The Financial Crisis through the Lens of Foreign Exchange Swap Markets

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During the financial crisis, non-US banks relied increasingly on foreign exchange swap markets to fund their US dollar asset holdings. This caused the cost of borrowing US dollars via the swap market to rise above the measured cost of borrowing US dollars directly in money markets – an apparent deviation from the covered interest parity condition. Pricing in the Australian dollar foreign exchange swap market, and to a lesser degree the cross-currency swap market, also reflected the global scarcity of US dollar funding at the height of the crisis.

Introduction

A key feature of the global financial crisis was the sharp increase in counterparty and liquidity risks in core money and credit markets. The dislocation of these markets forced banks to seek alternative funding sources, with the strains most acute for institutions outside of the United States funding US dollar assets, particularly institutions based in Europe. These institutions were often forced to raise funds in other currencies and then swap these into US dollars. As a result, the cost of raising US dollar funds via the foreign exchange swap market increased significantly relative to the benchmark cost of raising US dollars directly, an apparent breach of the covered interest parity (CIP) condition. This dislocation in interbank funding markets has received considerable attention recently, and was the topic of a recent report by the Committee on the Global Financial System (CGFS 2010). This article discusses key aspects of the dislocation through the lens of developments in foreign exchange swap markets, which play a key role in linking funding markets across currencies.

The first part of the article outlines the apparent failure of CIP across US dollar funding options and the factors that contributed to it. The second part focuses on the developments in Australian dollar foreign exchange (FX) swap and cross-currency swap markets. As with other currencies, it cost more to borrow Australian dollars and swap them into US dollars in the foreign exchange market than it did to borrow directly in US dollar money markets. This premium to borrow US dollars via the foreign exchange swap market was also reflected in the cross-currency swap market.

Global Developments

Borrowers wishing to raise short-term US dollars have the option of borrowing directly in US dollar money markets or raising funds in an alternative currency and exchanging these for US dollars in the foreign exchange market. In order to hedge the exchange rate risk that arises from borrowing in one currency and investing in another, investors will typically use a foreign exchange swap to exchange currencies. Under such a swap, two parties swap currencies at the beginning of the contract at the spot exchange

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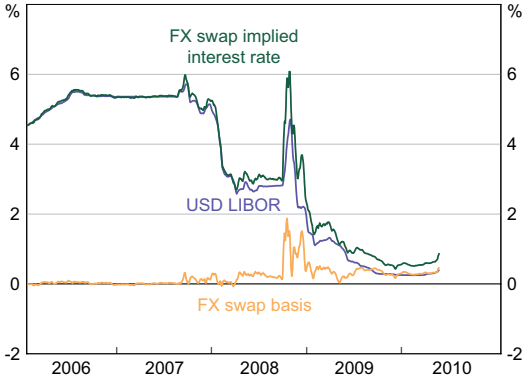
rate and agree to reverse the swap at the forward rate at the close of the contract.[1] In essence, the exchange is similar to a secured loan in the currency being received. Under normal circumstances, the forward rate is determined by the CIP condition, which states that the cost of obtaining US dollars by borrowing another currency and swapping into US dollars (the implied US dollar interest rate) should be the same as borrowing directly in the US dollar money market. A positive spread between the implied interest rate and the money market interest rate – termed the basis – implies a higher cost for obtaining US dollars via the foreign exchange market and a deviation from CIP.

Graph 1

EUR/USD FX Swap Basis

3-month maturity, 5-day-centred moving average



Sources: Bloomberg; RBA

The basis is measured by comparing the cost of borrowing via the swap market with the cost to globally active banks of raising US dollar deposits, typically proxied by US dollar LIBOR.[2] Historically, the basis measured in this way has been close to zero for most currency pairs, in line with the CIP condition. However, during the financial crisis a premium emerged to borrow US dollars via the swap market, raising costs for borrowers. For example, the basis on a 3-month EUR/USD foreign exchange swap widened to around 25 basis points following the initial signs of stress in money markets in August 2007 and then to around 200 basis points following the collapse of Lehman Brothers in September 2008 (Graph 1). The basis has since fallen in line with the dissipating tension in funding markets over 2009 and 2010, although the uncertainty generated by the Greek sovereign-debt crisis has seen the basis tick up recently. On average over the past year, the basis in the EUR/USD foreign exchange swap market has remained noticeably higher than prior to the crisis.

An increase in the premium to receive US dollars under swap indicates a shift in the relative demand for, and supply of, US dollars outside the United States. Demand for US dollar funding from non-US banks was persistently high through the crisis. At the onset of turmoil in 2007, many banks outside the United States had large US dollar asset positions that required ongoing funding. This was particularly the case in Europe, where banks had funded relatively long-term and illiquid US dollar investments using short-term funding (McGuire and von Peter 2009). The resulting maturity mismatch between assets and liabilities exposed these banks to funding (rollover) risk. Another example was in Korea, where banks had large short-term US dollar funding needs generated by domestic banks' provision of hedging products to Korean shipbuilders (CGFS 2010).

From late 2007, conditions in US money markets tightened considerably and non-US banks found it increasingly difficult to borrow US dollars directly. Large-scale redemptions from US money market funds saw these funds reduce their holdings of non-US banks' commercial paper while some central banks withdrew a portion of their US dollar foreign exchange reserves held on deposit at

1 For a detailed explanation of foreign exchange swaps and also cross-currency swaps see Baba, Packer and Nagano (2008).

2 The London Interbank Offer Rates (LIBOR) for the US dollar and a range of other currencies are reference rates based on the interest rates at which banks offer to borrow from each other on an unsecured basis in the London market. For the US dollar and the euro, 16 large globally active banks are surveyed for deposit-rate quotes at 11 am London time and then the mean of the middle eight quotes for each currency is calculated. Fifteen banks are common to the euro and US dollar panels.

non-US banks (McGuire and von Peter 2009). Following the collapse of Lehman Brothers, general counterparty concerns and a preference for greater precautionary balances meant that banks also became unwilling to lend in interbank markets, tightening the supply of US dollars (CGFS 2010). Increasingly, non-US institutions sought to borrow in alternative markets and swap the proceeds into US dollars through the foreign exchange swap market. From the perspective of US dollar lenders, foreign exchange swaps have a relatively low level of counterparty risk because they are secured by the exchange of principal at the beginning of the contract.

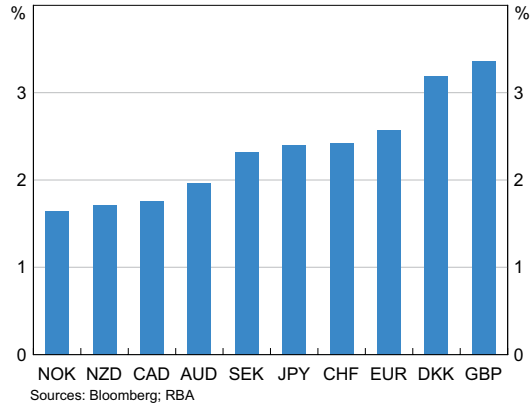
The global nature of the shortage of US dollars saw the basis increase across all US dollar crosses. The most affected were crosses against currencies from regions where banking sectors had the largest funding gaps in US dollars, including the United Kingdom and the euro area (Graph 2). Non-US banks also sought to borrow in third-currency markets in order to swap into US dollars, causing a basis to emerge even for currencies that were not associated with local banking sectors seeking to roll over short-term US dollar funding: in particular, there were reports of foreign banks raising funds in Japan, Singapore and Hong Kong for this purpose. In some instances, the additional demand for funding in these markets saw the local cost of funds rise (CGFS 2010).

Under ordinary market conditions, institutions would respond to these price differences so that deviations from CIP were very short-lived. Financial institutions would exploit the arbitrage opportunity by borrowing in US money markets and lending in the foreign exchange swap market and borrowers would shift towards raising US dollars directly in money markets. But during the financial crisis, institutions were severely restricted in their ability to exploit pricing anomalies. Concerns that counterparties would default on unsecured loans limited banks' ability to borrow US dollars directly.

Graph 2

Peak FX Swap Basis for USD Crosses

3-month maturity



Sources: Bloomberg; RBA

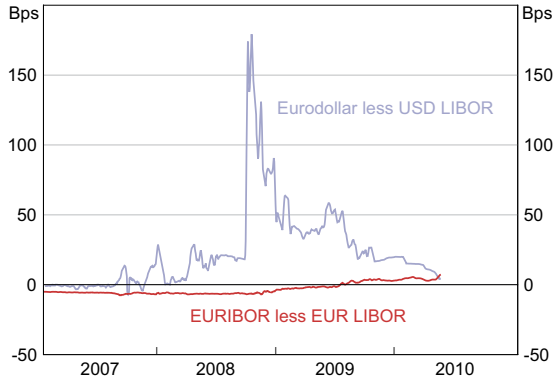
Further, balance sheet constraints, restrictions on non-essential trading activity and the preference for greater US dollar liquidity meant that institutions with access to US dollar funding cut back sharply on US dollar lending to non-US institutions even in the swap market (CGFS 2010).

An implication of this shift in risk assessment was that non-US banks appear to have paid higher risk premiums to obtain US dollar funding than for funding in other currencies. In essence, there was credit tiering specific to US dollar markets, similar to the large 'Japan premium' paid by Japanese banks during the late 1990s, such that LIBOR was not a relevant benchmark for many institutions seeking to borrow US dollars. Anecdotal reports suggest that the actual cost of US dollar funding exceeded LIBOR. One reason is that LIBOR is based on indicative (rather than contractual) borrowing rates. More significantly, however, the group of banks borrowing US dollars via the swap market is much larger and more diverse than the banks on the LIBOR panel and these banks appear to have been paying an historically large spread to LIBOR to borrow US dollars through the crisis.

An alternative benchmark of the average cost of raising offshore US dollar deposits for the wide

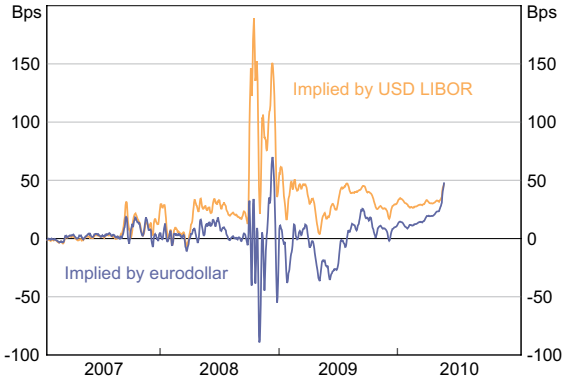
group of banks is the eurodollar rate published by the US Federal Reserve (Graph 3).[3] During the crisis, the spread of the eurodollar rate to US dollar LIBOR increased sharply, suggesting that average US dollar borrowing costs across the broader range of banks did exceed LIBOR. In contrast, the average rate to borrow euros for the wide group of banks (measured using EURIBOR) tracked the euro LIBOR rate closely throughout the crisis.[4]

Graph 3
Credit Spreads
3-month maturity, 5-day-centred moving average



Sources: Bloomberg; Board of Governors of the Federal Reserve System; RBA

Graph 4
EUR/USD FX Swap Basis
3-month maturity, 5-day-centred moving average



Sources: Bloomberg; Board of Governors of the Federal Reserve System; RBA

The conclusion that US dollar LIBOR was below the actual cost of borrowing US dollars in the market is consistent with the large measured basis in the swap market. The eurodollar spread to US dollar LIBOR corresponds closely with the premium paid to receive US dollars under swap. Calculating the basis using the eurodollar rate instead of US dollar LIBOR results in deviations from CIP that are much smaller on average, and at times imply a discount for US dollar funding through the foreign exchange swap market (Graph 4).

The widening of the eurodollar-US dollar LIBOR spread shows that credit tiering between the broad group of European banks and those on the LIBOR panel was more pronounced in US dollar funding markets than in euro funding markets. This indicated that the market was concerned about the ability of some institutions to repay US dollar debt in particular. The situation may have reflected lenders discriminating among borrowing banks on the basis of the quality and liquidity of the borrowing banks' US dollar assets, or simply general concerns about US dollar rollover risk leading lenders to discriminate against lesser-known 'names'. The spread may also reflect the fact that the broad group of banks had fewer US dollar funding options than the generally larger banks on the LIBOR panel and so competed more aggressively for US dollars in money markets.

Policy initiatives by central banks helped alleviate the strains in offshore US dollar funding markets. The initial tension in the foreign exchange swap market was addressed by the introduction in 2007 of US dollar central bank swap lines and US dollar liquidity operations by non-US central banks. The extension of these swap lines over 2008, particularly

3 The eurodollar rate is calculated from the best offered rates on offshore US dollar deposits brokered by ICAP at around 9.30 am New York time. Unlike LIBOR, the eurodollar rate is based on binding market quotes.

4 The euro interbank offer rate (EURIBOR) is an indicative rate for borrowing euros on an unsecured basis within Europe. Forty two European banks are surveyed for deposit-rate quotes at 10.45 am central European time and then the mean of the middle 70 per cent of quotes is calculated.

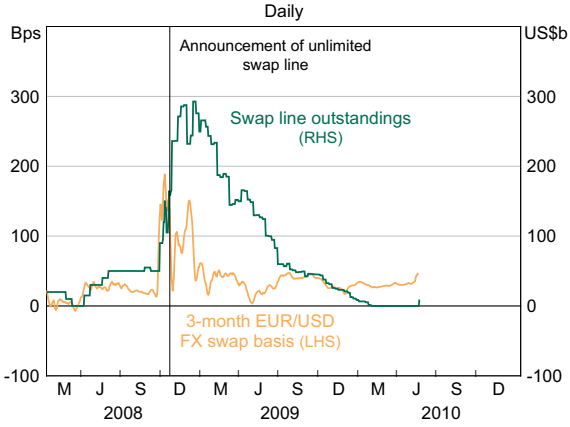
the decision to make several of the swap lines unlimited, successfully reduced the basis (Graph 5).[5] In addition, several facilities introduced within the United States to provide liquidity to US money market funds were likely to have indirectly provided liquidity to non-US banks by allowing US money market funds to resume purchasing offshore banks' commercial paper (Baba, McCauley and Ramaswamy 2009). As market conditions improved over 2009 and 2010, and the premium to borrow US dollars in the private sector decreased, use of these facilities declined significantly and the facilities themselves were largely wound up. In recent months, however, the uncertainty generated by the Greek sovereign-debt crisis has seen the friction in US dollar funding markets re-emerge and the US dollar swap lines between the Fed and central banks in Europe and Japan have been reopened.

Australian Developments

As was the case for other currencies, the global shortage of US dollars had an effect on the Australian dollar foreign exchange swap market. From close to zero prior to the crisis, a positive premium emerged to receive US dollars under swap first in August 2007 and then again in September 2008 (Graph 6). However, the premium was relatively short-lived for the AUD/USD pair compared to the EUR/USD pair, returning close to zero by the end of 2008. Indeed, US dollar funding through the foreign exchange swap market was relatively cheap in early 2009.[6]

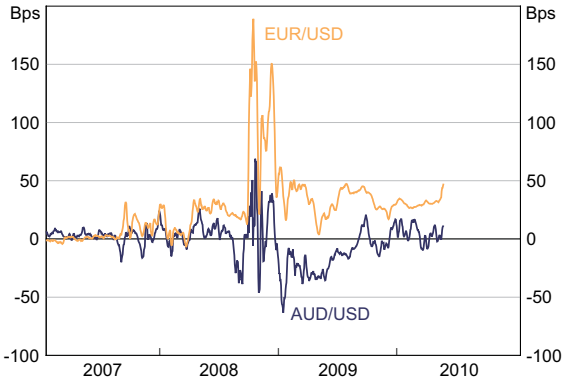
The premium in the AUD/USD foreign exchange swap market did not reflect strong demand for US dollars from Australian banks. Australian banks are funded primarily through longer-dated bond issuance and, in contrast to European banks, have a net liability position in US dollars. Rather, the premium in the AUD/USD swap market moved in line with other markets as the Australian dollar market was also a source of funds for international banks during the crisis. Capital flows data indicate that some banks within Australia increased their lending abroad, seemingly to related offshore entities, for a brief period around the collapse of Lehman Brothers. The crisis also saw a temporary reduction in capital inflows into Australia through late 2008 and early 2009.

Graph 5
ECB Swap Line and FX Swap Basis
Daily



Sources: Bloomberg; Board of Governors of the Federal Reserve System; RBA

Graph 6
FX Swap Basis
3-month maturity, 5-day-centred moving average



Sources: Bloomberg; RBA

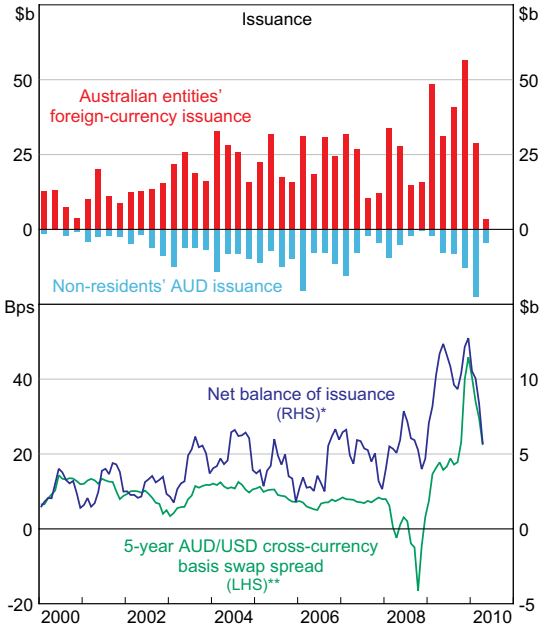
5 Several studies have assessed the effectiveness of the central bank swap lines at reducing the premium associated with borrowing US dollars via the swap market. See, for example, Baba and Packer (2009).

6 This calculation uses the bank bill swap rate (BBSW) as the benchmark interbank Australian dollar borrowing rate, which is the rate at which a prime bank could borrow Australian dollars in the Australian market at 10 am Sydney time. If measured using Australian dollar LIBOR, borrowing US dollars via the foreign exchange swap market would have appeared expensive through to mid 2009.

One effect of the dislocation in the swap market was to limit the ability of Australian non-bank financial institutions, such as fund managers, to roll over the hedges used to manage the exchange rate risk inherent in their international investment portfolios. The local banks which sell hedging products use the foreign exchange swap market to offset the risks involved in trading with their domestic customers. Uncertain about their own access to US dollars through the swap market, local banks became less willing to provide quotes to their clients (CGFS 2010).

The dislocation also affected the cost of hedging banks' own long-term foreign currency debt in the cross-currency swap market. Cross-currency swaps are used extensively by Australian banks to hedge foreign currency bond issuance at maturities of typically over three years. Although conceptually similar to a foreign exchange swap, the payments under a cross-currency swap mimic those under a floating-rate bond: the two parties exchange principal at the start of the contract, make floating-rate interest payments in the borrowed currency during the life of the contract and then reverse the exchange of principal at the close of the contract at the initial exchange rate. The cross-currency swap serves as a hedge against both interest rate risk and exchange rate risk.

Graph 7
Bond Issuance and the Cross-currency Basis Swap Spread



* Australian entities' foreign currency issuance less non-residents' domestic and offshore Australian dollar issuance; 6-month moving average
** Monthly average
Sources: Bloomberg; RBA

Historically, Australian institutions have paid a small premium over the interbank interest rate (typically the bank bill swap rate) to receive Australian dollars under a cross-currency swap. This premium, which represents the cost of hedging the foreign currency risk, is quoted directly by market participants and is also termed the basis, though it is not strictly equivalent to the basis in the foreign exchange swap market. The Australian dollar cross-currency swap market is used primarily by Australian institutions swapping the proceeds of foreign-currency bond issuance into Australian dollars and by foreigners swapping the proceeds of Australian dollar debt issuance into their domestic currency. The premium arises because of stronger relative demand to receive Australian dollars under swap; Australian institutions issue a greater value of foreign-currency bonds into international capital markets than foreigners issue Australian dollar-denominated bonds, such as Kangaroo bonds (Graph 7).[7]

During the crisis there was a marked increase in volatility in the quoted basis. In late 2008, the basis became large and negative, consistent with the premium to receive US dollars in the foreign exchange swap market. Various studies have concluded that there is a similar connection across the two swap markets for other currencies.[8] This movement in the basis occurred even though there was no sizeable change in the net balance of bond issuance through 2008; although issuance by Australian banks was lower in 2008 than prior to the crisis, this was

7 For details of this spread and its sensitivity to changes in issuance see Ryan (2007) and for a description of hedging foreign currency-denominated debt see Davies, Naughtin and Wong (2009).

8 See Baba *et al* (2008).

offset by lower Kangaroo bond issuance, so that the net balance of issuance increased only marginally.

Since early 2009, however, a premium has returned to receive Australian dollars in the cross-currency swap market consistent with the historical relationship. The premium is wider than prior to the crisis, reflecting the recent trends in net bond issuance. As conditions in financial markets improved, Australian banks have sought to lengthen the maturity of liabilities and have issued a large amount of foreign currency bonds in international capital markets (Black, Brassil and Hack 2010), whereas issuance of Kangaroo bonds has been slower to return to pre-crisis levels. There are signs that Kangaroo issuers are responding to the price discrepancy, with $20 billion of Kangaroo issuance in the March quarter 2010, and the basis has moderated from its peak.

Conclusion

The dislocation in unsecured US dollar funding markets during the financial crisis led foreign banks with large US dollar funding requirements to borrow US dollars increasingly through the secured foreign exchange swap market. At the same time, the supply of US dollars in this market was curtailed, leading to a premium to receive US dollars under swap. This apparent deviation from CIP persisted because institutions became unwilling to exploit arbitrage opportunities in an environment characterised by much higher counterparty risk. It also indicated a high degree of credit tiering in offshore US dollar funding markets.

Although Australian financial institutions did not have large US dollar asset positions to fund, at the height of the crisis the pricing of Australian dollar swaps moved broadly in line with the pricing for other currencies against the US dollar. Pricing of AUD/USD cross-currency swaps was also affected by the global US dollar shortage over 2008, but by early 2009 the historical relationship between the quoted basis and net bond issuance had re-emerged.

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