

The Global Financial Crisis and Offshore Dollar Markets

Niall Coffey, Warren B. Hrung, Hoai-Luu Nguyen,
and Asani Sarkar

Facing a shortage of U.S. dollars and a growing need to support their dollar-denominated assets during the financial crisis, international firms increasingly turned to the foreign exchange swap market and other secured funding sources. An analysis of the ensuing strains in the swap market shows that the dollar “basis”—the premium international institutions pay for dollar funding—became persistently large and positive, chiefly as a result of the higher funding costs paid by smaller firms and non-U.S. banks. The widening of the basis underscores the severity and breadth of the crisis as markets designed to facilitate the flow of dollars faltered and institutions worldwide struggled to obtain funds.

The financial crisis that began in the fall of 2007 caused a shortage of dollars just when banking institutions around the world needed them most.¹ Facing potential losses from their credit- and mortgage-related products, U.S. and non-U.S. banks alike began to worry about their ability to fund operations and, as a result, grew reluctant to lend dollars to one another. Very quickly, the interbank money markets became impaired. In particular, unsecured (uncollateralized) cash lending became quite restricted while other key funding sources, such as the commercial paper market, also dried up.

At the same time, non-U.S. institutions without a natural base of dollar deposits—in particular, the institutions’ off-balance-sheet conduits created to invest in U.S. mortgage products—had a growing need to support their dollar-denominated assets.² As the supply of dollars shrank and demand grew, international firms needing dollars increasingly turned to funding sources of a more secured nature, such as foreign exchange (FX) swaps—a development that in turn caused stresses in the swap and other funding markets.

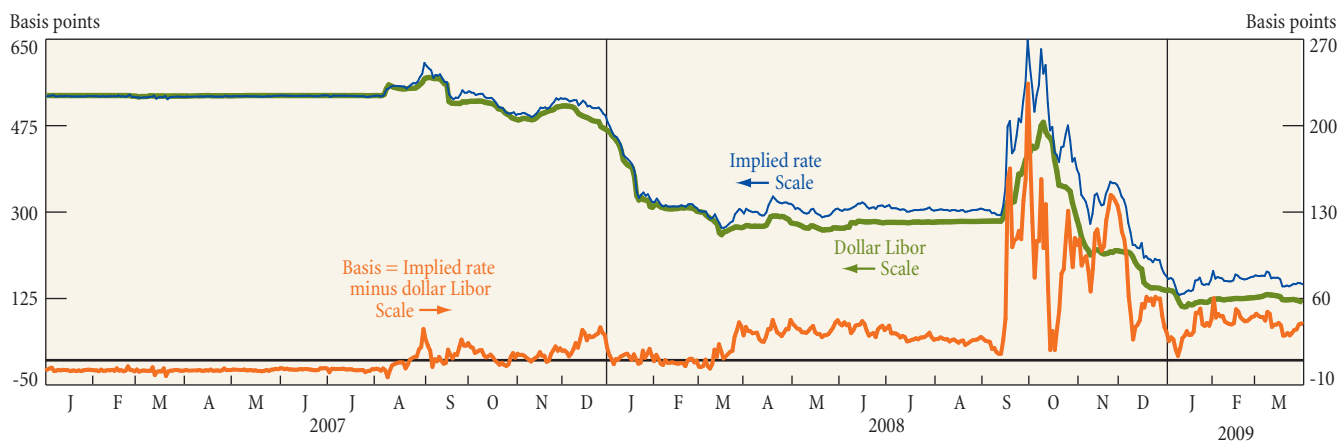
This edition of *Current Issues* examines the effects on the FX swap market of the difficulties international firms encountered obtaining dollars during the crisis. In the FX swap market, participants exchange one currency for another for a fixed period of time. The cost of the swap is determined by the difference between the spot and forward exchange rates for the two currencies, a differential normally equivalent to the difference between the interest rates denominated in those two currencies. Our analysis focuses on the dollar “basis”—the dollar-denominated interest rate implied

¹ The term “dollars” in this article refers to U.S. dollars.

² Baba, Packer, and Nagano (2008), for example, argue that during the recent crisis, European institutions sought out the foreign exchange swap market to finance their special purpose vehicles (SPVs). Companies typically use these vehicles to finance a large project without putting the entire firm at risk or to isolate themselves from financial risk by transferring assets to the SPV for management.

Chart 1

Movements in the Dollar Basis and Its Components January 2007 to March 2009



Sources: Reuters; Federal Reserve Bank of New York staff calculations.

Note: Libor is the London interbank offered rate.

from an FX swap minus a benchmark unsecured dollar-denominated lending rate such as Libor.³ Essentially, the basis is the premium paid by international institutions to obtain dollars in the FX swap market.

Prior to August 2007, when the financial crisis began, the basis was essentially zero, meaning that the cost of funding in dollars was nearly identical for most market participants regardless of their location or size.⁴ Since the onset of the crisis, however, the dollar basis in the FX swap market has become persistently large and positive; indeed, the basis skyrocketed to more than 200 basis points in September 2008 following the bankruptcy of Lehman Brothers (Chart 1).

Our study provides evidence that elevated levels of the basis during the crisis may be attributed primarily to the higher dollar funding costs of two types of institutions: smaller firms and non-U.S. banks. Both types of institutions appear to have paid a premium when borrowing funds, especially in the second half of 2008, compared with larger firms and U.S. banks. Moreover, this funding premium, which seems to reflect perceptions of higher risk associated with smaller firms and non-U.S. banks, is correlated with the dollar basis.

The widening of the basis illustrates the severity and breadth of the crisis as banking institutions across the world faced difficulties obtaining funding. The persistence of a wide basis also illustrates

³ The London interbank offered rate, or Libor, is an average interbank borrowing rate calculated and published daily by the British Bankers' Association (BBA). For the U.S. dollar, the BBA assembles quotes from sixteen contributing banks at 11 a.m. London time. After the top and bottom four quotes are discarded, the middle eight quotes are used to calculate an average, which then becomes that day's dollar Libor.

⁴ The expected value of the basis is in fact zero, according to the principle of covered interest rate parity, or CIP. This concept is discussed in an online appendix to this article, available at <http://www.newyorkfed.org/research/current_issues/ci15-6_appendix.pdf>.

an apparent breakdown in the “law of one price” during the crisis as heightened funding costs resulted in virtually identical securities being sold at vastly different prices. These funding strains in the FX swap market can have important effects on broader market functioning because a spike in funding costs could force banks to sell assets at distressed prices, an outcome that would have adverse consequences for the solvency of these institutions and for the stability of the global financial system.

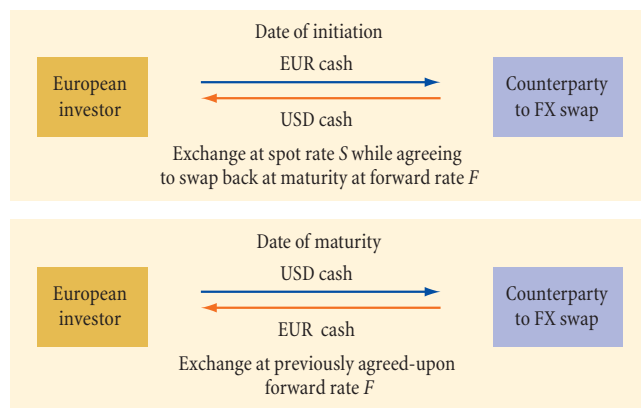
The Global Shortage of U.S. Dollars

International firms need U.S. dollars to fund their investments in U.S.-dollar-denominated assets, such as retail and corporate loans as well as securities holdings. The funding for these investments is typically obtained from a variety of sources: the unsecured cash markets, the FX swap market, and other short-term wholesale funding markets.

During the financial crisis, a global shortage of dollars occurred, primarily reflecting the funding needs of European banks. Baba, McCauley, and Ramaswamy (2009) show that European banks had substantially increased their U.S. dollar asset positions from about \$2 trillion in 1999 to more than \$8 trillion by mid-2007. Until the onset of the crisis, these banks had met their funding requirements mainly by borrowing from the unsecured cash and commercial paper markets and by using FX swaps. Unfortunately, most unsecured funding sources eroded during the crisis. For example, U.S. money market funds abruptly stopped purchasing bank-issued commercial paper after they faced large redemptions associated with the bankruptcy of Lehman Brothers (Baba, McCauley, and Ramaswamy 2009). The reduced availability of dollars resulted in higher dollar funding costs.

The remainder of this article describes the increase in dollar funding costs as reflected in the FX swap market, the primary

Euro-U.S. Dollar Foreign Exchange (FX) Swap



market enabling global financial institutions to manage multi-currency funding exposures without assuming the credit risk inherent in unsecured funding markets. As liquidity in major unsecured lending markets eroded, the demand for dollar funding through FX swap markets intensified sharply and pushed up the cost of raising dollars through FX swaps. Moreover, heightened demand for dollar funding in conjunction with a reduced willingness to lend dollars noticeably impaired the functioning of the FX swap market, particularly as term liquidity dried up.

The FX Swap Market and the Dollar Basis

In an FX swap, two parties exchange one currency for another at the current spot rate while simultaneously agreeing to reverse the transaction at a specified time in the future at the prevailing forward rate (see the diagram above). In essence, FX swaps allow counterparties to exchange funding at predetermined times in the future, in one currency for another, without incurring foreign exchange risk.⁵

To understand how an FX swap works, consider a European investor who is interested in investing euros for three months. The investor faces two options. She can invest her money in the unsecured euro cash market for three months at the prevailing euro-denominated interest rate. Alternatively, she can convert her euros into dollars through a three-month FX swap and invest the dollars for three months at the prevailing dollar-denominated interest rate—for example, by buying a three-month U.S. Treasury bill. After three months, the investor collects the final payout from the Treasury bill and concludes the FX swap by trading the dollars back for euros.⁶

⁵ However, Duffie and Huang (1996) show that these transactions are still subject to credit risk because there are costs associated with replacing the contract if the counterparty defaults.

⁶ More detail, including a description of how the FX basis is measured, is provided in the online appendix to this article, available at <http://www.newyorkfed.org/research/current_issues/ci15-6_appendix.pdf>.

These two ways of investing euros must provide equal returns at the end of three months; otherwise, arbitrageurs would exploit the less costly option until the two returns are equalized once again. Assuming a no-arbitrage condition and using data on the euro-dollar spot and forward rates as well as on euro Libor—a proxy for the European interest rate—we can calculate the dollar interest rate implied by euro-dollar FX swaps.

Our focus here is on the dollar basis, defined as follows:

$$\text{Dollar basis} = \text{Implied FX swap dollar interest rate} \\ - \text{benchmark dollar interest rate.}$$

For our analysis, we use the three-month FX swap rate and a three-month dollar interest rate. Therefore, the dollar basis rate applies to a three-month term loan.

The Behavior of the Dollar Basis during the Crisis

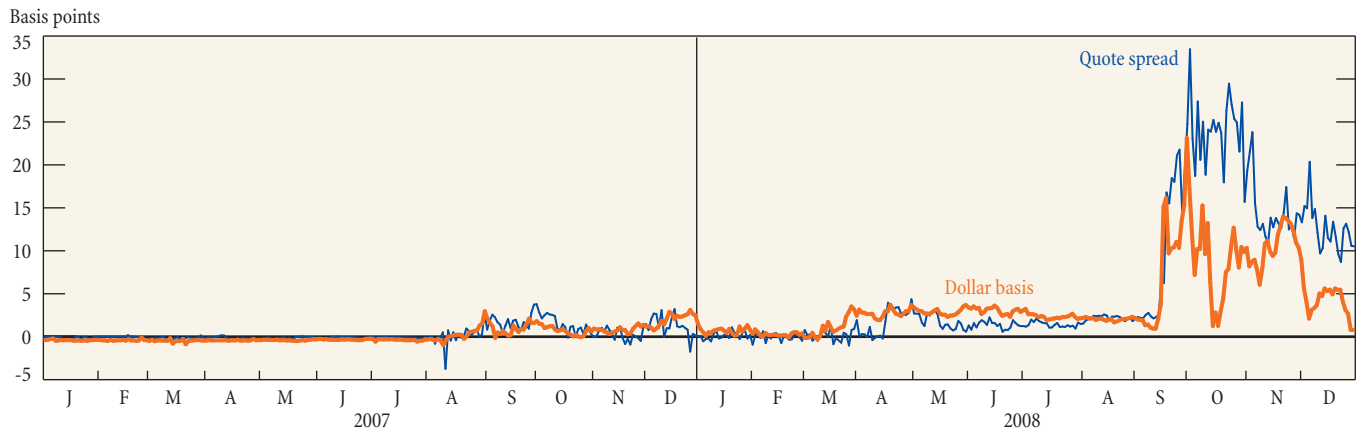
We calculate the dollar basis as the rate implied by the euro-dollar FX swap minus dollar Libor. Under normal conditions, the size of the dollar basis is expected to be minuscule because investors typically seek arbitrage opportunities; any nonzero levels are likely the result of temporary mispricings that are not arbitrated away. While historically the basis has hovered close to zero, during the recent crisis the dollar basis implied from euro-dollar FX swap prices has been consistently large and positive, implying a market-based dollar funding rate substantially higher than dollar Libor (Chart 1). Although down from the unprecedented levels seen following the Lehman bankruptcy, the basis remained at a high level as of March 2009.

Thus far, we have calculated the basis relative to dollar Libor. However, concerns have persisted throughout the crisis that dollar Libor may be understated. An important aspect of Libor is that it is determined from the daily publication of the individual quotes of sixteen of the world's largest banks. The suspicion is that, as market conditions worsened over the course of the crisis, some banks may have strategically underreported their true borrowing costs in order to conceal their problems. In this case, the widening of the basis may have been driven partly by banks' reported rates increasing by a smaller amount than would be expected given the levels of risk.

To address this concern, we recalculate the basis with respect to an alternative interest rate: the New York Funding Rate (NYFR), introduced in June 2008 and designed to ameliorate the perceived flaws in Libor.⁷ We find that the behavior of our alternative rate calculated on the NYFR basis closely tracks that of the Libor basis.

⁷ To mitigate the incentive to underreport borrowing rates, ICAP, the U.K. bond broker that introduced the NYFR, does not disclose the individual quotes or the actual composition of the contributing banks. While Libor banks are asked to provide an estimate of their own borrowing costs, NYFR banks are asked only for an estimate of the rate at which a representative bank would be likely to obtain funding. An illustration of the alternative basis rate can be found in Coffey et al. (2009).

Chart 2

Spread between Average Dollar Libor Quotes for Non-U.S. and U.S. Banks

Sources: Bloomberg L.P.; Reuters; Federal Reserve Bank of New York staff calculations.

Note: Libor is the London interbank offered rate.

Is the phenomenon of a positive and persistent dollar basis unique to the euro-dollar exchange rates used in our calculations? To answer this question, we estimate the dollar basis according to FX swap prices for five other currencies relative to the U.S. dollar: the Japanese yen, the British pound, the Swiss franc, the Australian dollar, and the New Zealand dollar.⁸ These other basis rates have also widened dramatically since September 15, 2008, and have generally followed a path similar to that of the euro-dollar basis. Therefore, the unusual behavior of the dollar basis extends to different interest rates and currency pairings, suggesting that the behavior is a real economic phenomenon and not a statistical artifact.

Explaining the Widening of the Dollar Basis

Persistent deviations of the basis from zero are likely to occur because the implied FX rate and Libor reflect the funding costs for different sets of institutions that have different risk profiles and liquidity needs. While these differences are negligible under normal conditions, they are likely to become accentuated when conditions become volatile. In particular, dollar Libor represents the funding costs of the largest institutions and is the benchmark rate for trillions of dollars of U.S. financial contracts, whereas the implied FX rate represents the funding costs of a diverse group of non-U.S. institutions, including smaller ones. Therefore, changes in the basis can take into account differences in the funding costs of non-U.S. institutions relative to U.S. institutions and of large firms relative to small ones.⁹

⁸ To calculate the basis for a currency pair, we use the same no-arbitrage condition but substitute the exchange rates and Libor for that currency. For example, for the pound-dollar currency pair, we back out an implied dollar rate using pound Libor, the spot pound-dollar FX rate, and the forward rate at which the pound-dollar FX swap is transacted.

⁹ The same distinctions are likely relevant for the NYFR basis. The NYFR rate is a New York-based rate and the participating institutions are generally the largest banks.

Funding Costs of U.S. and Non-U.S. Institutions

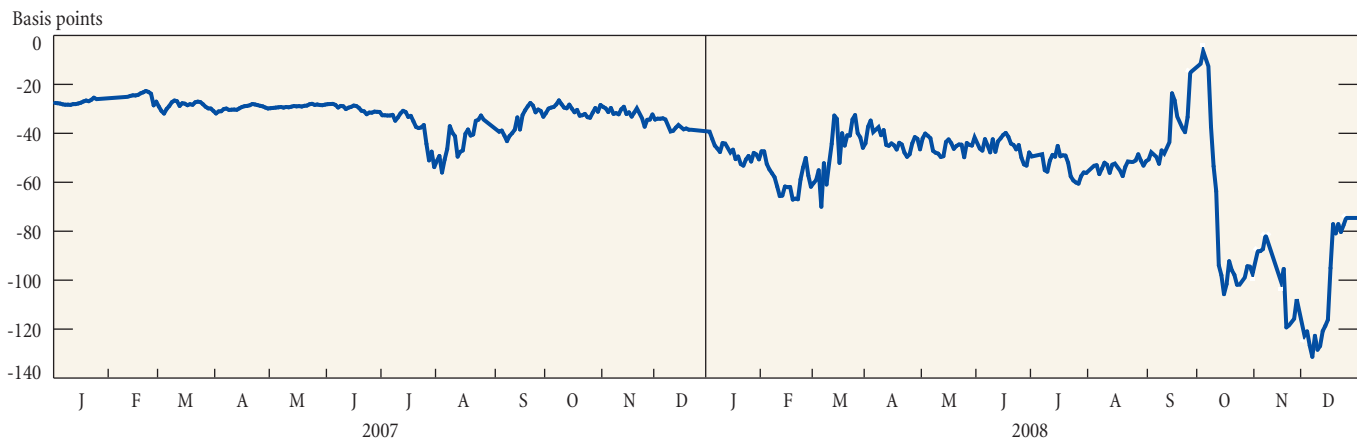
The quotes that the large banking firms submit to the Libor panel each day reflect the dollar funding costs of U.S. and non-U.S. institutions. Throughout the crisis, the average quote submitted by a non-U.S. bank has tracked slightly higher than the average quote submitted by a U.S. bank. This difference became more pronounced after September 2008 (Chart 2), suggesting meaningful differences in dollar funding costs across the two sets of institutions over this period.

Are changes in the basis associated with changes in the differential funding costs of U.S. and non-U.S. institutions? We find a strong positive correlation between the basis and the spread between average non-U.S. and U.S. Libor quotes (Chart 2). Moreover, the correlation is higher for the second half of 2008, the period when increases in the basis were particularly dramatic, than for either the 2007 crisis period or the first half of 2008. This higher correlation suggests that movements in the basis are associated with differences in the funding costs of non-U.S. institutions and their U.S. counterparts.

There are two related channels through which movements in the basis might incorporate the distinctions between U.S. and non-U.S. institutions. The first is through the institutions' relative risk profiles. A rise in the perceived risk of non-U.S. institutions relative to U.S. banks should increase the implied rate by more than Libor and widen the basis. However, a potential widening of the basis may also be attributable to a second channel—an excess demand for dollars, as explained earlier. Even without changes in relative risk, this excess demand for dollars may have driven up the implied rate, leading to a widening in the basis. Indeed, our evidence that the dollar basis estimated from different currency pairings has widened sharply since September 15, 2008, supports the hypothesis of a structural increase in the demand for dollars worldwide.

Chart 3

Difference between Credit Default Swaps of Libor Banks and CDX Index January 2007 to December 2008



Sources: Bloomberg L.P.; Markit.

Note: Libor is the London interbank offered rate.

Funding Costs of Large and Small Institutions

Banks that submit quotes to the Libor panel may be among the largest financial institutions in the world, but they represent only a portion of the market. In contrast, the supply of and demand for dollar funding among a vast community of international institutions determine FX swap rates. Thus, the implied rate reflects the borrowing costs of a broader and more diverse set of market participants than does Libor. Consequently, the basis can be interpreted as a measure of the dollar funding costs of the largest institutions relative to those of the broader market.

By itself, the increase in the basis provides insufficient evidence that borrowing rates for the largest institutions have risen less than the market rate. First, the basis is subject to multiple influences and is therefore not a direct measure of the relative borrowing costs of large institutions. Second, while it is true that large firms have fared better than others in some previous crises,¹⁰ the largest banks appear to have been more negatively affected than other banks in the current crisis, at least initially.

We can approximate the average credit risk of large banks on the Libor panel by averaging the prices of the credit default swap (CDS) contracts written on them.¹¹ The credit risk of a typical

¹⁰ Bernanke (1983), for example, shows that the Great Depression had a more adverse impact on the earnings of small and medium-sized firms compared with those of large firms.

¹¹ A CDS can be thought of as an insurance contract on a corporate bond or loan. The buyer of the contract pays a quarterly premium to the seller, who promises to cover the losses on the debt should the corporation default. A higher CDS price requires sellers to pay more to buyers in the event of default, mainly because investors perceive a higher probability of default and so place a greater value on insurance against that risk. Consequently, higher CDS prices generally indicate higher credit risk.

U.S. institution is captured by the CDX index, an average of the CDS prices of a large and diverse number of U.S. institutions.¹² Therefore, the difference between the average CDS prices of Libor banks and the CDX index indicates the relative credit risk of large banks compared with a representative group of U.S. institutions.

Typically, the average CDS price of Libor banks is less than that of the CDX index, reflecting the lower perceived credit risk of large banks compared with typical institutions during normal times (Chart 3). However, during the latter half of 2007 (the early part of the crisis), the gap decreased, indicating that the credit risk of the largest banks increased more than did the credit risk of typical institutions.

To obtain a direct measure of the relative borrowing costs of the largest institutions, we examine the spread between the euro-dollar interest rate and dollar Libor. The euro-dollar rate reflects the funding costs for a broad spectrum of financial institutions in the dollar funding markets. As such, its spread to Libor can be viewed in part as a measure of the extent to which average funding costs for the broader market have differed from those faced by large institutions that borrow funds denominated in dollars.¹³

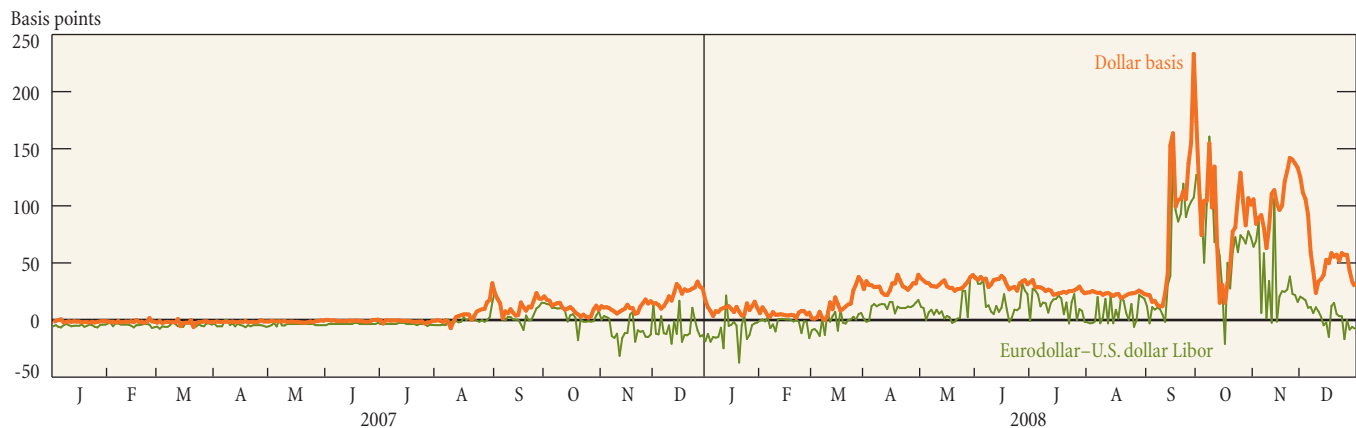
Although the spread between the euro-dollar rate and dollar Libor was fairly stable and close to zero prior to August 2007, it has since become more volatile (Chart 4). Notably, beginning in spring 2008, the spread was primarily positive and of a large

¹² Specifically, we use the CDX IG index, which consists of relatively high-quality U.S. institutions.

¹³ Both the euro-dollar rate and Libor are offshore interest rates on deposits denominated in dollars. The euro-dollar rate is a market rate on dollar transactions globally, not just in London. Libor, by contrast, is a survey-based rate fixed in London.

Chart 4

Eurodollar–U.S. Dollar Libor Spread January 2007 to December 2008



Sources: Bloomberg L.P.; Reuters; Federal Reserve Bank of New York staff calculations.

Note: Libor is the London interbank offered rate.

magnitude, implying that institutions in general were paying a premium relative to large firms for dollar funding over the period. This implication raises the issue of whether changes in the basis are associated with the different funding costs of large institutions. A look at the basis and the spread measures in Chart 4 suggests that these factors move together. We find a high positive correlation between the basis and the eurodollar–Libor spread for 2007–08. This correlation is particularly strong in the second half of 2008, the period for which we observe a sustained positive uptick in the basis.

What might have caused these funding-cost differentials between large institutions and the broader market in the first place? One possible answer is changes in relative risk. We generally expect interest rates to rise with the borrower's risk profile; therefore, changes in the credit risk or liquidity risk of large institutions relative to the risk of small firms should be reflected in the basis.

For example, if investors perceive an increase in the risk attached to large banks on the Libor panel relative to the risk of the broader market, we would expect Libor to increase more than the implied rate and, consequently, the basis would decrease. If, however, the relative risk of large banks is perceived to decrease, then the basis would increase. Thus, movements in the basis should have a negative correlation with changes in the relative credit risk of large institutions.

We find that as the financial crisis progressed from January 2008 onward, the difference between the CDS prices of Libor banks and those of typical U.S. institutions has generally become increasingly negative—in other words, the credit risk of Libor banks has increased less than that of U.S. institutions generally (Chart 3). There are two exceptions: the period right after the near-failure of Bear Stearns and the period immediately follow-

ing the failure of Lehman Brothers. During these periods, the gap in CDS prices shrank temporarily, indicating that the failure of these large institutions created a short-term perception of heightened credit risk for large banks in general.

Studying the association between the basis and the relative credit risk of Libor banks, we find that the correlation is -0.53 —meaning that, as we had conjectured, the basis is higher when the relative credit risk of large U.S. banks is lower.

In summary, the evidence appears to support the view that, as the crisis evolved, the credit risk of the largest banks generally increased less than that of other institutions, leading to a favorable differential in their funding costs relative to those of other institutions. These differential funding costs, in turn, were associated with an increase in the dollar basis.

Conclusion

As the financial crisis that began in the fall of 2007 deepened and spread, the supply of dollars shrank while demand grew. The ensuing breakdown in interbank money markets drove international institutions to seek other sources of dollars to fund their operations.

Our analysis of the dollar basis highlights the international dimensions of the current crisis. Differential access to dollar funding by U.S. and non-U.S. banks had profound effects on the borrowing rates for all institutions. Banks and the markets designed to facilitate the international flow of dollars—such as the eurodollar market and the FX swap market—were unable to respond to the extraordinary circumstances.

The widening of the basis illustrates the breakdown in arbitrage relationships that has afflicted many markets during the financial crisis. For example, eurodollar interest rates in New York

and London diverged during the crisis (McAndrews 2009)—as did yields on corporate bonds and credit default swaps, which are closely related securities (Garleanu and Pedersen 2009). The element common to all of these phenomena was increased funding costs, which impeded arbitrageurs from shrinking the basis between these types of securities. In addition, counterparty credit risk became prominent, and previously risk-free arbitrage trades suddenly became risky. Coffey, Hrung, and Sarkar (2009) find that both funding constraints and counterparty risk explain the rise in the basis and that the relative importance of each factor changed as the crisis evolved.

Our analysis also highlights the need to study diverse measures of funding costs during financial crises. Divergences between primarily domestic rates and primarily offshore rates may suggest stresses in international capital markets. Insights into the causes of these divergences can guide policy initiatives by helping regulators target the institutions and markets likely to be affected. A recent example is the Federal Reserve's bilateral currency swap arrangements with a number of international central banks. These arrangements enabled international central banks to provide dollars to firms in their local jurisdictions and appear to have been associated with reductions in dollar interest rates (Coffey, Hrung, and Sarkar 2009; McAndrews 2009).

The authors thank Ben Craig, Joseph Haubrich, and Jason Miu for valuable comments.

References

- Baba, Naohiko, Robert N. McCauley, and Srichander Ramaswamy. 2009. "U.S. Dollar Money Market Funds and Non-U.S. Banks." *BIS Quarterly Review*, March: 65-81.
- Baba, Naohiko, Frank Packer, and Teppei Nagano. 2008. "The Spillover of Money Market Turbulence to FX Swap and Cross-Currency Swap Markets." *BIS Quarterly Review*, March: 73-86.
- Bernanke, Ben. 1983. "Nonmonetary Effects of the Financial Crisis in the Propagation of the Great Depression." *American Economic Review* 73, no. 3 (June): 257-76.
- Coffey, Niall, Warren B. Hrung, and Asani Sarkar. 2009. "Capital Constraints, Counterparty Risk, and Deviations from Covered Interest Rate Parity." Federal Reserve Bank of New York *Staff Reports*, no. 393, September.
- Duffie, Darrell, and Ming Huang. 1996. "Swap Rates and Credit Quality." *Journal of Finance* 51, no. 3 (July): 921-49.
- Garleanu, Nicolae, and Lasse Heje Pedersen. 2009. "Margin-Based Asset Pricing and Deviations from the Law of One Price." Unpublished paper, University of California at Berkeley and New York University.
- McAndrews, James. 2009. "Segmentation in the U.S. Dollar Money Markets during the Financial Crisis." Unpublished paper, Federal Reserve Bank of New York.

ABOUT THE AUTHORS

Niall Coffey is chief dealer for foreign exchange and Warren B. Hrung a financial specialist in the Market Operations Monitoring and Analysis Function of the Federal Reserve Bank of New York's Markets Group; Hoai-Luu Nguyen is an economist in the Capital Markets Function and Asani Sarkar a research officer in the Money and Payments Studies Function of the Bank's Research and Statistics Group.

Current Issues in Economics and Finance is published by the Research and Statistics Group of the Federal Reserve Bank of New York. Linda Goldberg and Charles Steindel are the editors.

Editorial Staff: Valerie LaPorte, Mike De Mott, Michelle Bailer, Karen Carter

Production: Carol Perlmutter, David Rosenberg, Jane Urry

Subscriptions to *Current Issues* are free. Write to the Media Relations and Public Affairs Department, Federal Reserve Bank of New York, 33 Liberty Street, New York, N.Y. 10045-0001, or send an e-mail to pipubs@ny.frb.org. Back issues of *Current Issues* are available at http://www.newyorkfed.org/research/current_issues/.

The views expressed in this article are those of the authors and do not necessarily reflect the position of the Federal Reserve Bank of New York or the Federal Reserve System.