exp(x_i^c; \beta))^2 * \beta_2 \quad (4)$$

<sup>40</sup> See Verbeek (2004).

<sup>41</sup> See Verbeek (2004).

This marginal effect again depends on the value of the shortage. For the values of the shortages in our sample of countries, it ranges from close to zero to around 0.06 for the Swiss franc, to around 0.02 for the euro, and to around 0.01 for the yen.

We find that the probit and logit models give similar results for the significance of the coefficients (see Table 8.1) and the magnitudes of the marginal effects of the currency shortages on the probability of receiving a swap line in that currency for the Swiss franc, euro and yen where the effect is significant.

By contrast, in the specifications reported in Table 8.1 the relationship between the currency-specific shortage and the probability of receiving a swap line is not significant for the US dollar. One possible explanation is related to differences in time zones. In countries with time zones remote from the United States, US financial markets are closed during part or all of the trading day. This is for example the case in the mornings in European countries. During times when US markets are closed, commercial banks with US dollar shortages in such time zones, for example in Europe, are likely to have tried to obtain US dollar funding in the markets of other large international financial centres outside the USA, such as Japan and Singapore. Thus US dollar shortages were likely to have been passed from one time zone to another. An international financial centre which initially had a dollar surplus might experience large inter-bank outflows which had the effect of turning the surplus into a shortage. Furthermore, commercial banks in such countries may be less likely to have affiliates in the United States from which they could obtain US dollar liquidity, and would therefore be more likely to look for US dollar funding outside the USA. Consequently, given the international role of the US dollar, the Federal Reserve may have supplied US dollar funding via swap lines to large international financial centres, so as to ensure that the latter could distribute US dollar liquidity on to commercial banks in time zones remote from the US while US markets were closed.

To test this hypothesis, we add a dummy variable,  $d_i^{lfc}$ , in the probit regression for the probability of the country receiving a US dollar swap line from any country, which equals one if an economy is a large international financial centre (ie Australia, the euro area, Hong Kong, Japan, Singapore, Switzerland, and the United Kingdom), and zero otherwise. The vector of explanatory variables in the probit regression of equation (1) is now defined as  $x_i^c = x_i^s = (1, s_i^s, d_i^{lfc})$ , and the vector of coefficients is  $\beta = (\beta_1, \beta_2, \beta_3)$ . The results are shown in the middle column of Table 8.2. We can see that the coefficient on the dummy variable for an economy being a large international financial centre is statistically significant at the 1% level, consistent with our hypothesis. Moreover, when controlling for whether a country is a large international financial centre, our measure of the US dollar shortage becomes statistically significant at the 5% level in the probit regression. For the values of the US dollar shortages in our sample of countries, the marginal effect of the estimated US dollar shortage on the probability of receiving a US dollar swap line ranges from close to zero to around 0.01, similar to what we found for the yen above. These results suggest that economies with larger US dollar shortages on

our measure, and economies that are large international financial centres, had a statistically significantly higher probability of receiving a US dollar swap line.

Next, we repeat this exercise in the probit regression for the probability of the country receiving a US dollar swap line from the Federal Reserve, rather than from any country.<sup>42</sup> The dependent variable in the probit regression is now the probability that a country  $i$  receives a US dollar swap line from the Federal Reserve,  $y^{\text{Fed}}_i=1$ , and the explanatory variables are again  $x^{\$}_i=(1, s^{\$}_i, d_i^{\text{IFC}})$ , with the vector of coefficients being  $\beta=(\beta_1,\beta_2,\beta_3)$ ,

$$P(y^{\text{Fed}}_i=1 | x^{\$}_i) = \Phi(x^{\$}_i \beta) \quad (5)$$

The results are reported in Table 8.2 (right-hand column).

	From any country	From the Federal Reserve (Equation 5)
Constant, $\beta_1$	-0.73** (0.27)	-0.96** (0.30)
US dollar shortage, $\beta_2$	0.026* (0.010)	0.026* (0.011)
Dummy for large int. financial centre, $\beta_3$	4.94** (1.87)	5.24** (1.93)
McFadden $R^2$	0.31	0.35
Number of observations	39	39
** and * denote significance at the 1% and 5% level, respectively; standard errors are given in brackets.		

For swap lines provided by the Fed we also find that the coefficients on both the US dollar shortage and the dummy for a country being a large international financial centre are statistically significant. These results suggest that countries with larger US dollar shortages on our measure, and countries that are large international financial centres, had a statistically significantly higher probability of receiving a US dollar swap line from the Federal Reserve.

Finally, we add a variable for the difference in time zones between each country and New York,  $tz_i$  (in hours), in the probit regressions for the probability of the country receiving a US dollar swap line from any country. The vector of explanatory variables in the probit regression of equation (1) is now defined as  $x^c_i = x^{\$}_i = (1, s^{\$}_i, d_i^{\text{IFC}}, tz_i)$ , and the vector of coefficients is  $\beta=(\beta_1,\beta_2,\beta_3,\beta_4)$ . The results are reported in Table 8.3 (middle column). We find that the estimated coefficient on the difference in time zones is not

<sup>42</sup> India and Indonesia received a swap line from the Bank of Japan, but not from the Fed. All the other countries receiving US dollar swap lines did so from the Fed.

statistically significant in the regression. Next, we run the analogous regression for the probability of a country receiving a US dollar swap line from the Fed. The vector of explanatory variables in the probit regression of equation (5) is now defined as  $x_i^{\$} = (1, s_i^{\$}, d_i^{\text{ifc}}, tz_i)$ , and the vector of coefficients is  $\beta = (\beta_1, \beta_2, \beta_3, \beta_4)$ . A similar result holds in this case (see Table 8.3, right-hand column). This regression is also consistent with the Federal Reserve having a statistically significantly higher probability of providing swap lines to economies with larger US dollar shortages on our measure and to large international financial centres.<sup>43,44</sup>

	From any country	From the Federal Reserve
Constant, $\beta_1$	-0.61 (0.50)	-0.40 (0.51)
US dollar shortage, $\beta_2$	0.026* (0.011)	0.027* (0.011)
Dummy for large int. financial centre, $\beta_3$	4.99** (1.89)	5.74** (2.09)
Time zone difference to New York, $\beta_4$	-0.02 (0.07)	-0.10 (0.08)
McFadden $R^2$	0.31	0.39
Number of observations	39	39

\*\* and \* denote significance at the 1% and 5% level, respectively; standard errors are given in brackets.

Next, we study whether the actual amounts drawn on swap lines provided by the Federal Reserve at end-2008,  $\text{draw}_i^{\$}$  (in US dollar billions), depend significantly on our measure of a country's US dollar shortage,  $s_i^{\$}$  (in US dollar billions), for the sample of countries which received a swap line from the Federal Reserve. Data on drawings on Fed swap lines at end-2008 are shown in Table 11.2.

We estimate the following regression via OLS (with White heteroskedasticity-consistent standard errors),

$$\text{draw}_i^{\$} = \beta_1 + \beta_2 * s_i^{\$} + \beta_3 * d_i^{\text{ifc}} + \varepsilon_i \quad (6)$$

as well as the regression also including a variable for the difference in time zones,  $tz_i$ ,

<sup>43</sup> In studying the provision of swap lines by the Federal Reserve to emerging economies, Aizenman and Pasricha (2009) find that the exposure of US banks to emerging economies is significant in explaining the probability of an emerging economy receiving a Fed swap line.

<sup>44</sup> Yehoue (2009) finds that 'countries with bigger economies and depreciating currencies are more likely to seek cross-country FX swap facilities'. These conclusions are not inconsistent with our analysis, since bigger economies are, other things being equal, more likely to have larger currency-specific liquidity shortages than smaller ones; and depreciating currencies are one of the indicators of market stress that we identified in section 2.



$$\text{draw}_i^{\$} = \beta_1 + \beta_2 * s_i^{\$} + \beta_3 * d_i^{\text{ifc}} + \beta_4 * tz_i + \varepsilon_i \quad (7)$$

and a specification including the dummy variable for large international financial centres interacted with the difference in time zones,

$$\text{draw}_i^{\$} = \beta_1 + \beta_2 * s_i^{\$} + \beta_5 * d_i^{\text{ifc}} * tz_i + \varepsilon_i \quad (8)$$

Results of these regressions are shown in Table 8.4.

	Equation (6)	Equation (7)	Equation (8)
Constant, $\beta_1$	-2.53 (6.96)	-16.7 (15.8)	-2.20 (8.63)
US dollar shortage, $\beta_2$	0.36 <sup>+</sup> (0.17)	0.39* (0.17)	0.42* (0.18)
Dummy for large int. financial centre, $\beta_3$	69.6* (31.5)	59.0 (34.9)	-
Time zone difference to New York, $\beta_4$	-	2.85 (3.12)	-
Dummy for large int. financial centre * time zone difference, $\beta_5$	-	-	7.73 <sup>+</sup> (3.55)
Adjusted R <sup>2</sup>	0.56	0.53	0.55
Number of observations	14	14	14
**, * and <sup>+</sup> denote significance at the 1%, 5% and 10% levels, respectively; standard errors are given in brackets; White heteroskedasticity-consistent standard errors.			

We can see that the coefficient on the US dollar shortage is significant at the 5% level in two of the specifications, and at the 10% level in the remaining one. The dummy variable for large international financial centres is significant at the 5% level in the first specification, and the dummy variable for large international financial centres interacted with the variable for the difference in time zones is significant at the 10% level in the third specification. Goodness of fit of these regressions, as measured by the adjusted R<sup>2</sup>, are around 0.55. These results suggest that actual US dollar funding obtained by drawing on the Fed's swap lines at end-2008 was statistically significantly larger for countries with higher US dollar shortages on our measure, as well as for economies which are large international financial centres.

## 9. Risks to liquidity providers.

As noted above, swap arrangements were used during the credit crisis as a means of providing currency-specific liquidity to banks outside the home territory of the currency concerned, thus, in effect, widening the geographical reach of national open-market operations. The central banks which provided liquidity through swaps avoided the credit risk involved in lending to commercial banks by lending to the central banks in which they were located<sup>45</sup>; the latter central banks took the credit risk of lending to commercial banks in their territories. The central banks which provided liquidity in effect took sovereign credit risk by lending to other central banks.

The risk was mitigated by the fact that they took deposits, normally in the counterparty central bank's currency, as collateral, but it was not entirely eliminated. For example, the counterparty central bank might not be able to return the currency that it has drawn when the swap arrangement expires. In that case, the central bank that provided the currency would have to try to liquidate its collateral, which is normally in the form of the borrowing country's currency. However, the currency might have depreciated in the foreign exchange market<sup>46</sup>, and, even if the amount of collateral had been adjusted to take account of any exchange rate depreciation, it might be very difficult to sell a large amount of the currency in a short time in a possibly-illiquid market.

Central banks must take account of this risk in deciding whether to extend swap facilities. One way of dealing with the risk is to extend a swap line, but against another major currency rather than the domestic currency of the recipient country. For example, when the Swiss National Bank lent Swiss francs to the central banks of Hungary and Poland, the swaps were against euros, rather than forints and zlotys. Another way is to take high-quality assets denominated in the currency of the liquidity provider as collateral. Thus the ECB's facilities for Hungary and Poland simply enabled the central banks of those two countries to repo high-quality euro-denominated assets in their reserves in exchange for euro cash (so that the facilities were not swap lines, strictly speaking).

In some cases, the unavailability of foreign currency liquidity was not confined to particular banks but extended to the country as a whole, including its government. This might reflect market doubts about the sustainability of the country's macro-economic policies. In those cases, swaps could in principle be used to provide foreign currency liquidity to governments that were no longer able to obtain it in financial markets. If such market doubts were warranted, then it would normally be thought undesirable to provide swap lines, since their probable effect would be to delay necessary macro-economic adjustment. Moreover, the risks to central banks providing swap lines might be judged unacceptable. In such cases, swap lines would normally be extended only after the

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<sup>45</sup> See Bernanke (2009b)

<sup>46</sup> The Fed avoids this risk by denominating the loan repayment and interest in dollars. See Bernanke (2009b).

country concerned had reached a financing agreement with the IMF involving macro-economic policy adjustments, or at least when it was clear that such an agreement would be reached.

Iceland is a case in point. It had serious problems in its banking system, which was extremely large in relation to the Icelandic economy. Icelandic commercial banks had severe liquidity difficulties and, in order to try to help resolve them, the Central Bank of Iceland tried to arrange swap facilities with a number of other central banks. It was able to agree (on 16<sup>th</sup> May 2008) swap facilities with the central banks of Denmark, Norway and Sweden totalling EUR 1,500 million<sup>47</sup>. However, as it relates in a remarkable statement, it had no further success<sup>48</sup>. The statement makes it clear that the potential counterparty central banks were concerned about the risk they would be taking in entering a swap agreement with Iceland, and specifically about the large size of the Icelandic banking system. Later, Iceland obtained emergency financing from the IMF, and, having done so, it was able to extend the swap facilities it had received earlier.

As another example, the Bank of Latvia concluded on 16<sup>th</sup> December 2008 an agreement with the central banks of Sweden and Denmark under which it could draw up to EUR 500 million in total, as bridging loans to an expected IMF programme<sup>49</sup>.

Bridging loans to IMF programmes carry the risk that the IMF programme may not be agreed and the supporting funds may not be disbursed as had been expected at the time when the loan was made. In that case, the bridge could be a 'bridge to nowhere'. However, the countries which extend the loan presumably have good information about the progress of the loan negotiations, partly because they are themselves members of the IMF. Moreover they can feel confident that the IMF will make an adequate amount of money available on *some* terms, and can assess the likelihood that the government of the distressed country will reach an agreement with the IMF.

A separate risk for central banks providing liquidity in their own currency to foreign central banks is governance. The Federal Open Market Committee discussed this and the other risks involved at its meeting on 28 – 29 October 2008 when considering the proposal to set up swap arrangements with Mexico, Brazil, Korea and Singapore. The minutes report that:

*In their remarks, participants focused on the outlook for complementarity between these swaps and the new short-term liquidity facility that the International Monetary Fund was considering; on the governance and structure of the swap lines; and on the particular countries included. Several participants*

<sup>47</sup> See <http://www.sedlabanki.is/?PageID=287&NewsID=1766> .

<sup>48</sup> See <http://www.sedlabanki.is/?PageID=287&NewsID=1890> .

<sup>49</sup> See <http://www.bank.lv/eng/main/press/sapinfo/lbpdip/1612/> . The President of the ECB however made a statement in support of Latvia when he said "I have full confidence the government of Latvia will take the appropriate decisions needed on a domestic basis without any change in the currency." (Financial Times, 5 June 2009). Mr Trichet's choice of words makes it clear that he thought that macro-economic adjustment was needed.

*pointed to the international reserves held by the countries and the importance of ensuring that these temporary swap lines, like the others that had been established during the period, be used only for the purposes intended. On balance, the Committee concluded that in current circumstances the swap arrangements with these four large and systemically important economies were appropriate...*<sup>50</sup>

This discussion suggests that, in view of the risks, the Fed preferred to provide swap lines only in cases where other sources of financing were not available or not thought to be adequate, and to countries that are large and systemically important. One member of the FOMC (William Poole) dissented from the decision to establish the initial swap lines (and later decisions to extend the network) on the grounds that he viewed the swap agreement as unnecessary in the light of the size of the dollar-denominated foreign exchange reserves of the recipient central bank<sup>51</sup>.

It should not be imagined that countries which did not get a swap line from the Fed were *ipso facto* deemed to be too risky, or to be too small or systemically unimportant. The minutes of the FOMC meeting held on 16 September 2008 record that:

*The Committee considered a proposal intended to provide the flexibility necessary to respond promptly to requests from foreign central banks to engage in temporary reciprocal currency (“swap”) arrangements to be used in supporting dollar liquidity in their jurisdictions.*<sup>52</sup>

This makes it clear that the Fed made decisions about which countries should receive swap lines by responding to requests. It is reasonable to think that there were countries to which the Fed would have been quite willing to provide a swap line, but which did not ask for one.

Central banks need to be concerned about political as well as economic risks. Measures such as swap facilities, which appear on the surface to benefit only foreigners, are vulnerable to criticism from politicians, especially in hard economic times. The Fed has legal authority under the Federal Reserve Act to enter into swap agreements with foreign central banks. Nevertheless Chairman Bernanke was questioned aggressively in the U.S. House of Representatives by Congressman Grayson of Florida in July 2009 about why the Fed had provided the \$550 billion it had lent through swap lines to foreigners and not to Americans<sup>53</sup>.

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<sup>50</sup> See Federal Open Market Committee (2008b).

<sup>51</sup> Federal Open Market Committee (2007).

<sup>52</sup> See Federal Open Market Committee (2008a).

<sup>53</sup> See <http://www.youtube.com/watch?v=00ECLxK2YTs> .

## 10. Objectives of liquidity takers.

The countries which accepted swap lines providing foreign currency were concerned above all to maintain the stability of their banking systems, and in particular to ensure that commercial banks had the means to repay foreign currency liabilities as they fell due.

It is possible that some of them could have achieved this objective without the use of swap lines. For example, they could have provided the necessary liquidity to commercial banks in their domestic currency. However, as noted in section 2 above, the commercial banks would have been required to swap massive amounts of domestic currency into foreign currency to repay depositors who did not wish to roll over foreign currency deposits, and already-stressed swap markets in many currencies would have been unable to handle the necessary volume of transactions. And, in conditions of ample domestic-currency liquidity, sales of the domestic currency might have led to large depreciations and loss of welfare to the citizens of the country concerned.

Alternatively, they could have used their own foreign exchange reserves to provide the needed foreign currency liquidity. However, the reserves might not have been held in the particular currencies that were needed, and selling other currencies (or swapping them) to raise the needed currencies would have aggravated foreign exchange market stresses, as well as draining domestic currency liquidity from the banking system. In some cases, the reserves might have been invested in temporarily-illiquid assets, even if the assets were denominated in the needed currency. Moreover, in countries whose reserves were only modest in size relative to the liquidity need, and in the febrile atmosphere that prevailed at the time, the use of a large percentage of the reserves to provide liquidity support to commercial banks could have undermined confidence in the currency and led to a disproportionate depreciation of the exchange rate. In countries which used a pegged exchange rate as their monetary policy anchor, a large percentage fall in the reserves occurring in this way could have seriously undermined the credibility of monetary policy. Finally, in some countries, the purposes to which the reserves can be put are constrained by statute, and the permissible purposes might not include providing liquidity support to commercial banks.

Augmenting the reserves by means of foreign currency borrowing would have been expensive, if not impossible, for many countries in the circumstances of the time. A further alternative, for countries in which the majority of banks are foreign owned, was to do nothing, leaving it to the parent companies of the banks to solve their liquidity problems. A variant of doing nothing was to provide limited and expensive foreign currency liquidity facilities intended for use by domestically-owned banks only.

Most countries had powerful reasons to accept swap facilities if they were available, both to enable them to provide foreign currency liquidity without using their own reserves, and no doubt because the signal of international support that the swap lines conveyed was extremely valuable amid the prevailing economic and financial uncertainty.

## 11. Effects of swaps on liquidity providers<sup>54</sup>.

### I. The United States

The establishment of swap lines with the Fed might have been expected to ease pressures in FX swap markets involving the dollar. Some evidence is shown in Table 11.1.

Table 11.1

#### **Announcements of swap lines and covered interest differentials against US dollar<sup>1</sup>**

Using deposit rates:				
<i>Average differential during:</i>	<i>EUR</i>	<i>GBP</i>	<i>JPY</i>	<i>CHF</i>
5 days after 1/1/2007	3	1	0	1
5 days before 12/12/2007	17	19	15	7
5 days after 12/12/2007	32	20	23	7
15 – 17/09/2008	63	4	58	81
19 – 26/09/2008	26	3	3	22
30/09– 10/10/2008	54	57	63	-7
5 days after 13/10/2008	4	10	6	-5
5 days before 1/10/2009	0	-7	-3	4
Using Libor rates:				
<i>Average differential during:</i>	<i>EUR</i>	<i>GBP</i>	<i>JPY</i>	<i>CHF</i>
5 days after 1/1/2007	-1	0	-1	0
5 days before 12/12/2007	12	16	5	10
5 days after 12/12/2007	30	22	22	14
15 – 17/09/2008	87	29	80	109
19 – 26/09/2008	127	102	102	126
30/09– 10/10/2008	159	170	131	101
5 days after 13/10/2008	32	35	6	-24
5 days before 1/10/2009	38	19	31	30

<sup>1</sup> 3-month maturity, in basis points.

Sources: Bloomberg, authors' calculations.

<sup>54</sup> We are extremely grateful to Bilyana Bogdanova for her help in finding sources of data for this section and section 12, and in interpreting the data.

As regards the establishment of swap lines in December 2007, it suggests that they had no perceptible effect on covered interest differentials. As regards the progressive extension of swap lines in the second half of September 2008 – immediately after the failure of Lehmans on 15 September - the evidence suggests that it did not have a clear-cut constructive effect, and that any effect it may have had was overwhelmed by other pressures. However, the establishment of the unlimited swap lines on 13 October 2008 did finally appear to lead to a substantial narrowing in the covered interest differentials of some major currencies against the dollar (see Table 11.1), consistent with the results of Baba and Packer (2009).

Broadly speaking, the Fed repeatedly increased the size of its swap lines as the crisis intensified. It reacted very quickly as the crisis developed. For example, on 18 September 2008, in the week Lehman Brothers failed, it increased the total amount available on swap lines from \$67 billion to \$247 billion. The following week it added another \$43 billion (in two stages on 24 and 26 September), taking the total to \$290 billion. Then on 29 September, the total was more than doubled to \$620 billion. The final increase, on 13 and 14 October, removed any limits from the swap lines with the ECB and the central banks of the UK, Switzerland and Japan.

The Fed has published copious information about the use of the swap network. In particular, the Federal Reserve Bank of New York has published statistics of drawings on the swap lines that the Fed established. The end-quarter data are shown in table 11.2 below.

Table 11.2  
**Drawings of US dollars on Fed swap lines (\$ millions, end-quarters)**

End of	2007Q4	2008Q1	2008Q2	2008Q3	2008Q4	2009Q1	2009Q2	2009Q3
Canada								
ECB	20,000	15,000	50,000	174,742	291,352	165,717	59,899	43,662
Switzerland	4,000	6,000	12,000	28,900	25,175	7,318	369	0
Japan				29,622	122,716	61,025	17,923	1,530
UK				39,999	33,080	14,963	2,503	13
Denmark				5,000	15,000	5,270	3,930	580
Australia				10,000	22,830	9,575	240	0
Sweden					25,000	23,000	11,500	2,700
Norway					8,225	7,050	5,000	1,000
New Zealand								
Korea					10,350	16,000	10,000	4,050
Brazil								
Mexico							3,221	3,221
Singapore								
<b>TOTAL</b>	<b>24,000</b>	<b>21,000</b>	<b>62,000</b>	<b>288,263</b>	<b>553,728</b>	<b>309,918</b>	<b>114,585</b>	<b>56,576</b>

Source: Federal Reserve Bank of New York, 'Treasury and Federal Reserve Foreign Exchange Operations', various releases.

The total amount drawn rose during 2008 as the crisis intensified, especially after the Lehmans failure. The amount of drawings outstanding increased dramatically in the

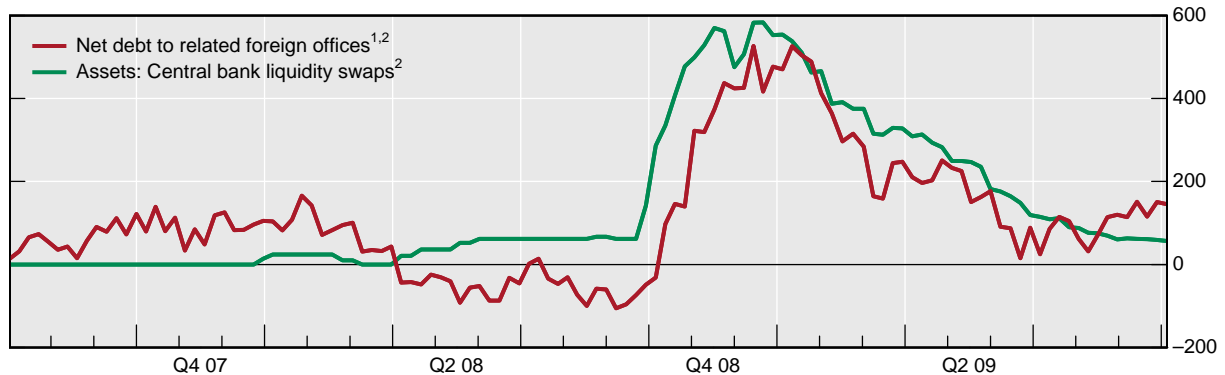
fourth quarter of 2008, and at the end of the year, total drawings were \$553.7 billion<sup>55</sup>. This was more than half of the total of BIS reporting banks' local claims on non-banks denominated in US dollars (see table 5.1 above), which is a striking measure of the severity of the crisis.

Much of the sudden demand for dollar funding in international markets immediately after Lehman's failure appears to have resulted from the drawing of dollar funds by commercial banks in the USA from their related foreign offices.<sup>56</sup> Graph 11.1 shows a close correspondence in the weekly data between US commercial banks' net debt to related foreign offices and the total amount outstanding on Fed swaps to foreign central banks. The main counterpart to the increase in US commercial banks' net debt to related foreign offices was a massive increase in cash assets.<sup>57</sup> In fact, most of the drawing-in of funds was done by foreign-related institutions in the USA, rather than domestically-chartered banks. Foreign-related institutions' ratio of cash assets to total assets increased from 4.2% on 3rd September 2008 to 19.1% on 31st December. This was a much bigger increase than for domestically-chartered banks, or for foreign banks in other jurisdictions such as Switzerland. The reasons why it took place are beyond the scope of this paper.

Graph 11.1

**US commercial banks' net debt to related foreign offices and Fed swaps outstanding**

In billions of US dollars



<sup>1</sup> All commercial banks; not seasonally-adjusted. <sup>2</sup> Wednesday level.

Sources: Federal Reserve tables H8 and H4.1.

The availability of the swap lines evidently helped to stabilise financial markets and the amount outstanding fell quite quickly during 2009. By October 2009, the share of FX

<sup>55</sup> The Fed reports the total amount outstanding as at Wednesday of each week. The peak total reported was \$583.1 billion on 17<sup>th</sup> December 2008.

<sup>56</sup> Possible reasons for this drawing-in of funds include that commercial banks in the United States (both domestically-chartered banks and foreign-related institutions) had to finance big increases in assets, as contingent commitments to provide funds crystallized (to be discussed in a future paper), and the fact that US money market funds withdrew dollar funding from non-US banks (see Baba et al. (2009)).

<sup>57</sup> For further discussion of banking and other US cross-border financial flows during the crisis, see Bertaut and Pounder (2009)



swaps in total assets of the Federal Reserve had fallen back to below 2%, from over 25% in late 2008 (see Graph 2 in the Appendix 1). Meanwhile, the appreciation of the dollar began to reverse from early March 2009, and other indicators of market stress eased. Accordingly, the swap lines, taken together with the other measures that were implemented, can be said to have achieved the objectives of the Federal Reserve.

## II. The euro area.

Because the external use of the euro takes place largely in time zones close to the euro area, and because many of the commercial banks involved have affiliates in the euro area and thus have access to euro-denominated liquidity provided by the ECB, the ECB's objectives in providing swap lines to neighbouring central banks were presumably mainly to help those countries avoid the economic disruption that an unrelieved liquidity shortage might have caused.

Table 11.3  
Selected items from Eurosystem balance sheet (EUR billions)

<b>Last Friday of</b>	<b>External foreign currency assets</b>	<b>Monthly changes</b>	<b>Domestic foreign currency assets</b>	<b>Monthly changes</b>	<b>External euro liabilities</b>	<b>Monthly changes</b>
Nov-07	142.16		25.17		28.75	
Dec-07	135.17	-6.99	41.91	16.74	45.09	16.34
Jan-08	140.03	4.86	36.36	-5.56	51.04	5.95
Feb-08	137.83	-2.21	24.71	-11.64	34.40	-16.64
Mar-08	141.12	3.30	34.81	10.10	47.91	13.52
Apr-08	138.66	-2.46	40.14	5.33	58.07	10.16
May-08	136.30	-2.36	54.94	14.80	73.37	15.30
Jun-08	135.27	-1.03	56.28	1.34	77.47	4.10
Jul-08	135.54	0.27	54.93	-1.36	77.99	0.52
Aug-08	135.37	-0.16	55.14	0.22	80.06	2.07
Sep-08	134.41	-0.96	103.15	48.01	127.46	47.41
Oct-08	155.16	20.76	205.83	102.68	303.38	175.92
Nov-08	159.67	4.51	208.20	2.37	278.36	-25.02
Dec-08	149.65	-10.02	229.52	21.32	285.99	7.63
Jan-09	159.18	9.53	171.21	-58.30	232.20	-53.79
Feb-09	155.68	-3.50	134.65	-36.56	202.56	-29.64
Mar-09	152.36	-3.33	140.84	6.19	207.20	4.64
Apr-09	157.92	5.56	125.31	-15.53	184.19	-23.01
May-09	158.04	0.13	103.03	-22.29	156.45	-27.74
Jun-09	159.74	1.70	75.11	-27.92	117.88	-38.57
Jul-09	159.61	-0.12	61.23	-13.88	98.26	-19.62
Aug-09	197.25	37.64	59.29	-1.94	93.39	-4.87
Sep-09	196.31	-0.94	58.10	-1.19	85.72	-7.68

Source: ECB.

Therefore, the assessment of the ECB's success in meeting its objectives is largely the same as the assessment of the success of the recipients of the ECB's swap lines in meeting their objectives, and that assessment is made in section 12 below. Information about the scale of the ECB's operations is provided in table 11.3.

External euro liabilities include the euros credited to the Fed and the Swiss National Bank as collateral for the dollars and Swiss francs borrowed on the swap facilities received by the ECB, as well as euros lent to central banks to which the ECB provided swap facilities. Domestic foreign currency assets include dollars and Swiss francs lent to euro area commercial banks. External foreign currency assets include the foreign currency that the ECB received as collateral from the central banks to which it provided swap lines, for example Denmark and Sweden. Such assets increased by roughly EUR 21 billion between the last Fridays of September and October, but the total of such assets is normally quite volatile from week to week and it is not possible to be confident that this figure represents accurately the amount provided by the ECB.

### III. Switzerland.

In the case of the Swiss franc network, the Swiss National Bank provided Swiss francs by means of foreign exchange swaps against euros, beginning in October 2008.. The facilities provided by the SNB included swap lines with the ECB and with the National Banks of Hungary (MNB) and Poland (NBP). The SNB also provided swaps through auctions to its normal commercial repo counterparties. Although the counterparties of these swaps were domestic commercial institutions rather than foreign central banks, it is nevertheless likely that they helped to relieve the shortage of Swiss francs in international markets. The ECB, the MNB and the NBP distributed Swiss francs drawn on their swap lines to euro area commercial banks through auctions which coincided with those organised by the SNB. The SNB's swap programme was terminated in January 2010<sup>58</sup>.

The amounts involved are reported in Table 11.4, which reports not only the total amount outstanding (from the SNB's balance sheet reports) but also calculations of the amounts outstanding from auctions conducted by the SNB, the ECB, the MNB and the NBP (from the announcements of the auction results). There is a residue, which in principle reflects amounts drawn by the ECB, the MNB and the NBP on their swap lines but not distributed, less any Swiss francs distributed by those central banks which were not obtained from their swap lines.

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<sup>58</sup> See the SNB's press release of 18<sup>th</sup> January 2010, [http://www.snb.ch/en/mmr/reference/pre\\_20100118/source/pre\\_20100118.en.pdf](http://www.snb.ch/en/mmr/reference/pre_20100118/source/pre_20100118.en.pdf).

End of	Total		Auctioned by SNB		Auctioned by ECB		Auctioned by MNB		Auctioned by NBP		Residue	
	CHF	EUR	CHF	EUR	CHF	EUR	CHF	EUR	CHF	EUR	CHF	EUR
Oct-08	38.8	26.3	18.6	12.6	18.8	12.8	0.0	0.0	0.0	0.0	1.3	0.9
Nov-08	46.3	30.1	23.2	15.0	21.8	14.2	0.0	0.0	0.2	0.1	1.2	0.8
Dec-08	50.4	33.8	22.4	15.0	26.0	17.4	0.0	0.0	0.5	0.3	1.5	1.0
Jan-09	51.0	34.3	18.1	12.2	30.7	20.7	0.0	0.0	0.6	0.4	1.5	1.0
Feb-09	61.8	41.7	22.6	15.3	36.2	24.5	0.8	0.5	0.3	0.2	1.9	1.3
Mar-09	62.2	41.2	23.0	15.3	36.5	24.1	0.8	0.5	0.8	0.5	1.2	0.8
Apr-09	53.7	35.6	15.2	10.1	35.8	23.7	0.9	0.6	0.3	0.2	1.6	1.0
May-09	60.9	40.3	22.6	15.0	36.1	23.9	0.6	0.4	0.2	0.1	1.4	0.9
Jun-09	48.5	31.8	15.0	9.9	30.5	20.0	0.5	0.4	0.2	0.1	2.2	1.5
Jul-09	32.0	21.0	11.5	7.5	18.9	12.4	0.1	0.1	0.2	0.1	1.4	0.9
Aug-09	29.4	19.4	12.5	8.2	15.5	10.2	0.0	0.0	0.2	0.1	1.2	0.8
Sep-09	12.3	8.1	1.8	1.2	9.9	6.5	0.0	0.0	0.1	0.0	0.6	0.4

Sources: Swiss National Bank, ECB, National Bank of Hungary (MNB), National Bank of Poland (NBP), authors' calculations.

All amounts are in billions. The euro amounts are the equivalent of the Swiss franc amounts, converted at the contemporaneous spot rate (Source: Bloomberg).

As Graph 11.2 shows, the Swiss franc appreciated steadily from October 2008 until late January 2009, followed by a period until the date of the monetary policy announcement on 12 March, when it appeared to be on a plateau. It seems reasonable to suppose that the swap lines contributed to containing the appreciation of the Swiss franc in early 2009, but the appreciation was reversed (and then only partly) only when the SNB announced official sales of Swiss francs.

#### IV. Asia and Latin America.

The motivations for the establishment of the Asian/Latin American network seem to have been diverse, and to a large extent of a longer-term nature. It is of course much too soon to attempt any assessment of these longer-term objectives.

However, the provision or enlargement of swap lines by China and Japan to Indonesia and Korea was clearly intended to address immediate market problems. Korea also received a swap line from the Federal Reserve. We assess the success of these operations in alleviating tensions in Korean financial markets in section 12 below.

The Bank of Japan's provision of yen through swap lines seems to have been on a much smaller scale than the Fed's provision of dollars, if indeed it provided any yen at all. Table 11.5 below compares the item 'foreign currency assets' in the Bank of Japan accounts with the Bank of Japan's drawings of dollars on its account with the Fed (published by the Federal Reserve Bank of New York)<sup>59</sup>. It shows an increase in foreign currency assets in the fourth quarter of 2008 amounting to some \$17 billion in excess of what is explained by the drawing on the Fed swap line. This 'excess increase' was reversed in the first quarter of 2009, but there was a further 'excess increase' of some \$8 billion in the second quarter of 2009 (see last column). It is tempting to think that the 'excess increase' in the fourth quarter of 2008 partly or wholly reflects drawings on swap lines provided by the Bank of Japan; but the Bank of Korea did not draw on the \$20 billion swap line set up on 12 December 2008<sup>60</sup> (the swap line with Indonesia was not set up until April 2009). Any drawings that were made in the second quarter of 2009 could in principle have been made by any country which had a swap line open with the Bank of Japan at the end of June.

Table 11.5

**Bank of Japan foreign currency assets and drawings on the swap line with the Fed**

	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>
	<b>Bank of Japan foreign currency assets (JPY 100mn)</b>	<b>Bank of Japan foreign currency assets (USD bn)</b>	<b>Change in quarter (USD bn)</b>	<b>BoJ drawings on Fed swap (USD bn)</b>	<b>Change in quarter (USD bn)</b>	<b>Residual change (=3-5) (USD bn)</b>	<b>Bank of Japan other deposits (JPY 100mn)</b>	<b>Bank of Japan other deposits (USD bn)</b>
Jun-08	54138	50.97		0.00			234	0.22
Sep-08	85466	80.54	29.57	29.62	29.62	-0.05	31503	29.69
Dec-08	172870	190.72	110.18	122.72	93.09	17.08	118224	130.43
Mar-09	108647	109.79	-80.93	61.03	-61.69	-19.24	57739	58.35
Jun-09	72068	74.79	-35.00	17.92	-43.10	8.10	17645	18.31
Sep-09	50061	47.18	-27.61	1.53	-16.39	4.11	1630	1.82

Sources: Bank of Japan, Federal Reserve Bank of New York, Bloomberg (exchange rates), authors' calculations.

Table 11.5 also shows 'other deposits' at the Bank of Japan, which include the yen deposits held by the Fed as collateral for the swap line. 'Other deposits' were very small in June 2008, before the swap line was opened, and they rise and fall closely with the

<sup>59</sup> Drawings by the Bank of Japan would add to 'foreign currency assets' because they would lead either to a rise in the Bank of Japan's balance at the Fed, or to a rise in the Bank of Japan's dollar claims on Japanese banks. Drawings by eg the Bank of Korea on the swap line provided by the Bank of Japan would lead to a rise in the balance on the Bank of Japan's won account at the Bank of Korea.

<sup>60</sup> Information provided to the authors by the Bank of Korea.

total of swap drawings as reported by the Fed. They were down to \$1.8 billion by the end of September 2009, when the amount outstanding on the swap was down to \$1.5 billion.

As regards the effects of the yen swap lines on Japan, the very sharp appreciation of the yen after Lehman Brothers failed (see Graph 6.10) was an indication of the severity of the stresses in yen financial markets. The appreciation of the yen was partly reversed in the spring of 2009 as market stresses eased, but nevertheless by the middle of 2009 the yen had appreciated on balance by very large amounts, particularly against other Asian currencies.

The central banks which provided their own currencies through swap facilities have made it clear that their main objective was to reduce stresses in financial markets. The Swiss National Bank was clearly concerned about the strength of market demand for Swiss francs and announced in March 2009 that it would sell Swiss francs for foreign currencies so as to contain the pressure for currency appreciation. More generally, the President of the SNB has discussed at length the SNB's changing attitude to the internationalisation of the Swiss franc<sup>61</sup>.

After Lehman Brothers failed, the effective exchange rate index of the yen, as calculated by the BIS, appreciated much more than those of the dollar and the Swiss franc (see Graph 11.2). The relatively modest appreciation of the dollar is probably partly explained by the Fed's willingness to provide very large amounts of dollar liquidity through swaps quickly and flexibly as market tensions mounted. As noted above, the Fed provided over \$550 billion in dollar liquidity, which represented more than half of BIS reporting banks' local US dollar assets vis-à-vis non-banks of \$1,015.1 billion. That was relatively more than was provided by the Swiss National Bank (about \$57 billion at the peak, including amounts provided to commercial counterparties, compared with local Swiss franc assets of \$166.0 billion), and much more than was provided by the Bank of Japan (about \$17 billion, compared with local yen assets of \$99.3 billion).

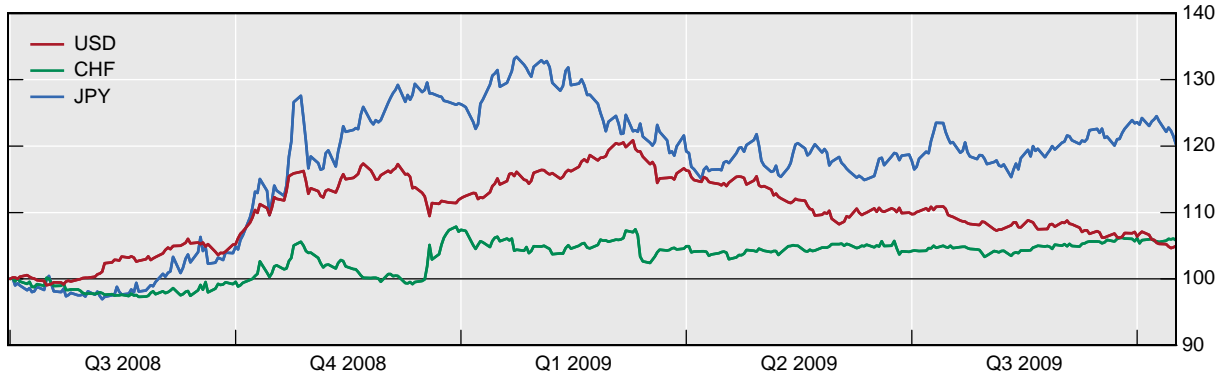
The fact that the yen appreciated by so much more than the Swiss franc may therefore be partly explained by differences in the provision of swap facilities. Another possible explanation is the decision by the Swiss National Bank to sell Swiss francs for foreign currencies; however, that can be only a partial explanation, because the decision was made only in March 2009, by which time the relatively powerful appreciation of the yen was already well established. The Bank of Japan commented that the 'rapid yen appreciation was mainly caused by unwinding of the yen-carry positions, reflecting investors' diminished risk-taking capacity against the background of the stock price declines and increased volatility, as well as tightening of interest rate differentials between Japan and overseas.'<sup>62</sup> Quite possibly only a small fraction of the yen carry trades were captured in the BIS international banking statistics quoted in section 5.

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<sup>61</sup> See Roth (2009).

<sup>62</sup> See Bank of Japan (2009).

Graph 11.2

**Nominal effective exchange rate indices**

<sup>1</sup> 30 June 2008=100.

Source: BIS.

## 12. Effects of swaps on recipient countries.

In this section we review the effects of the swap lines on the countries which drew on them to obtain foreign currency, and consider how large a contribution they made towards meeting those countries' objectives. In total, we review the experiences of twelve countries (or territories), which are summarized in the table below, classified into three groups. Table 12.1 sets out salient facts country by country.

Table 12.1  
**Summary statistics: countries which received swap lines (amounts in US\$ billions)**

	Fall in BIS reporting banks' assets <sup>1,2</sup>	Percent of original BIS reporting banks' assets <sup>1,3</sup>	Total support provided (max)	Drawings on swap lines (highest reported level)	Foreign exchange reserves at end Aug-08
<b>Large international financial centres</b>					
Australia	41.3	11.2	26.7	22.8	28.0
Euro area	512.8 <sup>4</sup>	14.7	293 (USD) 35 (CHF) <sup>5</sup>	291 (USD) 35 (CHF) <sup>5</sup>	212.4
Japan	50.0 <sup>6</sup>	13.3	127.6	123	971.6
Switzerland	206.3 <sup>7</sup>	24.5	31.1	28.9	44.5
United Kingdom	955.9 <sup>7</sup>	18.5	85.5	40.0	41.7
<b>Smaller international financial centres</b>					
Denmark	24.1 <sup>8</sup>	7.2	20.4	19.8	30.6
Sweden	37.0	10.9	30.8	25.0	27.6
Norway	41.5	13.6	9.1	8.2	47.0
<b>Countries which are not international financial centres</b>					
Korea	69.6	29.0	48 <sup>9</sup>	16	242.7
Mexico	8.3	7.7	3.2	3.2	96.1
Hungary	0.4	0.4	1.8	0 (see text)	25.2
Poland	12.2	9.5	0.7	0 (see text)	78.6

<sup>1</sup> Vis-à-vis the economies shown; for the euro area, Japan, Switzerland and the United Kingdom other than the economy's domestic currency. <sup>2</sup> In 2008Q4 and 2009Q1, unless otherwise stated. <sup>3</sup> Original refers to quarter prior to the reported period of the fall. <sup>4</sup> 2008 Q3 and Q4, and 2009Q1. <sup>5</sup> The Swiss franc amount shown is the maximum amount made available through auctions conducted by the ECB. See section 11 for further discussion. <sup>6</sup> 2008 Q2 and Q3. <sup>7</sup> Over the four quarters 2008Q2–2009Q1 inclusive. <sup>8</sup> 2008 Q3 and Q4. <sup>9</sup> As at the end of December 2008. More support was provided later.

Sources: BIS, IMF, national sources, BIS calculations.

## I. Large international financial centres.

BIS reporting banks reduced their claims on all the large international financial centres, as table 12.1 shows. However, the scale of the deposit withdrawal in relation to the initial level of claims differed widely across financial centres. In the case of Switzerland, it amounted to as much as 24.5%,<sup>63</sup> perhaps partly because of the difficulties of UBS, one of the two very large Swiss banks. In the UK, it was 18.5%,<sup>64</sup> again perhaps partly reflecting the problems of one particular bank, namely RBS. In the other international

<sup>63</sup> In currencies other than the Swiss franc.

<sup>64</sup> In currencies other than the pound sterling.

financial centres the reduction in claims was a much smaller percentage of the amount outstanding.

In all five centres, covered interest differentials against the dollar widened and became more volatile as commercial banks used domestic currency financing to replace dollar financing which had been withdrawn (Graph 6.1). And cross-currency basis swap spreads turned negative as banks went into the market seeking to pay floating-rate dollar interest and receive floating rate interest in their domestic currency (Graph 6.4)<sup>65</sup>. With the exception of the yen, all five currencies depreciated against the dollar immediately after Lehman's collapse (Graph 6.7). The Fed extended swap lines to all five central banks, and all five drew large amounts on them.

For the euro area, the United Kingdom, Japan and Switzerland, the evidence presented in Table 11.1 indicates that the dislocations in foreign exchange swap markets of their currencies against the US dollar were alleviated by the US dollar swap lines received by the ECB, the Bank of England, the Bank of Japan and the SNB after the limits on drawings were removed in October 2008 (see also Graph 6.1). Table 11.1 also shows that at the end of September 2009, FX swap spreads of the euro, yen, Swiss franc and sterling against the US dollar at the 3-month maturity, based on deposit rates, had largely normalised at values of up to 7 basis points. Note, however, that the FX swap spreads of the four currencies against the US dollar at the 3-month maturity based on LIBOR rates remained more elevated at around 20-40 basis points (see Table 11.1). This might, however, reflect remaining dislocations in the short-term money markets and problems of defining LIBOR rates. At the end of September 2009, cross-currency basis swap spreads of these four currencies against the US dollar at the longer maturity of one year remained wider than before the crisis, at around -20 to -40 basis points, suggesting continuing problems at longer maturities (see Graph 6.5).

Moreover, Graph 12.1 shows that the amounts of US dollars allotted in auctions by the ECB, Bank of England and Swiss National Bank, all or most of which presumably originally came from the Fed swap lines, fell back strongly in mid-2009 from their peaks reached in late 2008, suggesting that the need for drawing on the Fed swap lines had decreased significantly in the case of the ECB, and largely disappeared in the case of the Bank of England and Swiss National Bank.

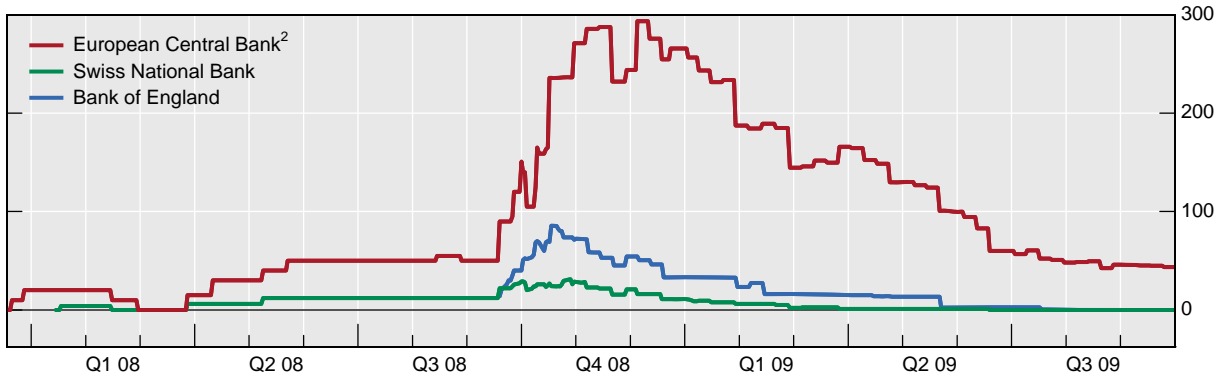
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<sup>65</sup> Curiously, the USD/AUD basis swap spread became positive towards the end of 2008.



Graph 12.1  
**US dollar auction allotments**

Amounts outstanding<sup>1</sup>



<sup>1</sup> Cumulative; in billions of US dollars. <sup>2</sup> Amounts outstanding in US dollar repo operations and US dollar FX swap operations.  
 Sources: Central banks; BIS calculations.

The **European Central Bank** provided US dollars to commercial banks by means of both collateralised loans and swaps. The total amount outstanding peaked at \$293 billion in early December 2008; at the end of December, the ECB had drawn \$291 billion from the Fed on the swap line, but the amount provided to commercial banks had fallen back to \$266 billion. The ECB's dollar provision to commercial banks fell steadily during the first half of 2009, as did the amount outstanding on the swap line (see Table 12.2). This suggests that market conditions had begun to stabilise and that banks' need for official support had decreased. But the amount outstanding on the ECB's swap line from the Fed was still substantial (\$43.7 billion) at the end of September 2009, suggesting that there was still some residual need for US dollar liquidity provided by the ECB.

The ECB also provided Swiss francs to commercial banks through auctions, using its swap line with the Swiss National Bank. Details are given in section 11 and in table 12.2.

Table 12.2

**Foreign currency provided to commercial banks and Eurosystem foreign exchange reserves**

<b>End of</b>	<b>US dollars provided to commercial banks by the ECB (\$ billion)</b>	<b>Swiss francs provided at auctions reported by the ECB (\$ billion equivalent)</b>	<b>Eurosystem foreign exchange reserves(\$ billion)</b>
Sep-08	150.7	0	210.3
Oct-08	271.2	17.4	210.2
Nov-08	244.0	19.2	204.2
Dec-08	265.7	25.8	202.0
Jan-09	187.3	27.8	191.1
Feb-09	144.5	32.5	186.4
Mar-09	165.7	33.1	189.2
Apr-09	130.1	33.0	187.9
May-09	99.7	35.4	191.9
Jun-09	59.9	29.9	192.5
Jul-09	48.3	18.6	197.9
Aug-09	46.1	15.4	197.8
Sep-09	43.7	10.1	195.0

Sources: ECB, BIS calculations, IMF.

Lending of dollars by the **Swiss National Bank** peaked at \$31.1 billion in late October 2008, after the Fed had removed the limit on swap line drawings. This peak amount was nearly three-quarters of Switzerland's total foreign exchange reserves that month (see table 12.3). The swap line allowed the SNB to provide dollar liquidity without drawing down the foreign exchange reserves.

The amounts of US dollars allotted in auctions by the SNB fell to US\$0.02 billion at end-July 2009, implying that foreign exchange market conditions had sufficiently stabilised so that demand for US dollar funds had fallen strongly from their peak in late October 2008.

Table 12.3

**US dollar auction allotment and foreign exchange reserves in Switzerland**

<b>End of</b>	<b>US dollar auction allotment by the SNB (\$ billion)</b>	<b>Foreign exchange reserves in Switzerland (\$ billion)</b>
Sep-08	28.9	44.2
Oct-08	28.5	43.3
Nov-08	20.9	43.1
Dec-08	10.9	44.2
Jan-09	6.1	43.5
Feb-09	2	43.3
Mar-09	1.0	49.1
Apr-09	1.0	49.3
May-09	1.0	51.7
Jun-09	0.02	75.3
Jul-09	0.02	75.0
Aug-09	0.01	75.1
Sep-09	0	78.9

Sources: SNB, IMF, BIS calculations.

The **Bank of England's** dollar lending to UK banks peaked at \$85.5 billion in October 2008 (see Table 12.4). The amount fell to \$33.1 billion at the end of December 2008 and to \$0.01 billion at end-July 2009, implying that market conditions had stabilised to the point at which the swap line was no longer needed.

Table 12.4

**US dollar auction allotment and foreign exchange reserves in the United Kingdom**

<b>End of</b>	<b>US dollar auction allotment by the BoE (\$ billion)</b>	<b>Foreign exchange reserves (\$ billion)</b>
Sep-08	40.0	40.7
Oct-08	72.4	41.4
Nov-08	54.3	41.8
Dec-08	33.1	41.6
Jan-09	23.5	37.2
Feb-09	16.0	36.5
Mar-09	15.0	37.1
Apr-09	13.5	37.3
May-09	2.5	42.2
Jun-09	2.5	41.2
Jul-09	0.01	39.9
Aug-09	0.01	39.7
Sep-09	0.01	39.7

Sources: Bank of England, BIS calculations, IMF.

Although, according to the data in Table 12.1, the outflows of funds from **Japan**<sup>66</sup> were more modest in scale, and replaced in 2008Q4 by net inflows, commercial banks in Japan nevertheless experienced liquidity shortages in dollars. The Bank of Japan drew on its swap line with the Fed to finance lending of dollars to commercial banks. The Bank of Japan's foreign currency assets peaked at \$191 billion at the end of December 2008. However, in June–August 2008, before the credit crisis intensified, those assets had been around \$50 billion, so the increase was about \$140 billion. Analysis of the auction results published by the Bank of Japan shows that the amount of dollars it supplied through auctions peaked at \$127.6 billion in December 2008. As table 11.5 shows, the quarterly profiles of the Bank of Japan's foreign currency assets and its drawings on the Fed swap matched closely, except that the Bank of Japan acquired some net foreign currency assets in 2008Q4 that were not matched by drawings from

<sup>66</sup> In currencies other than the Japanese yen.

the Fed (see section 11 above for discussion). As noted above in section 11, the swap line had been all but repaid by the end of September 2009.

In response to the crisis, the **Reserve Bank of Australia** opened a swap line with the Fed. Its initial upper limit, set on 24 September 2008, was US\$10 billion, but it was trebled in size to US\$30 billion on 29 September. In commenting on the decision that it and other central banks had taken to provide US dollar funding to domestic commercial banks, the Reserve Bank of Australia said that

*'the decision to provide US dollar funding by some of these central banks, including the RBA, does not reflect vulnerabilities in their own banking sectors; rather, it is intended to alleviate global pressures by improving the distribution of US dollar liquidity across different time zones and locales.'*<sup>67</sup>

Table 12.5

**Reserve Bank of Australia balance sheet – selected items**

	Liabilities to overseas	Amount drawn on Fed swap <sup>1</sup>	Gold and foreign exchange assets
Wednesdays	USD bn	USD bn	USD bn
27/08/2008	1.6		39.1
24/09/2008	1.7	10.0	37.2
29/10/2008	20.9		57.7
26/11/2008	23.6		59.1
31/12/2008	25.5	22.8	62.2
28/01/2009	11.9		46.4
25/02/2009	11.3		44.0
25/03/2009	11.4	9.6	45.0
29/04/2009	5.1		45.0
27/05/2009	3.5		47.0
24/06/2009	1.1	0.2	46.4
29/07/2009	0.9		46.3
26/08/2009	0.8		44.2
30/09/2009	0.7	0	45.6

<sup>1</sup> As at nearest end-quarter date.

Source: Reserve Bank of Australia.

<sup>67</sup> Reserve Bank of Australia (2008, Box B).

The evolution of the key features of the RBA's balance sheet is shown in table 12.5. 'Gold and foreign exchange assets', which include US dollar loans to Australian commercial banks, increased by about US\$23 billion between the end of August 2008 and the end of the year<sup>68</sup>. This was more or less exactly matched by drawings on the Fed swap. The liquidity situation seems to have improved after the beginning of 2009, probably helped by the stabilization of commodity prices, and the swap had been repaid by the end of September.

In all five cases, central bank dollar loans to commercial banks and the amounts outstanding on the Fed swap had fallen back substantially by the middle of 2009. On 24 September the ECB, the Bank of England and SNB were able to announce that in light of reduced demand for funds, they intended to discontinue the current 84-day US dollar repo operations after a final operation at the start of October, though the 7-day US dollar repo operations would continue until January 2010<sup>69</sup>. This strongly suggests that the objective of the swap lines, to stabilise market conditions, had been largely achieved.

Could it have been achieved without the swap lines? Japan's foreign exchange reserves were much larger than the amount of dollars that the Bank of Japan lent to commercial banks (though most of the reserves are managed by the Ministry of Finance and not the Bank of Japan), so it could be said that Japan did not need its swap line. The same could not be said of any of the other financial centres. In Australia, Switzerland and the UK, the attempt to finance dollar liquidity provision out of foreign exchange reserves would have led to such a heavy percentage depletion of reserves as to run the risk, in the nervous atmosphere prevailing at the time, of loss of market confidence in the creditworthiness of the country concerned. The euro area's foreign exchange reserves would have been insufficient to finance the ECB's dollar liquidity provision (see table 12.1).

Among other large international financial centres, **Hong Kong** experienced substantial outflows of funds, in that BIS reporting banks' assets vis-à-vis Hong Kong fell by US\$33.4 billion (10.2% of the initial total) in 2008Q4 and 2009Q1. However, there was a strong demand for Hong Kong dollars, reflecting the closing out of carry trades which had been financed using Hong Kong dollars, and the Monetary Authority announced on 30 September 2008 five temporary measures to provide HK dollar liquidity to commercial banks, including HK dollar swaps against US dollars<sup>70</sup>. It was announced on 26 March

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<sup>68</sup> Analysis of the auction results indicates that the peak level of US dollar loans was \$26.7 billion, reached on 31<sup>st</sup> October.

<sup>69</sup> See <http://www.bankofengland.co.uk/publications/news/2009/072.htm>, [http://www.ecb.int/press/pr/date/2009/html/pr090924\\_2.en.html](http://www.ecb.int/press/pr/date/2009/html/pr090924_2.en.html), [http://www.snb.ch/en/mmr/reference/pre\\_20090924\\_1/source/pre\\_20090924\\_1.en.pdf](http://www.snb.ch/en/mmr/reference/pre_20090924_1/source/pre_20090924_1.en.pdf)

<sup>70</sup> See Hong Kong Monetary Authority (2008), Box 4.

2009 that the swap facility would be made permanent<sup>71</sup>. We know of no indications that Hong Kong used the swap line that it had obtained from the People's Bank of China.

**Singapore** also experienced outflows. BIS reporting banks' assets vis-à-vis Singapore fell by US\$102.1 billion (20.8% of the initial total) in 2008Q4 and 2009Q1. Singapore received a US\$ 30 billion swap line from the Fed but did not draw on it.

## II. Smaller international financial centres.

Denmark, Sweden and Norway were all seriously affected by the credit crisis. Graphs 6.2 and 6.5 show how covered interest differentials and basis swap spreads reacted. The Norwegian krone and the Swedish krona both depreciated against the euro (see Graph 6.8).

**Denmark** faced the particular concern that its currency is a member of ERM2 and Danmarks Nationalbank accordingly undertakes to maintain the krone within a fluctuation band +/- 2.25% around its central rate against the euro. In fact the krone normally remains within a much narrower margin around the central rate. The krone remained very close to its ERM2 parity against the euro throughout the credit crisis, with the support of official outright purchases of kroner, which amounted to DKK 64.6 billion (EUR 8.7 billion) in September and October 2008<sup>72</sup>.

Danish banks, like others, experienced withdrawals of foreign currency deposits<sup>73</sup>, and Danmarks Nationalbank established two swap lines, one with the Fed, opened on 24 September for \$5 billion and increased to \$15 billion on 29 September, and the other with the ECB for EUR 12 billion opened on 27 October. It used swap drawings to finance auctions of euro and dollar deposits to commercial banks<sup>74</sup>. The amounts involved are shown in table 12.6, which shows the monthly reserve totals published by the Nationalbank, together with predetermined outflows, which reflect the proceeds of swap drawings. During September - November 2008, the Nationalbank lent the equivalent of DKK 115.6 billion in euros and dollars. Total swap drawings reached DKK 116.3 billion (EUR 15.6 billion) at the end of November. Had Danmarks Nationalbank made the foreign currency loans without the support of the swap lines, its reserves would have fallen to DKK 52.7 billion (EUR 7.1 billion) at the end of October 2008, less than a third of the end-August total.

During October, the Danish government issued a guarantee of bank deposits (on 5 October), and the Nationalbank raised interest rates by 40 basis points (the lending rate and the CD rate) on 7 October and by a further 50 basis points on 24 October, while ECB rates were falling. That marked the turning point, and funds began to flow back into Denmark during November, as table 12.6 shows. The fact that a moderate positive interest differential vis-à-vis the euro area was able to attract funds back to Denmark in

<sup>71</sup> See Hong Kong Monetary Authority (2009), page 50.

<sup>72</sup> See Danmarks Nationalbank (2009a), page 10. Figures come from balance sheet data published by Danmarks Nationalbank.

<sup>73</sup> See Danmarks Nationalbank (2008 and 2009a).

<sup>74</sup> See Danmarks Nationalbank (2009b), pages 47–50.

these circumstances demonstrates the credibility of Denmark's exchange rate commitment.

Danmarks Nationalbank was able to begin purchasing foreign exchange, and over the eleven months November 2008 – September 2009, it sold DKK 193.3 billion for foreign exchange worth about EUR 25.9 billion – more than three times the amount of reserves it had spent in intervention during September and October 2008. The market demand for Danish kroner in and after November 2008 partly reflected the differential between the lending rates of Danmarks Nationalbank and the ECB, which remained wider than usual. It is possible that Danmarks Nationalbank's decision to maintain an unusually wide interest rate margin over the euro area was motivated partly by a desire to build up the reserves out of a concern that the financial crisis had showed that they were not large enough. On the other side of the account, Denmark provided euro swap lines to Iceland and Latvia, but the amounts were relatively small (see Appendix 2 for details).

Table 12.6

## Denmark: influences on international liquidity

End of	Reserves	Predetermined outflows	Intervention during month to purchase foreign exchange (net)	Foreign currency lending to banks	<i>equivalent in</i>		Reserves net of predetermined outflows
	DKK bn	DKK bn	DKK bn	DKK bn	USD (USD bn)	EUR (EUR bn)	DKK bn
Aug-08	166.7	0.4					167.1
Sep-08	163.8	-25.0	-0.7	25.5	4.8	3.4	138.8
Oct-08	133.7	-81.0	-63.9	85.3	14.6	11.4	52.7
Nov-08	176.4	-116.3	31.6	114.6	19.5	15.4	60.1
Dec-08	223.7	-108.2	24.7	116.0	21.8	15.6	115.5
Jan-09	226.2	-96.6	12.1	933.6	16.1	12.6	129.6
Feb-09	241.8	-71.3	10.1	70.6	12.0	9.5	170.5
Mar-09	267.3	-55.7	18.1	44.3	7.9	5.9	211.6
Apr-09	291.3	-43.6	8.9	44.3	7.9	5.9	247.7
May-09	331.1	-34.4	28.5	34.5	6.6	4.6	296.7
Jun-09	334.4	-36.0	6.7	36.4	6.9	4.9	298.4
Jul-09	340.1	-33.4	6.6	33.6	6.4	4.5	306.7
Aug-09	377.8	-15.1	26.9	15.6	3.0	2.1	362.7
Sep-09	398.0	-6.0	19.1	6.3	1.2	0.8	392.0

Source: Danmarks Nationalbank, Bloomberg (exchange rates).



In **Sweden**, the Riksbank opened a swap line with the Fed on 24 September; initially for \$10 billion, it was increased to \$30 billion on 29 September. The Riksbank began auctioning dollar loans to Swedish banks as from 1 October. By the end of October, it had lent \$ 23.9 billion and by the end of the year the total was up to \$ 25 billion. Up to the end of the year, the dollar loans to domestic banks were matched in amount by drawings on the Fed swap (see table 12.7). Commercial banks repaid some \$9.3 billion of foreign currency loans to the Riksbank in January, and the fall in the Riksbank's external kronor liabilities in that month (see table 12.7) suggests that the Fed swap was partly repaid. However, in February the need for foreign currency loans increased again as the krona depreciated, and by the end of March the volume of foreign currency loans made by the Riksbank had reached \$30 billion. Nevertheless, \$2 billion (net) was repaid to the Fed during the first quarter.

Table 12.7

## Sveriges Riksbank balance sheet - selected items (SEK billion)

End of	External foreign currency claims	(in \$ bn)	Domestic foreign currency claims	(in \$ bn)	External kronor liabilities	External foreign currency liabilities	(in \$ bn)	Domestic foreign currency liabilities	(in \$ bn)	Drawing on Fed swap (in \$ bn)
Aug-08	174	26.9	0	0.0	0	16	2.6			
Sep-08	235	34.0	0	0.0	0	65	9.4			
Oct-08	186	23.9	186	23.9	150	51	6.6			
Nov-08	204	25.2	187	23.1	189	35	4.3			
Dec-08	200	25.6	196	25.0	189	9	1.1			25.0
Jan-09	207	24.8	131	15.7	79	60	7.1			
Feb-09	207	23.0	246	27.2	194	58	6.5			
Mar-09	196	23.7	247	30.0	194	58	7.0			23.0
Apr-09	199	24.8	248	30.8	196	59	7.3			
May-09	189	25.0	197	26.1	132	60	7.9			
Jun-09	281	36.5	138	17.9	124	37	4.8	66	8.6	11.5
Jul-09	278	38.6	84	11.7	65	38	5.2	66	9.2	
Aug-09	304	42.8	66	9.3	53	37	5.2	66	9.3	
Sep-09	297	42.7	26	3.7	20	8	1.2	91	13.1	2.7

Source: Sveriges Riksbank.

Market conditions improved in the second quarter, and the commercial banks repaid some \$12.1 billion of foreign currency loans to the Riksbank, which in turn repaid \$7.3 billion of the Fed swap. On 12 June, the Riksbank and the ECB announced that the Riksbank was borrowing EUR 3 billion from the ECB under a EUR 10 billion swap agreement that had been made on 20 December 2007. In the third quarter, the commercial banks repaid a further \$14.2 billion of foreign currency loans to the Riksbank.

Sweden extended swap lines to Iceland (EUR 500 million), Latvia (EUR 375 million) and Estonia (SEK 10 billion) during the crisis. The swap lines to Iceland and Latvia were too small to have any material effect on Sweden's own finances.

In **Norway**, in response to the drying-up of dollar liquidity, Norges Bank greatly expanded the scale of its krone liquidity provision. In addition, having obtained a swap line from the Fed for \$5 billion on 24 September 2008, increased to \$15 billion on 29 September, in October it began providing dollar fixed-rate loans. Moreover, Norges Bank provided krone loans against euros and dollars both domestically and to foreign banks active in the Norwegian money market<sup>75</sup>.

Table 12.8 shows the evolution of relevant parts of Norges Bank's balance sheet. 'Other domestic assets', which include foreign currency lending to Norwegian banks, increased to \$9.1 billion at the end of November 2008<sup>76</sup>; and its foreign currency component was \$8.3 billion at the end of December. It fell to \$5.1 billion at the end of June 2009 and \$1.0 billion at the end of September. Its rise and fall were closely matched by drawings on the Fed swap line.

'Other foreign assets', which includes krone loans to foreign banks active in the Norwegian money market, rose very quickly to the equivalent of \$8.7 billion at the end of November 2008, and its domestic currency component fell from \$8.0 billion at the end of December to \$5.3 billion at the end of June 2009 and \$1.1 billion at the end of September.

In all three countries, the amount of dollar loans to commercial banks and the amounts outstanding on swap lines have fallen back substantially during 2009, suggesting that the objectives of the swap lines have been achieved. In Denmark, the objective was ensuring not only that the banks could repay their deposits on time but also that Denmark's exchange rate commitment, which is the foundation of its monetary policy, could be maintained. In the event, the credibility of the exchange rate commitment proved to be robust, but it might have been threatened if there had been a much larger fall in the reserves. It is doubtful whether Denmark or Sweden could have provided effective support to their banks as they did had they not received swap lines very quickly from the Fed after the Lehman failure, and from the ECB a little later, since the necessary provision of liquidity would have used up most of their reserves.

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<sup>75</sup> See Norges Bank (2008), page 28.

<sup>76</sup> Analysis of the auction results published by Norges Bank suggests that the foreign currency lending component was \$8.9 billion.

Table 12.8

## Norges Bank balance sheet – selected items (NOK billion)

	International reserves	Other foreign assets	Other domestic assets	domestic currency	foreign currency	Other domestic assets	foreign currency	Foreign liabilities	of which deposits	Drawings on Fed swap
	(USD bn)	(USD bn)	(USD bn)	(USD bn)	(USD bn)	(USD bn)	(USD bn)	(USD bn)	(USD bn)	(USD bn)
Aug-08	257.7	47.6	0.2	0.0	0.2	1.0	0.2	46.8	8.6	0.1
Sep-08	261.7	44.6	8.6	1.5	0.8	4.9	0.8	44.9	7.7	0.1
Oct-08	263.4	39.2	50.5	7.5	3.0	20.3	3.0	109.4	16.3	33.9
Nov-08	296.8	42.3	61.1	8.7	9.1	63.9	9.1	165.5	23.6	61.0
Dec-08	357.3	51.4		55.8	8.0			175.1	25.2	55.9
Jan-09	333.8	48.3		47.3	6.9			161.3	23.3	47.6
Feb-09	349.7	49.7		47.3	6.7			156.6	22.2	47.5
Mar-09	314.5	46.7		47.3	7.0			147.2	21.8	47.4
Apr-09	315.2	48.1		34.2	5.2			124.7	19.0	34.3
May-09	307.8	48.9		34.2	5.4			114.0	18.1	34.2
Jun-09	308.4	47.9		34.2	5.3			112.3	17.5	34.2
Jul-09	301.1	49.2		6.5	1.1			59.2	9.7	6.5
Aug-09	270.9	45.0		6.5	1.1			59.2	9.8	6.5
Sep-09	282.8	49.0		6.5	1.1			61.0	10.6	6.5

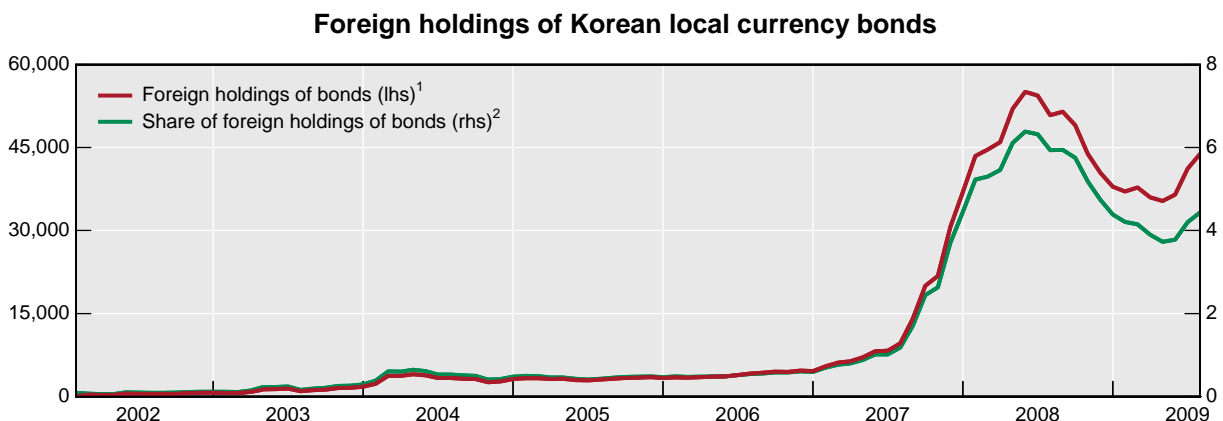
Sources: Norges Bank, Federal Reserve Bank of New York, Bloomberg (exchange rates).

### III. Countries which are not international financial centres

The effects of the financial crisis on **Korea** were particularly severe. Korean banks, like other banks, encountered funding problems. The won depreciated very heavily after Lehman Brothers failed; by the end of November the depreciation had reached 25% against the dollar and 33% against the yen (see Graph 6.10). In addition, covered interest rate differentials against the yen turned positive, as Korean banks which were unable to get foreign currency funding turned to the swap market to convert won borrowing into foreign currencies (see Graph 6.3). The profile of covered interest rate differentials against the dollar was very similar.

As shown in Table 12.1, external assets of BIS reporting banks vis-à-vis Korea fell by \$69.3 billion in 2008Q4 and 2009Q1. In addition, there were heavy sales of Korean local-currency government bonds by non-residents (see Graph 12.2), of the order of won 15 - 20 trillion.

Graph 12.2



<sup>1</sup> Amounts outstanding in KRW billion. <sup>2</sup> In per cent.

Sources: JP Morgan, authors' calculations.

On 21 October 2008, the Korean Ministry of Strategy and Finance issued a press release on the financial crisis, in which it said that, among other measures, the government and the Bank of Korea would provide additional dollar liquidity, amounting to \$30 billion, to the banking sector by utilising foreign exchange reserves.<sup>77</sup>

The Bank of Korea obtained swap lines from three sources. On 30 October 2008, it obtained a \$30 billion swap line from the Fed; and on 12 December it obtained swap lines of CNY 1,800 billion or KRW 38 trillion from the Peoples' Bank of China and of \$20

<sup>77</sup> See Ministry of Strategy and Finance of Korea (2008).

billion equivalent from the Bank of Japan. The Bank of Korea reports that 'the establishment of the currency swaps themselves actually had a positive announcement effect in stabilizing the financial market unrest, as price variables have shown rapid recoveries'<sup>78</sup>. By the end of 2008, it had drawn \$10.35 billion on the Fed swap, to finance foreign currency lending to commercial banks. It made no drawings, then or later, on the swap lines with the People's Bank of China or the Bank of Japan<sup>79</sup>. The funds drawn on the Fed swap were lent to commercial banks, and, in addition, the Bank of Korea supplied \$10.27 billion to commercial banks through swap transactions between October and December 2008, financed out of its own reserves<sup>80</sup>.

The Bank of Korea's provision of foreign currency liquidity continued into 2009, and in January, it lent a further \$6.0 billion (net) to commercial banks, financed by drawings on the Fed swap line.

Korean government funds also provided foreign currency liquidity. The Bank of Korea noted (Bank of Korea (2009b), footnote 8) that

*the government (Foreign Exchange Stabilization Fund) also announced its own foreign currency liquidity supply plans for 10.0 billion US dollars by swap trading, 14.0 billion US dollars by competitive auction loans, and 11.0 billion US dollars by support for trade finance, for a total of 35.0 billion US dollars. An additional 27.4 billion US dollars was supplied through the Export-Import Bank of Korea.*

By the end of December 2008, government funds had provided \$27.4 billion in foreign currency liquidity in addition to the \$20.6 billion provided by the Bank of Korea, making a total of \$48 billion<sup>81</sup>. Between the end of August and the end of December, Korea's foreign exchange reserves fell by \$42.0 billion (however, this will have included changes in the dollar value of non-dollar currencies held in the reserves), and Korea drew \$10.35 billion from the Fed (ignoring any possible drawing from the Bank of Japan). The foreign currency liquidity of the Korean monetary authorities thus fell by an amount of the order of \$52 billion. The difference of roughly \$4 billion between the fall in the foreign exchange reserves and the amount of foreign exchange liquidity provided to commercial banks through loans or swaps may have represented the amount spent on outright purchases of won for dollars.

In the first quarter of 2009, Korea's reserves increased by \$5.1 billion but the Bank of Korea drew a further \$5.6 billion net from the Fed. Therefore it seems likely that transactions by the Korean monetary authorities in the first quarter of 2009 were such as

<sup>78</sup> See Bank of Korea (2009b)

<sup>79</sup> Information provided to the authors by the Bank of Korea. In a document published on 28 January 2009 (see Ministry of Strategy and Finance (2009)), the Bank of Korea commented, in relation to the swap agreement with the Peoples' Bank of China, that 'the two sides have agreed to explore the possibility and extent of converting the swap currencies into reserve currencies.'

<sup>80</sup> See Bank of Korea (2009a). Also, between December 2008 and February 2009, the Bank of Korea supplied \$0.15 billion of foreign exchange through the purchase of export bills.

<sup>81</sup> Information provided to the authors by the Bank of Korea.

to generate only a small net outflow of foreign exchange, and possibly an inflow. In the second and third quarters of 2009, there was a clear improvement in Korea's international liquidity as the foreign exchange reserves increased by \$43.8 billion while \$12.0 billion was repaid to the Fed. And the won stabilised somewhat in foreign exchange markets, as chart 6.10 shows.

Korea's reserves, which were \$243.2 billion at the end of August 2008, would have been large enough to meet the demand for foreign currency liquidity. The swap facilities were in that sense not essential to the financing of the liquidity provision. However, there is no reason to doubt the Bank of Korea's assertion that their availability had a positive effect on market sentiment; and market sentiment might have deteriorated further if there had been a larger fall in the reserves. In other words, the demand for foreign currency liquidity might have been greater in absence of the swap facilities.

In spite of the foreign currency liquidity that the Korean authorities provided, financial market stresses clearly remained in the third quarter of 2009: for example, covered interest differentials between the won and the yen (and the dollar) were very wide (see Graph 6.3)<sup>82</sup>. The Bank of Korea commented in April 2009 that

*'This seems chiefly attributable to the rise in risk premiums caused by the competition to secure dollars in the international financial market and by concerns about the rising credit risks of domestic financial institutions'.<sup>83</sup>*

To the extent that the residual stresses reflected the credit risks of financial institutions, they could not have been alleviated by additional liquidity provision. However, additional liquidity provision might have reduced the competition to secure dollars (or other foreign currencies) in the international financial market.

As the crisis has abated, Korea has been quick to rebuild its foreign exchange reserves, suggesting that the authorities are anxious to support economic recovery and, perhaps, they are concerned that they may need more liquidity as a protection against future possible financial instability.

In **Mexico**, the peso depreciated very sharply after Lehman Brothers failed; its effective exchange rate index fell by 23.3% between the end of August 2008 and the end of February 2009. Covered interest differentials curiously turned sharply negative for a period: in other words, it was cheaper to borrow dollars indirectly, by borrowing pesos and swapping them, than directly. They returned to moderate negative levels, of around

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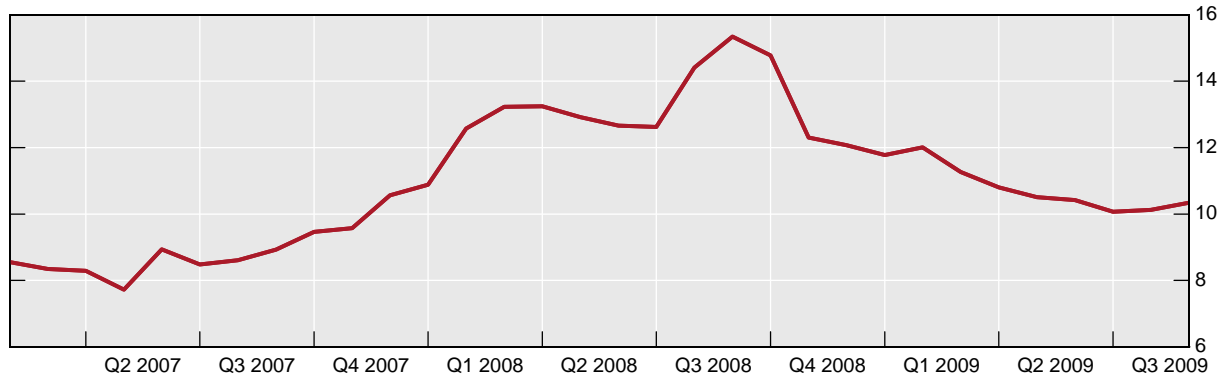
<sup>82</sup> The forward exchange market in Korea is heavily influenced by large-scale forward sales of won for dollars by shipbuilding companies. However, the fact that covered interest differentials were much wider in the third quarter of 2009 than in the third quarter of 2007 suggests that the financial crisis had a lasting effect.

<sup>83</sup> Bank of Korea (2009c), page 43.

100 basis points, in early January 2009. There were substantial foreign sales of Mexican government securities, as Graph 12.3 shows<sup>84</sup>.

Graph 12.3

**Foreign holdings of Mexican government bonds<sup>1</sup>**



<sup>1</sup> As percentage of total government bonds outstanding.

Source: National data.

The Banco de Mexico responded initially to the crisis by increasing the rate of official purchases of pesos for dollars<sup>85</sup>, partly in order to help relieve liquidity pressures in the spot foreign exchange market related to corporate losses on derivative positions<sup>86</sup>. Mexico's foreign exchange reserves fell by \$13.8 billion during October 2008. The Fed established a swap line for \$30 billion with the Banco de Mexico on 29<sup>th</sup> October 2008, and it seems to have had a positive announcement effect: in the 5 trading days after the announcement, the peso was 5.8% stronger against the dollar on average than in the 5 trading days before the announcement. However, the swap line was not drawn on until April 2009, when the Banco de Mexico auctioned dollar deposits to commercial banks, drawing \$3.2 billion on the swap for the purpose<sup>87</sup>. Also in April 2009, Mexico obtained a Flexible Credit Line from the IMF for some \$47 billion.

Mexico appears to have overcome the crisis quite effectively using mainly its own foreign exchange reserves (which were \$96.1 billion at the end of August 2008). It also received backup support from the IMF. The Fed swap was probably helpful in improving Mexico's market credibility, but, although they were used, the funds that it provided seem to have played only a minor role.

Following the failure of Lehman Brothers on 15 September 2009, the currencies of **Hungary** and **Poland** depreciated very strongly in the foreign exchange market (see

<sup>84</sup> For fuller discussion of the effects of the credit crisis on Latin America, see Jara, Moreno and Tovar (2009).

<sup>85</sup> See Banco de Mexico (2009), page 84.

<sup>86</sup> See International Monetary Fund (2009b), page 20.

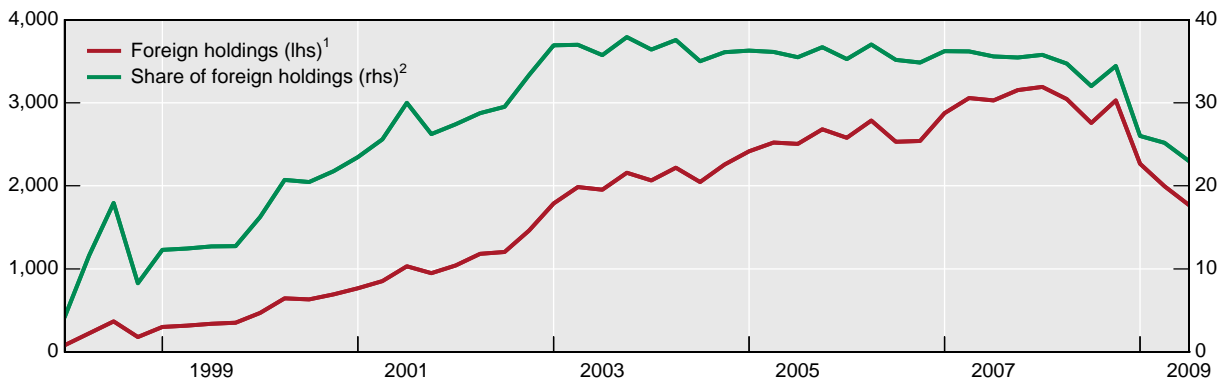
<sup>87</sup> See Banco de Mexico (2009), p.48. The swap line, for a maximum of \$30 billion, had been opened on 29 October 2008.

Graph 6.8). In both countries, covered interest differentials and cross-currency basis swap spreads against the euro widened substantially and remained very wide by historical standards (Graphs 6.2 and 6.5.).

In early October, the impairment in foreign currency swap markets triggered problems in **Hungary**, including in the form of a fall in the share price of OTP Bank (viewed as vulnerable since, although mainly foreign-owned, its ownership was dispersed rather than concentrated) and a sharp reduction in foreign demand for local currency bonds.<sup>88,89</sup> The fall in foreign holdings of Hungarian forint-denominated government securities is shown in Graph 12.4. Moreover, total foreign currency housing loans were the equivalent of EUR 7.6 billion at the end of August 2008. The forint depreciated sharply, with banks no longer prepared to exchange euros for forints in foreign currency swap markets<sup>90</sup>. The events in Hungary had spillover effects in Poland and the Czech Republic, leading to an increase in the yield spreads of national currency-denominated government bonds between end-September and 23 October<sup>91</sup>.

Graph 12.4

#### Foreign holdings of Hungarian local currency government bonds



<sup>1</sup> Amounts outstanding at end-quarter in HUF billions. <sup>2</sup> In per cent.

Sources: National data, authors' calculations.

This led several central banks, including the National Bank of Hungary (MNB), to take the role of counterparties in swap transactions in which they provided euros and Swiss francs to banks in swaps against their domestic currencies.<sup>92</sup> The MNB obtained euro financing facilities from the ECB against high-quality euro collateral, and Swiss franc financing from the Swiss National Bank, using the CHF/EUR swap arrangements. Neither of these facilities increased the amount of foreign currency available to Hungary; the ECB facility simply enabled the MNB to turn high-quality euro assets into cash, and the SNB facility enabled it to exchange one foreign currency for another. However in

<sup>88</sup> In mid-October, there were no bidders at local currency government bond auctions, leading to an increase in local currency bond spreads.

<sup>89</sup> See Mihaljek (2009).

<sup>90</sup> For a discussion of the swap market in forints, see Mak and Pales (2009).

<sup>91</sup> See Austrian National Bank (2008), p. 17ff.

<sup>92</sup> See Austrian National Bank (2008).



November 2008, the Hungarian government reached agreement with the IMF and the European Commission on a stand-by credit facility of up to EUR 20 billion, of which EUR 6.9 billion was drawn in 2008Q4<sup>93</sup>. External borrowing of foreign currency will have reduced depreciation pressure on the forint, by helping the central bank finance foreign currency swaps with commercial banks, and thereby reducing the need for commercial banks and others to sell forints in the spot market for euros at a time when the foreign currency swap market was not functioning. Official borrowing may also have offset some depreciation pressure on the forint arising from an unwinding of currency hedges in the FX swap market associated with the reduction in foreign holdings of Hungarian government securities.

The MNB's swaps with credit institutions, which from March to August 2009 included one-week CHF/EUR, three-month EUR/HUF and six-month EUR/HUF central bank FX-swaps, peaked in April - May 2009 at HUF 362 billion, or the equivalent of EUR 1.3 billion (see Table 12.10). On average in September 2009, the MNB's swaps with credit institutions were down to HUF 159 billion, (EUR 0.6 billion).<sup>94</sup>

The announcement of the ECB facility on 16 October 2008, and the announcement on 25 June 2009 that the SNB swap line would continue until the end of October, appear to have had some immediate positive impact on cross-currency basis swap spreads against the euro. The first announcement of the SNB swap line on 28 January 2009 had no immediate positive impact, though it was followed by a narrowing of spreads (see Table 12.9 and Graph 6.5). However, three-month covered interest differentials and one-year cross-currency basis swap spreads against the euro were still much wider on average over the third quarter of 2009 than before the financial crisis, at around 58 basis points and 88 basis points respectively, but nevertheless much lower than in early 2009 (see Graphs 6.2 and 6.5). This suggests that market stresses have persisted<sup>95</sup>.

<sup>93</sup> See Magyar Nemzeti Bank (2009), page 20, Box 1-1.

<sup>94</sup> A time series of the MNB's swaps with credit institutions is shown in Graph 8 of the MNB's 'Charts to the press release on the statistical balance sheet of the MNB, August 2009', available at [http://english.mnb.hu/Engine.aspx?page=mnb\\_n statisztikai\\_idosorok&ContentID=11489](http://english.mnb.hu/Engine.aspx?page=mnb_n statisztikai_idosorok&ContentID=11489).

<sup>95</sup> It may be argued that the three-month deposit and swap markets, and the one-year basis swap market, are not very liquid in Hungary, so that the data quoted in this paragraph do not constitute strong evidence of persisting market stresses. However, the fact that those markets are not very liquid is in itself a sign of stress. And covered interest differentials against the euro were still substantial even at shorter maturities. The average differentials in 2009Q3 at the one-week and one-month maturities were 37 and 26 basis points, respectively.

Table 12.9

**Hungary: cross-currency basis swap spreads against the euro<sup>1</sup>**

Before crisis	5 days from	01.01.2007	-8
ECB Swap line	5 days before	16.10.2008	-108
	5 days from	16.10.2008	-95
SNB Swap line	5 days before	28.01.2009	-227
	5 days from	28.01.2009	-232
SNB Swap line	5 days before	25.06.2009	-118
	5 days from	25.06.2009	-89
Latest	5 days before	1.10.2009	-95

<sup>1</sup> At the one-year maturity, in basis points; averages over periods shown.

Sources: Bloomberg, authors' calculations.

Since the MNB's facilities with the ECB and the SNB could not augment its reserves, it can be said that Hungary financed all of its support for the foreign currency liquidity of its commercial banks from its own reserves, augmented by external official borrowing undertaken by the government.

Table 12.10

**Hungary: selected data**

	Swaps with credit institutions* (monthly averages)		Foreign currency reserves (end period)	Loan drawings (end period)
	HUF billion	EUR billion	EUR billion	EUR billion
May-08			16.6	0
Jun-08			17.2	0
Jul-08			17.0	0
Aug-08			17.2	0
Sep-08			17.5	0
Oct-08			17.6	0
Nov-08			23.0	
Dec-08			24.1	6.9
Jan-09			24.4	
Feb-09			24.7	
Mar-09	297.1	1.0	27.8	
Apr-09	361.9	1.2	26.9	
May-09	361.9	1.3	26.3	
Jun-09	356.0	1.3	26.9	
Jul-09	252.5	0.9	28.9	
Aug-09	200.9	0.7	29.3	
Sep-09	159.4	0.6	29.4	

\* This item includes one-week CHF/EUR, three-month EUR/HUF and six-month EUR/HUF central bank FX-swaps.

Sources: MNB, IMF, Bloomberg (exchange rates), authors' calculations.

The post-Lehman intensification of the financial crisis affected **Poland** in much the same way as it did other countries (see Graphs 6.2, 6.5 and 6.8). At the end of August 2008, total foreign currency loans to households were the equivalent of EUR 29.5 billion. Settlement of currency options written by Polish enterprises led to an additional demand

for foreign currencies (see NBP (2009b)). The NBP, like the MNB, obtained euro financing facilities from the ECB against high-quality collateral, and a Swiss franc swap line against euro collateral from the Swiss National Bank. As in the case of Hungary, these facilities did not augment the country's international reserves. By March 2009, the NBP had not drawn on the ECB facility, though it had obtained Swiss francs from the SNB using euros from its reserves as collateral<sup>96</sup>. In addition, Poland established a flexible credit line of \$20.6 billion with the IMF in May 2009, on which it had not drawn, however, by end-August 2009 (see Table A1 in the appendix).

There is no evidence that the swap line announcements had an immediate positive impact on cross-currency basis swap spreads (see Table 12.11 and Graph 6.5), or any lasting effect on covered interest differentials (Graph 6.2). As in Hungary, basis swap spreads and covered interest rate differentials both remained unusually wide: the average 3-month covered interest differential against the euro over the third quarter of 2009 was 49 basis points and the average one-year basis swap margin was 98 basis points.

Table 12.11

**Poland: cross-currency basis swap spreads against the euro<sup>1</sup>**

before crisis	5 days from	01.01.2007	-7
SNB Swap line	5 days before	07.11.2008	-152
	5 days from	07.11.2008	-150
ECB Swap line	5 days before	21.11.2008	-135
	5 days from	21.11.2008	-135
SNB Swap line	5 days before	16.01.2009	-80
	5 days from	16.01.2009	-89
SNB Swap line	5 days before	25.06.2009	-125
	5 days from	25.06.2009	-125
latest	5 days before	1.10.2009	-92

<sup>1</sup> At the one-year maturity, in basis points; averages over periods shown.  
Sources: Bloomberg, authors' calculations.

The NBP offered foreign exchange swaps in USD/PLN and EUR/PLN to commercial banks from 17 October 2008 at a seven-day maturity, with the first foreign exchange swap being concluded on 21 October 2008 (see NBP (2009a)). On 17 November 2008 the NBP began conducting foreign exchange swap transactions in CHF/PLN, also at a seven-day maturity, and the NBP carried out two kinds of such operations in 2008. On three occasions in 2008 the NBP also conducted CHF/PLN swaps with 84-day maturity.

The NBP deliberately made the terms that it offered for these swaps expensive, so as to encourage banks to look for funding elsewhere, and in particular, in the case of foreign-owned banks, to seek funding from their parent banks. By end-December 2008, the balance of foreign exchange swaps had risen to about PLN 2 billion equivalent, or about EUR 0.5 billion<sup>97</sup>, and at the end of April 2009 it was PLN 1.8 billion (about EUR 0.4

<sup>96</sup> See NBP (2009b), page 13.

<sup>97</sup> See NBP (2009a), figure 9.

billion). As in the case of Hungary, this must have been financed entirely from Poland's own reserves, because neither of the NBP's facilities, with the ECB and the SNB, increased the amount of foreign currency available to Poland. The NBP reported in June 2009 that it had not drawn on the ECB facility<sup>98</sup>, but it did use the swap line with the SNB to obtain Swiss francs in exchange for euros (see table 11.4). At the end of March 2009, the NBP announced that it would liberalise access to central bank credit as from the end of May, including lengthening the maximum maturity of normal foreign exchange swap operations to a month. Table 12.12 shows that Poland's reserves net of predetermined outflows fell by just EUR 1.6 billion between the end of August and the end of December 2008. Thus liquidity provision by the NBP made only a modest contribution to relieving the shortage of foreign currency.

Table 12.12

## Poland: Reserves net of predetermined outflows

	Reserves net of predetermined outflows			Level EUR bn	Change in month EUR bn
	Reserves EUR bn	Predetermined outflows Foreign currency loans, securities, and deposits EUR bn	Other EUR bn		
May-08	51.0	-5.4	-11.9	33.7	
Jun-08	52.2	-5.7	-10.9	35.5	1.8
Jul-08	54.4	-5.7	-12.2	36.5	1.0
Aug-08	55.3	-3.7	-11.7	39.9	3.4
Sep-08	51.6	-4.5	-8.0	39.1	-0.8
Oct-08	50.0	-4.7	-4.8	40.6	1.5
Nov-08	49.3	-4.6	-3.6	41.0	0.5
Dec-08	44.1	-4.6	-1.3	38.3	-2.8
Jan-09	46.1	-3.2	-1.8	41.2	2.9
Feb-09	48.8	-3.2	-1.8	43.9	2.7
Mar-09	46.1	-2.8	-1.3	42.0	-1.9
Apr-09	48.0	-2.8	-2.6	42.7	0.7
May-09	48.4	-3.0	-2.5	43.0	0.3
Jun-09	47.7	-2.6	-2.1	42.9	-0.1
Jul-09	50.8	-3.0	-2.6	45.2	2.3
Aug-09	53.0	-3.0	-2.1	48.0	2.7
Sep-09	53.4	-3.0	-2.0	48.4	0.5

Source: NBP.

In both Hungary and Poland, all the market indicators suggest that the effects of the credit crisis were very substantial and that they have not yet passed. As noted in section 5 above, the fact that transactions in the forint and the zloty cannot be settled through the Continuous Linked Settlement Bank may help to explain why covered interest differentials involving these currencies are so wide. It cannot be said that the central bank swap technique failed to deal with the problems, because the facilities provided

<sup>98</sup> See NBP (2009b), page 13.

could not augment either country's reserves. The swap technique strictly speaking was not really tried.

By contrast to the experiences of Hungary and Poland, in the **Czech Republic** cross-currency basis swap spreads increased only mildly, and returned to the very low value of 6 basis points at end-September 2009, close to pre-crisis levels, suggesting that stresses in cross-currency swap markets were much less severe there, and that the Czech Republic had no need to obtain swap lines (see Graph 6.5).

### 13. Conclusions.

The objectives of countries providing swap lines included allowing foreign central banks to provide sufficient foreign currency liquidity to their commercial banks, and relieving stresses in foreign exchange markets, including foreign exchange swap and cross-currency basis swap markets.

We related the probability of a country receiving a central bank swap line in a currency to a measure of currency-specific liquidity shortages for a large number of advanced and emerging economies based on the BIS international banking statistics, and found a significant relationship in the case of the US dollar, the euro, the yen and the Swiss franc. Moreover, we found that economies which are large international financial centres had a statistically significantly higher probability of receiving a US dollar swap line from the Federal Reserve, as well as from any country. We also found that actual US dollar funding obtained by drawing on the Fed's swap lines at end-2008 was statistically significantly larger for economies with higher US dollar shortages on our measure, as well as for economies which are large international financial centres.

From our assessment in section 11, we conclude that the swap lines provided by the Federal Reserve were very effective in relieving US dollar liquidity stresses and stresses in foreign exchange markets, so that the Fed's objectives were substantially met. It seems plausible that had the Fed not acted as it did, global financial instability would have been much more serious, and that the recession would consequently have been deeper. This effectiveness of the Fed's actions was most likely due to the fact that funds were provided quickly, limits were raised flexibly as the financial crisis intensified, especially after the failure of Lehman Brothers, and that large amounts were provided via the swap lines. The Federal Reserve consciously accepted some financial risk, but as noted in section 9, the risks were managed, and no losses were incurred for the swap lines which had expired by 1<sup>st</sup> February 2010<sup>99</sup>. The attractiveness of the dollar as a trading and investment currency has probably been enhanced by the Fed's actions.

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<sup>99</sup> The Federal Reserve reestablished temporary swap lines with several major central banks in May 2010, as discussed in Section 7.

The ECB had less need to provide euro liquidity, since a larger share of the external demand for euros was in countries close to the euro area, where banks were more likely to have parent or subsidiary banks that could pass on euro liquidity obtained from the ECB. The ECB provided limited amounts of euros to European countries outside the euro area, and took on little financial risk in doing so, by requiring in some cases high-quality euro collateral, instead of the domestic currency of the country receiving the swap line. Their effectiveness in relieving stresses in foreign exchange and cross-currency basis swap markets, and in containing the depreciation of the domestic currencies in countries affected by euro liquidity shortages, was limited. The Swiss National Bank provided Swiss franc/euro swaps to replace non-functioning swap markets, and limited its risk exposure in some cases by taking euro cash as collateral, rather than the domestic currency of the country receiving the swap line. Although the Swiss National Bank provided substantial amounts of Swiss francs to both central banks and commercial counterparties through its swap lines, they had little apparent effect on covered interest differentials and in relieving downward pressure on the currencies of Hungary and Poland, and only mixed effects on cross-currency basis swap markets. It is not clear whether swap lines provided by the Bank of Japan were used. Market stress indicators showed little relief, for example, in Korea. Many of the swap lines established by the People's Bank of China had the longer-term objective of promoting bilateral trade in the trading partners' own currencies, without the use of the US dollar. It is too early to assess whether this objective has been met.

The main objective of countries receiving swap lines was to provide sufficient foreign currency liquidity to ensure that banks could meet deposit withdrawals in foreign currencies. Central banks had several alternatives to the use of swap lines to meet these objectives. First, they could have provided domestic currency liquidity, which commercial banks would have had to swap into foreign currency. However, this approach had the disadvantage of aggravating stress in foreign exchange swap markets and cross-currency basis swap markets. Secondly, central banks could have sold their domestic currency for foreign currencies, which however would have had the disadvantage of leading to large domestic currency depreciations. Thirdly, central banks could have used their own foreign exchange reserves to provide foreign currency liquidity. However, a large part of their foreign exchange reserves may have been in the wrong currencies, and given the dislocation in the foreign exchange swap markets, they might have been difficult or expensive to swap into the desired currency. Moreover, the amount of the foreign exchange reserves may not have been large enough to provide the required foreign currency liquidity, or they might have been invested in temporarily illiquid assets. Fourthly, central banks in countries with mainly foreign-owned banks had the option of not providing additional foreign currency liquidity, but instead relying on the foreign parent banks to provide foreign currency liquidity to the subsidiaries in their country. However, this was not a feasible option for countries with mainly domestically owned banks, and for countries with mainly foreign-owned banks there was no guarantee that the parent banks would indeed provide the required liquidity. Given the disadvantages of

these other four options, central banks had powerful reasons to accept swaps from foreign central banks if available.

From our assessment of the effect on the recipients of swap lines in section 12, we conclude that among the large international financial centres, only the United States and Japan had sufficiently large foreign exchange reserves to be able to support its banks with foreign currency liquidity without the use of swap lines, and without running the risk of depleting their foreign exchange reserves to such an extent that it could lead to greater stresses in foreign exchange swap markets or a depreciation of the currency. For the other large international financial centres, namely the euro area, the United Kingdom, Switzerland and Australia, providing foreign currency liquidity out of their foreign exchange reserves would have used up a substantial fraction of their foreign exchange reserves. In Hong Kong, stresses in foreign exchange and cross-currency basis swap markets were never large, and the swap line provided by the People's Bank of China may not have been needed. Singapore did not draw on its swap line from the Fed.

We also conclude that among the smaller financial centres which drew on swap lines (Denmark, Norway and Sweden), only Norway had sufficiently large foreign exchange reserves to support its commercial banks with foreign currency liquidity without central bank swap lines. Among non-financial centres, Hungary and Poland drew only relatively small amounts on their swap lines, which provided funds only against high-quality euro collateral in the case of the ECB, or euros in the case of the Swiss National Bank. The swap lines seem not to have made a substantial impact. In Korea, stresses in foreign exchange swap and cross-currency basis swap markets persisted, and the central bank swap lines were not successful in removing them. Mexico, Poland and Hungary received support from the IMF in the form of a flexible credit line or a stand-by arrangement.

Looking ahead, even after the swap lines are all repaid, the situation is not likely to go back to what was previously regarded as normal. The credit crisis will leave behind it a greatly heightened appreciation of liquidity risk. Central banks had to go to extraordinary lengths to make liquidity available to their banking systems, and in the international arena, as the paper shows, several countries were saved from a serious financial instability only by the willingness of the Federal Reserve to make very large amounts of dollar liquidity available at very short notice. Monetary authorities will surely not be willing to accept in the future the same amount of risk that, perhaps unwittingly, they accepted in the past.

They are likely to react in two ways. First, they will want to ensure that there is less liquidity risk in their banking systems - or, more precisely, less liquidity risk which, if crystallized, would require the government to assist. This will apply to foreign currency liquidity risk just as much as to domestic currency liquidity risk, if not more. Limiting domestic currency liquidity risk could be achieved through regulatory measures requiring commercial banks to maintain higher liquidity ratios, or by charging commercial banks risk-based premiums for the liquidity insurance that central banks provide, or both.

Limiting foreign currency liquidity risk could also be achieved through regulatory measures, for example by limiting the foreign currency exposures of commercial banks.

Second, they will surely want to acquire more or better insurance against foreign currency liquidity risk. This could be achieved by countries unilaterally increasing their foreign exchange reserves, either through borrowing in international credit markets or by otherwise running balance of payments surpluses for a while, as was done for a number of years after 1997-98 by the countries most severely affected by the Asian financial crisis. Such unilateral actions would add to the contractionary pressures on the global economy, but they are likely to happen *faute de mieux* if no alternative is made available.

One possible alternative is that the swap lines which have been set up since the credit crisis began could be institutionalized in some way, so that they became a permanent feature of the international financial landscape, and the subject of permanent central bank co-operation. As a minimal first step, the documentation of standard swap agreements could be codified so that new swap lines could be established quickly and safely. Going beyond that, and reaching agreement on extending the term of swap agreements so that they provided the recipients with durable assurance of access to liquidity, would be difficult. The selection of countries which could benefit from institutionalized swap lines would be contentious. And there would be difficult moral hazard issues to resolve. The Federal Open Markets Committee was concerned about governance issues when it extended temporary swap lines to foreign central banks. Those concerns would be magnified if the swap lines represented a long-term commitment. How could the Federal Reserve be sure that the funds it provided would be used for the purposes intended? Could the funds be used by countries to finance unsustainable domestic policies and postpone necessary macro-economic adjustments? And to make the swap lines conditional, in order to meet this concern, would undermine their purpose, since conditional swap lines would not provide the beneficiaries with the required assurance of access to funds in an emergency.

It is beyond the scope of this paper to explore these issues in any depth, but in the light of the experiences that we have described and analysed, it is clear that they will need to be resolved in the post-crisis rebuilding of the international monetary system.



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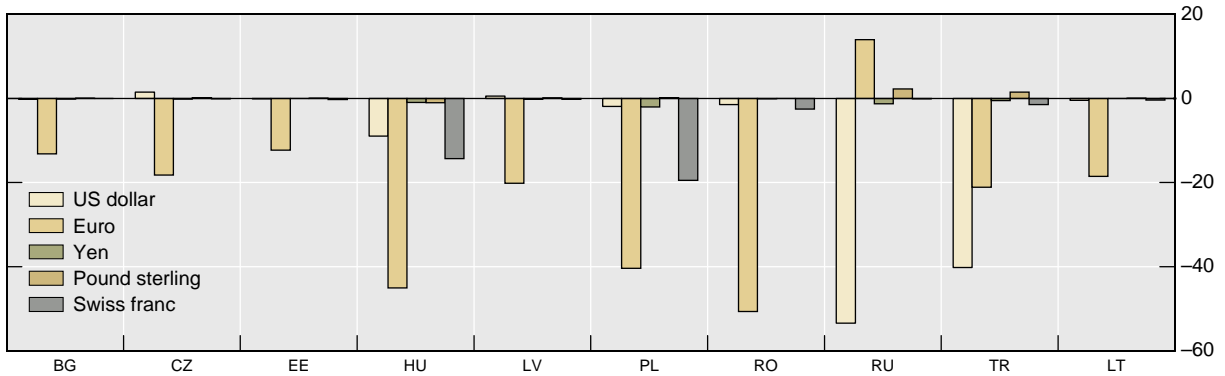
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## Appendix 1 Supplementary data.

Graph 1a

### Net outstanding cross-border claims on BIS reporting banks by economies shown<sup>1</sup>

In billions of US dollars, December 2008



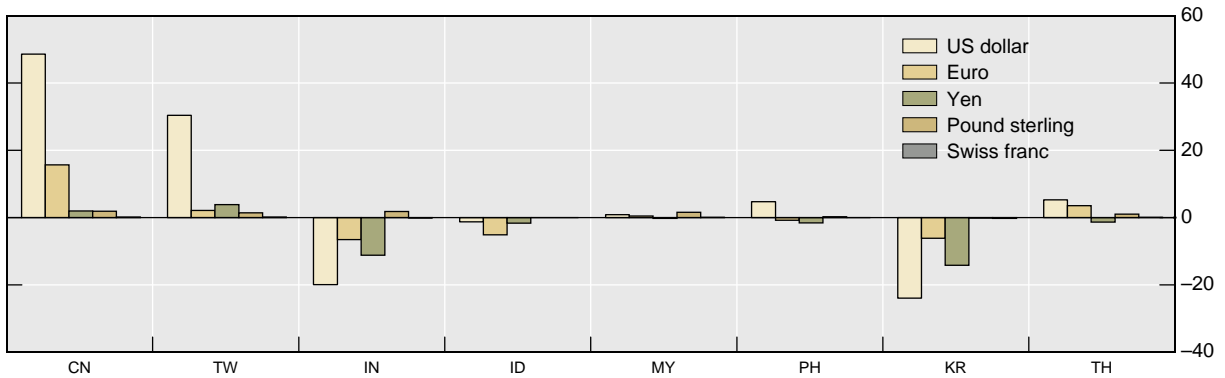
<sup>1</sup> See Graph 5.3 for a list of abbreviations of economies.

Sources: BIS locational international banking statistics, authors' calculations.

Graph 1b

### Net outstanding cross-border claims on BIS reporting banks by economies shown<sup>1</sup>

In billions of US dollars, December 2008



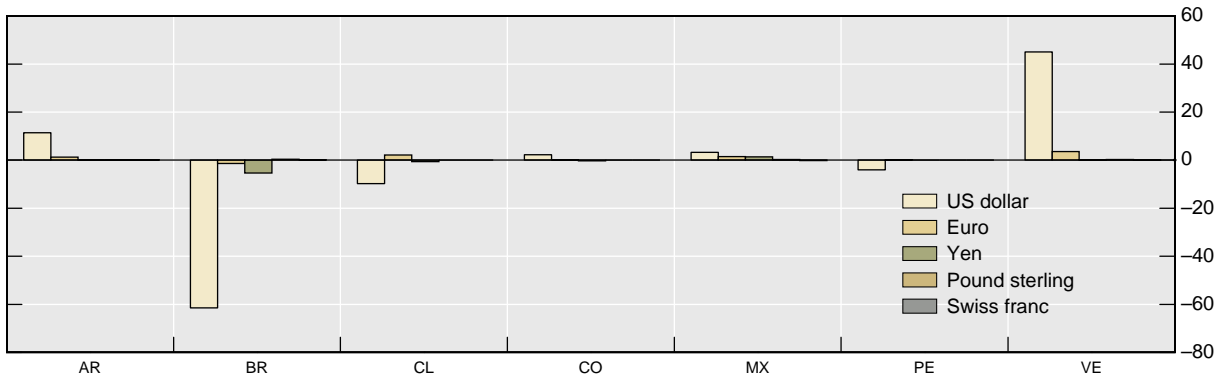
<sup>1</sup> See Graph 5.3 for a list of abbreviations of economies.

Sources: BIS locational international banking statistics, authors' calculations.

Graph 1c

**Net outstanding cross-border claims on BIS reporting banks by economies shown<sup>1</sup>**

In billions of US dollars, December 2008



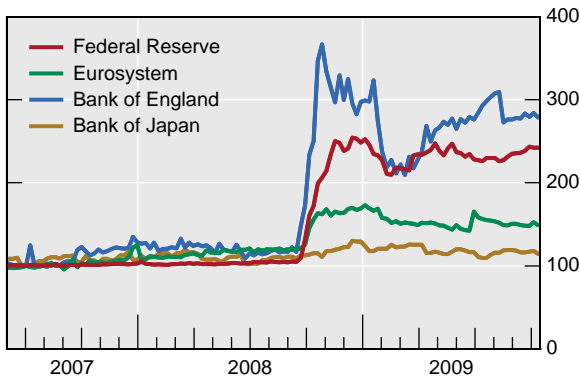
<sup>1</sup> See Graph 5.3 for a list of abbreviations of economies.

Sources: BIS locational international banking statistics, authors' calculations.

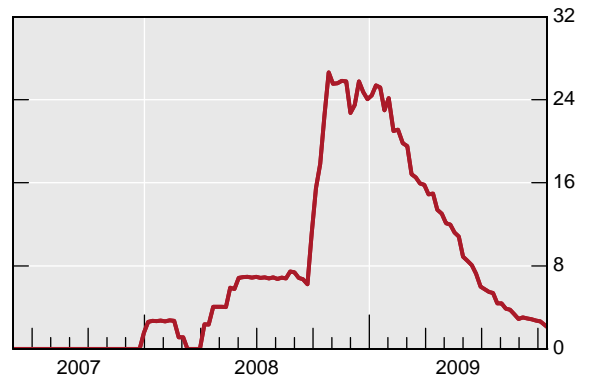
Graph 2

**Central bank total assets and FX swaps**

Central bank total assets<sup>1</sup>



FX swaps of the Federal Reserve<sup>2</sup>



<sup>1</sup> In national currency; mid-2007 = 100. <sup>2</sup> In per cent of total assets of Federal Reserve.

Sources: Datastream; national data.

Table A1

**IMF stand-by arrangements and flexible credit lines**

Current Financial Arrangements (GRA) as of October 1, 2009 (in millions of SDRs)

Member	Effective Date	Expiration Date	Amount Agreed	Undrawn Balance	Total GRA Credit	
					Outstanding	As percent of Quota
<b><i>Stand-by Arrangements</i></b>						
Armenia	06.03.2009	05.07.2011	534	269	264	287
Belarus	12.01.2009	11.04.2010	2,270	1,314	956	247
Bosnia	08.07.2009	30.06.2012	1,015	832	183	108
Costa Rica	11.04.2009	10.07.2010	492	492	--	--
El Salvador	16.01.2009	31.03.2010	514	514	--	--
Gabon	07.05.2007	06.05.2010	77	77	--	--
Georgia	15.09.2008	14.06.2011	747	365	383	254
Guatemala	22.04.2009	21.10.2010	631	631	--	--
Hungary	06.11.2008	05.10.2010	10,538	2,901	7,637	735
Iceland	19.11.2008	18.11.2010	1,400	840	560	476
Latvia	23.12.2008	22.03.2011	1,522	808	714	563
Mongolia	01.04.2009	01.10.2010	153	61	92	180
Pakistan	24.11.2008	30.12.2010	7,236	3,833	3,403	329
Romania	04.05.2009	03.05.2011	11,443	5,355	6,088	591
Republic of Serbia	16.01.2009	15.04.2011	2,619	1,918	702	150
Seychelles	14.11.2008	13.11.2010	18	10	8	90
Sri Lanka	24.07.2009	23.03.2011	1,654	1,447	241	58
Ukraine	05.11.2008	04.11.2010	11,000	4,000	7,000	510
18 Arrangements			53,863	25,667	28,231	
<b><i>Flexible Credit Line</i></b>						
Colombia	11.05.2009	10.05.2010	6,966	6,966	--	--
Mexico	17.04.2009	16.04.2010	31,528	31,528	--	--
Poland	06.05.2009	05.05.2010	13,690	13,690	--	--

Source: IMF (<http://www.imf.org/external/np/tre/activity/2009/100109.htm>).



## Appendix 2 List of swap lines

Table A2

### List of swap lines extended since December 2007

Date	Counterparty central bank	Amount (bn)	Expiry date
<b>1. Swap lines extended by the Fed to provide dollars.</b>			
12 December, 2007	European Central Bank	20	Jun 2008
	Swiss National Bank	4	Jun 2008
11 March, 2008	European Central Bank *	30	Sept 2008
	Swiss National Bank*	6	Sept 2008
2 May, 2008	European Central Bank*	50	Jan 2009
	Swiss National Bank*	12	Jan 2009
30 July, 2008	European Central Bank*	55	Jan 2009
18 September, 2008	European Central Bank*	110	Jan 2009
	Swiss National Bank*	27	Jan 2009
	Bank of Japan	60	Jan 2009
	Bank of England	40	Jan 2009
	Bank of Canada	10	Jan 2009
24 September, 2008	Reserve Bank of Australia	10	Jan 2009
	Sveriges Riksbank	10	Jan 2009
	Danmarks Nationalbank	5	Jan 2009
	Norges Bank	5	Jan 2009
26 September, 2008	European Central Bank*	120	Jan 2009
	Swiss National Bank*	30	Jan 2009
29 September, 2008	Bank of Canada*	30	Apr 2009+
	Bank of England*	80	Apr 2009
	Bank of Japan*	120	Apr 2009
	Danmarks Nationalbank	15	Apr 2009
	European Central Bank*	240	Apr 2009
	Norges Bank*	15	Apr 2009+
	Reserve Bank of Australia	30	Apr 2009+
	Sveriges Riksbank*	30	Apr 2009+
	Swiss National Bank*	60	Apr 2009+
13 October, 2008	Bank of England*	Unlimited	Apr 2009+
	European Central Bank*	Unlimited	Apr 2009+
	Swiss National Bank*	Unlimited	Apr 2009+
14 October, 2008	Bank of Japan*	Unlimited	Apr 2009+
28 October, 2008	Reserve Bank of New Zealand	15	Apr 2009+
29 October, 2008	Banco Central do Brasil	30	Apr 2009+
	Banco de Mexico	30	Apr 2009+
	Bank of Korea	30	Apr 2009+
	Monetary Authority of Singapore	30	Apr 2009+

\* Denotes an extension or enlargement of an existing facility.

+ The expiry date of these swap lines was extended first to October 2009 and later to February 2010.

## 2. Swap lines under which the Fed can receive foreign currencies

6 April, 2009	Bank of England	GBP 30	Oct 2009**
	European Central Bank	EUR 80	Oct 2009**
	Bank of Japan	JPY 10,000	Oct 2009**
	Swiss National Bank	CHF 40	Oct 2009**

\*\* The expiry date of these swap lines was later extended to February 2010.

## 3. Swap lines extended by the European Central Bank to provide euros

20 December, 2007	Sveriges Riksbank	10	
16 October 2008	Magyar Nemzeti Bank	5	Not specified
27 October, 2008	Danmarks Nationalbank	12	'As long as needed.'
21 November, 2008	National Bank of Poland	10	Not specified

## 4. Other swap lines in the extended euro network

### a. Danmarks Nationalbank supplying euros

16 May, 2008	Central Bank of Iceland	0.5	Extended in November 2008 until end-2009.
16 December, 2008	Bank of Latvia	0.125	

### b. Norges Bank supplying euros

16 May, 2008	Central Bank of Iceland	0.5	Extended in November 2008 until end-2009.
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### c. Sveriges Riksbank

16 May, 2008	Central Bank of Iceland	0.5 (EUR)	Extended in November 2008 until end-2009.
16 December, 2008	Bank of Latvia	0.375 (EUR)	
27 February, 2009	Bank of Estonia	10 (SEK)	

## 5. Swap lines extended by the Swiss National Bank to provide Swiss francs

15 October, 2008	European Central Bank	Not specified	Jan 2009*+
7 November, 2008	National Bank of Poland	Not specified	Jan 2009*+
28 January 2009	Magyar Nemzeti Bank	Not specified	Apr 2009*+

\*+ The expiry dates of these swap lines were later extended to April, then to October 2009 and again until January 2010. Swap operations were discontinued after 25 January 2010.

+\* The expiry date was later extended to October 2009, then to January 2010. Swap operations were discontinued after 25 January 2010.

## 6. Asian swap lines

### a. People's Bank of China

12 December, 2008	Bank of Korea	180 (CNY) 38,000 (KRW)	3 years
20 January, 2009	Hong Kong Monetary Authority	200 (CNY) 227 (HKD)	3 years
8 February, 2009	Bank Negara Malaysia	80 (CNY) 40 (MYR)	3 years
11 March, 2009	National Bank of Belarus	20 (CNY) 8,000 (BYR)	3 years

23 March, 2009	Bank Indonesia	100 (CNY) 175,000 (IDR)	3 years
2 April, 2009	Central Bank of Argentina	70 (CNY) 38 (ARS)	3 years

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**b. Bank of Japan**

30 June, 2008	Reserve Bank of India	3 (USD)	
12 December, 2008	Bank of Korea	20 (USD)	Jan 2009***
6 April, 2009	Bank Indonesia	12 (USD)	

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\*\*\* The expiry date was later extended first to October 2009, and later to February 2010.

Sources: Central banks.

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