INTERNATIONAL MONETARY FUND

Understanding Financial Interconnectedness

Prepared by the Strategy, Policy, and Review Department and the Monetary and Capital Markets Department, in collaboration with the Statistics Department and in consultation with other Departments

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- ***Financial interconnectedness***. Countries are financially interconnected through the asset and liability management (ALM) strategies of their sovereigns, financial institutions, and corporations. This financial globalization has brought benefits as well as vulnerabilities. In particular, the speed with which illiquidity and losses in some markets can translate into global asset re-composition points to the risks of interconnectedness.
- ***Mapping global risks***. Understanding the nature of these interconnections is essential for tracking the build-up of systemic risk concentrations, identifying the "fault lines" along which financial shocks propagate, and enhancing macro-prudential surveillance and policy making. This paper takes initial steps toward understanding financial interconnectedness by first outlining the architecture of cross-border finance and then exploring two related fault lines—funding models and ratings—that played a pivotal role in the global financial crisis.
- ***Architecture of cross-border finance***. The vast majority of global finance is intermediated by a handful of large, complex financial institutions (LCFIs), which transact on a few payments and settlements systems and operate out of a small set of countries that serve as global *common lenders* and *borrowers*. These countries form the "core" of cross-border financial flows and connect countries with one another. The transmission of shocks and the spillover of policies and financial conditions occur largely through these core economies.
- ***Balance sheet transformations***. In the run up to the crisis, LCFIs generally increased their reliance on market-sensitive funds, as the global search for yield prompted a move away from more expensive deposit funding. Facilitated by regulatory arbitrage, this liability re-composition also reflected, and was supported by, changes on the asset side, through securitization, ratings creep, and leverage. This process resulted in balance sheet growth and aided greater interconnections of banks with nonbank funding sources and across borders. It also resulted in the buildup of systemic risk concentrations and formed the critical fault lines along which liquidity shocks were subsequently transmitted globally.
- ***Next steps***. To further develop an accurate understanding of financial interconnections and the buildup of systemic risk concentrations, large data gaps need to be bridged and additional analytical tools developed. For bilateral and multilateral surveillance, a deeper appreciation of interconnections beyond simply aggregated country-level analysis is required. Further dialogue with policy makers is also needed on the macro-prudential policies to address risks.

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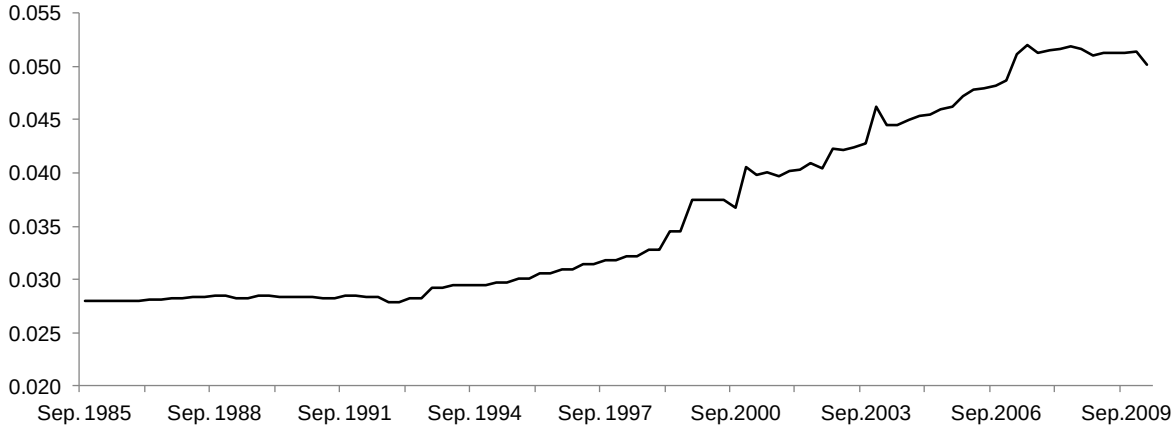
I. INTRODUCTION[1]

1. ***Interconnectedness***. The rapid financial globalization of the past three decades—reflected in the over six-fold increase in the external assets and liabilities of nations as a share of GDP (see Lane and Milesi-Ferretti, 2007)—has been accompanied by an increase in financial interconnectedness. Countries have become more and more inter-linked with each other, particularly since the mid-1990s, as the asset and liability management (ALM) strategies of their sovereigns, financial institutions, and corporations have become increasingly global in nature (Figure 1).

Figure 1. Cross-Border Financial Interconnectedness, 1985–2010

(Index of the number of bilateral links between economies, as a share of all possible bilateral links)



Source: Fund staff estimates, based on Hattori and Suda (2007) and banking sector data from the BIS.

2. ***Vulnerabilities***. This financial globalization has brought benefits, such as scale, more efficient intermediation of savings, and pooling of risks. It has also brought vulnerabilities. The speed with which illiquidity and losses in some markets can translate into global asset re-composition is evidence both of the risks associated with interconnectedness and of the efficiencies of the transmission and intermediation process. Shocks in one part of the system can be amplified and transmitted through common intermediaries pursuing global ALM strategies that collectively become overexposed to risk in the upswing of a credit cycle and overly risk-averse in a downswing.

[1] Prepared by a staff team led by David Marston (SPR) and Laura Kodres (MCM) and comprising Ritu Basu, Rishi Goyal, Olessia Korbut, Samar Maziad, Tola Oni, and Karim Youssef (SPR), and Sylwia Nowak and Juan Solé (MCM). Paul Austin and Alicia Hierro (STA) provided invaluable assistance with data from the Coordinated Portfolio Investment Survey (CPIS), as did the Bank for International Settlements (BIS) and Lipper (Thomson Reuters) on international banking and the global funds industry, respectively.

3. ***Risk maps***. In a highly interconnected world, as agents typically fail to take account of the effects of their actions on others, the *potential* for systemic risk rises. As observed in the run up to the crisis, a build-up of leverage and liquidity mismatches at the same time can leave the global financial system vulnerable to adverse changes in the macroeconomic and market environment, and pervasive interconnections can result in a rapid transmission of adverse shocks across the global financial system. The crisis has led to calls for *global financial risk maps* to understand interconnectedness, track the build-up of systemic risk concentrations, and improve surveillance (Issing et al., 2009). Such maps could be used to:

- discern common themes across countries (e.g., exposures to common networks of intermediaries), the most important risk drivers, and the amplification or mitigation as well as the propagation mechanisms of shocks;

- analyze the channels for cross-border spillovers and enable policy makers to better understand the risks that their economies face, the effectiveness of alternative policy options, and more generally reforms of the global financial architecture; and

- complement efforts underway at the national level at strengthening systemic risk assessments.

4. ***First steps***. This paper seeks to advance our understanding of interconnectedness, by mapping some aspects of the architecture of global finance and investigating a set of critical "fault lines" related to interconnectedness along which systemic risks were built up and shocks transmitted in the crisis. It thus takes initial steps toward operationalizing enhanced financial sector and macro-financial surveillance called for by the Executive Board (see PIN/10/52 and IMF, 2010a and 2010b) and by experts such as de Larosiere et al. (2009), who argued that the Fund is "uniquely placed for playing an over-arching role in ensuring high-quality macroeconomic and macro-prudential surveillance even if it may need to further deepen its analysis of financial market developments … and developing … an international risk map." Getting a better handle on interconnectedness would strengthen the Fund's ability, together with the Financial Stability Board, to track systemic risk concentrations. It would also inform spillover and vulnerability analyses, and sharpen bilateral and multilateral surveillance.

5. ***What this paper does and does not do***. The paper uses available data on cross-border banking from the Bank for International Settlements (BIS) in the run up to and during the crisis, as well as a novel dataset on the global funds industry (money market, mutual, hedge, exchange-traded, and pension funds), to *illustrate* global financial interconnections and risk concentrations in the run up to the crisis. To be very clear, the paper does *not* construct a global risk map, nor does it attempt to point out where systemic risks are currently building up or might arise in the future. There are significant data gaps that preclude the completion of a comprehensive risk map—gaps that can only be bridged with buy-in from the membership on the value of such an exercise. The *role of this paper* is

to suggest how such analyses might be undertaken and to offer some new perspectives on augmenting financial surveillance at the multilateral and bilateral levels.

6. ***The story***. The paper is divided into three related parts:

- *Architecture* (section II): the architecture of cross-border finance is one of concentration and interconnections. Countries are exposed to certain key money centers or "nodes"—*common lenders and borrowers*—through which the majority of global finance is intermediated. These exposures reflect transactions that occur predominantly through a small, core set of large complex financial institutions (LCFIs) engaged in global ALM.[2]
- *Balance sheet transformations* (section III): financial interconnections increased in the run up to the crisis, as illustrated in Figure 1. Given the low nominal interest rates, LCFIs in the key money centers engaged in riskier activities, innovating on both the asset and liability sides. These innovations resulted in a *transformation of liabilities* as well as of *assets* that intimately linked confidence- or market-sensitive funding sources with securitization, ratings, and leverage. They gave rise to funding risks and a heavy dependence on dollar funding markets—critical fault lines—that were borne out in the crisis.
- *Other fault lines* (section IV): ratings dependence also constitutes a fault line closely related to the interconnected financial system, as does the concentration of settlements platforms. But while the shortcomings of ratings are well known, the robustness of the payments and settlements systems through this crisis has been an unheralded success.

The way forward, including filling data gaps, is discussed in section V. Section VI concludes with issues for discussion.

II. An Architecture of Cross-Border Financial Interconnectedness

This section describes the global financial system, with an emphasis on its concentration and interconnections. The BIS's international banking data, the IMF's portfolio statistics, and a hitherto unused dataset on the global funds industry point to close and significant connections across economies as well as between banks and various types of private sector funds.

A. Concentration

7. ***Global financial system***. The global financial system is highly concentrated. Global financial intermediation is carried out predominantly by about 20 key LCFIs, operating in a handful of jurisdictions and transacting over a few payments and settlement platforms.

[2] The term "large complex financial institution" or "LCFI" was coined by the Bank of England in its December 2001 *Financial Stability Review* and refers to those institutions that are among the largest ten participants in a number of capital market activities measuring relative business size. The original set comprised 15 institutions.

- *Institutions*. These LCFIs are systemic players, measured by importance in global book running for bonds, structured finance, U.S. asset backed securities, syndicated loans, equities, and custody asset holders (see Table 1—a "book runner" is the main underwriter or lead manager in debt, securities, or equity issuances). They operate with global ALM strategies and are engaged, either directly or through affiliates, in banking, securities, and insurance operations. They comprise bank as well as nonbank institutions, such as investment banks, money market funds, and structured investment vehicles (SIVs) (see Supplement 1, section I). The nonbank entities are often linked to banks, including through credit and liquidity enhancement mechanisms, a behavior that has been fueled in part by the desire to avoid regulations.

- *Markets and instruments*. LCFIs dominate the markets for debt, equity securities, syndicated loans, securitization, structured financial products, and OTC derivatives. They are the main counterparties for large insurers and some of the biggest broker dealers. "Shadow" institutions associated with the LCFIs in the run up to the crisis, namely, SIVs and conduits, typically borrowed short term, such as in money market and commercial paper markets, to invest longer term in instruments such as mortgage-backed securities. These markets are highly correlated, interconnected by asset allocation (and, more generally, ALM) strategies and counterparties such as insurers and broker-dealers.

- *Infrastructure*. The infrastructure of payments and settlements is also highly concentrated, largely occurring over a few systems (BIS, 2008a)—including CLS (for foreign exchange), DTC (for stocks and bonds), Target II (for domestic and cross-border payments in the Euro area), Clearstream and Euroclear (for securities), and SWIFT (for common messaging across systems). In addition, Bank of New York Mellon, JP Morgan, State Street, and Citigroup are the most important custody banks, which arrange settlement of security transactions, gather information on securities cash-flows, and manage any associated cash and foreign exchange transactions when required. This concentrated infrastructure held up during the crisis—an unheralded success—owing to the application of lessons learned from previous crises, namely, the use of real time gross settlements, delivery versus payment in securities, and payments versus payment in foreign currency settlements, which effectively removed principal counterparty risks from transactions (see Section IV).

Some well-known LCFIs are presented in Table 1, based on being among the top book runners (or underwriters/lead managers in issuances). By virtue of their global reach, these LCFIs can reap diversification benefits. At the same time, they are also "super spreaders" of crisis and losses in stressful times; during the recent global crisis, 18 institutions accounted for more than half of the $1.8 trillion losses reported by the world's banks and insurance companies.

Table 1. Key LCFIs

(Defined by top book runners)

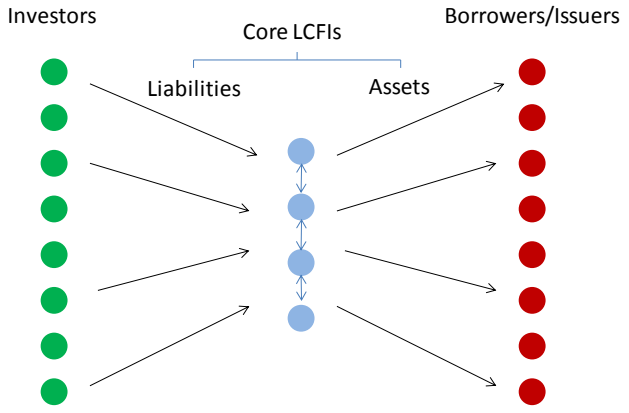
		International Bonds	Structured Finance	US ABS	Syndicated Loans	Equities		
		(All currencies)	All Intl Issuers			Asia-Pacific	Europe/Middle East/Africa	US
Institution	Country	Rank	Rank	Rank	Rank	Rank	Rank	Rank
JPMorgan Chase 1/	US	1	2	3	1	8	1	1
Barclays Bank PLC	UK	2	3	1	15			7
Deutsche Bank AG	Germany	3	9	5	8		4	10
Bank of America	US	4	4	2	2	6	3	4
HSBC	UK	5	6		24		10	
Credit Suisse Group	Switzerland	6		7	18			6
Citigroup 1/	US	7	7	4	6	4	7	9
UBS	Switzerland	8						
BNP Paribas	France	9			7			
RBS	UK	10	5	6	12		9	
Goldman Sachs	US	11		10	13	1	2	3
Morgan Stanley	US	12		8	22	10	6	2
Credit Agricole SA	France	14			9		5	
Lloyds Banking Group	UK		8					
Rabobank	Netherlands		10					
Wells Fargo	US			9	10			8
State Street 1/	US							
BNY Mellon 1/	US							

1/ Some of the largest holders of custody assets.

Sources: Thomson Reuters *International Financing Review* , Issue 1831, May 1, 2010, and IMF staff estimates.

8. ***Architecture***. As the main intermediaries at the center of the global financial system, these LCFIs actively raise and channel funds from investors (aggregate liabilities of LCFIs) to borrowers (LCFIs' assets) both within and across borders (Figure 2; see also IMF, 2010c, for a discussion on interconnectedness across countries, institutions, and markets arising from the intra-group exposures of LCFIs). Financial sector assets have grown very rapidly in recent years: consolidated banking assets (measured by the BIS) rose from $13.2 trillion in 2002 to $30.5 trillion in 2009, whereas the nonbank fund industry (measured by Lipper data for mutual funds, money market funds, hedge funds, pension funds, and exchange traded funds both open and closed ended) increased from $11.7 trillion to $26.8 trillion over the same period.

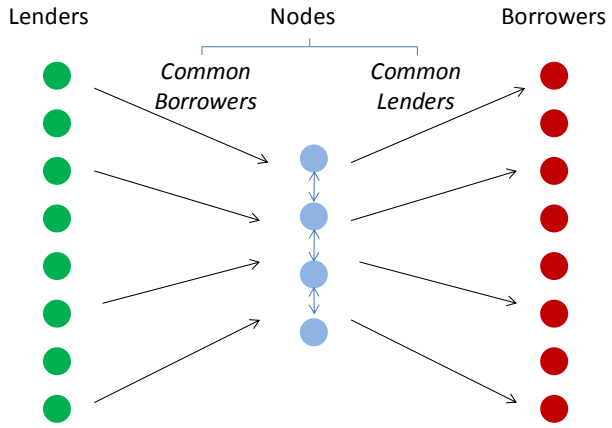
Figure 2. LCFIs at the Center of the Global Financial System



9. ***Cross-border interconnections***. With LCFIs operating out of a handful of jurisdictions, the funds raised and invested can be viewed from a cross-border lens as (gross) flows and exposures via a small set of economies where the LCFIs are based. One way in which these intermediating economies or central "nodes" in the cross-border financial system operate is as *common lenders/investors* to the borrowing economies as well as *common borrowers* from the investing economies (Figure 3). The cross-border lens has the merit that cross-border data are more easily available compared with data on cross-LCFI

exposures. The next subsection discusses cross-border interconnectivity using different (and not all consistent) data sources, whereas the subsections that follow begin to unpack interconnections between banks and nonbanks (funds), including across borders. Even across countries, the data are far from comprehensive, however. For instance, they exclude information on cross-border derivative exposures.

Figure 3. Global Financial System in Cross-Border Perspective



B. Cross-Border Interconnectedness

10. ***Common lenders***. There are eight global common lenders—France, Germany, Japan, the Netherlands, Spain, Switzerland, the United Kingdom, and the United States—and a few other economies that are common lenders to specific regions, determined using the BIS's banking statistics. Common lenders are defined as economies whose banking systems provide over 5 percent of the funding for a number of economies.[3]

- *Global common lenders*. Funding provided by the eight global common lenders is significant. Foreign exposure data from BIS's international banking statistics reveals that these lenders held two-thirds of the on-balance sheet financial claims vis-à-vis the rest of the world at end 2009: 65 percent of advanced economies, 77 percent of emerging markets and developing economies, and 81 percent of offshore centers. France and the United Kingdom each held 12 percent of all foreign claims, Germany 11 percent, Japan and the United States 8 percent each, and the Netherlands, Spain, and Switzerland each held 5 percent (Table 2 and Supplement 1, section II).
- *Regional common lenders*. While global common lenders dominate lending to different regions and to offshore centers, there are specific regional common lenders, such as Austria, Italy, and Greece to Central and Eastern Europe, Sweden to the Baltics, and Australia to the advanced Asia Pacific region (Table 3). Some regions such as the Middle East and North Africa and sub Saharan Africa, however, rely only on the global common lenders.

[3] The methodology used for determining common lenders was developed by Sbracia and Zaghini (2001) and extended by Árvai, Driessen, and Ötker-Robe (2009). It contrasts with the methodology used in the recent exercise to determine a set of systemically important countries to undergo mandatory FSAPs (IMF, 2010e). In this latter exercise, systemically important countries were determined using a more detailed set of definitions for interconnectedness *and* four metrics to gauge the size of the financial system relative to its home economy. The purpose of the exercise was to determine an overall rating of systemic importance of a financial system in a country in the context of its potential effect on the real economy. Data covering all IMF members were required for the analysis.

Table 2. Common Lenders: Global and Regional

(Foreign claims owed to global and regional common lenders as a share of the total foreign liabilities worldwide) 1/

	Total foreign claims	Australia	Austria	Belgium	Canada	France	Germany	Greece	Italy	Japan	Netherlands	Spain	Sweden	Switzerland	United Kingdom	United States
All countries	100.0	1.6	1.8	1.4	2.5	12.4	10.8	0.5	3.2	8.0	5.2	4.5	2.3	5.4	12.0	8.2
Advanced Economies	82.8	1.5	1.1	1.2	1.8	10.7	9.3	0.2	2.4	6.4	4.5	3.1	1.9	4.6	9.5	6.0
Advanced Asia-Pacific Economies	10.0	0.8	0.0	0.0	0.0	1.1	0.6	0.0	0.0	0.7	0.5	0.0	0.0	0.5	2.1	1.6
Advanced North-American Economies	19.5	0.1	0.1	0.2	1.5	2.0	1.9	0.0	0.2	3.0	1.0	0.7	0.1	2.3	3.8	0.3
Euro Area	35.8	0.1	0.7	0.8	0.0	6.0	4.5	0.1	1.9	1.8	2.2	1.0	0.8	1.0	3.3	2.1
Other Advanced European Economies	17.4	0.4	0.3	0.3	0.2	1.7	2.3	0.1	0.3	0.9	0.8	1.4	1.0	0.8	0.2	2.0
Emerging and Developing Economies	12.7	0.0	0.6	0.2	0.0	1.2	1.0	0.3	0.6	0.7	0.6	1.4	0.3	0.4	1.6	1.6
Central and Eastern Europe	3.2	0.0	0.5	0.1	0.0	0.3	0.4	0.3	0.5	0.0	0.2	0.0	0.3	0.0	0.0	0.1
Baltics	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0
Other Central and Eastern European Countries	2.9	0.0	0.5	0.1	0.0	0.3	0.4	0.3	0.4	0.0	0.2	0.0	0.0	0.0	0.0	0.1
CEE incl. AE CEE	3.9	0.0	0.9	0.3	0.0	0.5	0.4	0.3	0.6	0.0	0.2	0.0	0.0	0.0	0.0	0.1
Commonwealth of Independent States	0.8	0.0	0.1	0.0	0.0	0.1	0.1	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.1
Developing Asia	2.8	0.0	0.0	0.0	0.0	0.2	0.2	0.0	0.0	0.3	0.1	0.0	0.0	0.1	0.6	0.5
Middle East and North Africa	1.3	0.0	0.0	0.0	0.0	0.4	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.3	0.1
Sub-Saharan Africa	0.7	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.1
Western Hemisphere	3.7	0.0	0.0	0.0	0.0	0.2	0.1	0.0	0.0	0.2	0.1	1.3	0.0	0.1	0.3	0.7
Offshore Centers	6.7	0.0	0.0	0.1	0.0	0.8	1.0	0.1	0.1	1.3	0.2	0.1	0.1	0.6	0.8	0.7
Memo items																
European Union	52.6	0.5	1.3	1.1	0.3	7.6	6.8	0.4	2.4	2.5	3.1	2.4	1.6	1.8	3.4	4.0
Advanced G20	54.9	0.6	0.5	0.6	1.7	6.6	5.2	0.1	1.4	5.1	3.1	2.5	0.5	3.9	6.4	4.4
Emerging G20	6.1	0.0	0.1	0.0	0.0	0.5	0.4	0.1	0.1	0.4	0.3	1.0	0.0	0.2	1.0	1.1

Source: BIS Quarterly Review: December 2009, Table 9B: Consolidated foreign claims of reporting banks - immediate borrower basis on individual countries by nationality of reporting banks.

Table 3. Common Lenders by Region

(Shows common lenders in percent of total claims to that region equal to or greater than 5 percent.
Global common lenders are in **bold** and represent more than 5 percent of foreign claims to all included countries.)

Central & Eastern Europe		Developing Asia		Middle East & North Africa		Sub Saharan Africa		Western Hemisphere	
Austria	16	**UK**	21	**France**	27	**UK**	49	**Spain**	34
Italy	14	**US**	18	**UK**	24	**France**	12	**US**	19
Germany	12	**Japan**	12	**US**	10	**Germany**	9	**UK**	8
France	10	**Germany**	7	**Germany**	7	**US**	7	**Japan**	7
Greece	9	**France**	6	**Japan**	5				
Sweden	8	**Netherlands**	5						
Netherlands	7								

Advanced Asia Pacific		Advanced North American		Euro Area		European Union		Offshore Centers	
UK	21	**UK**	19	**France**	17	**France**	14	**Japan**	19
US	16	**Japan**	16	**Germany**	13	**Germany**	13	**Germany**	15
France	11	**Switzerland**	12	**UK**	9	**US**	8	**UK**	12
Australia	8	**France**	10	**Netherlands**	6	**UK**	7	**France**	12
Japan	7	**Germany**	10	**US**	6	**Netherlands**	6	**US**	10
Germany	6	Canada	8	**Italy**	5	**Japan**	5	**Switzerland**	9
Switzerland	5	**Netherlands**	5	**Japan**	5	Italy	5		
Netherlands	5					**Spain**	5		

Source: BIS Quarterly Review: December 2009, Table 9B: Consolidated foreign claims of reporting banks - immediate borrower basis.

- *Interconnections with advanced economies*. The common lenders are considerably exposed to advanced economies, reflecting the high degree of interconnectedness among developed financial systems. On average, the exposure of global common lenders to advanced economies was about 80 percent at end 2009, compared with 14 percent to emerging market and developing economies (Supplement 1, section II). Austria, Italy, and Spain were the common lenders with the largest relative exposure to emerging markets.

- *Stability*. The group of global and regional common lenders has been broadly constant since 2002. Based on the data available so far (coverage is limited), Spain has been the only country to rise from being a regional common lender (to Western Hemisphere) to becoming a global common lender. The role of Austria, Italy, and Sweden as regional common lenders has increased over time, although none has become a global common lender.

11. ***Common borrowers***. The common lenders are also common borrowers. The BIS data for borrowing, which is available for a more limited set of countries (Supplement 1, section II), show that common lenders receive on average 60 percent of their cross-border bank funding from other common lenders. Australia, Austria, and the United States are most dependent on the cross-border bank funding from other common lenders, whereas France, Netherlands, and Switzerland are most exposed to the rest of the common lenders.

12. ***Common investors***. A similar architecture of concentration and a broadly similar set of common lenders emerge from the cross-country securities' data compiled by the IMF in its annual Coordinated Portfolio Investment Survey (CPIS). So, the two data sources—BIS international banking statistics and the CPIS—convey broadly similar pictures of the cross-border financial architecture.

- *Global common investors*. France, Germany, Japan, Luxembourg, the United Kingdom, and the United States are the key global investors in securities (based on the same threshold as the BIS analysis above, namely, at least 5 percent of global or regional portfolio holdings—see Supplement 1, section II; Luxembourg's cross-country banking exposures are not publicly available, so its importance as a common lender using BIS data cannot be discerned).

- *Regional common investors*. Global investors are important regional investors, such as France, the United Kingdom and the United States in the Middle East and North Africa, Sub-Saharan Africa, and Western Hemisphere countries, and Japan in the Western Hemisphere countries (18.9 percent). In addition, a small number of economies are critical regional nodes. For instance, Austria has been an important investor in Central and Eastern Europe, with a share of regional liabilities rising from 8 percent in 2001 to over 18 percent in 2008. Switzerland is the main holder of portfolio assets in the Baltics (22.6 percent). Hong Kong SAR has invested in developing Asian countries (18.5 percent). Kuwait is invested in the Middle East and North Africa, holding over 26 percent of regional liabilities in 2008, and Mauritius has become an important node for emerging G20 countries (10.7 percent) and developing Asia (18.1 percent).

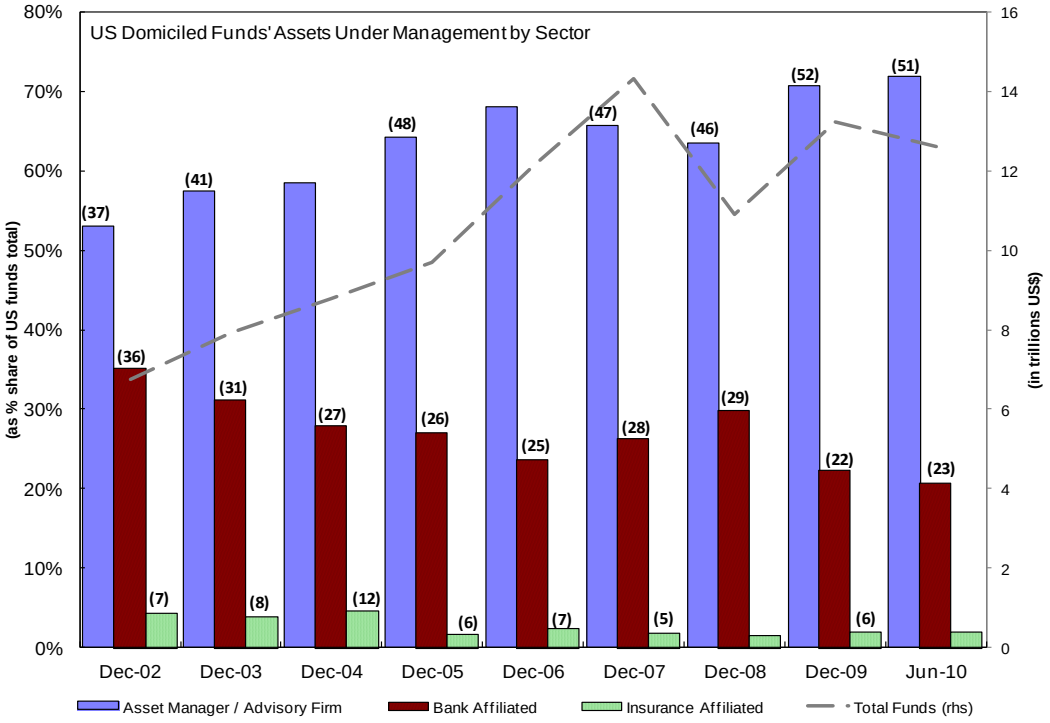
- *Stability*. The set of common investors has remained roughly constant over time, although there has been a significant increase in cross-border portfolio investments and a trend toward asset diversification among global common investors. Asset allocation in the United States, the United Kingdom, and Luxembourg has shifted away from advanced economies and toward emerging markets and off-shore centers, particularly the Cayman Islands. Japan and Hong Kong SAR also significantly increased their portfolio investments in off-shore centers at the expense of investments in the United States.

C. Bank-Fund Interconnections

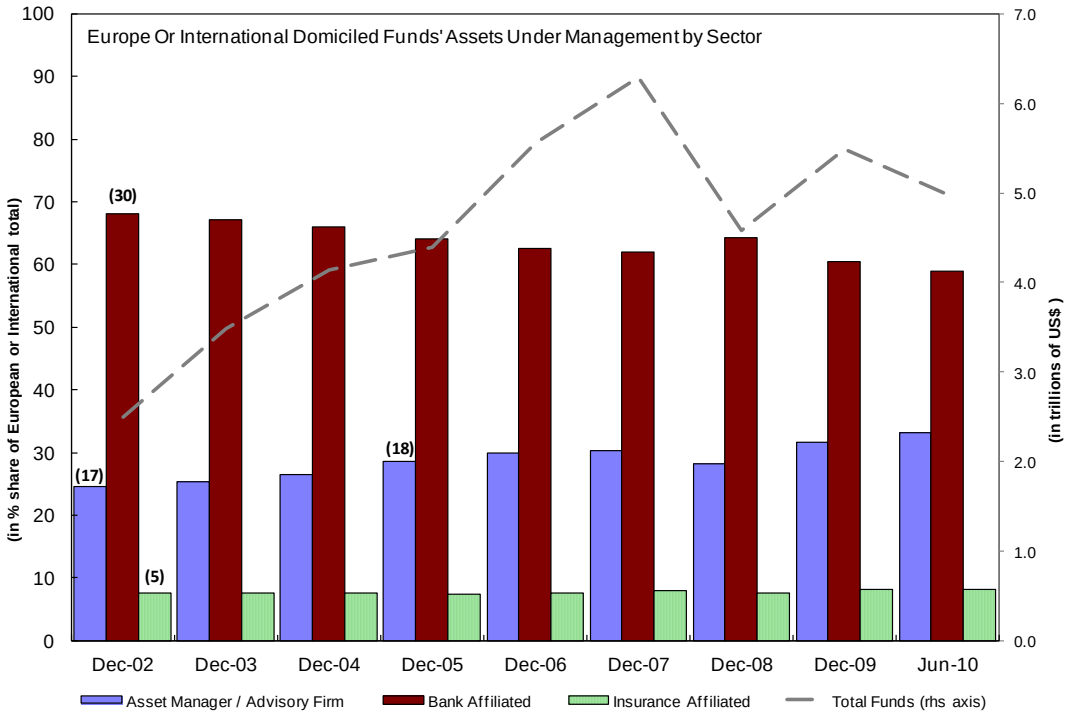
13. ***Bank-fund and bank-shadow bank connections***. The securities covered in the CPIS are held not only by banks, which are captured in the BIS's banking statistics, but also by nonbank financial intermediaries, such as money market mutual funds and pension funds, as well as other institutions. In many instances, the funds are closely related to and interconnected with banks, even if they may appear to be independent. Understanding these interconnections sheds further light on this aspect of the architecture of global finance.

- *Sizes.* In Europe, with over $5 trillion of assets under management, nearly two-thirds of the funds are bank affiliated. In the United States, where independent asset managers and advisory firms play a more significant role in managing around two-thirds of the over $12 trillion of assets under management, a small number of major banks nonetheless manage 20–25 percent of total assets (Figure 4).

Figure 4. Funds Industry: Affiliation with Banks



The number in parentheses indicates the number of banks used in the calculations. It is not repeated when it is consistent through the years.
Source: Lipper (Thomson Reuters).



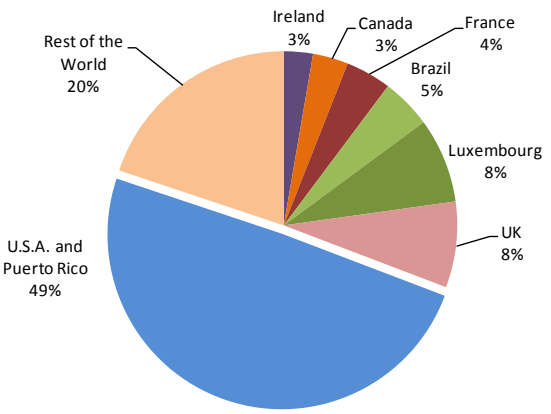
The number in parentheses is the number of banks used in the calculations. It is not repeated when it is consistent through the years.
Source: Lipper (Thomson Reuters).

- *Channels*. Interconnections between banks and funds take various forms, such as explicit and implicit guarantees of fund net asset values by their affiliated banks and funds, which facilitated the balance sheet expansion of LCFIs (section III). As funds predominantly hold securities, central to the link between banks and funds is the role of LCFIs in the creation, registration, custody, sale, and market-making of securities.

14. ***Funds***. This paper uses a unique dataset on the global funds industry compiled by Lipper (Thomson Reuters) to systematically analyze the cross-border and LCFI architecture of funds and complement the above analysis based mainly on the BIS's international banking statistics. The data cover mutual funds, money market funds, hedge funds, pension funds, and exchange traded funds both open and closed end.[4]

- *Size and concentration*. The global funds industry is nearly as large as the international banking system, but it is even more concentrated. Total assets of the funds industry were about $27 trillion at end 2009, down from $29¼ trillion at end 2007 (measured as the assets under management of domiciled funds—a fund is domiciled in a country if it is legally incorporated and subject to the regulatory oversight and supervision of that country). At end June 2010, asset values had fallen somewhat further to $25½ trillion. By assets, half the funds were domiciled in the United States, while the United Kingdom and Luxembourg were 8 percent each and France and Brazil were about 5 percent each. These five economies account for about 75 percent of the global funds industry (Figure 5). Among the remainder, Germany, Italy, Switzerland, and Spain are prominent.

Figure 5. Funds, by Country
(Domiciled funds as a share of the world total, June 2010)



Rest of the World includes 67 countries with available data in 2010.
Source: Lipper (Thomson Reuters).

- *Intermediation of funds*. The data point to the central role of LCFIs in intermediating funds (i.e., managing funds and providing custodial services) as well as identify the cross-border activities of funds, namely, the source countries from which funds are raised, the destination countries into which the funds are directed, and the currency breakdown of investments (although coverage is often limited). Box 1 presents a map

[4] Since some of these funds represent money market mutual funds and hedge funds, there is an element of leverage involved implying a potential accelerator for deleveraging during a downturn or period of instability.

of funds' intermediation in Switzerland. It reveals a high degree of concentration in the Swiss funds industry—two large LCFIs, Credit Suisse and UBS, dominate intermediation—with significant cross-border and cross-currency exposures. Supplement 1, section III provides a summary map for other key money centers.

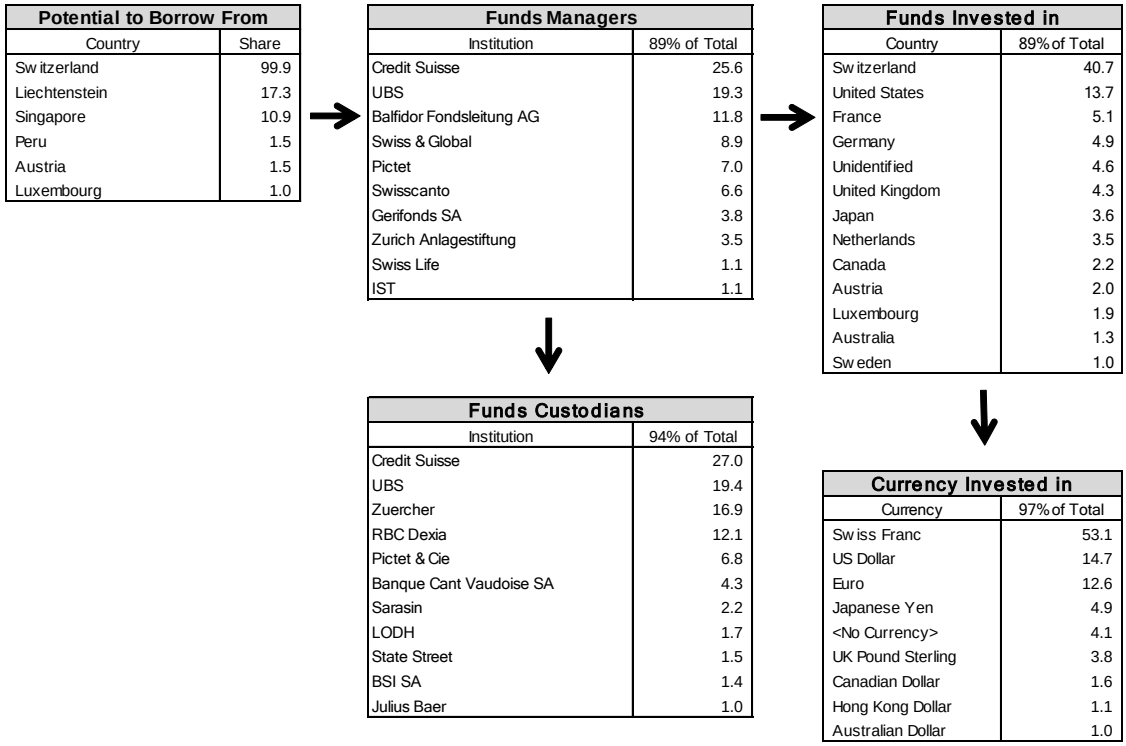
Box 1. Switzerland: Mapping the Funds' Industry

The two large Swiss LCFIs—Credit Suisse and UBS—intermediate about half of the assets under management of Swiss funds, with large insurance companies and financial firms managing much of the rest (Figure 6). They are also the biggest custodians of funds.

Nearly all Swiss funds are registered for sale to the public in Switzerland. Some are also registered for sale in Liechtenstein and Singapore, and some in Austria, Peru, and Luxembourg—funds registered for sale in other countries give access to investors in those countries to investment opportunities through these funds. Overall, the funds raise resources predominantly in Switzerland, but invest about 60 percent abroad.

About half of the investments are in foreign currency, pointing to the potential importance of foreign currency swap markets for the operations of the LCFIs to manage currency risk. These swap markets experienced considerable strains during the crisis (see section III below). The large intervention of central banks, including the U.S. Federal Reserve, in the amount of $600 billion initially and uncapped subsequently, reflects the importance of these markets for the core operations of the LCFIs.

Figure 6. Switzerland: A Simplified View of the Funds Industry



Potential to Borrow From

Country	Share
Switzerland	99.9
Liechtenstein	17.3
Singapore	10.9
Peru	1.5
Austria	1.5
Luxembourg	1.0

Funds Managers

Institution	89% of Total
Credit Suisse	25.6
UBS	19.3
Balfidor Fondsleitung AG	11.8
Swiss & Global	8.9
Pictet	7.0
Swisscanto	6.6
Gerifonds SA	3.8
Zurich Anlagestiftung	3.5
Swiss Life	1.1
IST	1.1

Funds Invested in

Country	89% of Total
Switzerland	40.7
United States	13.7
France	5.1
Germany	4.9
Unidentified	4.6
United Kingdom	4.3
Japan	3.6
Netherlands	3.5
Canada	2.2
Austria	2.0
Luxembourg	1.9
Australia	1.3
Sweden	1.0

Funds Custodians

Institution	94% of Total
Credit Suisse	27.0
UBS	19.4
Zuercher	16.9
RBC Dexia	12.1
Pictet & Cie	6.8
Banque Cant Vaudoise SA	4.3
Sarasin	2.2
LODH	1.7
State Street	1.5
BSI SA	1.4
Julius Baer	1.0

Currency Invested in

Currency	97% of Total
Swiss Franc	53.1
US Dollar	14.7
Euro	12.6
Japanese Yen	4.9
<No Currency>	4.1
UK Pound Sterling	3.8
Canadian Dollar	1.6
Hong Kong Dollar	1.1
Australian Dollar	1.0

Share of total is calculated separately for each category. "Potential to Borrow From" is the total value of funds that are registered for sale. For each category, the top performers with more than 1 percent share are listed.

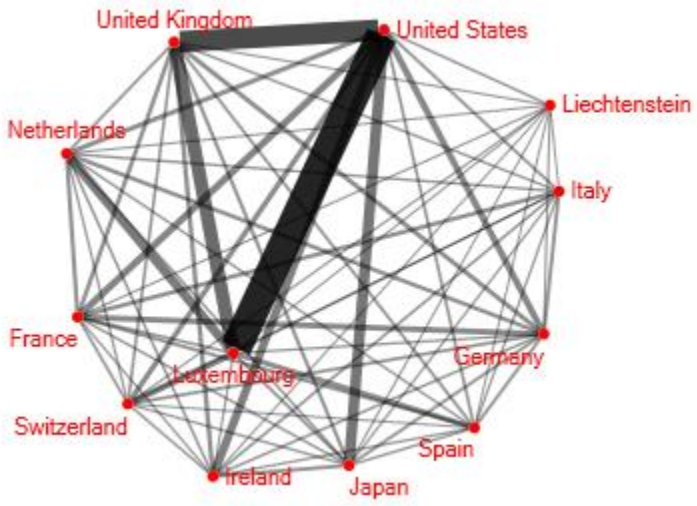
Sources: Lipper (Thomson Reuters) and staff calculations.

D. Mapping Cross-Border Funds' Exposures

15. ***Using Lipper***. Besides individual country maps of the funds industry as illustrated in Figure 6, multi-country maps of cross-border funds' exposures can be drawn to complement—and inform—the cross-border banking interconnections in Tables 2 and 3. This subsection presents illustrative cross-border maps of funds' exposures to highlight the principal nodes in the global funds industry, the role of offshore centers, and how an individual country's interconnections can be analyzed.

16. ***Principal nodes***. The Lipper data identify the principal nodes—i.e., those with the largest number of connections across countries—as the United States, the United Kingdom, Luxembourg, France, Germany, Japan, Spain, Switzerland, the Netherlands, Italy, Ireland, and Liechtenstein (Figure 7; the methodology and additional maps are elaborated on in Supplement 1, sections IV and V, respectively). These nodes are closely connected to all other countries and to each other. They are broadly similar to the nodes identified earlier, but they also highlight the importance of centers such as Luxembourg. The links among the United States, United Kingdom, and Luxembourg are especially strong, and are denoted in Figure 7 by thicker and darker lines to signify greater relative exposures among the various nodes.

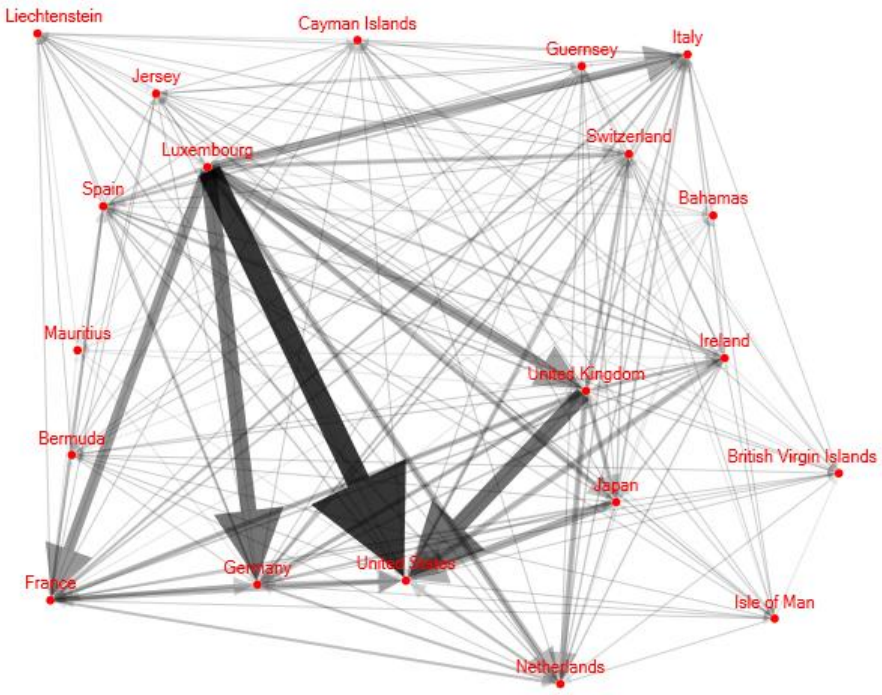
Figure 7. Cross-Border Funds: Principal Nodes



Sources: Lipper (Thomson Reuters); and Fund staff calculations.

17. ***Conduits***. While nodes such as the United States, United Kingdom, Germany, and France have large underlying real economies and, therefore, the capacity to absorb a large share of funds into their domestic economies, others such as Luxembourg and Liechtenstein are primarily conduits to investment destinations. Luxembourg, for instance, distributes funds to the main centers (i.e., the United States, Germany, France, Italy, United Kingdom, the Netherlands, Switzerland, and Spain) and, in turn, receives funds from Liechtenstein and Cayman Islands, among others (Figure 8).

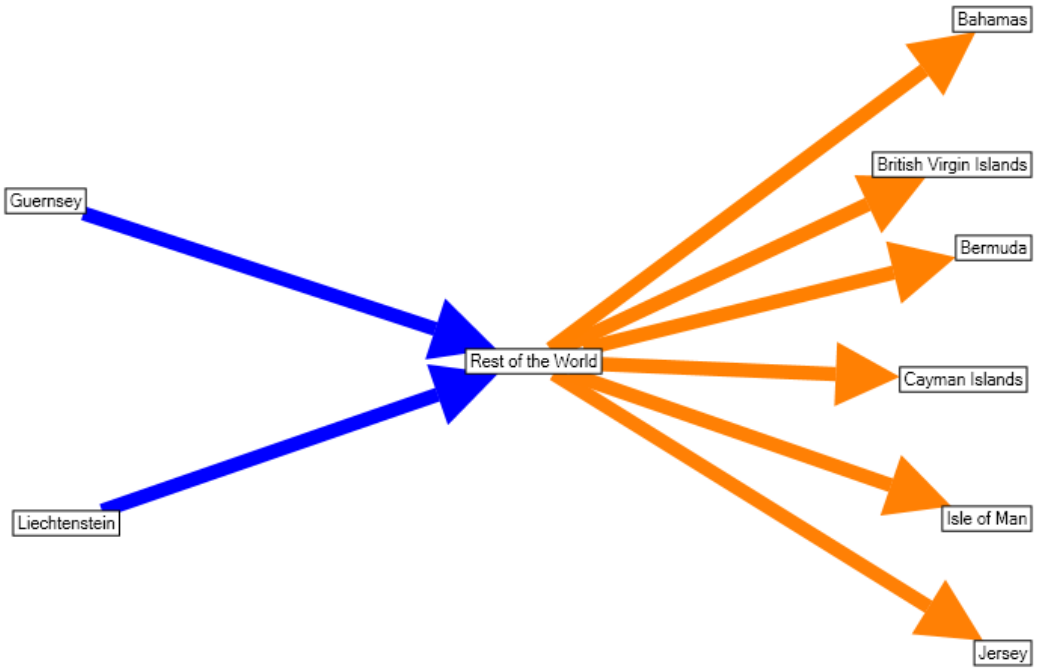
Figure 8. Conduits: Luxembourg as an Example



Sources: Lipper (Thomson Reuters); and Fund staff calculations.

18. ***Integrated architecture***. Although data gaps have thus far limited the analysis and integrated treatment of offshore centers in the global financial architecture, the rise of offshore financial centers gives the impression of a seemingly dispersed or decentralized global financial architecture with many centers. But the analysis of holdings and cross-border exposures in the funds data reveals a core group of centers or nodes, such as the United States, United Kingdom, Luxembourg, and France, around which the offshore centers are clusters and to which they channel funds sourced globally (see also Lane and Milesi-Ferretti, 2010; Milesi-Ferretti, et al., 2010; and He and McCauley, 2010). Figure 9 illustrates clusters of offshore centers that *together pass-through funds* (i.e., receive and distribute funds to the rest of the world). Guernsey and Liechtenstein are distributors of funds to the core nodes, whereas the Bahamas and Bermuda are more collectors of funds for the clusters of off-shore centers.

Figure 9. Offshore Financial Centers: Pass-through of Funds



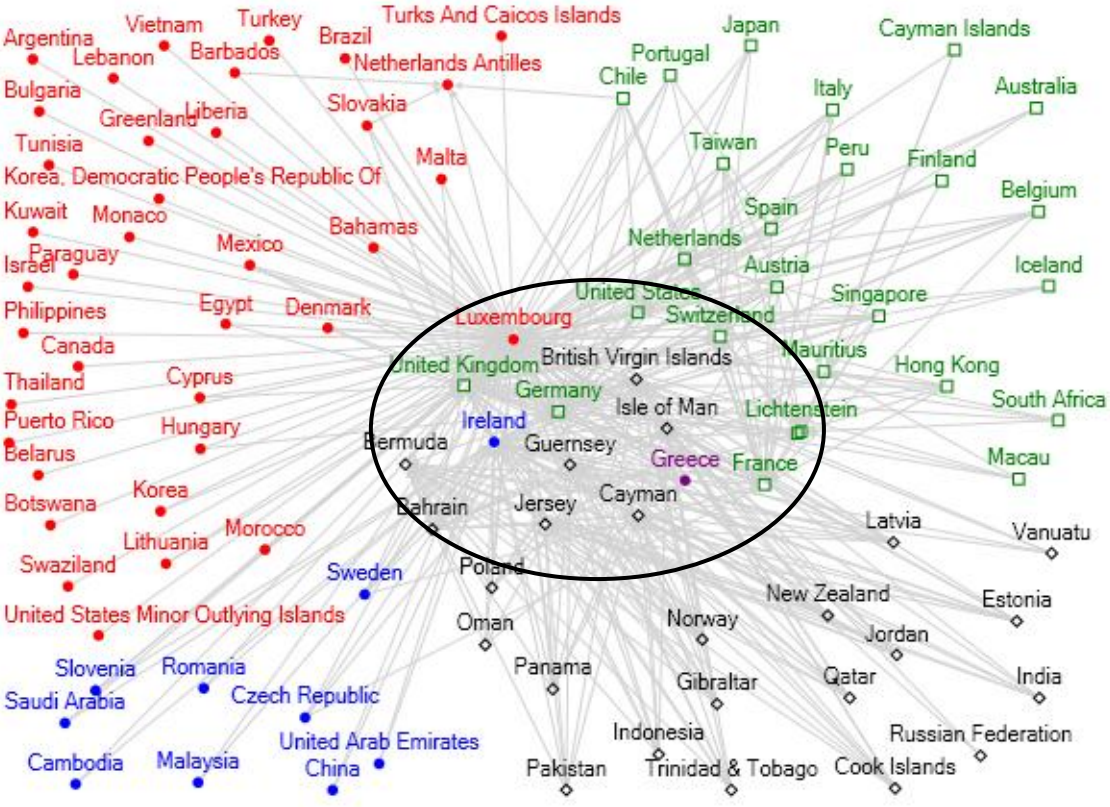
Sources: Lipper (Thomson Reuters); and Fund staff calculations.
Note: The arrows indicate the direction of the relationship; the width is for presentational purposes only, and do not have any special meaning.

19. ***Maps***. Cross-border maps may also be constructed showing a specific country's interconnections with groups of other countries. Such maps may subsequently be used to evaluate a range of hypotheses about the propagation of shocks and vulnerabilities to cross-border developments. Box 2 illustrates Greece's interconnections with different clusters of countries, using the funds' data. The data show that Greece is connected to several core countries, which provides an indication of why asset allocations and flows among the core may have had systemically significant effects, despite the small overall exposure of core banking systems to Greece.

Box 2. Greece: An Illustrative Map of Funding Exposures

An illustration of Greece's interconnections in cross-border funding flows reveals why funding strains in Greece in the first half of 2010, despite being by itself small, might have translated into pressures on other Euro Area peripherals. Recall that banking exposures to Greece were relatively small in the context of banks' balance sheets; yet, concerns about the strength of balance sheets and the ability of other Euro Area peripheral countries with fiscal and financial vulnerabilities to finance themselves increased as the Greek situation worsened. Using the funds' data, Figure 10 presents four clusters (i.e., countries that together form more of a closed system), centered around a set of core connections that are closely linked to Greece: (i) a red cluster of countries with access to funds domiciled in Luxembourg; (ii) a black cluster with access to funds domiciled in the offshore centers of British Virgin Islands, Jersey, Cayman, Guernsey, and the Isle of Man; (iii) a blue cluster with Ireland at the core; and (iv) a green cluster of the U.S. with several key European and other countries. Greece is interconnected with each of the central nodes of these clusters. This close interconnection across other core countries suggests why asset re-allocations and flows might have been large systemically, with potentially significant impact on countries such as Ireland.

Figure 10. Cross-Border Exposures: Greece's Interconnections



Sources: Lipper (Thomson Reuters); and Fund staff calculations.

E. Summary

20. ***Architecture***. The above analyses using currently available data point to a core set of LCFIs and countries that are at the center of global finance. Building a comprehensive map of the global financial architecture requires bringing together data from a range of sources—BIS banking statistics, Lipper's information on funds, and securities information from the CPIS are only three available sources—and making them consistent and coherent (for instance, by ensuring that there is no double counting). But a holistic global picture of LCFIs' activities and of cross-border flows of funds, including for instance international reserve accumulation and sovereign wealth funds, is lacking. Access to datasets that provide such information is far more limited. For instance, most of the detailed BIS data on exposures to sectors are confidential and only cover certain economies. The subset of derivatives data collected by DTCC can only be accessed in part if a regulator can show that they have a material interest in a subset of the data. While the Senior Supervisors' Group has started collecting some LCFI exposures data, which is strictly confidential to a small group of supervisors, the picture of LCFIs' activities remains incomplete.

21. ***Access and use***. Accessing such data, which would need to be made more comprehensive in terms of coverage of countries and sectors, and be available in a timely manner, would be essential to building a full-fledged map of the cross-border financial architecture, comprehensively identifying and analyzing *spillovers* of economic and financial conditions and policies, and assessing the potential channels of *contagion* and the *buildup of risks* within the system.[5] This would enable macroeconomic and supervisory policymakers to better monitor developments and improve policy formulation. That said, the set of countries on which detailed data of LCFIs, market, and cross-border exposures are needed is quite small, even if the data itself identifies a larger number of countries from which funding is obtained or assets are purchased. Moreover, these data measure exposure in the sense of outstanding amounts at current prices, but do provide information about the sensitivities to various price movements. Use of derivatives data is particularly problematic.

[5] Later in 2010, STA is to publish the results of the first coordinated survey of foreign direct investment (CDIS), which will provide information on bilateral country positions in direct investment.

III. Balance-Sheet Transformations and Funding Risk

Increased financial interconnectedness in recent years reflected broadly similar global ALM strategies of key LCFIs that resulted in a greater reliance on market-sensitive funding sources (such as the funds discussed above) and on securitized assets, ratings, and leverage. This section discusses these balance sheet transformations that underpinned the increased financial interconnectedness and formed the critical fault lines along which the crisis unfolded. The focus of this section is particularly on funding risks across borders and among LCFIs, while the next section looks at ratings.

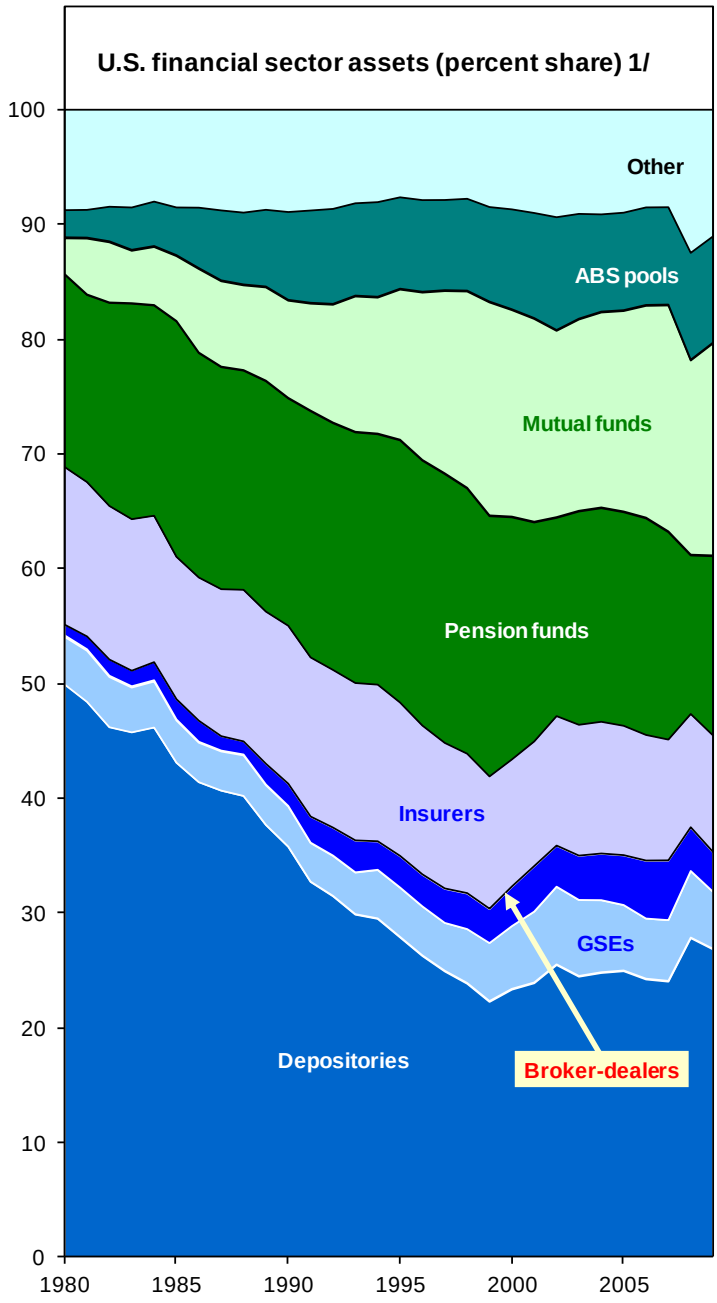
A. The Story

22. ***Tranformation***. Underpinning the increased financial interconnections over the past decade has been a transformation of the balance sheets of LCFIs and of the financial system as a whole. This changing mix of liabilities and assets reflects a continued search for higher returns, given the low global interest rates that prevailed since 2002, and more generally the incentives to procyclically expand the balance sheet.

- *Liability side*. To lower costs, institutions began to move away from relatively costly deposits, which were subject to a higher regulatory burden such as reserve requirements and deposit insurance premia, to noncore funding sources such as money market mutual funds (MMMFs), short-term commercial paper, and repos (see Figure 11; IMF, 2010f, Figures 2.11 and 2.12; and Shin and Shin, 2010, Figure 4). Nondeposit funding sources linked to banks typically carried liquidity and credit guarantees from their affiliated banks to ensure they retained deposit-like characteristics of liquidity and safety. This created one important link between funds and banks. Moreover, MMMFs could invest only in short term, highly rated, and low-yielding debt securities (liquid and safe), and not in higher yielding loans. For example, financing of special purpose vehicles, such as U.S. asset-backed securities, was through short-term paper.

- *Asset side*. To further enhance margins, LCFIs increased fee-based activities, which involved new instrument creation (e.g., asset-backed securities and collateralized debt obligations) and more active ALM. Fee income supplemented net interest income, and was more flexible, as firms could tailor products and services to clients' individual needs. This resulted in increased sophistication and complexity of assets (e.g., structured securities) as well as integrated and interconnected product lines. ALM strategies were deployed to actively manage risk (e.g., interest rate and funding risk) that arose from greater use of securities and to invest and trade. Interconnections among LCFIs also intensified as a result of these ALM strategies.

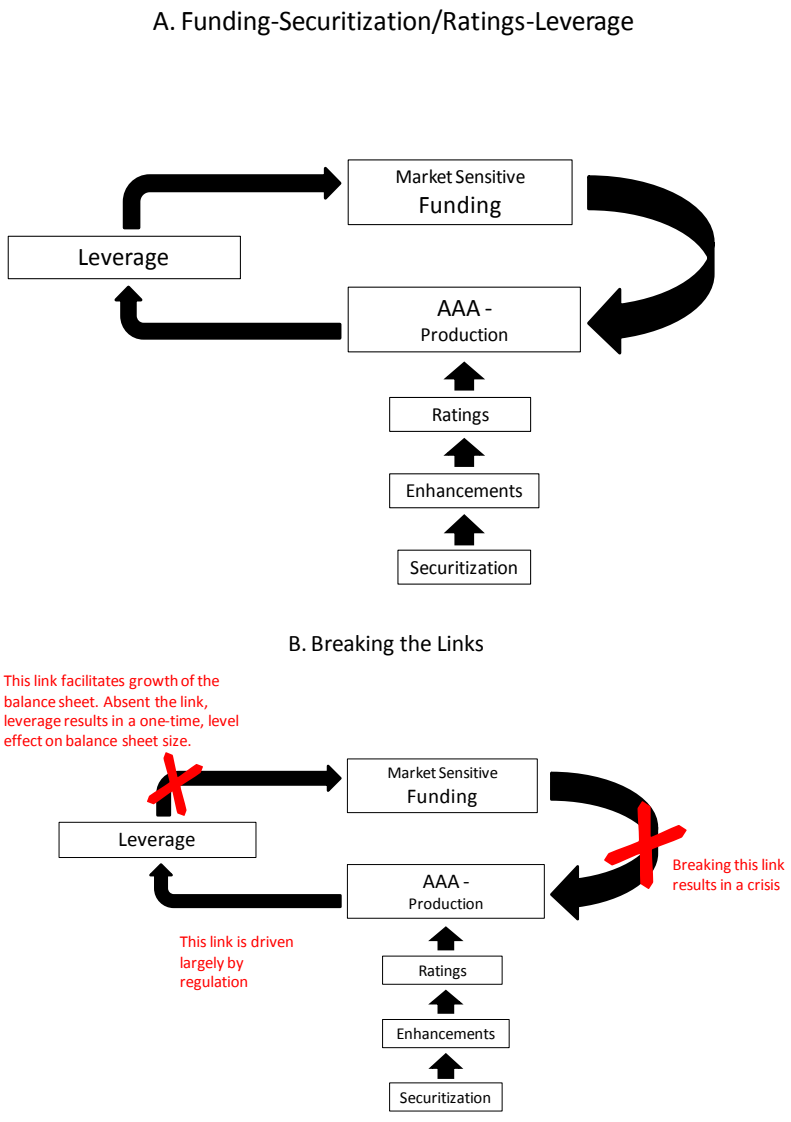
Figure 11. From Core to Non-Core Funding Sources



Source: Bhatia (2007), updated through end 2009.
1/ Excludes assets managed by hedge/private equity funds.

23. ***Asset-liability links***. The transformation of liabilities and assets were intimately linked. As liabilities moved from core to noncore and confidence-sensitive funding sources, and many funds could invest only in highly-rated and short-term securities, asset holdings became increasingly concentrated in AAA-rated securitized products. The high ratings were supported by guarantees, enhancements, and protection in the form of credit default swaps. Higher ratings further fueled expansion of the balance sheet, as they carried lower capital charges and thus facilitated leverage. *Securitization, ratings, leverage, and market-sensitive funding thus became the engines of balance sheet growth (Figure 12) that more closely connected banks with funds and nonbanks, with each other, and across borders*.

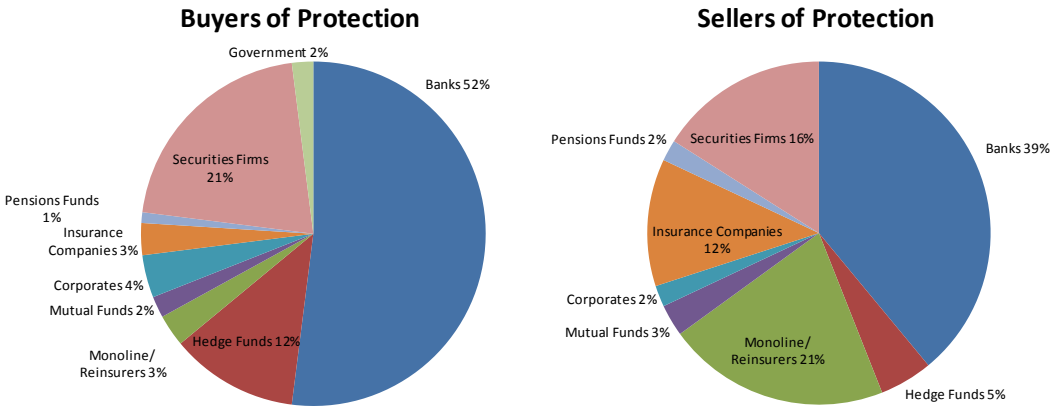
Figure 12. Engines of Balance Sheet Growth



24. ***Critical role of the United States***. The U.S. financial markets played a central role in the above process, through important LCFIs situated in and operating out of the United

States constituting one-half of the global funds industry, and serving as a key source of innovation of financial products and markets. Structured and highly complex financial products linked to the U.S. housing market, for instance, promised yield, safety, and liquidity. CDS protection and guarantees that further underpinned the credit worthiness of the structured products were ultimately provided by the U.S. monoline insurers and some major insurers like AIG FP (Figure 13). International banks *and* funds sought to expand their exposure to dollar-denominated assets yielding higher returns and being considered "safer" than investment opportunities at home. McGuire and von Peter (2009) estimate that this trend was particularly pronounced for some European banking systems, which substantially increased the amount of long-term dollar-denominated claims on nonbank entities.

Figure 13. Insurance Industry Net Seller of Protection to Banks



Source: British Bankers Association 2006.

B. Funding Models and Risks

25. ***Wholesale financing as a fault line***. The growing reliance on short-term wholesale financing to fund leveraged activities has enhanced sensitivities of both systemic stability and the balance sheet growth engine to investor and market confidence. Countries, like LCFIs, are exposed to funding vulnerabilities that may be cross-border and correlated in nature. Currency-specific shortages facing countries in the crisis precipitated the establishment of swap lines 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. In effect, foreign central banks were used to extend the geographical scope of their liquidity operations. Mapping these funding risks—potential difficulties in rolling over short-term liabilities falling due—is, therefore, critical not just for surveillance to proactively address susceptibility to funding shocks but also for crisis management to

facilitate official liquidity assistance, an issue that remains germane as long as balance sheets remain impaired across important parts of the global financial system.

26. ***Bank funding models***. While resort to short-term wholesale funding has increased, there are a variety of bank funding models across which funding risks appear differentiated. Many banks borrowed wholesale (unsecured and short term in domestic and off-shore interbank and money markets, as well as in foreign exchange swap markets and secured markets such as the repos market); others had access to foreign currency deposits through branches and affiliates. Based on an analysis of international banking data (BIS, 2010b), Japanese banks and, to a lesser extent, French and German banks have funded most of their foreign activity from their home offices. Spanish and Canadian banks have made extensive use of local funding networks. On the other hand, Swiss and U.S. banks have obtained a substantial share of funding outside their home countries, borrowing cross-border in financial centers.

27. ***Vulnerabilities***. The expansion of banks with decentralized funding bases made them dependent on cross-border and cross-currency funding, whereas reliance on local and deposit-based funding bases may have shielded some of the banks at the start of the crisis (BIS 2010 a,b). But the question arises whether local or deposit-based funding would be enough to shake off the troubles coming from the interconnections among LCFIs across markets, such as in the foreign exchange swap markets that were used by banks to hedge cross-currency funding risks or from interconnections arising from banks accessing the same pools of funds. Risks were amplified as the funding found its way into long term, yet market sensitive and mostly dollar-based, securitized instruments. Moreover, links with the funds industry exacerbated risks, given the close affiliation of banks and funds, especially in Europe (Figure 4). Losses arising from the cross-border and cross-currency exposures of funds amplified losses for some banks (¶s 29–30).

28. ***Cross-currency funding risks***. The international expansion of bank balance sheets via short-term borrowing from the dollar interbank market or short-term nondollar liabilities with the currency risk hedged via foreign exchange swaps left those banks exposed to cross-currency funding risk, which can be seen in confidential BIS data.

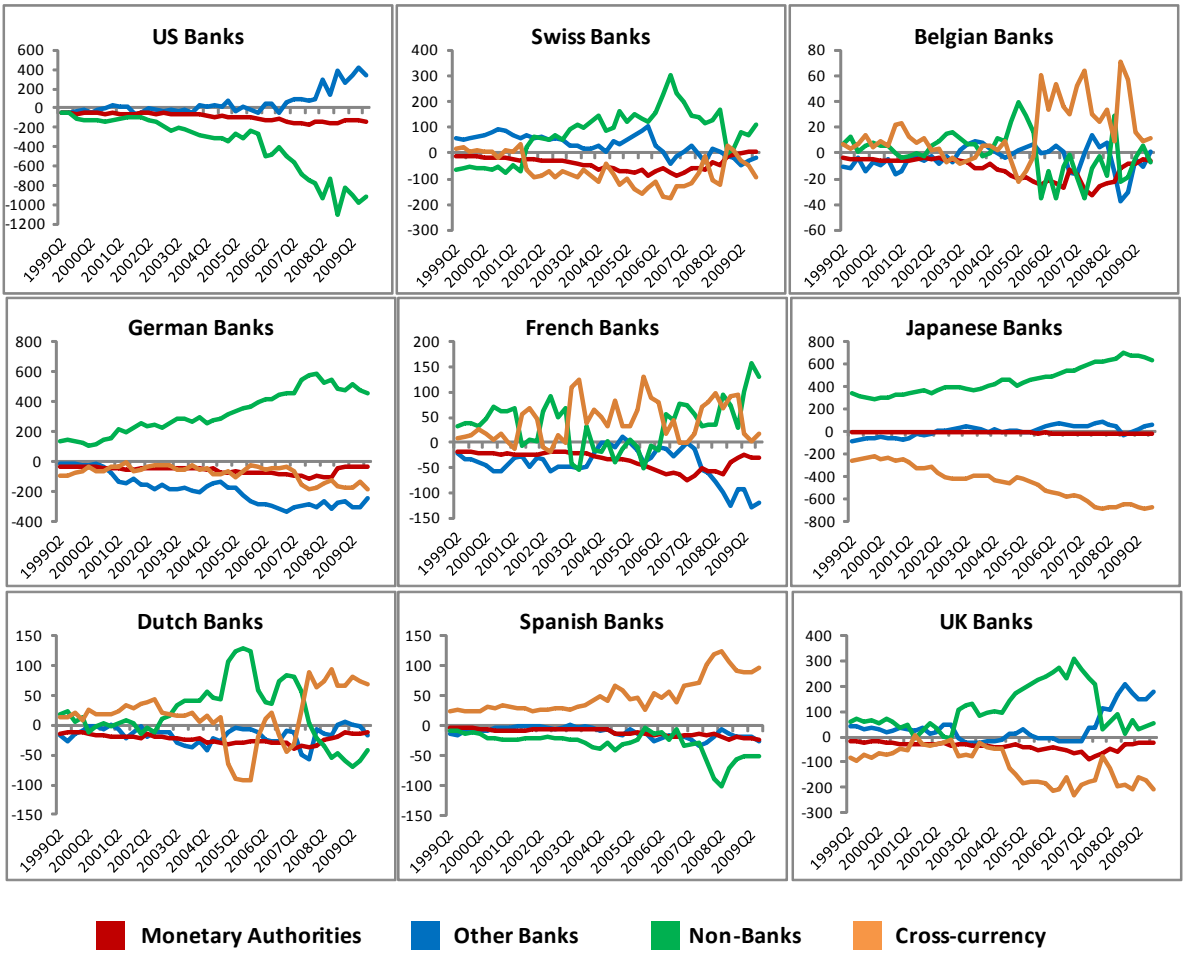
- *Estimated size*. The BIS (e.g., McGuire and von Peter, 2009, and Cecchetti et al., 2010) estimates that, by mid-2007, the major European banks' dollar funding shortfall had reached $1–1.2 trillion. Until the onset of the crisis, European banks had met these funding needs by borrowing from interbank markets ($435 billion) and monetary authorities ($386 billion), and by using foreign exchange swaps ($315 billion).

- *National differences*. Different national banking systems funded their dollar positions differently (Figure 14). For instance, U.K., Swiss, German, and Dutch banks had, by mid-2007, the largest funding gaps among European banks. But each of these banking

systems funded the gaps by relying on different markets. For instance, German banks relied largely on interbank funding, whereas U.K. banks maintained a balanced interbank position and depended more on cross-currency swaps.

Figure 14. Banking Sector: Cross-Border Dollar Funding

Net U.S. Dollar-Denominated Foreign Positions, by Counterparty Sector (in USD billions)



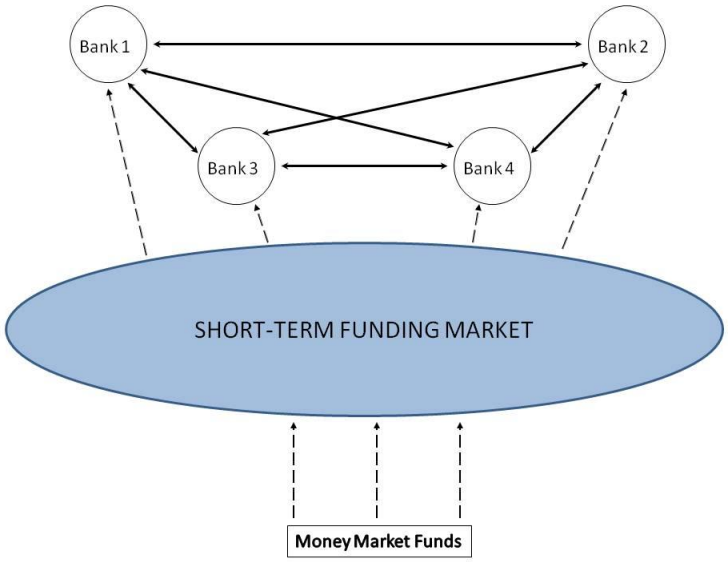
Source: Bank for International Settlements.

- *The crisis*. The failures of Lehman and AIG triggered a severe liquidity squeeze in interbank and derivative markets—including foreign exchange swap markets—raising concerns about the viability of financial institutions dependent on dollar wholesale funding (see GFSR, October 2008, Baba, McCauley and Ramaswamy, 2009, and Baba and Packer, 2009b). In the face of dollar shortages, many European financial institutions moved to actively convert euros into dollars through foreign exchange swaps, creating a one-sided market as U.S. counterparties became more cautious and spreads began to reflect relative counterparty risks (Baba and Packer, 2009a). As the turmoil in financial markets deepened, concerns over

counterparty risk expanded beyond European institutions, and the dollar shortage problem gained global proportions. U.S. subsidiaries of international banks increased their borrowing from the U.S. Federal Reserve, which eventually prompted the Federal Reserve to set up dollar-swap facilities with a large number of central banks in other countries, especially in Europe.

29. ***Nonbanks***. Difficulties in the funding industry compounded the funding difficulties of banks during the crisis. Faced with, for instance, $320 billion of redemptions in one week, money market mutual funds became unable to continue providing the nearly $2 trillion of credit they typically extended daily, thus exacerbating the funding challenges of the banks. Tracking banks' funding patterns vis-à-vis nonbanks and risks in the operations of the latter are, therefore, essential for better capturing funding risks (see Figure 15). As noted, risks arising from the cross-currency and cross-border investments of funds would add to the risks of banks that are not captured in the (confidential) BIS data. The Lipper data reveal that funds generally hold a net long dollar position (Supplement 1, section III), partly reflecting the fact that funds globally have purchased the asset-backed paper issued by LCFIs in dollars and served as a key funding source for them (see also Acharya and Schnabl, 2010). The funds have also invested heavily cross-border, with the United States being the main investment destination for such investments, besides the other key global common lenders.

Figure 15: LCFI Interconnections: An Illustration of Bank and NonBank Linkages



30. ***Fund bailouts***. Bailouts of money market mutual funds by their affiliated banks were needed in some cases so as not to "break the buck" (i.e., have the net asset value of the shares fall below the principal or par value of the underlying investments) and undermine confidence in these nondepository (and noninsured) funding sources. According to Moody's

(2010), 62 funds, including at least 36 U.S. funds and an estimated 26 European funds, received support from their affiliated or parent banks from August 2007 to end 2009. Support from managers of money market mutual funds in the United States and Europe exceeded $12 billion during this period. Moreover, during 1980–2007, an estimated 146 funds received support from their affiliated or parent institutions to prevent them from breaking the buck. Focusing only on bank data would, therefore, yield an incomplete picture on the funding risks within the financial system.

C. LCFI Interconnections

31. ***Inter-LCFI linkages***. As noted above and illustrated in Figure 15, inter-LCFI linkages have been central to their operations—from the funding side (e.g., repos and short-term debt vis-à-vis banks and nonbanks) as well as from the asset side (e.g., holding of asset-backed commercial paper issued by other LCFIs—capital regulations imply that holding one's own repackaged loans does not result in higher credit ratings and leverage and hence holding others' loans has a regulatory-based benefit). Off-balance sheet operations have also involved linkages, and concentration, among LCFIs; going down the chain of CDS protection, for instance, revealed that such protection was eventually being provided in large part by major insurers like AIG FP and the monoline insurers (Figure 13). However, very little information is available on such linkages, in no small part due to confidentiality.

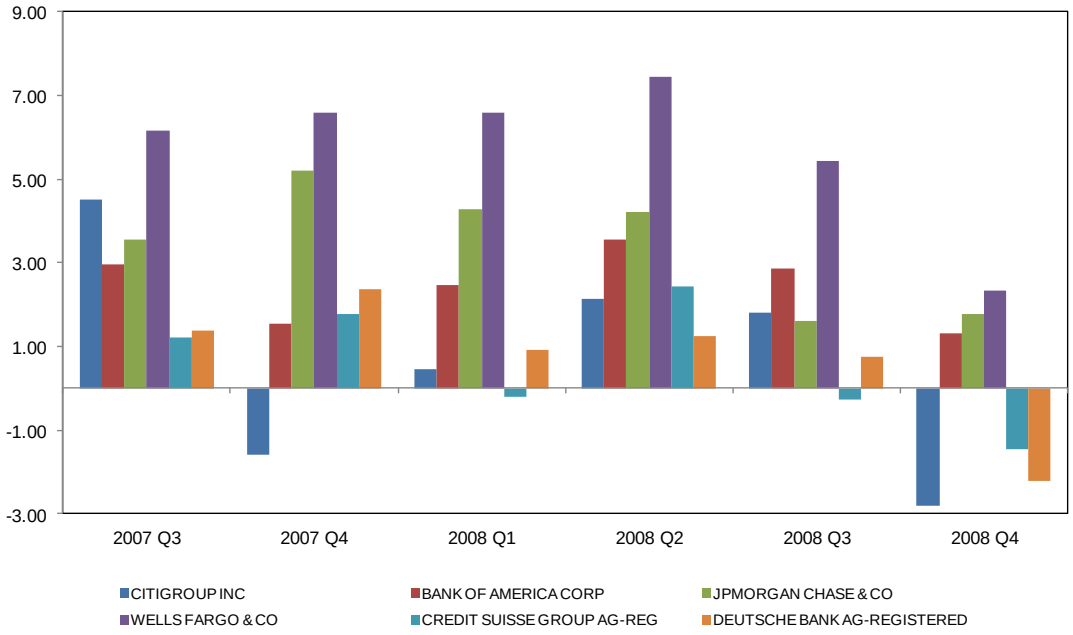
32. ***A hypothetical exercise***. To illustrate a funding risk map of LCFI interconnections, a hypothetical exercise is conducted of a funding stress event that adversely impacts a particular LCFI. Contagion to other LCFIs with exposures to this institution is then modeled using network analysis. The results are illustrative; absent detailed data, a number of assumptions are made, which could be sharpened significantly were more data available. The analytical framework is explained in Supplement 1, section VI.[6] In the first stage, a firm's profit or financial margin (the difference between the variable yield and the cost of funding for the institution) is related to the cost of interbank funds and the internal rate of return on the LCFI's balance sheet; the impact of a shock to funding costs (via changes in LIBOR-OIS spreads) on profitability or retained earnings is, therefore, derived. In the second stage, contagion is modeled by assessing whether—in a sequence of simulation rounds where LCFIs are differentially affected, depending on their direct and indirect exposures—the impact on retained earnings, which serves as a buffer against shocks, breaches a specified threshold. The simulations help to identify the resilience or weakness of each bank to funding cost shocks and contagion effects.

33. ***Calibration***. The exercise is calibrated to the observed compression in financial margins and retained earnings of 6 core LCFIs during the 2007–09 crisis. In the last quarter

[6] Other exercises to assess connections among institutions include Chan-Lau et al. (2009), Segoviano and Goodhart (2009), and Espinosa and Solé (2010) and Tressel (2010).

of 2007, some financial institutions suffered a sharp compression in their financial margins, particularly, Citigroup whose margins turned negative (Figure 16). The compression, in turn, decreased earnings, which in time exacerbated concerns about the viability of institutions most dependent on wholesale funding (Figure 17). Arguably, the distress suffered by Citigroup affected the institutions that were exposed to it or that had exposures to the same types of assets.[7] During 2008, other institutions also experienced a decrease in their margins, while all institutions suffered a sharp reduction in retained earnings in the first quarter of 2008 (Figure 17), *well before* the stresses induced by Lehman's collapse.

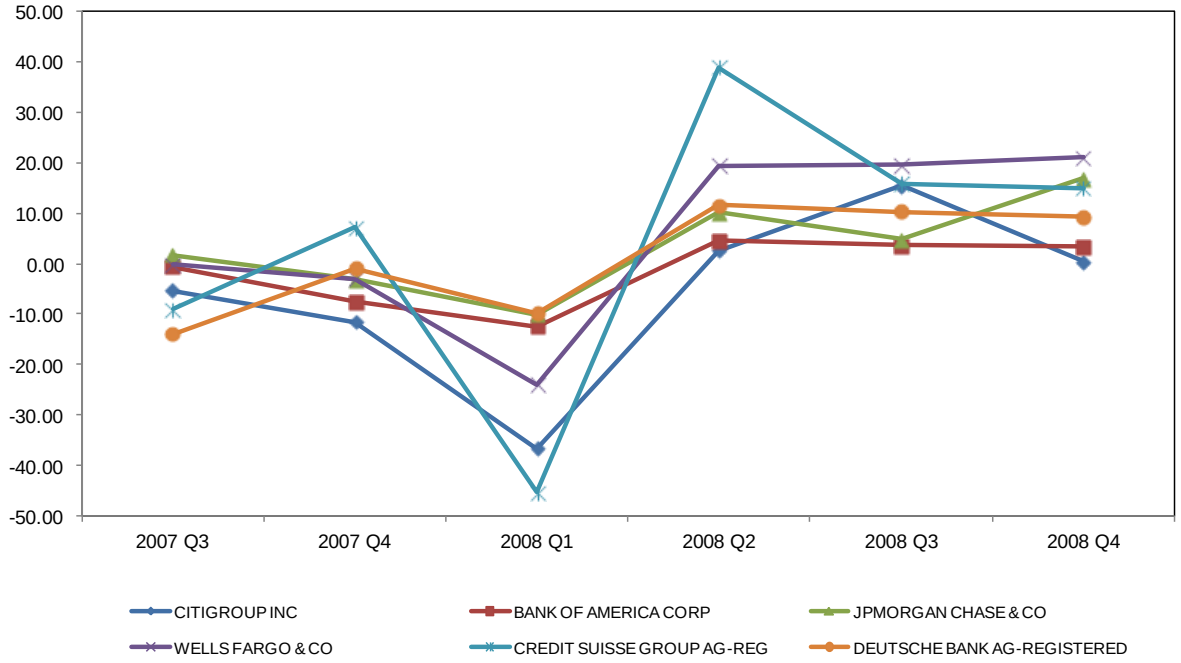
Figure 16. Financial Margins of Selected LCFIs
(basis points)



Sources: Bloomberg; and Fund staff calculations.
Note: Financial margin is the difference between the variable yield and the cost of funding for the institution as a whole.

[7] Direct exposures can take several forms, such as, holdings of Citigroup's securities (i.e., a credit exposure *to* Citigroup), which decreased in value after Citigroup started facing difficulties, or funding provided by Citigroup that suddenly is no longer available (i.e., a funding exposure *from* Citigroup). An indirect exposure takes place when two institutions hold similar assets of a third institution. Large fire sales of these assets by one of the holding institutions may cause decrease in value of the assets held by the other institution.

Figure 17. Change in Retained Earnings—Selected LCFIs
(quarter-on-quarter)



Sources: Bloomberg; and Fund staff calculations.

34. ***Simulations***. Table 4 presents the simulation results of an initial margin shock calibrated to the actual margins faced by these institutions in the fourth quarter of 2007, along with information on the overall inter-bank exposures of the LCFIs from their respective balance sheets. Since bilateral inter-bank exposures are not available, these results are hypothetical only, and assume that interbank exposures are spread equally among the given LCFIs. In no way should these results be interpreted as the actual chain of events that would transpire if an LCFI was the recipient of a liquidity shock. Contagion occurs when retained earnings fall by more than 5 percent as a result of losses stemming from an exposure to other institutions in distress. No LCFI escapes the impact of the funding shock in this simulation. Taking as a starting point the initial margin compression experienced by Citigroup translates into difficulties concurrently in Bank of America and, in the second round of contagion, Credit Suisse and Intesa Sanpaolo. In subsequent rounds, the combined effect of difficulties in these institutions is that several other institutions are adversely impacted. HSBC is the most resilient in this simulation, but it too succumbs to funding cost shocks after all others have done so.

Table 4. Contagion among LCFIs: A Simulation

Contagion Round	1	2	3	4
CITIGROUP INC	x			
BANK OF AMERICA CORP	x			
JPMORGAN CHASE & CO			x	
WELLS FARGO & CO			x	
CREDIT SUISSE GROUP AG-REG		x		
DEUTSCHE BANK AG-REGISTERED			x	
HSBC HOLDINGS PLC				x
BARCLAYS PLC			x	
UNICREDIT SPA			x	
INTESA SANPAOLO		x		
BANCO SANTANDER SA			x	

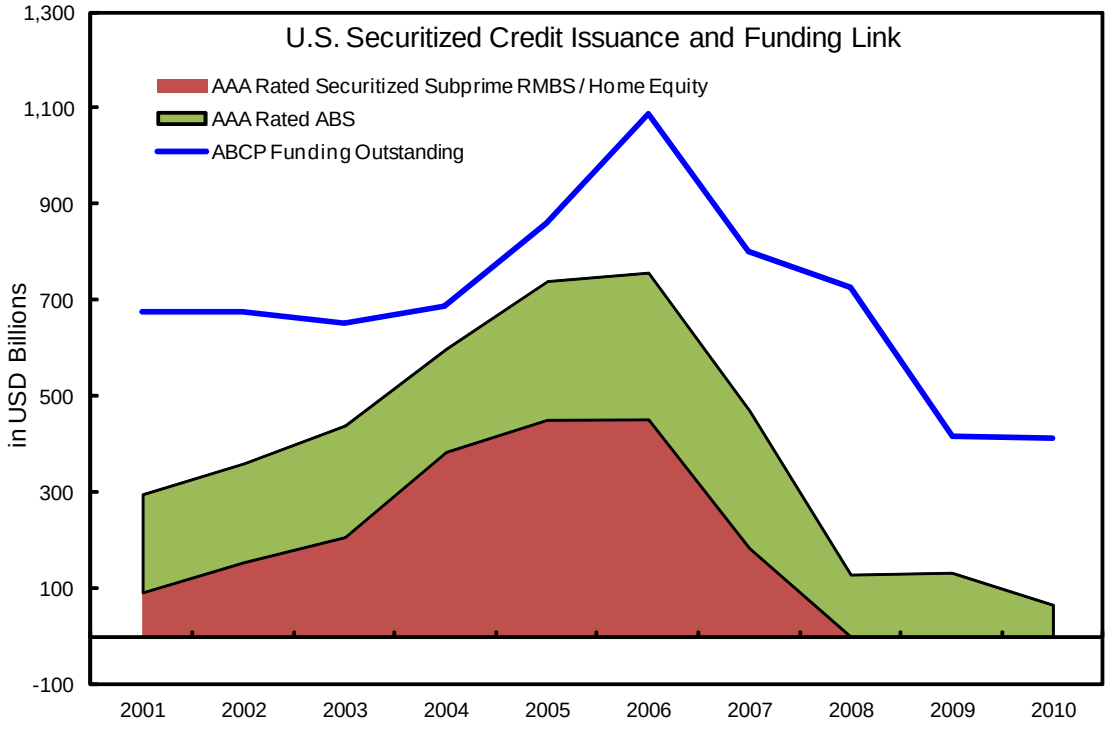
IV. Other Fault Lines: Ratings and Platforms

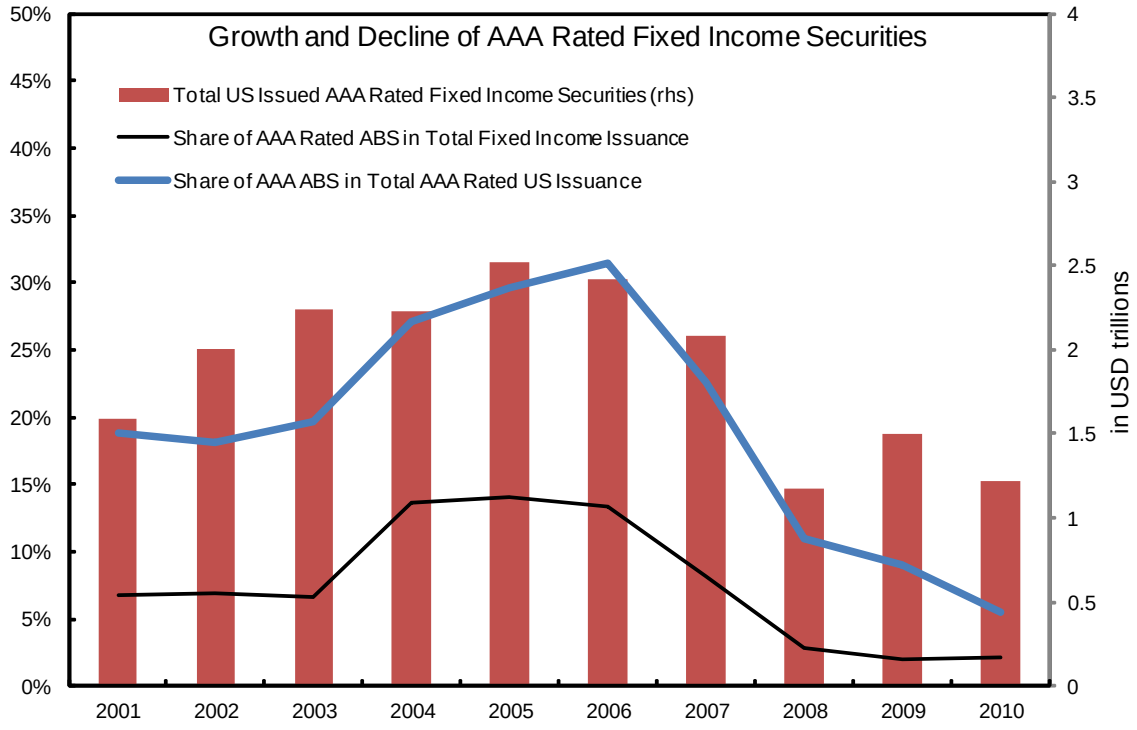
Ratings played an important role in the balance sheet transformations that have driven increased financial interconnectedness, and constitute another critical fault line along which stresses were formed and shocks transmitted during the crisis. This role reflects, on the one hand, regulatory arbitrage and, on the other, investment mandates of various financial institutions. This section elaborates on the role of ratings, whose systemic effects follows from global interconnectedness. The section also looks at the concentration of payments and settlements system as another potential fault line—most transactions take place over a few platforms, and the failure of any of these platforms could severely impede global finance. Yet, an untold story of the crisis has been the resilience of these platforms.

A. Ratings and Asset Allocation

35. ***Systemic role***. Ratings played a systemic role in the crisis, by facilitating asset and ALM innovation to boost yields on securities for clients and on profit margins for those who constructed them. Such innovation spawned an explosion of products—with features akin to AAA in other contexts—and related vehicles to facilitate distribution. Fragilities arose from this "hardwiring" of ratings of structured products and the vehicles that housed them, whose ratings themselves were sensitive to market value changes and/or to the ratings of their underlying assets (Figure 18, and BIS, 2008b). Small changes in the credit quality of the underlying assets translated into large changes in the ratings of the structured credit products (IMF 2009b).

Figure 18. U.S.: Ratings and Securities, 2001-10





Sources: J.P. Morgan and staff calculations.

36. ***Infrastructure***. The infrastructure supporting these innovations was also rating dependent.

- *Monolines*. As an example, major monolines have generally enjoyed AAA ratings. Since the rating serves as a lower bound for the rating of any insured instrument, and the main investors using monoline guarantees of credit quality alongside their investments of structured credit products were seeking to attain assets of very high credit quality, a downgrade would eliminate most, if not all, of the value of this combination and thus threaten the business model of the monoline insurers. The sharp widening of subprime mortgage spreads beginning in mid-2007 and rising defaults resulted in large charges against monolines' income and shareholders' equity as a consequence of their exposure to this market segment. This led to a number of monoline bond insurers being downgraded by the credit rating agencies. These events highlight the linkages between the ratings of a monoline and the rating of the products it guaranteed, as well as their common vulnerability.

- *SIVs*. The business model and operations of SIVs are also highly dependent on rating requirements and provide another example of "hardwiring." The funding problems faced by SIVs appear to have been linked to the criteria imposed by rating agencies in rating debt instruments issued by these vehicles. Changes in the market value of SIVs' assets can lead to certain tests (liquidity and capital adequacy) being violated. These tests, which are intended to protect the interest of senior creditors, can lead to a pause in growth or a deleveraging through a run-off of assets and the repayment of senior creditors. However, recent events have shown that, when applied to a number of SIVs at the same time, these intended protections can create a downward spiral of asset prices generating further rounds of deleveraging and asset sales that depress prices further still.

37. ***Implications***. With global financial interconnections, the hardwiring of ratings can have systemic implications. Geographical dispersion of rated products is no guarantee of a reduction of concentration risk. There could be an underestimation of common vulnerabilities that arise from (i) the risk of correlated asset deterioration; (ii) the reality of a concentrated pool of common intermediaries and the likelihood that these assets are dependent on a common strategy of credit enhancements; and (iii) the fact that intermediaries are all concentrated in the same strategy of innovation.

B. Platforms

38. ***Concentration***. The centrality and concentration of national and cross border payment and settlement systems constitute another potential fault line that, however, functioned smoothly during the crisis. The success of these systems largely reflects risk management and resolution arrangements that provided market confidence and predictability of payments. At the height of the crisis, the payment and settlement systems

processed dramatically increased transactions volumes, sharp increases in placement and execution of collateral to support increased demand for precautionary liquidity, and larger and more frequent margin payments. Overall, the payment and settlement systems functioned without disruption. For a few systems, the unexpected increase in transaction volumes raised concerns regarding technological capacity, but these issues were resolved without impact on other systems or markets. Even in the case of CLS Bank, a settlement system for foreign exchange trades that experienced a temporary capacity-related problem from a surge in foreign exchange activity, these issues were resolved such that settlements were completed on each day.

39. ***Robustness***. Among the specific features mitigating the operational and financial risks of payment and settlement systems are:

- *Intraday liquidity*. This feature, which exists in almost all real-time gross settlement (RTGS) systems, allowed central banks to support the increased liquidity needs when and as needed during the crisis.

- *Collateralization procedures and eligibility.* Intraday liquidity provision by central banks is collateralized. Collateralization procedures, which were implemented in advance, helped to facilitate the provision of additional liquidity by being able to process more collateral without difficulty. Furthermore, the types of eligible collateral to be accepted by central banks were also defined in advance, with some central banks expanding their eligible collateral lists during the crisis and as a precautionary measure. However, some institutions had difficulty delivering securities to central banks and other counterparties on a cross-border, cross-currency basis for same-day settlement. These difficulties were attributed mainly to operational obstacles such as the differences in business and processing hours of systems in different time zones.

- *Liquidity-saving features.* Modern RTGS systems are equipped with liquidity-saving features such as queuing and offsetting mechanisms. By identifying back-to-back transactions, the systems were able to deliver payments on a net basis, reducing the need for cash transfers on a gross basis.

- *Risk management procedures for CCP*. Central counterparties (CCPs) risk management tools include margin calls, guarantee of clearing funds, and access to private credit lines. The increased volatility in asset prices during the crisis led financial institutions to face larger and more frequent margin calls from CCPs. A few CCPs that did not already have this capacity took the extraordinary step of conducting multiple margin calls within the same day. The existence of CCPs that net market positions and assume counterparty risk reduced the overall risk than otherwise might have been the case.

- *Procedures to handle defaulting participants.* The majority of CCPs have procedures to handle the positions of the defaulting clearing members. The procedures to wind-up Lehman's positions worked relatively well, although the difficulty was to agree on the prices of some of the more illiquid derivatives. In some cases, CCPs used auction mechanisms among the surviving clearing members to identify prices.

40. ***Reforms***. Although CCPs worked well in this crisis where they were available, there are a growing number of CCPs being set up worldwide. It will be important to upgrade the set of minimum standards for the construction and risk management of CCPs as the current set is quite general. The Committee of Payment and Settlement Systems and the International Organization of Securities Commissions are working on such standards.

V. WAY FORWARD

A. Summary

41. ***Architecture***. The mapping of the global financial architecture and the fault lines discussed are not exhaustive. Rather, the paper sketches global financial interconnections with implications for the Fund's macro-financial surveillance. The limited data available corroborate an architecture where:

- A core set of countries and financial systems are at the center of global finance. These nodes intermediate close to two-thirds of claims on the rest of the world, but importantly are interconnected among themselves. While some regions have common exposures to a regional node, even these nodes are connected to the global players.

- The distinction between banks and nonbanks is becoming less meaningful owing to ownership structures and common exposures to markets. Funds are closely related to banks with affiliation rates ranging between 25–67 percent across the United States and Europe. Moreover, these "independent funds" play a critical role in the funding strategies of the LCFIs of the common and regional lenders.

- Off-shore centers are largely "pass-throughs" in support of bank/nonbank global ALM strategies. In the main, these centers have clustered around the core common lenders.

- Although individual common lenders with affiliated funds and off-shore centers have unique exposure networks to groups of countries, the scope for the transmission of shocks *across* networks remains real, given interconnections among common lenders.

42. ***Durability and development***. Though some dimensions of this architecture are likely durable—for instance, the existence of LCFIs and "hard-wired" ratings and settlement systems—the specific shape could be more transient, depending on circumstances and the macroeconomic and regulatory environment. Searching for higher returns through riskier

activities in recent years and procyclically expanding their balance sheets, agents availed themselves of arbitrage opportunities and technology to innovate. This gave rise to instruments and vehicles that resulted in a particular configuration of exposures. Going forward, macroeconomic developments and changes in the regulatory architecture are already laying the basis for further innovation, changes, and movements along the risk/return frontier that will evolve into new exposures and networks.

B. Surveillance

43. ***Frameworks and products***. Knowledge of funding networks and cross-border interconnections would inform Fund financial surveillance both at the multilateral and bilateral levels. It could help focus the analysis of spillovers, as well as identify common features and themes across countries, such as exposures to similar networks and risk concentrations. It could also enhance the host of models developed in the last several years to monitor systemic risks and that currently form the basis of spillovers and assessments of systemic risk concentrations (IMF, 2009a and 2010d). Keeping abreast of changing interconnections and networks that may be re-configured as a result of, for instance, regulatory changes would permit an analysis—and policy discussion—of evolving vulnerabilities. As immediate challenges:

- *Financial spillover assessments*, especially for common lenders, are critical. One implication of financial interconnectedness is that policies relevant at the national level can have systemic implications. This is especially relevant for common and regional lenders in the architecture where the ALM strategies of LCFIs in response to particular policies have cross border and, in some cases, global implications. For example, the breadth of regulatory change underway—and in a low interest rate environment—will likely result in adaptations of business models and strategies that would affect exposures and need close monitoring.

- *Networks and bilateral surveillance*. Macro-financial surveillance, currently done in Article IV surveillance and Financial Sector Assessment Program (FSAP) assessments, needs to be augmented with consideration of how a given country's financial system sits in the global financial network. Swap lines established during the crisis, the decision to bail-out AIG, the spillovers from crises in Greece, Dubai, and Kazakhstan are all examples of how network of exposures elicited policy action. Tracking network exposures and their macroeconomic implications requires a surveillance equivalent of a "supervisory college." Supervisory colleges focus on the global reach of individual banks or LCFIs from a regulatory perspective, but without consideration of geography. Similarly, monitoring *groups* of countries that are closely linked via financial exposures is essential to effective macro-financial surveillance. The Fund is ideally positioned to fulfill this role. Such an approach could better capture macro-financial risks in individual countries. With an appropriate level of granularity, analysis of networks could also enhance existing regional surveillance

and form the basis for engaging with "regional risk boards" as exists in the EU and are emerging in the Nordic/Baltic area and Asia.

44. ***Macro-financial policies***. Understanding financial interconnections, and the risks emanating from these interconnections, must inform the Fund's policy advice. Both at the systemic and the country levels, framing macroeconomic and macro-prudential policies to address also the buildup of risk concentrations emanating from interconnected networks can make for more effective advice. For instance, pursuing certain policies, such as specific funding strategies to shield the banking system from given risks, cannot be treated in isolation of the broader network to which the system is connected. The Fund is uniquely positioned to contribute to the macroeconomic and prudential policy debate to address the buildup of systemic and national-level risk.

C. Data

45. ***Incomplete***. Existing data to which the Fund has access, including international investment positions data and the efforts of Milesi-Ferretti et al., 2010, in improving external balance sheet information of economies, can take us some distance towards operationalizing the approach described above. But, as the crisis has revealed, enhancing, augmenting, and widening access to the datasets that support understanding of financial interconnections—including of the core LCFIs—is essential to effective surveillance. There is a lack of a holistic global picture of LCFIs' activities, such as on the connections among LCFIs, among banks and nonbanks, and across borders. This is true for the asset and funding sides of the balance sheet, and off-balance sheet, none of which are covered adequately by traditional data sources, such as national statistical agencies that the Fund normally liaises with.

46. ***Access***. Data exist that could be useful to fleshing out a global financial risk map, but access is limited because of confidentiality.

- *BIS*. The BIS has the most comprehensive source of information on banks' international financial claims and liabilities, providing breakdowns by currencies and by country counterparties. But detailed information on cross-border banking cannot be shared without express authorization from its members. There are no substitutes to these data as publicly available sources of banking data, such as Bloomberg or BankScope, do not provide the necessary breakdowns to conduct cross-border financial sector surveillance.

- *Supervisors*. Even if access were granted to the full range of the BIS's data, such data would not be sufficient to map the range of interconnections, as it precludes important other information such as on funds (or other nonbanks), on markets, and relationships among LCFIs. The Senior Supervisors' Group has recently begun compiling some information on large cross-border exposures of some LCFIs, but it is constrained by

confidentiality protocols to share this information beyond group members. Supervisory colleges are similarly constrained.

- *IMF and reserves*. It should be noted that the Fund itself compiles information on members' reserves by currency (COFER), instrument (INFER), and securities (SEFER) that due to confidentiality commitments it cannot share, even internally, in a more granular form than published without recourse to its membership. Moreover, coverage is limited, as certain economies with large reserve holdings are missing; such information would be essential to mapping global exposures and flows of funds.

- *Private data sources*. In the private domain, some data are available for purchase (e.g., *Lipper*), but other important sources, such as derivatives data from *DTCC*, are available only—and that too only in small part—if a regulator can demonstrate a material interest in a subset of the data. Yet others require special effort. Consider, for instance, the information available to *custody banks*, which play a unique role in the financial sector, arranging settlement of and for security transactions, gathering information on securities cash-flows, and managing any associated cash and foreign exchange transactions when required (i.e., collect and transmit cash-flows arising from securities). The ability to access and aggregate the information visible to custody banks would provide policymakers with an unprecedented wealth of information on global financial flows. However, while custodial data can be a valuable source of information and are used by some countries to compile resident-based data, from previous Fund investigations, there are typically legal restrictions on the provision of data relating to nonresidents, and the ability of custodians to supply data in formats useful for macro-analysis can sometimes be limited.

47. ***Efforts underway***. The G20 data initiative has begun work to address these data gaps. Building on the IMF Staff Policy Position Note, "Addressing Information Gaps," (Johnston et al., 2009), the Fund participates in an FSB working group to address G20 recommendations dealing with (i) improved data collection and information sharing on linkages across financial institutions, and (ii) the drafting of a common template by end-2010 on the exposures of systemically important global financial institutions (see *The Financial Crisis and Information Gaps* and *The Financial Crisis and Information Gaps: Progress Report, Action Plans, and Timetables*, Reports to the G20 Finance Ministers and Central Bank Governors, October 29, 2009 and May 2010, respectively). Drawing on the data needs identified by the working group, as part of this initiative, the Fund has contributed its own draft data template for systemically important financial institutions that combines both the micro- and macro-financial data needs underlying the Fund's surveillance activities (Supplement 1, section VII). This proposed template is being considered as one of the inputs to developing a common template for systemically important institutions as a means of addressing the data gaps identified earlier. The work will, in part, broaden the set of data available for mapping and assessing risks associated with financial linkages among systemically important institutions. Further, in support of network analysis, discussions are underway under the G20 data gaps initiative to enhance both the BIS's International Banking

Statistics and the IMF's CPIS. The Fund, jointly with the OECD, is to host a conference early in 2011 to discuss the modalities to promote flows of funds and sectoral accounts more generally among G20 and other advanced economies.

48. ***Complementing existing efforts***. Overcoming the data challenges requires buy in from the membership on the value of a global financial risk map in Fund surveillance. Many of the confidentiality issues, including those constraining the BIS and the IMF, derive from limitations imposed by the membership on provision and use of data to the IFIs. In this regard, it should be noted that Article VIII, Section 5 expressly states that members are "under no obligation to furnish information in such detail that the affairs of individuals and corporations are disclosed." Limitations on access to data extend to relevant information collected by the public sectors in individual countries. While such data compilations serve the public good in a national context, better recognition of the value of situating national financial systems in the context of global financial interconnectedness—that is, the *international public good* character of this information—could form the basis for exploring modalities for voluntary sharing and access (e.g., levels of aggregation, frequency, and masking of institutions' names), with appropriate confidentiality protocols (such as memoranda of understanding; see IMF, 2010b). Moreover, in addition to the enhancements being contemplated under the G20 data gaps initiative, data that would be useful to elaborating a risk map include: (i) cross border derivatives and counterparties—some of which are collected by DTCC; and (ii) cross border funds—e.g., purchasing a Lipper license (for this paper, a short-term trial license was used to access a part of the data).

D. Areas of Future Work

49. ***More comprehensive mapping***. The illustrative mappings provided in this paper are incomplete in that they do not include information on derivatives, the range of bank-nonbank relations are only partially documented, and the country source of funding for the nonbanks (funds) is limited. The mappings could be further developed on the basis of data that are purchased from private vendors (with relevant licenses for access), and seeking specific permission from the membership for access to confidential data that are already provided to the BIS and IMF. This includes data on reserves of key international reserves holders that can help map global financial flows (and gross, not just net, financial flows). Further overcoming access issues, such as with the DTCC, can provide for a more comprehensive map.

50. ***Operationalizing the architecture***. Notwithstanding the limitations, the essential architecture of cross-border interconnectedness outlined above can be made operational for the purposes of surveillance. Meaningful data modules can be extracted and set up to support bilateral surveillance, spillover reports, cross-country analyses, regional economic outlooks, multilateral surveillance, and work on vulnerability assessments. More focused streams of work are also possible, such as taking a closer look at the interconnections and shock propagation mechanisms among the common lenders and methods of detecting other types of important intermediaries. Better understanding the network structure of each

common lender, assessing the interconnections of lenders with other countries in their orbit, and comparing networks could form the basis of yet another stream of work. Companion papers could be undertaken in each of these areas.

VI. Issues for Discussion

51. ***Directors' views*** are sought on:

- the value of the types of network concepts and mappings illustrated in this paper;
- the usefulness of this approach to augmenting surveillance;
- efforts that the Fund should undertake in better understanding financial interconnectedness and integrating this work into its broader surveillance and policy work; and
- the importance of closing the data gaps, particularly with regard to LCFIs.

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