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Global Banking Glut and Loan Risk Premium

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European global banks intermediating U.S. dollar funds are important in influencing credit conditions in the United States. U.S. dollar-denominated assets of banks outside the United States are comparable in size to the total assets of the U.S. commercial bank sector, but the large gross cross-border positions are masked by the netting out of the gross assets and liabilities. As a consequence, current account imbalances do not reflect the influence of gross capital flows on U.S. financial conditions. This paper pieces together evidence from a global flow of funds analysis, and develops a theoretical model linking global banks and U.S. loan risk premiums. The culprit for the easy credit conditions in the United States up to 2007 may have been the "Global Banking Glut" rather than the "Global Savings Glut." [JEL F32, F33, F34]
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Real estate booms riding on the back of rapidly increasing banking sector credit have rightly drawn attention to the role played by permissive external financial conditions in the amplification of the credit boom. Fluctuations in capital flows in recent years have ignited a lively debate over the

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nature of "global liquidity" and its transmission across borders, both for emerging and advanced economies.

The role of external financing conditions has been particularly relevant for the United States, with some attributing the permissive financial conditions in the United States during the middle years of the last decade to the accumulated global current account imbalances and the "Global Savings Glut" emanating from emerging economies (Bernanke, 2005).

Although the term "global liquidity" is often used in debates over external financial conditions, the precise definition has been more difficult to pin down. One task in this lecture will be to formulate a theoretical model of global liquidity and set it against the evidence from the global flow of funds. It is fitting that we revisit the issue of global liquidity in this Mundell Fleming Lecture. The conceptual leap in Fleming (1962) and Mundell (1963) was to elevate international capital flows as a separate component of study, not merely as the residual to the outcome from the real side of the economy.

There have been far-reaching structural changes in the operation of the global financial system since the late 1950s and early 1960s when the Mundell-Fleming model was formulated and refined, and none more so than in cross-border banking. Given the importance of banking sector portfolio decisions and the ensuing capital flows for the global financial system, it seems a timely occasion to revisit some of the time-honored building blocks of the Mundell-Fleming model in the lecture that bears their names.

In this lecture, I will put forward the hypothesis that cross-border banking and the fluctuating leverage of the global banks are the channels through which permissive financial conditions are transmitted globally. In formulating and exploring this hypothesis, the focus will be on the impact of global liquidity on the advanced economies, especially the United States and Europe.[1]

My hypothesis is motivated by the evidence from an aggregate flow of funds analysis, building on the BIS banking statistics. The evidence points to the combination of two features that is critically important for understanding recent events—the two elements being *European banks* and *U.S. dollar funding*.

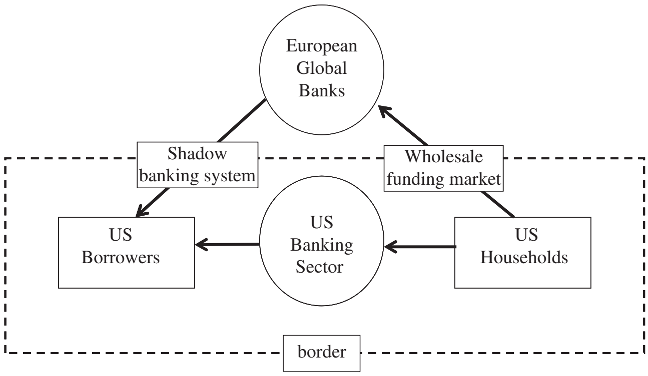
First, we will see that the U.S. dollar-denominated assets of banks outside the United States are comparable in size to the total assets of the U.S. commercial banking sector, peaking at over $10 trillion prior to the crisis. The BIS banking statistics reveal that a substantial portion of external U.S. dollar claims are the claims of European banks against U.S. counterparties.

Second, on the funding side, we extend earlier studies that have shown how European global banks financed their activities by tapping the wholesale funding market in the United States.[2] For instance, the interoffice accounts

[1]The impact of global liquidity on emerging and developing economies has been explored in Bruno and Shin (2011).

[2]See, for instance, the BIS studies by Baba, McCauley, and Ramaswamy (2009) and McGuire and von Peter (2009) on the use of U.S. dollar wholesale funding by European global banks. Acharya and Schnabl (2009) report that European banks were sponsors for around

Figure 1. European Global Banks Add Intermediation Capacity for Connecting U.S. Savers and Borrowers



of foreign bank branches in the United States reveal that foreign banks were raising large amounts of U.S. dollar funding in the United States and then channeling the funds to head office. Through these and other means, the large gross claims of European banks on U.S. counterparties are matched by their large gross liabilities to U.S.-based savers.

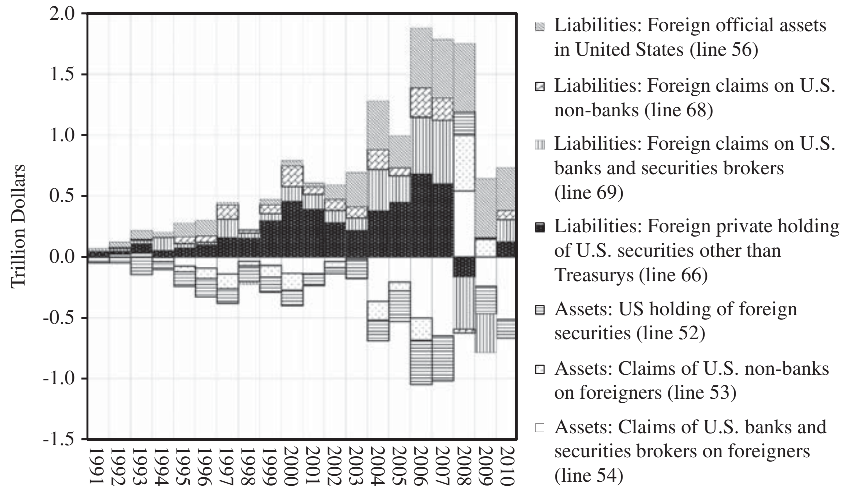
The broad picture that emerges of the role of European global banks in determining U.S. financial conditions can be depicted in terms of the schematic in Figure 1. European banks draw wholesale funding from the United States and then lend it back to U.S. residents. Although European banks' presence in the domestic U.S. commercial banking sector is small, their impact on overall credit conditions looms much larger through the shadow banking system in the United States that relies on capital market-based financial intermediaries who intermediate funds through securitization of claims.

The role of European global banks in determining U.S. financial conditions reinforces the importance of tracking *gross* capital flows, as emphasized by Obstfeld (2012a and 2012b) and Borio and Disyatat (2011). In Figure 1, the large gross assets and gross liabilities of the European banks net out, and are not reflected in the current account that tracks only the *net flows*. To the extent that the banking sector plays an important role in influencing credit conditions, it is gross flows rather than net flows that we should be tracking.

Net capital flows are also of concern to policymakers, and rightly so. Persistent current account imbalances hinder the rebalancing of global demand. Current account imbalances also hold implications for the long-run sustainability of the net external asset position, as recently emphasized by

70 percent of the asset-backed commercial paper (ABCP) originated prior to the subprime crisis.

Figure 2. U.S. Gross Capital Flows by Category



Source: U.S. Bureau of Economic Analysis. Increase in U.S. liability to foreigners is indicated by positive bar, increase in U.S. claims on foreigners is indicated by negative bar. Only a subset of gross flows is included, so that flows do not sum to zero.

Obstfeld (2012b).[3] The purpose here is to make the narrower claim that the current account may not be as informative about overall credit conditions as gross capital flows, and to propose a theoretical framework for the claim.

Figure 2 plots U.S. gross capital flows by category of flows. An increase in U.S. liabilities to foreigners is indicated by an upward-pointing bar (gross capital inflow), while an increase in U.S. claims on foreigners is indicated by a downward-pointing bar (gross capital outflow).[4] While official gross flows from current account surplus countries are large (gray bars), we see that private sector gross flows are much larger. The downward-pointing bars before 2008 indicate large outflows of capital from the United States through the banking sector, which then re-enter the United States through the purchases of non-Treasury securities. The schematic in Figure 1 is useful to make sense of the gross flows.

As we will see shortly, foreign banks' U.S. branches and subsidiaries drive the gross capital outflows through the banking sector by raising wholesale funding in the United States through money market funds (MMFs) and then shipping it to headquarters. Remember that foreign banks' branches and subsidiaries in the United States are treated as U.S. banks in

[3]See also Obstfeld and Rogoff (2007); Lane and Milesi-Ferretti (2007) and Gourinchas and Rey (2007) and the postcrisis updated evidence in Gourinchas, Govillot, and Rey (2010).

[4]The line numbers in Figure 2 refer to the balance of payments table from the U.S. Bureau of Economic Analysis: www.bea.gov/newsreleases/international/trade/trad_time_series.xls

the balance of payments, as the balance of payments accounts are based on residence, not nationality.

The gross capital inflows to the United States represent lending by foreign (mainly European) banks via the shadow banking system through the purchase of private label mortgage-backed securities and structured products generated by the securitization of claims on U.S. borrowers. In this way, European banks may have played a pivotal role in influencing credit conditions in the United States by providing U.S. dollar intermediation capacity. However, since the eurozone has a roughly balanced current account while the United Kingdom is actually a *deficit* country, their collective *net capital flows* vis-à-vis the United States do not reflect the influence of their banks in setting overall credit conditions in the United States. The distinction between net and gross flows is a classic theme in international finance,[5] but deserves renewed attention given the new patterns of gross capital flows because of global banking.

This lecture comes in two parts. In the first part, I will piece together the evidence from the global flow of funds in drawing out the main hypothesis. The evidence comes from the BIS banking statistics, which is supplemented with other aggregate data from previous studies and the Federal Reserve's Flow of Funds data for the United States.

The second part of the lecture develops a theoretical model of the impact of global banking on U.S. domestic credit conditions. The credit supply component of the model is the flip side of a credit risk model where lending expands to fill up any spare balance sheet capacity when measured risks are low. The balance sheet constraint binds all the time, so that in periods of low measured risks, balance sheets must be large enough so that the risk constraint binds *in spite of* the low measured risks.

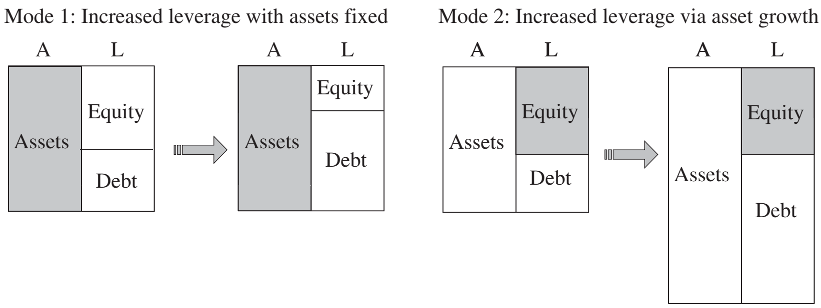
In formulating the model of credit supply as the flip side of a credit risk model, the approach rests on the corporate finance of bank balance sheet management. In textbook discussions of corporate financing decisions, the set of positive net present value (NPV) projects is often taken as being exogenously given, with the implication that the size of the balance sheet is fixed. Leverage increases by substituting equity for debt, such as through an equity buy-back financed by a debt issue, as depicted by the left-hand panel in Figure 3.

However, the left-hand panel in Figure 3 turns out not to be a good description of the way that the banking sector leverage varies over the financial cycle. The distinguishing feature of the banking sector leverage cycle is that leverage fluctuates through fluctuations in the total size of the balance sheet with equity being the predetermined variable. Hence, leverage and total assets tend to move in lock-step, as depicted in the right-hand panel of Figure 3.[6]

[5]See for instance Kindleberger's (1965) Princeton Essay in International Finance (Kindleberger, 1965).

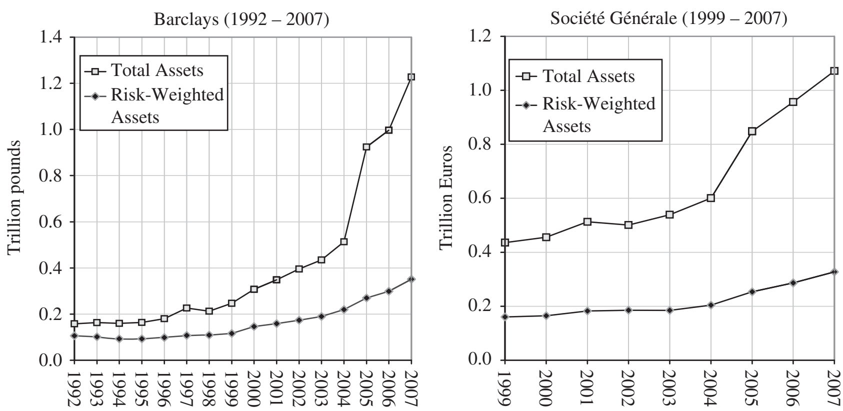
[6]Adrian and Shin (2008 and 2010) discuss the evidence from U.S. investment banks, while Bruno and Shin (2011) show in their empirical investigation of capital flows to emerging economies that non-U.S. global banks behave similarly.

Figure 3. Two Modes of Leveraging Up



Note: In the left panel, the firm keeps assets fixed but replaces equity with debt. In the right panel, the firm keeps equity fixed and increases the size of its balance sheet.

Figure 4. Total Assets and Risk-Weighted Assets of Barclays and Société Générale



Source: Bankscope.

Banks and other financial intermediaries' lending depends on their "balance sheet capacity." Balance sheet capacity, in turn, depends on two things—the amount of bank capital and the degree of "permitted leverage" as implied by the credit risk of the bank's portfolio and the amount of capital that the bank keeps to meet that credit risk. Bank lending expands to fill up any spare balance sheet capacity when measured risks are low. Since the balance sheet constraint binds *all the time*, lending expands in tranquil times in order that the risk constraint binds *in spite of* the low measured risks. Borio and Disyatat (2011) have coined the term "excess elasticity" to describe the tendency of the banking system to expand when financial constraints are relaxed.

The consequences of excess elasticity can be seen in Figure 4 which plots the total assets and risk-weighted assets of two typical European global banks—Barclays and Société Générale. Even as total assets were growing rapidly up to the eve of the crisis in 2007, the risk-weighted assets of the banks were growing moderately, reflecting the low levels of measured risks, and implying low levels of equity capital on the banks' balance sheets.

More research is needed in order to answer two key questions. Why was it Europe that saw such rapid increases in banking capacity, and why did European (and not U.S.) banks expand intermediation between U.S. borrowers and savers? Two likely elements of the answer to both questions is the regulatory environment in Europe and the advent of the euro. The European Union was the jurisdiction that embraced the spirit of the Basel II regulations most enthusiastically, while the rapid growth of cross-border banking within the eurozone after the advent of the euro in 1999 provided fertile conditions for rapid growth of the European banking sector.

The permissive bank risk management practices epitomized in the Basel II proposals were already widely practiced within Europe as banks became more adept at circumventing the spirit of the initial 1988 Basel I Accord. Basel II was subsequently codified most thoroughly in the European Union through the EU's Capital Adequacy Directive (CAD).[7] In contrast, U.S. regulators have been more ambivalent toward Basel II, and chose to maintain relatively more stringent regulations (at least, in the formal regulated banking sector) such as the cap on bank leverage.

In order to emphasize the link between the expansion of global banking and the risk management practices embodied in the Basel II regulations, the key element of the theoretical model employed in this lecture will be the Vasicek (2002) credit risk model, which has served as the backbone of the Basel capital rules.

The central message of this lecture is that the current account may not be as informative about overall credit conditions as gross capital flows, especially gross capital flows generated by the banking sector. If the claim is correct, then there are two important implications, one for policymakers and one for researchers. Policymakers on their guard against the build-up of financial vulnerabilities cannot rely merely on monitoring the current account. Researchers, for their part, must take the financial system seriously when addressing overall financial conditions, rather than seeing the financial sector as just the residual of the real side of the economy. In this respect, researchers would do well to retrace the motivation for the work of Fleming (1962) and Mundell (1963), who elevated capital flows as a topic worthy of study in its own right. We will review some of the specific methodological lessons at the end of the lecture.

The outline of the lecture is as follows. I begin in the next section by taking stock of the evidence from the BIS banking statistics on the global flow of funds. Section II presents the formal model of direct and intermediated credit where the main implications of the impact of global

[7]See Danielsson et al. (2001) for an early comment on the potential adverse impact of Basel II for financial stability. See also Shin (2010, chapter 10) for historical background.

banks on credit conditions are derived as consequences. The paper concludes with some observations on the origin of the European banking crisis of 2011 and the likely impact of the European crisis on global financial stability.

I. Global Flow of Funds Perspective

Let us begin by examining the evidence for the role of global banks in determining U.S. financial conditions. We will take a "flow of funds" approach by tracking gross flows in the economy, but from a global perspective. As stated at the outset, the two themes that emerge from the investigation is the role of *European global banks* as the protagonists in the transmission of global liquidity and the *U.S. dollar* as the currency underpinning the global banking system. Taken together, the two elements imply a pivotal role for European banks in determining financial conditions in the United States.

Much of our evidence comes from the banking statistics of the Bank for International Settlements (BIS), and so some preliminary remarks are in order on how to read the numbers.[8] The BIS data come in two forms. First is the *locational banking statistics*, which are based on the principle of residence, and which are consistent with the residency principle underlying balance of payments and national income statistics. Under the locational statistics, the branches and subsidiaries of the global banks are classified together with the host country banks.

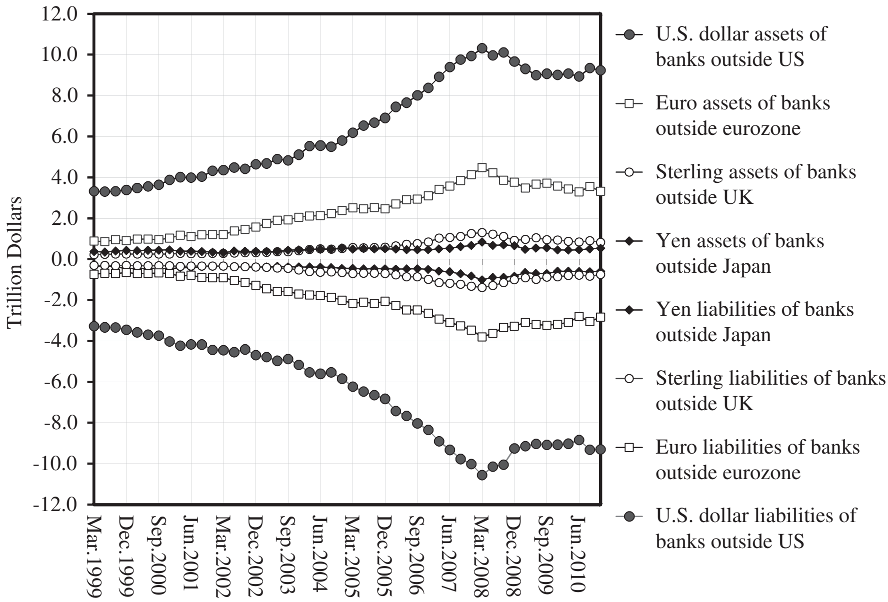
The second type of data from the BIS are the *consolidated statistics*, based on the nationality of the parent bank. Within the consolidated banking statistics, *foreign claims* include the local claims of branches and subsidiaries, while the *international claims* exclude local claims in local (that is, host country) currency.

Figure 5 is from the BIS locational banking statistics, and plots the foreign currency assets and liabilities of BIS-reporting banks, classified according to currency. The top plot represents the U.S. dollar-denominated assets of BIS-reporting banks in foreign currency, and hence gives the U.S. dollar assets of banks outside the United States. The bottom plot in Figure 5 gives the corresponding U.S. dollar-denominated liabilities of banks outside the United States. It is immediately clear from the figure that the U.S. dollar plays a much more prominent role in cross-border banking than does the euro, sterling, or yen.

To gain some perspective on the size of the U.S. dollar assets in Figure 5, we can plot the total assets series next to the aggregate commercial banking sector in the United States, which is given in Figure 6. We see that U.S. dollar assets of banks outside the United States exceeded \$10 trillion in 2008:Q1, and briefly overtook the U.S. chartered commercial banking sector in terms of total assets. So, the sums are substantial. It is as if an offshore banking

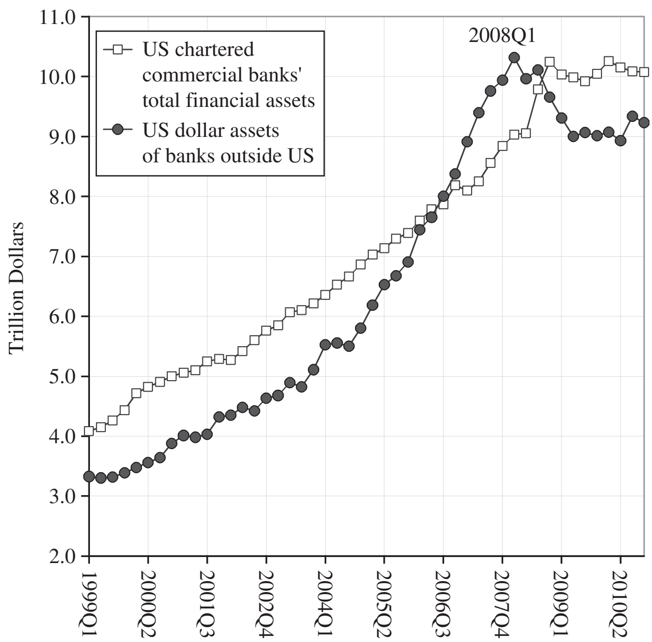
[8]See BIS (2009) for details on the BIS banking statistics. See McGuire and von Peter (2009) for an example of how the BIS statistics can be used in combination to reconstruct aggregate cross-border banking positions.

Figure 5. Foreign Currency Assets and Liabilities of BIS Reporting Banks by Currency



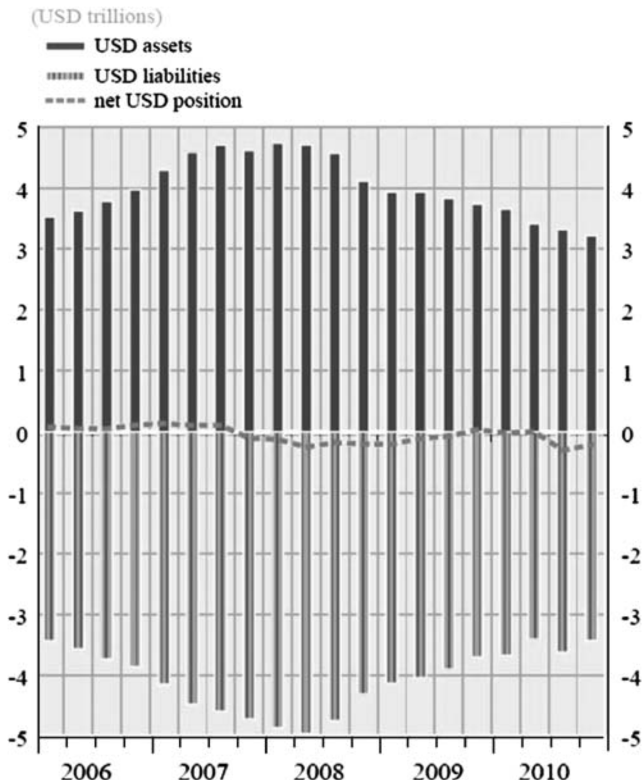
Source: BIS locational banking statistics, Table 5A.

Figure 6. U.S. Dollar Foreign Currency Claims and U.S. Commercial Bank Total Assets



Source: Flow of Funds, Federal Reserve, and BIS locational banking statistics, Table 5A.

Figure 7. U.S. Dollar-Denominated Assets and Liabilities of Euro Area Banks

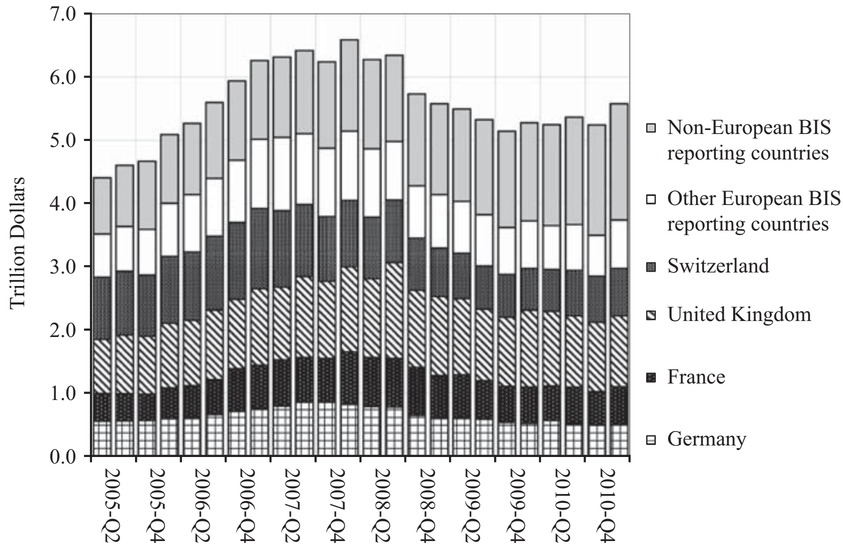


Source: ECB Financial Stability Review, June 2011, p. 102.

sector of comparable size to the U.S. commercial banking sector is intermediating U.S. dollar claims and obligations.

Figure 7 is taken from the June 2011 issue of the European Central Bank's Financial Stability Review (ECB, 2011), and shows the U.S. dollar-denominated assets and liabilities of the eurozone banks. The chart displays the typical combination of the large gross U.S. dollar positions but small net positions that is the central theme in this lecture. The gross positions are very large—reaching nearly $5 trillion at their peak. However, the assets and liabilities mirror each other closely, so that the resulting net position is very small by comparison. Since the balance of payments statistics only measure the net positions, accumulated current account positions will do a poor job of reflecting the underlying gross positions. It is worth noting that Figure 7 deals with the eurozone banks only. They leave out the U.K. and Swiss banks, which (as we see below) play a very substantial intermediating role for credit in the United States. Borio and Disyatat (2011) examine U.S. gross capital flows by region, and note that although the gross inflows from current account surplus countries such as China, Japan and the oil exporters are large, the largest inflows prior to the crisis came from Europe.

Figure 8. Foreign Claims of BIS Reporting Banks on U.S. Counterparties



Source: BIS consolidated banking statistics, Table 9D.

Asset Side

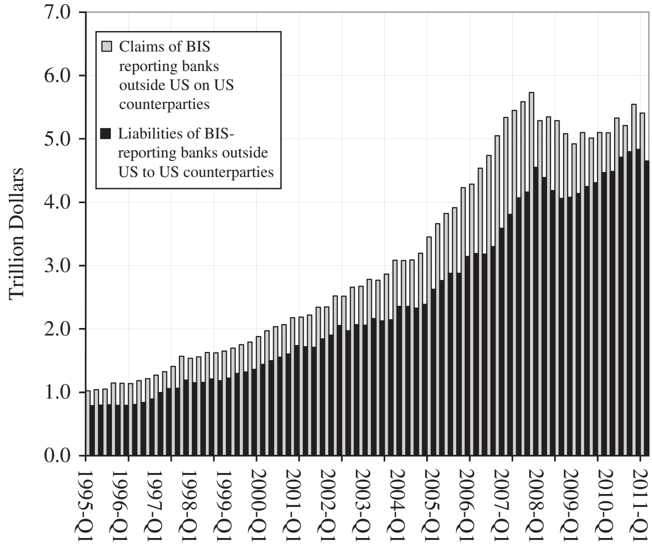
Having documented the size of the U.S. dollar-denominated positions of the global banks outside the United States, we now address how much of the U.S. dollar-denominated assets are claims against U.S. counterparties. Obtaining an answer to this question is important in ascertaining the impact on credit conditions in the United States, rather than U.S. dollar-denominated lending that goes elsewhere in the world (for instance, to the emerging economies).

The BIS consolidated banking statistics (Table 9D) provide insights on how much of the U.S. dollar-denominated claims are actually claims on U.S. borrowers. Figure 8 shows the foreign claims of BIS reporting banks on U.S. counterparties, broken down by the nationality of the lending bank. We see that the U.K. and Swiss banks had very substantial claims on U.S. counterparties, large even compared with the French and German banks. Together, the European global banks had claims of over $5 trillion against U.S. borrowers at the peak of the credit boom.

Some caution is necessary in interpreting these numbers. Figure 8 shows the foreign claims of BIS reporting banks, and hence includes the dollar loans extended by U.S.-based subsidiaries and branches. As such, Figure 8 is not strictly comparable to Figure 5, which is based on the locational banking statistics. Indeed, it is notable that the consolidated exposures of BIS reporting banks on U.S. counterparties falls well short of the $10 trillion sum given by Figure 5, even including the assets of local subsidiaries and branches.

The gap between the $10 trillion sum given by Figure 5 and the U.S. exposures in Figure 8 suggest that the $10 trillion figure may overstate the

Figure 9. Claims and Liabilities of BIS-Reporting Banks Outside United States on U.S. Counterparties (*All Currencies*)



Source: BIS locational banking statistics, Table 6A.

extent of the intermediation activity conducted by the European banks in connecting U.S. savers and borrowers. Another fix on how much of the $10 trillion is with U.S. counterparties is given in Figure 9 from the BIS locational statistics (Table 6A) that shows the claims and liabilities of banks outside the United States on U.S. counterparties. Even though this series includes claims in all currencies, the series peaks at $5.73 trillion,[9] leaving a big gap compared with the $10 trillion figure. Part of the remainder of the $10 trillion sum may be accounted for by lending to emerging economies, but another possibility (perhaps more plausible) is that the $10 trillion sum incorporates substantial double-counting of U.S. dollar exposures that are held between global banks. Yet another possibility is that the holdings of offshore financial centers account for part of the gap. More disaggregated data would help to resolve these questions. What is clear is that a very substantial portion of the $10 trillion dollar-denominated assets do not involve directly a U.S. counterparty, highlighting the importance of the U.S. dollar as the currency that underpins the global banking system.

Although the BIS banking statistics do not provide a detailed breakdown of assets held by the bank by identity of borrower, data on holdings of U.S.

[9]The U.S. dollar only series peaks at $4.8 trillion in 2008:Q1, of which $1 trillion is the claim held by branches of U.S. banks on their parent. I am grateful to Carol Bertaut and Laurie DeMarco for pointing this out. See also Cetorelli and Goldberg (2009 and 2011) who document the workings of internal capital markets U.S. banks.

securities suggest that a substantial portion of the claims of European banks were U.S. private label securities. Milesi-Ferretti (2009) draws on evidence from the U.S. Treasury on foreign holdings of U.S. securities to show that the bulk of nongovernment securities (and not guaranteed by the U.S. GSEs such as Fannie Mae and Freddie Mac) were held by European investors, while countries with large current account surpluses such as China and Japan held mainly U.S. Treasury securities or GSE securities.

Taken together with the BIS data, the picture that emerges is of a substantial amount of credit being extended to U.S. borrowers by the European banks, albeit indirectly through the shadow banking system in the United States through the purchase of mortgage-backed securities and structured products generated by securitization. Since erosion of lending standards is key to the subsequent mortgage crisis, understanding the possible link between the erosion of lending standards and the expansion of credit is crucial. This task is taken up in the theory section below.

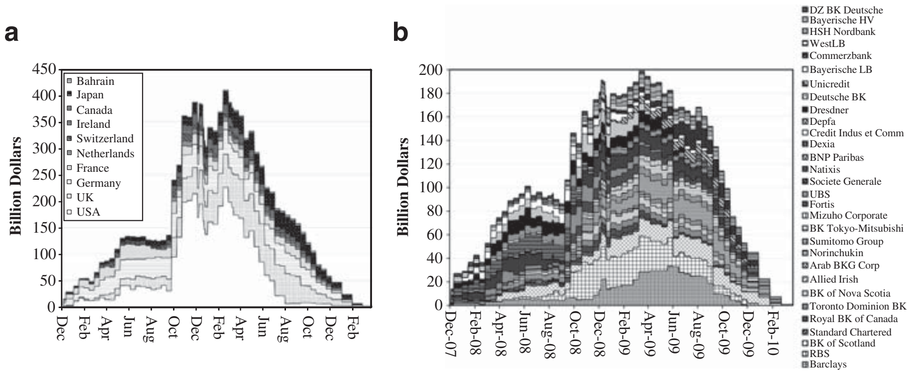
The fact that the rapid expansion of credit through private label mortgage securitizations came from European global banks puts the "Global Savings Glut" hypothesis into new focus. China, Japan and other current account surplus economies have often been cited as contributing to permissive financial conditions in the United States (Bernanke, 2005),[10] but these countries held mainly Treasury and GSE securities rather than the private label securities that provided financing for subprime mortgages. Although GSEs channeled funding to the U.S. housing market also, subprime lending was securitized mainly through private label (that is, non-GSE) securitizations. Of the non-U.S. intermediaries, it was the European banks that were exposed most to the securities and structured products associated with subprime.

More recently, Bernanke, Bertaut, DeMarco, and Kamin (2011) and Bertaut, DeMarco, Kamin, and Tryon (2011) have drawn attention to capital flows emanating from European investors, pointing to the need to modify the original Global Savings Glut hypothesis. They also consider a mechanism whereby the current account surplus countries had an indirect impact on U.S. credit conditions by pushing down long-term yields on U.S. Treasury securities, thereby inducing a substitution away from Treasury securities into private label securities by European investors—a type of "crowding out" effect. However, such an account sits uncomfortably with the evidence from Figure 8 that European global banks raised their assets in the United States, increasing their claims against U.S. borrowers by close to 40 percent from 2005 to 2007, rather than merely substituting their holdings away from Treasuries into private label securities.

Further work may uncover the extent to which the current account surplus countries drove European banks into private label securities, but a more plausible mechanism for the expansion of European banks' assets

[10]Closely related to the Global Savings Glut argument is the hypothesis that emerging economies lack high-quality financial assets, and that the demand for high quality of assets by emerging economy residents results in current account imbalances and lower interest rates in the United States. See, for instance, Caballero, Fahri, and Gourinchas (2008).

Figure 10. Outstanding Claims on Federal Reserve's Term Auction Facility (TAF) by Nationality (Left Panel) and the Top 30 Non-U.S. Banks (Right Panel)



Source: Federal Reserve disclosures on TAF.

against U.S. borrowers appears to be the increase in the overall size of their balance sheets driven by lower measured risks and increased balance sheet capacity. Rather than the "Global Savings Glut," it seems more plausible to attribute the lowering of credit standards prior to the subprime crisis to the "Global Banking Glut" generated by the overcapacity in the banking sector. We derive a formal model of the Global Banking Glut in our theory section below. Another snapshot of the asset side of the European global banks is from the Federal Reserve's disclosures on the liquidity support given to commercial banks under the Term Auction Facility (TAF), as given in Figure 10.[11] The TAF was introduced at the end of 2007 in the early stages of the financial crisis as a way to provide Federal Reserve liquidity support to commercial banks by auctioning off short-term funding, without forcing banks to face the stigma of borrowing from the Federal Reserve's discount window. The banks that borrowed under TAF posted eligible collateral at the Federal Reserve, and hence the total amount borrowed under the TAF gives a rare glimpse of the bank-by-bank breakdown of the emergency liquidity received from the Federal Reserve. TAF funding was in addition to the U.S. dollar funding received by European global banks under the central bank swap facility between the Federal Reserve and the European Central Bank.

The right-hand panel of Figure 10 plots the amounts outstanding under the TAF program for the top 30 non-U.S. banks, and the left-hand panel classifies the borrowing bank by nationality for the top 10 U.S. banks and top 30 non-U.S. banks. Two features stand out from the charts in Figure 10. The first is that the non-U.S. banks' total borrowing is large relative to U.S. banks' borrowing. The relative magnitudes are roughly comparable at the peak. The second feature that stands out is the preponderance of European

[11] www.federalreserve.gov/monetarypolicy/taf.htm

banks in the list of non-U.S. recipients of TAF funding. The U.K. banks are especially prominent, led by Barclays, RBS, and Bank of Scotland. The list also reveals some unlikely names, such as Norinchukin (the Agricultural Savings Bank of Japan) and the German landesbanks, who are likely to have ventured into U.S. dollar lending in their search for higher yielding assets to deploy their large domestic deposit bases.

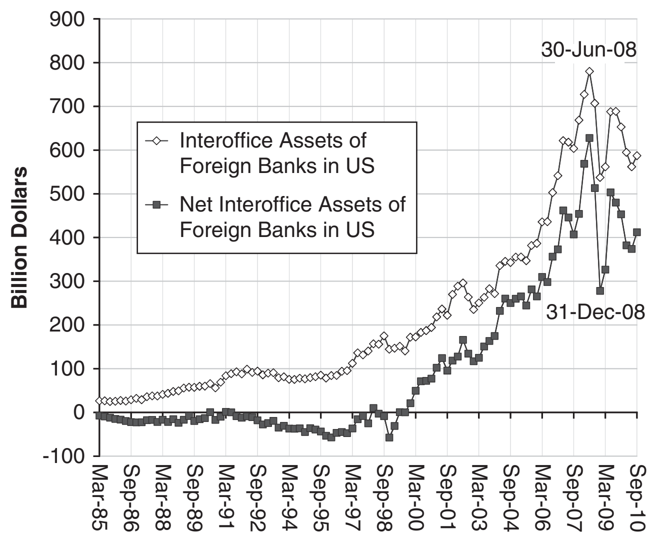
Liabilities Side

We now turn to the liabilities side of the European global banks' balance sheet in the schematic of Figure 1, and examine the evidence on how they raised U.S. dollar funding. A recent BIS (2010) study notes that as of September 2009, the United States hosted the branches of 161 foreign banks who collectively raised over $1 trillion worth of wholesale bank funding, of which $645 billion was channeled for use by their headquarters. MMFs in the United States are an important source of wholesale bank funding for global banks.

Even in *net terms*, foreign banks have been channeling large amounts of dollar funding to head office. That is, the funding channeled to head office is much larger than the funding received by the branch from head office. The BIS (2010) study finds that foreign bank branches had a net positive inter-office position in September 2009 amounting to $468 billion vis-à-vis their headquarters.

Figure 11 plots the interoffice assets of foreign bank branches in the United States together with the net interoffice series. Interoffice assets are

Figure 11. Interoffice Assets of Foreign Bank in the United States



Source: Federal Reserve, series on "Assets and Liabilities of U.S. Branches and Agencies of Foreign Banks."

Table 1. U.S. Prime Money Funds' Assets in Non-U.S./European Bank Obligations (% Each Asset Class) Mid-2008

Fund	CDs and Time Deposits	Commercial Paper	Corporate Notes	Repos	Total	Net Assets, $Billions
Fidelity Cash Reserves	91/73	28/27	54/34	70/70	63/51	128
JPMorgan Prime Money Market	98/94	35/31	57/39	73/73	67/62	120
Vanguard Prime Money Market	94/69	39/25	0/0	68/68	33/24	106
BlackRock Liquidity Temp	95/91	4/4	37/17	13/13	51/47	68
Reserve Primary	98/88	24/18	54/51	18/18	43/37	65
Schwab Value Advantage	91/64	24/19	58/48	67/67	54/40	61
GS FS Prime Obligations	0/0	0/0	0/0	2/2	0/0	56
Dreyfus Inst Cash Advantage	85/71	32/25	33/24	0/0	62/51	49
Fidelity Inst Money Market	100/91	44/44	51/36	45/45	61/54	47
Morgan Stanley Inst Liq Prime	4/4	19/19	0/0	91/91	37/37	34
Dreyfus Cash Management	92/75	46/30	31/31	0/0	70/56	33
AIM STIT Liquid Assets	95/69	25/20	27/16	84/84	57/45	32
Barclays Inst Money Market	67/57	10/6	30/21	21/21	24/19	31
Merrill Lynch Premier Inst Portfolio	92/80	32/25	46/36	45/45	60/51	26
Fidelity Inst Money Market: Prime	100/90	33/33	51/34	15/15	56/47	21
Total	92/78	26/22	47/33	51/51	50/42	878
Share of asset class in assets	34	26	13	11	100	

Source: Baba, McCauley, and Ramaswamy, BIS Quarterly Review, 2009.

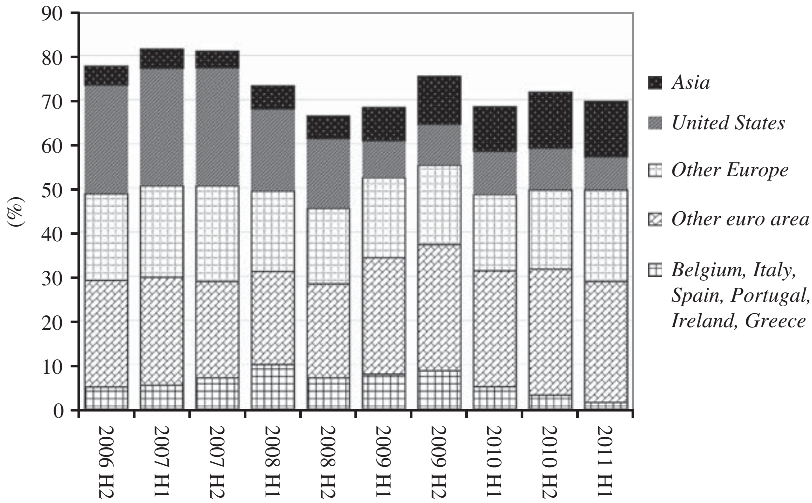
claims of the branch on head office, while the *net interoffice* assets are the claims of the branch minus the claims of head office against the branch. We see that interoffice assets of foreign bank branches in the United States increased steeply in the last two decades, saw a sharp decline in 2008, but bounced back in 2009.

We would normally expect a negative number for the net interoffice assets of foreign banks in most countries, since the role of the branch is to bring funding from head office to operate local assets. However, the United States is very special in this regard. Net interoffice assets were, indeed, negative in the 1980s and most of the 1990s, but in 1999, net interoffice assets surged into positive territory and increased steeply thereafter. Rather than being a lending outpost for the parent bank, the U.S. branches became a funding source for the parent.

Table 1 reproduces the table from Baba, McCauley, and Ramaswamy (2009) which provides a snapshot of the way that European banks obtained dollar funding on the eve of the 2008 Lehman crisis. By mid-2008, 50 percent of the assets of U.S. prime MMFs were short-term obligations of foreign banks, with the lion's share owed by European banks.

Figure 12, taken from the recent issue of the IMF's Global Financial Stability Report, plots the time series of the amount owed by banks to U.S. prime MMFs expressed as a percentage of the total assets of the 10 largest prime MMFs, representing $755 billion of the $1.66 trillion total prime MMF assets in June 2011. We see the preponderance of bank obligations as the primary asset class of the prime MMFs, especially the obligations

Figure 12. Amount Owed by Banks to U.S. Prime Money Market Funds (% of Total), Based on Top 10 Prime MMFs, Representing $755 Billion of $1.66 Trillion Total Prime MMF Assets, Classified by Nationality of Borrowing Bank



Source: IMF GFSR September 2011, data from Fitch.

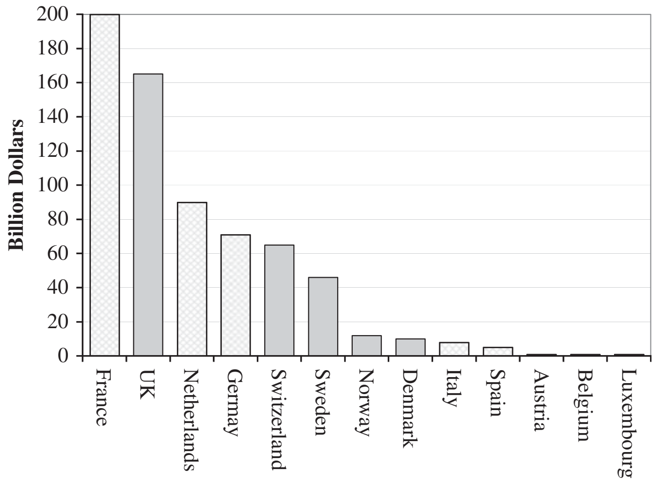
of European banks. We see from this chart that, in essence, the U.S. prime MMFs serve as the base of the shadow banking system in the United States, playing a comparable role to customer deposits in the regulated banking sector. The difference is that the intermediation chain in the shadow banking sector can be much longer and multilayered, involved many categories of financial intermediaries.

Figure 13 provides a breakdown of the nationality of the European banks that borrowed from prime MMFs, as of June 2011. U.K. banks are significant borrowers from MMFs, in line with the evidence on the TAF liquidity support provided by the Federal Reserve. However, it is French banks that stand out in Figure 13, perhaps explaining the funding pressures that have emerged for French banks during European financial crisis of 2011. We return to a discussion of the European crisis in the concluding section.

One additional snapshot on the funding side of European global banks from early 2007 is given by Acharya and Schnabl (2009), who examine data provided by the rating agency Moody's to classify the nationality of the sponsoring bank for the special purpose vehicles (SPV) that held U.S. mortgage-related assets, and who were funded by asset-backed commercial paper (ABCP). Table 2 reproduces the table from Acharya and Schnabl (2009) on the sponsors of ABCP, classified according to currency and by the nationality of the sponsoring bank.

The table reveals that over 70 percent of the ABCP was issued in U.S. dollars, and yet most were from SPVs sponsored by European banks. Only around 30 percent of the U.S. dollar-denominated ABCP vehicles

Figure 13. Amounts Owed by European Banks to U.S. Prime Money Market Funds, Classified by Nationality of Borrowing Bank (end-June 2011)



Source: IMF GFSR September 2011, data from Fitch.

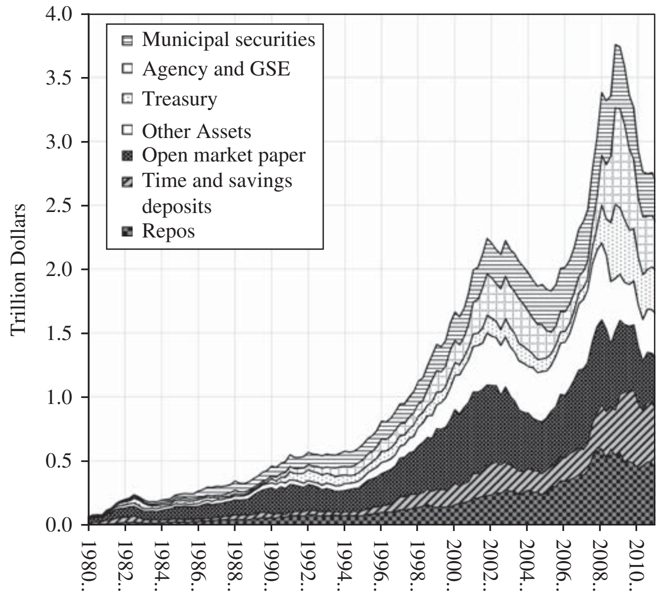
Table 2. ABCP Sponsor Location and Funding Currency ($Million) January 1, 2007

Currency/Sponsor Location	U.S. Dollars	Euro	Yen	Other	Total
Belgium	30,473	4,729	0	0	35,202
Denmark	1,796	0	0	0	1,796
France	51,237	23,670	228	557	75,692
Germany	139,068	62,885	0	2,566	204,519
Italy	1,365	0	0	0	1,365
Japan	18,107	0	22,713	0	40,820
Netherlands	56,790	65,859	0	3,116	125,765
Sweden	1,719	0	0	0	1,719
Switzerland	13,082	0	0	0	13,082
United Kingdom	92,842	62,298	0	3,209	158,349
United States	302,054	0	0	2,996	305,050
Total	714,871	219,441	22,941	12,444	969,697

Source: Acharya and Schnabl (2009), data from Moody's.

were sponsored by U.S. banks. ABCP-funded vehicles figured prominently in the subprime crisis and were the first to suffer distress in the early stages of the financial crisis in 2007. Whereas U.S. banks had liquidity backstops including the Federal Home Loan banks, as well as ultimately the Federal Reserve, the same was not the case for European banks, who were subject to liquidity shortages from the beginning of the crisis. The chart on the TAF borrowing from the Federal Reserve classified by nationality of the borrowing bank in the left-hand panel of Figure 10 reveals that European

Figure 14. U.S. Money Market Mutual Fund Assets



Source: Federal Reserve, Flow of Funds.

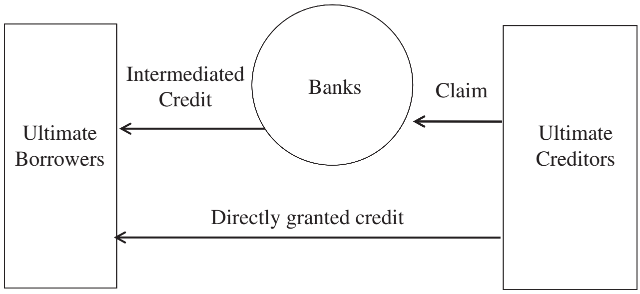
banks made most use of TAF funding before the Lehman bankruptcy in September 2008.

Although the pattern of European banks' funding is reasonably well understood, there is a large gap in the magnitudes that can be accounted for by MMFs alone. Figure 14 plots the total assets of U.S. MMFs categorized into types of claim, taken from the U.S. Flow of Funds accounts. Excluding government liabilities, the assets held by MMFs have fluctuated between $1 trillion to $2 trillion in recent years. Although these are substantial sums, they fall far short of the liabilities of BIS reporting banks outside the United States given in Figure 9, which reached $4.55 trillion in 2008:Q1, let alone the $10 trillion figure from the BIS locational banking statistics in Figure 5.

Moreover, whereas the BIS banking statistics on the asset side of bank balance sheets are relatively well developed through the consolidated exposures categorized by nationality and by counterparty, there is much less information available on the liabilities side from the BIS banking statistics. The difficulties are compounded by the fact that the flow of funds data in Europe are surprisingly sparse, even for the United Kingdom. Remedying the data gaps would be an important first step in shedding light on shifting global financial conditions.

By focusing on the banking sector, I have implicitly treated bank liability aggregates as being driven by the banks' funding decision, rather than the MMF investor's portfolio decision. However, both "demand pull" and "supply push" elements will be important in practice. Merely charting the total assets of the MMF sector does not distinguish the demand and

Figure 15. Direct and Intermediated Finance



supply-led growth in the total outstanding amounts, and some of the fluctuations can be attributed to the shifting demand for short-dated (near)-riskless claims that are cash substitutes (see Pozsar, 2011). We return to this issue in our formal model section.

II. Model of Direct and Intermediated Credit

Motivated by the evidence on the role of cross-border banking, I now turn to the task of formalizing the link between total intermediation capacity of the banking sector and market risk premiums. The model is one where credit flows from savers to borrowers in two ways—directly and indirectly, as illustrated in Figure 15.

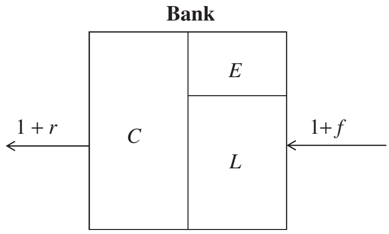
Credit to ultimate borrowers comes from two sources. The first is through directly granted credit where households invest in bonds that are claims to a diversified loan portfolio, in the way to be described below. The second is through the banking sector, which takes in deposits from households and lends out to the borrowers to fund their projects. The term "deposit" is intended to encompass any short-term liquid claim on a financial intermediary, including holdings in MMFs. Household lenders in the economy are risk averse and have mean-variance preferences. As argued below, the results do not rest on mean-variance preferences, and the mechanism is quite general.

Bank Credit Supply

Banks are risk neutral and maximize profit subject only to a Value-at-Risk (VaR) constraint that limits the probability of bank failure. Specifically, the VaR constraint stipulates that the probability of bank failure has to be no higher than some (small) threshold level $\alpha > 0$. We do not derive micro-foundations for the VaR constraint for the bank here,[12] but merely note that banks say they follow it, and the regulators say that they ought to follow it. We will simply take the rule as given and follow the consequences of such

[12]See Adrian and Shin (2008) for a possible microfoundation for the VaR constraint as a consequence of constraints imposed by creditors.

Figure 16. Notation for Bank Balance Sheet. *C* is the Amount Lent Out at Date 0, Financed with Equity *E* and Deposits *D*



behavior for credit supply and lending standards. In keeping with the overall theme of the paper, the particular model of credit risk that drives the VaR constraint will be the one adopted by the Basel Committee for Banking Supervision (BCBS, 2005).

Because of an aggregation result across banks to be shown below, it is without loss of generality to consider the banking sector as being a single bank, encompassing domestic and global banks. As long as all banks are subject to the same VaR constraint, we may treat the whole banking sector (domestic and global) to be one bank.

The notation to be used is given in Figure 16. The bank lends out amount C (with "C" standing for "credit") at date 0 at the lending rate r, so that the bank is owed $(1+r)C$ in date 1 (its notional assets). The lending is financed from the combination of equity E and debt funding L, where L encompasses deposit and money market funding. The cost of debt financing is f so that the bank owes $(1+f)L$ at date 1 (its notional liabilities).

The economy has a continuum of binary projects, each of which succeeds with probability $1-\varepsilon$ and fails with probability ε. Each project uses debt financing of 1, which the borrower will default on if the project fails. Thus, if the project fails, the lender suffers credit loss of 1. The correlation in defaults across loans follows the Vasicek (2002) model, which has served as the backbone of Basel capital requirements (Basel Committee on Banking Supervision, 2005). Project j succeeds (so that borrower j repays the loan) when $Z_j > 0$, where Z_j is the random variable

$$Z_j = -\Phi^{-1}(\varepsilon) + \sqrt{\rho}Y + \sqrt{1-\rho}X_j, \tag{1}$$

where $\Phi(.)$ is the c.d.f. of the standard normal, Y and $\{X_j\}$ are independent standard normals, and ρ is a constant between zero and one. Y has the interpretation of the economy-wide fundamental factor that affects all projects, while X_j is the idiosyncratic factor for project j. The parameter ρ is the weight on the common factor, which limits the extent of diversification that investors can achieve. Note that the probability of default is given by

$$\Pr(Z_j < 0) = \Pr(\sqrt{\rho}Y + \sqrt{1-\rho}X_j < \Phi^{-1}(\varepsilon)) = \Phi(\Phi^{-1}(\varepsilon)) = \varepsilon. \tag{2}$$

Banks are able to diversify their loan book by lending small amounts to a large number of borrowers. Conditional on Y, defaults are independent. The bank can remove idiosyncratic risk by keeping C fixed but diversifying across borrowers—that is, by increasing number of borrowers but reducing the face value of individual loans. In the limit, the realized value of assets is function of Y only, by the law of large numbers. The realized value of the bank's assets at date 1 is given by the random variable $w(Y)$ where

$$\begin{aligned} w(Y) &= (1+r)C \cdot \Pr(Z_j \geq 0 | Y) \\ &= (1+r)C \cdot \Pr(\sqrt{\rho}Y + \sqrt{1-\rho}X_j \geq \Phi^{-1}(\varepsilon) | Y) \\ &= (1+r)C \cdot \Phi\left(\frac{Y\sqrt{\rho} - \Phi^{-1}(\varepsilon)}{\sqrt{1-\rho}}\right). \end{aligned} \tag{3}$$

Then, the c.d.f. of $w(Y)$ is given by

$$\begin{aligned} F(z) &= \Pr(w \leq z) = \Pr(Y \leq w^{-1}(z)) = \Phi(w^{-1}(z)) \\ &= \Phi\left(\frac{1}{\sqrt{\rho}}\left(\Phi^{-1}(\varepsilon) + \sqrt{1-\rho}\Phi^{-1}\left(\frac{z}{(1+r)C}\right)\right)\right). \end{aligned} \tag{4}$$

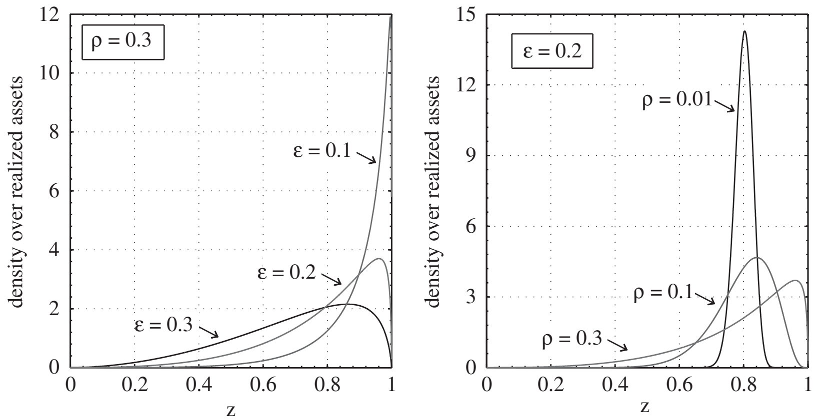
The density over the realized assets of the bank is the derivative of Equation (4) with respect to z. Figure 17 plots the densities over asset realizations, and shows how the density shifts to changes in the default probability ε (left-hand panel) or to changes in ρ (right-hand panel). Higher values of ε imply a first degree stochastic dominance shift left for the asset realization density, while shifts in ρ imply a mean-preserving shift in the density around the mean realization $1-\varepsilon$.

The bank takes its equity E as given and adjusts the size of its loan book C and funding L so as to keep its probability of default to $\alpha > 0$.[13] Since the bank is risk-neutral and maximizes profit, the VaR constraint binds whenever expected profit to lending is positive. The constraint is that the bank limits lending so as to keep the probability of its own failure to α. Since the bank fails when the asset realization falls below its notional liabilities $(1+f)L$, the bank's credit supply C satisfies

$$\Pr(w < (1+f)L) = \Phi\left(\frac{\Phi^{-1}(\varepsilon) + \sqrt{1-\rho}\Phi^{-1}\left(\frac{(1+f)L}{(1+r)C}\right)}{\sqrt{\rho}}\right) = \alpha. \tag{5}$$

[13]See Adrian and Shin (2008 and 2010) for empirical evidence that banks take equity as given and adjust leverage by adjusting the size of their balance sheet.

Figure 17. The Two Charts Plot the Densities Over Realized Assets When *C*(1+*r*)=1. The Left-Hand Chart Plots the Density Over Asset Realizations of the Bank When ρ=0.1 and ε is Varied from 0.1 to 0.3. The Right-Hand Chart Plots the Asset Realization Density When ε=0.2 and ρ Varies from 0.01 to 0.3



Re-arranging Equation (5), we can derive an expression for the ratio of notional liabilities to notional assets for the bank.

$$\frac{\text{Notional liabilities}}{\text{Notional assets}} = \frac{(1+f)L}{(1+r)C} = \Phi\left(\frac{\sqrt{\rho}\Phi^{-1}(\alpha) - \Phi^{-1}(\varepsilon)}{\sqrt{1-\rho}}\right). \tag{6}$$

From here on, we will use the shorthand φ to denote this ratio of notional liabilities to notational assets. That is,

$$\varphi(\alpha, \varepsilon, \rho) \equiv \Phi\left(\frac{\sqrt{\rho}\Phi^{-1}(\alpha) - \Phi^{-1}(\varepsilon)}{\sqrt{1-\rho}}\right), \tag{7}$$

φ can be seen as a normalized leverage ratio, lying between zero and one. The higher is φ, the higher is bank leverage and the greater is credit supply.

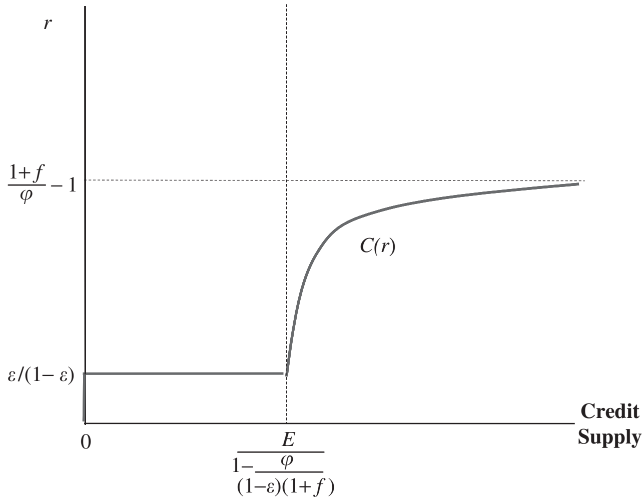
We can solve for bank credit supply C and demand for deposit funding L from Equation (6) and the balance sheet identity $C = E + L$ to give

$$C = \frac{E}{1 - \frac{1+r}{1+f}\cdot\varphi} \quad \text{and} \quad L = \frac{E}{\frac{1+f}{1+r}\cdot\frac{1}{\varphi} - 1}. \tag{8}$$

Figure 18 plots bank credit supply as a function of the lending rate r. Note that both C and L are proportional to bank equity E, so that an aggregation property holds for bank lending and bank funding. Therefore, the leverage of the *bank* and the *banking sector* are interchangeable in our model, and is given by

$$\text{Leverage} = \frac{C}{E} = \frac{1}{1 - \frac{1+r}{1+f}\cdot\varphi}. \tag{9}$$

Figure 18. Bank Credit Supply Curve



In the case of European banks that intermediate dollar funds between U.S. savers and borrowers, changes in C and L due to European banks represent *gross* capital flows. The change in bank liabilities ΔL due to European banks appears as a gross outflow of capital from the United States to the country where the headquarters of the European bank is situated. On the asset side, the additional credit ΔC granted by the European bank will be recorded as a gross capital *inflow* from the headquarters country of the bank into the United States. As long as the equity of the European banks remains fixed, we have (by the balance sheet identity $C = E + L$) that

$$\overbrace{\Delta L}^{\text{outflow}} - \overbrace{\Delta C}^{\text{inflow}} = 0 \tag{10}$$

so that the *net* capital flow between the United States and the headquarters jurisdiction of the European bank is zero, no matter how large are ΔL and ΔC. Equation (10) can be interpreted as the model counterpart to the schematic capital flow diagram of Figure 1 and the balance of payments charts in Figure 2. Since the current account is a measure, only the net flows between countries, the impact of rapid growth in bank lending through the European banks will not show up in the balance of payment statistics for the United States, potentially obscuring the build-up of financial vulnerabilities from policymakers. The contributions by Borio and Disyatat (2011) and Obstfeld (2012a and 2012b) have served to highlight the importance of gross capital flows.

Credit Supply by Bond Investors

We now turn to the credit supply coming directly from households. Recall that households are risk averse with mean-variance preferences. They have identical risk tolerance τ. Households lend to borrowers by purchasing bonds that are claims on a diversified pool of loans that have removed idiosyncratic credit risk so that the return densities are identical to those for the bank loan book described above.

Households hold a portfolio consisting of three component assets—risky bonds, cash and deposits in the bank. As stated already, deposits include claims on MMFs that serve as the base of the shadow banking system. We assume that deposits are guaranteed by the government (at least implicitly) so that households treat cash and deposits as being perfect substitutes.[14] We also assume that the households have sufficient endowments so that the wealth constraint is not binding in their choice of holding for the risky bonds. The demand for bonds (supply of credit) of mean-variance investor i with risk tolerance τ is then given by the first-order condition:

$$C_i = \frac{\tau[(1-\varepsilon)(1+r)-1]}{\sigma^2(1+r)^2}, \tag{11}$$

where σ^2 is variance of one unit of notional assets. That is, σ^2 is the variance of $w(Y)/C(1+r)$. The rest of the investor's wealth is held in cash and deposits.

Suppose there is measure N of mean-variance investors in the economy, and that $T = \tau N$. Aggregating the bond holdings across all households, the aggregate supply of credit from bond investors is thus given by:

$$C_H = \frac{T[(1-\varepsilon)(1+r)-1]}{\sigma^2(1+r)^2}. \tag{12}$$

"H" stands for the "household" sector. In the appendix, we show that the variance σ^2 is given by

$$\sigma^2 = \Phi_2(\Phi^{-1}(\varepsilon), \Phi^{-1}(\varepsilon); \rho) - \varepsilon^2, \tag{13}$$

where $\Phi_2(\cdot, \cdot; \rho)$ is the cumulative bivariate standard normal with correlation ρ.[15] The right-hand panel of Figure 19 plots the variance σ^2 as a function of ε. The variance is maximized when $\varepsilon = 0.5$, and is increasing in ρ. The left-hand panel of Figure 19 plots the normalized leverage φ as a function of ε.

Since bank liabilities are fully guaranteed by the government they earn the risk-free rate. Further, let the risk-free rate be zero, so that $f = 0$. Since bank credit supply is increasing in φ while bond investor credit supply is decreasing in σ^2, the effect of an increase in ε (assuming that $\varepsilon < 0.5$) is to decrease credit supply from both groups of creditors.

[14] This is an assumption made for simplicity of the solution, and does not affect the overall conclusions. If MMF shares are not guaranteed, then the small credit risk in MMF shares will need to be factored into the portfolio decision.

[15] See Vasicek (2002) for additional properties of the asset realization function $w(Y)$.

Figure 19. Left-Hand Panel Plots the Normalized Leverage Ratio φ as a Function of ε. The Right-Hand Panel Plots the Variance σ^2 as a Function of Epsilon for Two Values of ρ

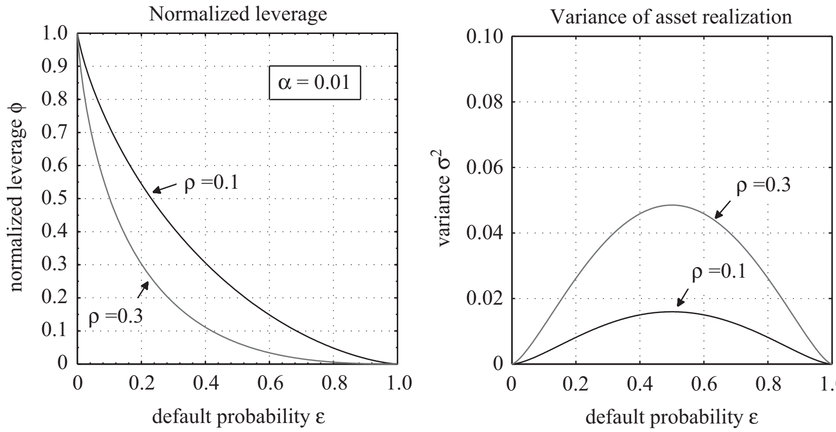


Figure 20 depicts the credit supply from banks and bond investors (left-hand panel) and the effect of a decrease in the probability of default ε, which shifts the supply of credit outward for both types of creditors.

Comparative Statics of Credit Supply

The risk premium in the economy is given by the excess return to the creditors. Given our assumption that the risk-free rate is zero, the risk premium π is given by

$$\pi = (1-\varepsilon)(1+r)-1. \tag{14}$$

We will now explore the properties of iso-lending curves for banks that plot the combination of default probability ε and risk premium π that give rise to the same credit supply by banks. The iso-lending curve for banks corresponding to bank credit C_B is given by

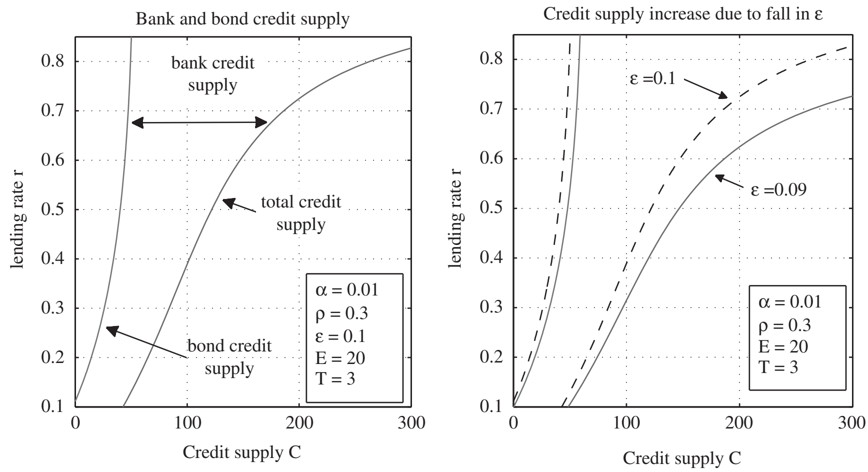
$$\pi(\varepsilon) = \left(1-\frac{E}{C_B}\right)\frac{1-\varepsilon}{\varphi(\varepsilon)}-1. \tag{15}$$

For banks, the iso-lending curve has the property that when ε is small, the iso-lending curve is close to being vertical in (ε, π)-space. From Equation (15), we have

$$\pi'(\varepsilon) = -\left(1-\frac{E}{C_B}\right)\left[\frac{1-\varepsilon}{\varphi^2}\varphi'(\varepsilon)+\frac{1}{\varphi}\right], \tag{16}$$

where $\varphi'(\varepsilon)\to-\infty$ as $\varepsilon\to 0$. Hence, the slope of the iso-lending curve tends to $+\infty$ as $\varepsilon\to 0$. Figure 21 plots the iso-lending curves in (ε, π)-space for

Figure 20. This Figure Depicts Credit Supply from Banks and Bond Investors (Left-Hand Panel) and the Effect of a Fall in ε from 0.1 to 0.09. The Other Parameters are as Indicated in the Box

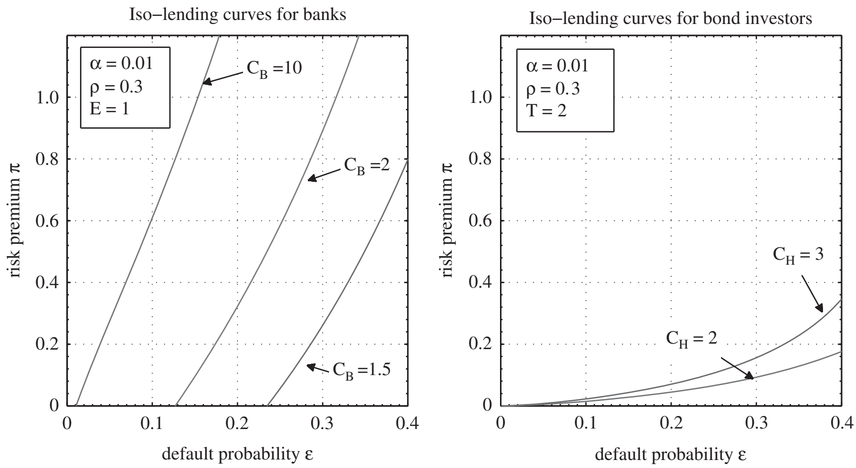


banks (left panel) and bond investors (right panel). Parameter values are as indicated in the figure.

The vertical limiting case of the bank iso-lending curves is crucial for our analysis and is revealing about the behavioral traits of banks. To say that the iso-lending curve is vertical is to say that bank lending decisions depend only on the "physical" risk ε, rather than the risk premium π. This feature comes from the combination of the risk-neutrality of the bank, and the constraint that limits its probability of failure. Risk neutrality means that the risk premium π enters only through its VaR constraint. Conventional risk-averse portfolio investors would focus on the tradeoff between physical risk ε and the risk premium π. The right-hand panel of Figure 21 shows the iso-lending curves of the bond investors, to be derived shortly. Although we have used mean-variance preferences for convenience for the bond investors, any conventional risk averse preferences would imply a nontrivial tradeoff between physical risk and risk premium. The fact that this tradeoff disappears for banks is key to understanding the Global Banking Glut.

In the Mundell-Fleming model, capital flows are considered in a simple financial market setting where investors are motivated by the relative interest rates across countries. The implicit portfolio decisions did not contend with fluctuations in risk appetite of the investors concerned. However, the introduction of the banking sector creates several unfamiliar features. For instance, the leverage constraint of the banks gives rise to behavior where the banks act as if their attitudes to risk change depending on the market outcome. During a boom, a favorable shock increases risk-bearing capacity, and induces banks to lend more by borrowing more. Thus, the favorable

Figure 21. Iso-Lending Curves in (ε, π)-Space for Banks (Left Panel) and Bond Investors (Right Panel). Parameter Values are as Indicated in the Boxes



shock acts to change the banks' "as if" preferences (see Shin (2010) for more detailed discussion). The resulting demand and supply responses can be perverse, giving rise to upward-sloping demand responses and downward-sloping supply responses.

Understanding the special nature of banking brings us closer to grasping the impact of banking sector fluctuations for financial conditions, and the comparative statics results to be reported below reveal key aspects. Our results do not rest on mean-variance preferences of the bond investors. They depend only on the fact that bond investors have iso-lending curves that have shallower slopes as compared with the banks. As long as banks and bond investors differ in their behavioral characteristics, the relative weight of banks and bond investors in the credit market will shift to changes in fundamentals. It is the shifting weight of the banking sector that has important implications for economy-wide financial conditions.

The bond investors' iso-lending curves in (ε, π)-space follow from the supply of credit by bond investors given by Equation (12), from which we can derive the following quadratic equation in π

$$\frac{C_H \sigma^2}{T(1-\varepsilon)^2}(1+\pi)^2 - (1+\pi) + 1 = 0. \tag{17}$$

The iso-lending curve for bond investors corresponding to bond credit supply of C_H is given by

$$\pi(\varepsilon) = \frac{1 - \sqrt{1 - 4C_H \sigma^2 / T(1-\varepsilon)^2}}{2C_H \sigma^2 / T(1-\varepsilon)^2} - 1. \tag{18}$$

Comparative Statics of Risk Premium

Let us now close the model by positing an aggregate demand for credit. The demand for credit is a decreasing function of the risk premium, and is denoted by $K(\pi)$. The market clearing condition is then

$$\underbrace{\frac{E}{1-\frac{1+\pi}{1-\varepsilon}\varphi}}_{C_B}+\underbrace{T\frac{(1-\varepsilon)^2\pi}{\sigma^2(1+\pi)^2}}_{C_H}=K(\pi). \tag{19}$$

We can address our first substantive question. How does the risk premium π vary to shifts in the physical risks ε? Provided that ε is small—so that it lies in the plausible range for the probability of default—and provided that the risk premium is not too large, the risk premium π is an increasing function of ε.

Proposition 1 *Suppose ε is small so that $|\partial\varphi/\partial\varepsilon|>\varphi/(1-\varepsilon)$ and the risk premium is small so that $\pi<1$. Then the market risk premium π is strictly increasing in ε.*

In other words, an increase in physical risk also raises the market risk premium. More relevant for our narrative of the subprime crisis is the reverse effect. A *decline* in the physical risk compresses the market risk premium π, allowing lower quality projects to be funded.

To prove Proposition 1, note first that credit supply by bond investors is declining in ε, and that bank lending declines in ε if $|\partial\varphi/\partial\varepsilon|>\varphi/(1-\varepsilon)$. Meanwhile, we can also show $\partial C_B/\partial\pi>0$ and—assuming $\pi<1$—we also have $\partial C_H/\partial\pi>0$. Defining the excess supply of credit function $G(\varepsilon,\pi)\equiv C_B+C_H-K(\pi)$, we have

$$\frac{d\pi}{d\varepsilon}=-\frac{\partial G/\partial\varepsilon}{\partial G/\partial\pi}=-\frac{\frac{\partial C_B}{\partial\varepsilon}+\frac{\partial C_H}{\partial\varepsilon}}{\frac{\partial C_B}{\partial\pi}+\frac{\partial C_H}{\partial\pi}-K'(\pi)}>0. \tag{20}$$

Since bank credit is declining in ε, the balance sheet identity implies that the funding L used by banks is also declining. We thus have the following important corollary to Proposition 1.

Proposition 2 *Confining shocks to the economy to those on the default probability ε, aggregate bank liabilities* L *increase if and only if the market risk premium π decreases.*

Proposition 2 points to a possible rationale for tracking bank liability aggregates in the economy. Tracking L may be a useful window on the financial conditions in the economy, since it mirrors the credit risk premium π. The larger is L, the more compressed is π, and hence the lower are lending standards in the economy, allowing lower quality projects to be funded. Our model is not sufficiently developed to make welfare claims on whether the lower credit standards are "excessively" low. The claim is merely a comparative statics claim that larger L is associated with lower π.

Bank liabilities L could be seen as a version of a monetary aggregate, and so Proposition 2 could be interpreted as a rationale for tracking monetary aggregates. However, the motivation for monitoring L in our context is very different from the traditional monetarist motivation arising from the quantity theory of money and the focus on inflation. Indeed, in real-world implementation of monitoring bank liability aggregates, the focus could be on the most volatile and procyclical components of bank liability aggregates—the "noncore" liabilities of the banking sector. Shin and Shin (2010) discuss the rationale for monitoring noncore liabilities for financial stability purposes, and Hahm, Shin, and Shin (2011) show in a panel probit study of emerging and developing economy financial crises that noncore liabilities figure strongly in explaining financial crises.

Paradoxically, it is when the quantity of short-term, apparently "safe" liabilities of banks are at their largest that the risk premiums ruling in the economy are at their lowest. However, the paradox is only apparent once we realize that the short-term "safe" claims held by households are funding sources for financial intermediaries who use the funding they receive to pass on credit to ultimate borrowers. Since financial intermediaries are aggressive lenders when the risk premium is low, their funding aggregates are large precisely when they are lending aggressively, and when lending standards are being eroded. This interpretation of the role of apparently "safe" short-term claims is at variance with accounts that emphasize an exogenous shift in preferences to holding such safe claims, and explains to some extent why the money market sector assets in Figure 14 see such large fluctuations over the financial cycle.

In our model, L determined by the banks' leverage decision. In practice, however, the portfolio decision of depositors would also matter. Rather than the banks "sucking in" funding from depositors, we could, alternatively, see the depositors "throwing themselves at" the banks in their portfolio decision. Pozsar (2011) takes the latter perspective and emphasizes the demand for short-term cash-like claims by asset management firms who operate large "cash pools."

Ascertaining the relative magnitudes of "demand pull" and "supply push" elements in determining banking sector liability aggregates would entail careful empirical analysis, possibly through methods such as vector autoregressions with sign restrictions that can identify demand- and supply-driven responses. Even here, however, some caution is required. In the shadow banking system, with many-layered intermediaries, the funding to one intermediary is supplied by another intermediary. For instance, when broker dealers borrow through a securities repo, the creditor may be another intermediary. As such, any empirical determination of the relative strength of demand push and supply pull forces should ideally focus on the final stage of the intermediation chain to the extent possible.

Relative Size of Banking Sector

We now address another stylized fact concerning the size of the banking sector and the vulnerability to a reversal. Specifically, when the default probability ε declines, what happens to the size of the banking sector—both in absolute terms, and in relative terms compared with the bond investor sector? Proposition 3 addresses these questions. Provided that credit demand $K(\pi)$ is not too elastic, a decline in ε is followed by an increase in the size of the banking sector, both in absolute terms and as a proportion to the total credit provided in the economy.

Proposition 3 *Suppose that ε is small enough so that the iso-lending curve of banks is steeper than the iso-lending curve of bond investors. Then, there is $M > 0$ such that, provided $|K'(\pi)| \leq M$, a decline in ε is associated with an increase in banking sector assets, both in absolute terms and as a proportion of the total credit received by borrowers.*

Proposition 3 can be proved using a graphical argument using the iso-lending curves for banks and bond investors. Figure 22 illustrates an initial equilibrium given by the crossing point for the iso-lending curves for banks and bond investors. In this illustration, total credit supply is 20, with 10 coming from banks and 10 coming from bond investors. The four regions indicated in Figure 22 correspond to the four combinations of credit supply changes by banks and bond investors. Region A is when both banks and bond investors increase credit supply, while Region C is where both reduce credit supply.

Now, consider a fall in ε that puts us to the left side of the banks' iso-lending curve, implying an increase in bank credit. In addition, the market risk premium π falls, as a consequence of Proposition 1.

Consider first the benchmark case where the credit demand curve is vertical, so that $K'(\pi) = 0$. Then, we have the combination of an increase in bank credit supply while total credit supply is unchanged, implying that bond credit supply must fall for the market to clear. Thus, the new equilibrium (ε, π) pair must lie in Region B in Figure 22. In Region B, bank credit supply goes up while bond investors lend less.

Now, let us allow that the credit demand curve is not vertical. For small absolute values of $K'(\pi)$, we know from Equation (20) that $d\pi/d\varepsilon$ does not decline much in absolute value from the case where the demand for credit curve is vertical. In other words, when $|K'(\pi)|$ is small, the new equilibrium (ε, π) pair must still lie in Region B in Figure 22. Thus, the banking sector supply of credit increases, but the bond investor sector's supply either stays the same or decreases. This is sufficient for Proposition 3.

The decline in risk premiums in low default environments gives way to the exact opposite phenomenon when default risk starts to increase as the financial cycle turns. As ε increases because of the deterioration of fundamentals, we have the combination of sharply higher risk premiums and the contraction in bank lending. Bond investors are then induced by the higher risk premiums to

Figure 22. Crossing Point for the Iso-Lending Curves of Banks and Households

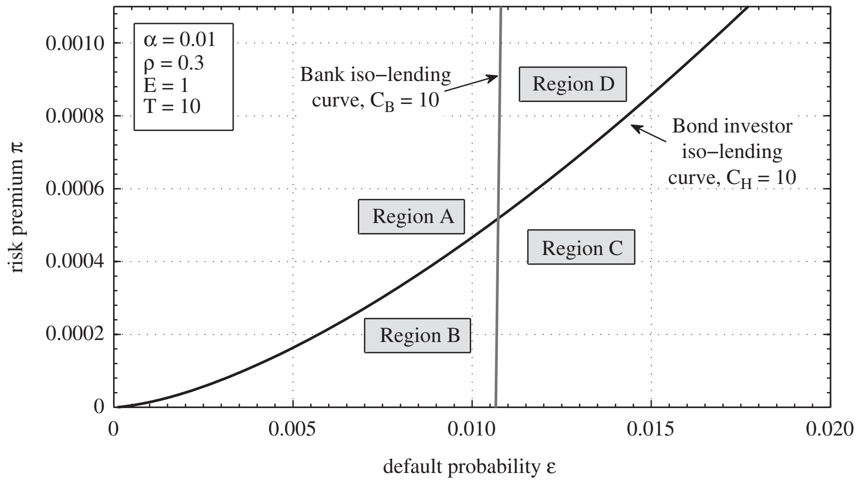
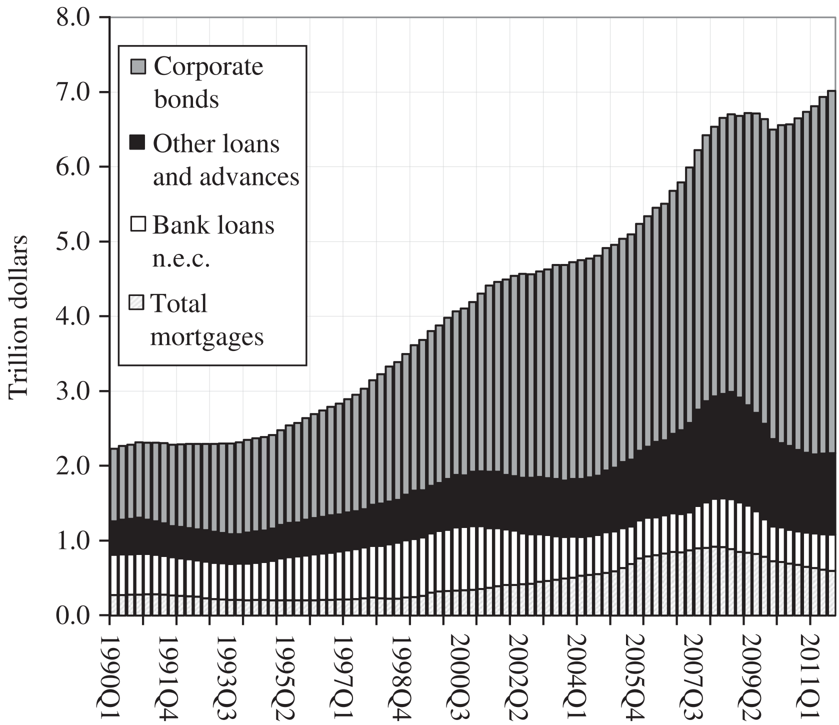


Figure 23. Total Credit to the U.S. Non-Financial Corporate Sector



Source: U.S. Flow of Funds, Table L102.

close the credit supply gap in the market. The recoiling from risks, sharply higher risk premiums and the substitution of bank lending by bond financing can be seen in the aggregate Flow of Funds evidence for the United States in the aggregate credit to the nonfinancial corporate sector.

Figure 23 is from the U.S. Flow of Funds, showing the aggregate credit to the nonfarm, nonfinancial corporate business sector. What is notable is how the contraction in total credit is fairly modest over the recent crisis, even though loans from financial intermediaries contracted quite sharply. The slack is taken up by the increase in bond financing. However, for this to happen, prices must adjust in order that the risk premium rises sufficiently to induce risk-averse bond investors to make up for the lost banking sector credit. Thus, a fall in the relative credit supplied by the banking sector is associated with a rise in risk premiums.

For macro activity, such a rise in the risk premium exerts contractionary effects on the real economy. Gilchrist and Zakrajsek (2011) document evidence that credit spreads have substantial effect on macro activity measures. Thus, the financial friction that such a mechanism generates is one that works through prices, rather than through a shrinkage in the total quantity of credit. Adrian, Colla, and Shin (2011) show that the aggregate evidence from the Flow of Funds is mirrored in the micro data for new loans granted and bond issues at the level of individual companies, suggesting that the model of bank and bond credit supply sketched here holds some promise in explaining the recent experience in the United States and elsewhere.

III. Concluding Remarks

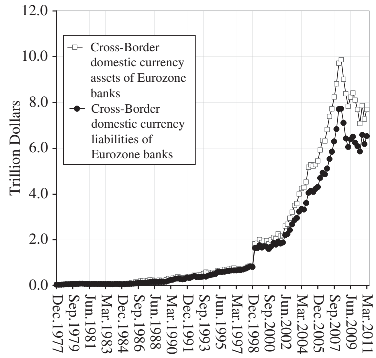
This lecture has explored the hypothesis that the driving force behind the fluctuations in credit standards is the leverage cycle of the global banks. Our findings reinforce the argument in Borio and Disyatat (2011) on the importance of *gross* capital flows between countries in determining financial conditions, rather than *net* flows. Gross flows, and in particular measures of banking sector liabilities should be an important source of information for risk premiums and hence financial sector vulnerability.

We conclude with some reflections on the European financial crisis of 2011 in the light of the evidence on the global banking glut.

As mentioned at the outset, an important unresolved question is why European banks expanded so rapidly in the decade beginning in 1999. An important part of the explanation must surely be the advent of the euro in 1999. As well as expanding credit to borrowers in the United States, European banks expanded lending within the eurozone, too. Figure 24 is from the BIS locational banking statistics, plotting the cross-border assets and liabilities of eurozone banks in *domestic currency*. Thus, after 1999, the series denotes the cross-border euro-denominated lending and borrowing by the eurozone banks.

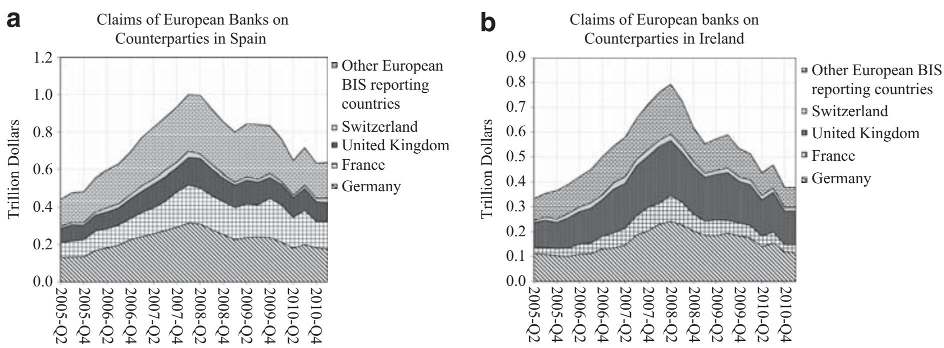
Figure 24 shows that cross-border banking within the eurozone experienced explosive growth, especially after around 2003. This was the period when

Figure 24. Cross-Border Domestic Currency Assets and Liabilities of Eurozone Banks



Source: BIS locational banking statistics, Table 5A.

Figure 25. Foreign Claims of European BIS-Reporting Banks on Counterparties in Spain (Left Panel) and Ireland (Right Panel)

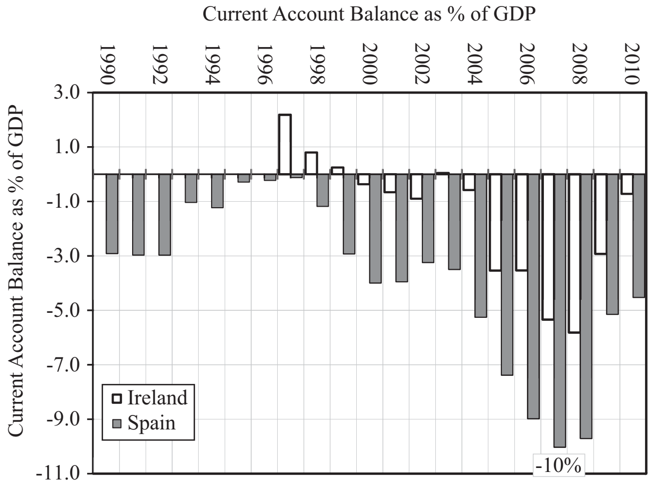


Source: BIS consolidated banking statistics, Table 9D.

European banks' lending to U.S. borrowers saw sharp increases, also. The consequences for borrowers in countries that underwent property booms, such as Spain and Ireland, was that they were borrowing in increasing amounts from other European banks, as shown in Figure 25. Again, we must exercise some caution in reading these charts. Figure 24 is from the locational statistics, and hence do not consolidate lending by local subsidiaries, while Figure 25 comes from the consolidated banking statistics and incorporate claims on local borrowers by subsidiaries.

Nevertheless, compared with other dimensions of economic integration within the eurozone, cross-border mergers in the European banking sector remained the exception rather than the rule. Herein lies one of the paradoxes of eurozone integration. The introduction of the euro meant that "money"

Figure 26. Current Account of Ireland and Spain



Source: IMF International Financial Statistics.

(that is, bank liabilities) was free-flowing across borders, but the asset side remained stubbornly local and immobile. As bubbles were local but money was fluid, the European banking system was vulnerable to massive runs once banks started deleveraging.

The banking flows that funded the property booms in Ireland and Spain were mirrored by their ballooning current account deficits, as shown in Figure 26. Unlike the "offshore" intermediation by European banks for savers and borrowers in the United States, the gross cross-border banking flows within the eurozone are better captured by the current account since there was less netting of gross flows going in opposite directions so that gross and net capital flows are more closely aligned. The current account deficits of Spain and Ireland were therefore more closely aligned to the gross banking sector flows.

The perspective of the global banking glut sheds much light on current conjuncture and the European financial crisis of 2011. The European crisis carries the hallmarks of a classic "twin crisis" that combines a banking crisis with an asset market decline that amplifies banking distress. In the emerging market twin crises of the 1990s, the banking crisis was intertwined with a currency crisis. In the European crisis of 2011, the twin crisis combines a banking crisis with a sovereign debt crisis, where the mark-to-market amplification of financial distress worsens the banking crisis.

As the European banking crisis deepens, the deleveraging of the European global banks will have far-reaching implications not only for the eurozone, but also for credit supply conditions in the United States and capital flows to the emerging economies. Just as the expansion stage of the global banking glut relaxed credit conditions in the United States and elsewhere, its reversal will tighten U.S. credit conditions. Its impact in the emerging economies (especially in emerging Europe) could be far-reaching. In this sense, there is a huge amount at stake in the successful resolution of the European crisis, not only for Europe but for the rest of the world.

In this lecture, I have argued that global liquidity is a banking sector phenomenon, and that the financial stability implications of global liquidity are intimately tied to the leveraging/deleveraging cycle of the global banks. Much work remains to be done in exploring the implications for macro-prudential policy.

APPENDIX

In this appendix, we present the derivation of the variance of the asset realization $w(Y)$ in Vasicek (2002). Let $k = \Phi^{-1}(\varepsilon)$ and $X_1, X_2, \ldots, X_n$ be i.i.d. standard normal.

$$\begin{aligned} E[w^n] &= E\left[\left(\Phi\left(\frac{Y\sqrt{\rho}-k}{\sqrt{1-\rho}}\right)\right)^n\right] \\ &= E\left[\prod_{i=1}^{n} \Pr\left[\sqrt{\rho}Y + \sqrt{1-\rho}X_i > k \mid Y\right]\right] \\ &= E\left[\Pr\left[\sqrt{\rho}Y + \sqrt{1-\rho}X_1 > k, \ldots, \sqrt{\rho}Y + \sqrt{1-\rho}X_n > k \mid Y\right]\right] \\ &= \Pr\left[\sqrt{\rho}Y + \sqrt{1-\rho}X_1 > k, \ldots, \sqrt{\rho}Y + \sqrt{1-\rho}X_n > k\right] \\ &= \Pr[Z_1 > k, \ldots, Z_n > k] \end{aligned}$$

where $(Z_1, \ldots, Z_n)$ is multivariate standard normal with correlation ρ. Hence

$$E[w] = 1 - \varepsilon$$

and

$$\begin{aligned} \operatorname{var}[w] &= \operatorname{var}[1 - w] \\ &= \Pr[1 - Z_1 \leq k, 1 - Z_2 \leq k] - \varepsilon^2 \\ &= \Phi_2(k, k; \rho) - \varepsilon^2 \\ &= \Phi_2(\Phi^{-1}(\varepsilon), \Phi^{-1}(\varepsilon); \rho) - \varepsilon^2 \end{aligned}$$

where $\Phi_2(\cdot, \cdot; \rho)$ cumulative bivariate standard normal with correlation ρ.

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