

# LITERATURE REVIEW ON THE STABILITY OF FUNDING MODELS

- Financial intermediaries perform maturity and liquidity transformation by issuing liquid, short-term liabilities while holding illiquid, longer-term assets.
- This study discusses the intermediaries' role as liquidity provider and the inherent fragility associated with it.
- Yorulmazer reviews the standard framework of the literature to consider factors that make financial intermediaries more or less stable, such as the combination of deposit-taking and loan-making activities and the role of interbank markets for coinsurance against liquidity shocks.
- The study also looks at developments in the financial sector affecting the stability of intermediaries. These include the shift of some activity to less regulated parts of the financial system and the growing importance and size of the repo market.

## 1. INTRODUCTION

This article provides a review of the economics literature on the stability of banks and other financial intermediaries, with a policy-oriented focus on their funding models. We first discuss the standard framework used in the literature to analyze the fragility of financial institutions that perform maturity and liquidity transformation. Then we consider potential factors that amplify or mitigate such financial fragility. Finally, we review developments in the financial sector that may have affected the stability of funding models.

## 2. THE STANDARD FRAMEWORK

### 2.1 What Is Maturity Transformation and Why Does It Cause Illiquidity?

We begin by describing the standard framework used in the literature—which is based on maturity transformation and the risk of a run and loss of significant funding sources—to think about the fragility of financial intermediaries.

One important role played by financial intermediaries is *maturity and liquidity transformation*, namely, issuing liquid, short-term liabilities while holding illiquid, longer-term

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assets. This arrangement allows investors to benefit from an intermediary's special skills in making high-return investments while maintaining the ability to shift funds to other uses, if needed. This flexibility is particularly valuable to investors who face significant uncertainty about the timing of their liquidity needs, because a financial intermediary can provide them with insurance against this uncertainty. In this section, we discuss the role of financial intermediaries as liquidity providers and the inherent fragility associated with this role.

In their seminal work, Bryant (1980) and Diamond and Dybvig (1983) provide a framework that illustrates the role of financial intermediaries in providing liquidity insurance. This framework has become the standard platform for studying financial fragility.

In the Diamond-Dybvig model, there are three dates, and depositors are initially uncertain about the date at which they will want to consume. Each depositor will turn out to be either the "early" type, who wants to consume in the interim date, or the "late" type, who wants to consume in the final date. On the initial date, the bank invests the resources collected from the depositors into a long-term asset. This asset yields a return of  $R > 1$  at the final date for each unit invested. However, there is a cost to liquidate the asset early. If the asset is liquidated at an interim date, it yields a return of one per unit invested. Although each depositor is uncertain as to when she will need to consume, the fraction of depositors who will want to consume early is known by the bank. By pooling the funds it collects, the bank can insure depositors against their liquidity-preference shocks. In fact, the bank can achieve an efficient allocation of resources in this environment by offering a contract that promises depositors a consumption level of  $c_1$  if they withdraw in the interim period, and a consumption level  $c_2$  if they withdraw in the final period. These values are chosen so that  $1 < c_1 < c_2 < R$  holds. This arrangement is preferred by depositors because it provides them with an opportunity to better smooth their consumption, compared with what they could achieve on their own.<sup>1</sup>

Notice that this arrangement is self-enforcing in the following sense. A depositor who is the early type will always prefer to withdraw in the early period and receive  $c_1$ , while a depositor who is the late type will prefer to withdraw in the late period and receive  $c_2$  as long as she is confident the bank will have the necessary funds available. When all late-type depositors wait until the late period to withdraw, the bank can indeed afford to pay  $c_2$  to each of them, which justifies their decision to wait.

<sup>1</sup> A depositor who invests funds directly in the long asset would consume 1 if she turns out to be the early type and  $R$  if she is the late type. The arrangement here is strictly preferred by the depositor as long as her coefficient of relative risk aversion is greater than 1.

There is, however, another possible outcome. If patient depositors become nervous about the bank's ability to pay them in the late period, they may choose to withdraw in the early period. This outcome resembles a *run* on the bank, which causes all assets to be liquidated early and leaves each depositor with only one unit of consumption. Note that this outcome is also self-enforcing, in the sense that it is rational for each depositor to withdraw in the interim period because she correctly anticipates that the bank will run out of funds by the late period. This outcome is strictly inferior to the "good" outcome described above and can be viewed as a coordination failure among depositors.

Diamond and Dybvig (1983) view this multiplicity of equilibria as capturing, in a stylized way, the inherent fragility of financial intermediaries.<sup>2</sup> If, for whatever reason, depositors and other investors become nervous that the bank will fail, their actions will tend to make this belief self-fulfilling.<sup>3</sup> Their model does not address the question of what events might cause depositors' beliefs to shift and, hence, trigger a run. In the next section, we provide a short discussion on the different views about the origins of bank runs that have emerged in the literature.

Although the Diamond-Dybvig model focuses on the role of intermediaries as providers of liquidity, other functions performed by intermediaries could be added to the framework. For example, intermediaries play the important role of delegated monitors for creditors. Diamond (1984) develops a theory of financial intermediation based on minimum cost production of costly information about borrowers. An intermediary (for example, a bank) performs the task of costly monitoring of loan contracts written with the borrowing firms. It has a cost advantage in doing so because the alternative is either duplication of effort, if each lender monitors directly, or a free-rider problem, in which case no lender monitors and no valuable information is produced. If this intermediary also performs maturity transformation by issuing short-term liabilities, the type of fragility described above can easily arise.

<sup>2</sup> Also see Ennis and Keister (2009) for a model of runs as a multiple-equilibrium phenomenon. Some studies take a different approach, however, in which a bank run occurs with positive probability in the unique equilibrium. See, for example, Postlewaite and Vives (1987), Chari and Jagannathan (1988), and Goldstein and Pauzner (2005).

<sup>3</sup> This basic framework can also be extended to study issues related to secured funding, as in Martin, Skeie, and von Thadden (2010).

## 2.2 What Causes Runs—Fundamental Asset Values or Fear?

While the inherent fragility of bank deposits can result in depositor runs and liquidation, what triggers these runs? According to one view, bank runs can be triggered by anything that causes depositors to become pessimistic, including what might be called “mass hysteria” (Kindleberger 2000). The Diamond-Dybvig model is consistent with this view, since it does not offer a theory of what triggers a crisis. The shift in depositors’ beliefs is typically modeled as resulting from exogenous random events (often labeled “sunspots”).

The historical evidence, however, indicates a significant correlation between bank runs and the current condition of particular sectors, or of the economy as a whole. Gorton (1988) conducts an empirical analysis using U.S. data from the late nineteenth and early twentieth centuries to investigate the origins of banking panics and finds a close relationship between the occurrence of banking panics and the overall state of the economy. Calomiris and Gorton (1991) use a larger data set and find similar evidence. In parallel with this historical evidence, another view of the origins of bank runs claims that these runs are natural consequences of the business cycle and that they are information-driven. If there is adverse information about the banks’ prospects, depositors anticipate the difficulties banks may face in honoring their promised payments so they may choose to withdraw their funds. Therefore, bank runs are essentially triggered by adverse news about the soundness of banks. This view of bank runs has been modeled by Allen and Gale (1998).<sup>4</sup>

In a recent article, Morris and Shin (2009) try to reconcile two different views on the origins of bank runs. In particular, they distinguish between and try to measure three distinct types of risk: 1) *insolvency risk*, the conditional probability of default due to deterioration in asset quality if there is no run by short term creditors; 2) *total credit risk*, which is the unconditional probability of default due to either a (short-term) creditor run or (long-run) asset insolvency; and 3) *illiquidity risk*, which is the difference between the first two, specifically,

<sup>4</sup> Although the business cycle view of bank runs has strong empirical support, there are also instances in which healthy banks experienced runs. Saunders and Wilson (1996) examine deposit flows in 163 failed and 229 surviving banks over the Depression era of 1929-33 in the United States. In 1929 and 1933, they find evidence of “flight to quality,” in which withdrawals from failed banks were associated with deposit increases in surviving banks. However, they observe a decrease in deposits in both failed and surviving banks for the period 1930-32. One possible explanation for these events is that the depositors may not have accurate information about each bank and may base their decisions on publicly available information such as the overall state of the economy or even the number of recent bank failures. Therefore, imperfect information can lead to runs on healthy banks. Ennis (2003) offers a different interpretation, arguing that the observed correlation between runs and economic fundamentals does not imply that healthy banks are immune to runs.

the probability of a default due to a run when the institution would otherwise have been solvent. An important contribution of Morris and Shin (2009) is to define clear measures of these different types of risk. Furthermore, they also discuss how the three kinds of risk vary with different features of a bank’s balance sheet. In particular, they show that illiquidity risk is 1) decreasing in the “illiquidity ratio,” the ratio of realizable cash on the balance sheet to short-term liabilities; 2) increasing in the “outside option ratio,” a measure of the opportunity cost of the funds used to roll over short-term liabilities; and 3) increasing in the “fundamental risk ratio,” a measure of ex post variance of the asset portfolio.

## 3. FACTORS THAT AFFECT RUNS AND THE DAMAGE THEY CAUSE

In this section, we discuss various factors that make financial intermediaries more or less stable. First, we talk about various features specific to banks that may help stability, such as banks combining deposit-taking and loan-making activities. We then consider the fragility associated with short-term wholesale funding. We review the role of interbank markets for coinsurance against liquidity shocks as well as various frictions that may undermine this important role. We also talk about the damaging effects of fire sales and briefly mention various regulatory and supervisory policies used for sustaining stability.

### 3.1 Why Are Banks Organized as Deposit-Taking and Loan-Making Institutions?

The fact that banks combine the activities of deposit-taking and lending (through the lines of credit they provide to firms) may give them an advantage over financial arrangements in which these activities are performed separately. Kashyap, Rajan, and Stein (2002) provide theoretical and empirical evidence that banks benefit from the synergies of these two activities. A simple example can be used to illustrate their point. Suppose there are two intermediaries: a finance company that relies on long-term debt, and a bank that issues demand deposits. Since depositors have the option of liquidation on demand, everything else equal, the bank can raise funds by offering a lower return than that of the finance company. The downside of demand deposits is that withdrawals can be unpredictable such that the bank must carry some cash in its portfolio and incur the opportunity cost for doing so. Let us assume that these two intermediaries also compete

to attract corporate loans. To keep the story simple, let us also assume that line-of-credit usage and deposit withdrawals are perfectly and negatively correlated. In this situation, the bank does not need to hold any additional cash in its portfolio for the credit line. By combining the two activities, a bank is able to economize on cash holdings, carrying a smaller buffer than what would have been needed by a financial institution that performs these services separately. Therefore, banks can provide liquidity to both depositors and firms in a more efficient way than if these activities were provided separately.

Of course, firms (particularly large ones) can use alternative sources to satisfy their liquidity needs, such as the commercial paper market. As documented by Saidenberg and Strahan (1999), large firms' use of these alternative sources has significantly increased over time in the United States. However, in times of financial distress, even large firms may have difficulty raising funds through these alternative sources or may find these sources too costly. To insure against this situation, firms also maintain credit lines with banks. Saidenberg and Strahan (1999) show that during the 1998 Long-Term Capital Management turmoil, firms shifted from the commercial paper market to banks for liquidity. They also show that during this period, banks experienced deposit inflows, verifying that line-of-credit usage and deposit withdrawals were negatively correlated. As a result, banks still play an important role as "liquidity providers of last resort," even to large businesses. Gatev and Strahan (2006) provide further evidence on the same issue for the United States. However, Ivashina and Scharfstein (2010) show that after the failure of Lehman Brothers, banks simultaneously experienced runs by short-term creditors when borrowers drew down their credit lines.

These results depend on the assumption that banks do not actually fail in the distressed states studied. In a recent study, Santos (2011) documents that while deposits may flow back to banks in the aggregate during periods of crisis, depositors tend to exit banks that are doing poorly. At the same time, corporate borrowers increase their drawdown rates on credit lines, and this effect is more pronounced among banks experiencing larger losses. As a result, banks that experience larger losses during a crisis experience both a decline in deposits and an increase in demand for liquidity through existing credit lines, indicating a limit to the synergies between deposit-taking and loan-making.

### 3.2 Fragility of Wholesale Funding

While most retail deposits are demandable upon request, they usually constitute a more stable form of funding for banks compared with funding in wholesale markets. Many countries

have deposit insurance, up to certain limits, that add to the stability of retail deposits as a source of funding. Furthermore, some academic studies show that switching and search costs lead depositors to change banks infrequently, which adds to the stability of retail deposits. Kiser (2002) uses survey data on households' decisions to change or remain with their checking or savings account providers to show that the distribution of household tenure is wide, and that about a third of households have never changed depository institutions.<sup>5</sup> However, one has to keep in mind that deposit insurance may be an important factor contributing to the stickiness of retail deposits.

Funding from wholesale markets, especially when it is short-term, is usually considered more flighty since it is typically not insured and subject to rollover risk (Acharya, Gale, and Yorulmazer 2011).<sup>6</sup> Furthermore, runs in the wholesale market can be destructive and costly socially. In a recent article, Huang and Ratnovski (2011) point to that issue. On the one hand, wholesale funding allows sophisticated financiers to monitor banks—disciplining bad banks, but refinancing good ones. On the other hand, in an environment with a costless but noisy public signal on bank project quality, short-term wholesale financiers have lower incentives to conduct costly monitoring and may instead withdraw funds based on negative public signals, triggering inefficient liquidations too often.

### 3.3 Interbank Markets as a Source of Liquidity

Interbank markets, where banks lend to and borrow from other banks, help banks coinsure against liquidity shocks. It may be the case that in certain states, some banks experience high liquidity shocks while other banks experience liquidity surpluses. By lending and borrowing in the interbank market, banks may coinsure against liquidity shocks (Allen and Gale 2000; Leitner 2005).<sup>7</sup> Goodfriend and King (1988) argue that with sophisticated interbank markets, a solvent bank that needs liquidity will always get it from the interbank market and therefore will never be illiquid. They argue that because of

<sup>5</sup> Gondat-Larralde and Nier (2006) use data for current account switching behavior for the United Kingdom. The data imply that a representative current account holder would only change banks every ninety-one years. Also see Kim, Kliger, and Vale (2003) for a study on Norway.

<sup>6</sup> Goldsmith-Pinkham and Yorulmazer (2010) analyze the role of excessive reliance on wholesale funding during the Northern Rock episode.

<sup>7</sup> In addition, banks monitor each other through lending and borrowing relations in the interbank market (Rochet and Tirole 1996). While monitoring can be very costly (or not feasible) for dispersed depositors, cross-holdings may provide banks with incentives to monitor each other's activities (peer monitoring), which can be a crucial disciplining device that influences banks to run their affairs in a more prudent way.

the existence of efficient interbank markets, central banks can provide sufficient liquidity via open market operations, and the interbank market will allocate the liquidity among banks.

Although the interbank market may perform these very important roles in many cases, there may be potential failures, too. The following discussion investigates these potential market failures and the cases in which the interbank market may not work as efficiently as required.

### *Asymmetric Information*

When interbank participants see that a bank wants to borrow, they may not know the exact reason. For example, it may be the case that the bank wants to borrow for liquidity reasons or because the bank is insolvent. Therefore banks may not be willing to take the risk and may decide not to lend. Because of this information asymmetry, a solvent bank may not get funding from the interbank market.

One possible solution to asymmetric information is to borrow against collateral (Bester 1985). However, Flannery (1996) argues that while other market participants may know the value of the bank's portfolio as a whole, they may not have adequate information about the individual assets in the portfolio. If market participants do not have sufficient resources to purchase the whole portfolio, rather only a small proportion of it, they may fear that they end up purchasing the lowest quality assets. Hence, information asymmetry may lead to a lemons problem, in which the bank may try to keep the high-quality assets in its portfolio while liquidating the bad ones quickly. As a result, when loans are sold or borrowed against, they may not generate their full value in the interbank market.

### *Banks May Exploit Other Banks' Liquidity Needs*

In a situation where some banks need liquidity, the cash-rich banks may try to take advantage of the cash-stricken ones. If the number of banks that are subject to the liquidity shock is large, banks with excess liquidity may exert market power and charge higher than competitive interest rates on interbank loans (Donaldson 1992). Furthermore, cash-rich banks may even refuse to lend in order to force cash-stricken banks to sell their assets at fire-sale prices so that they can acquire those assets at cash-in-the-market prices and make windfall profits (Acharya, Gromb, and Yorulmazer 2012).<sup>8</sup>

<sup>8</sup> See also Diamond and Rajan (2011) and Gale and Yorulmazer (2013) for models that feature a speculative motive in which banks do not lend with the expectation of potential future profits from fire sales.

### *Banks May Free-Ride on Liquidity*

Holding liquid assets may have an opportunity cost in terms of foregone higher returns from illiquid assets. In the presence of an interbank market, banks may rationally choose to hold lower levels of the liquid asset and may rely on other banks' liquid asset holdings. Bhattacharya and Gale (1987) build a model of interbank coordination in which individual banks that are subject to liquidity shocks can insure each other against these shocks through a borrowing-lending mechanism designed by the central bank—the “discount window.” However, in the presence of informational asymmetry among banks, where the composition of liquid and illiquid assets in each bank's portfolio and the size of the liquidity shock each bank faces is private information, such a mechanism may fail to perform efficiently and banks may have an incentive to under-invest in liquid assets. Banks will rely on the interbank market for their liquidity needs and will free-ride on the common pool of liquidity so that even in the presence of an interbank market, there might be liquidity shortages at the aggregate level. Similar arguments have been made by Repullo (2005) in the context of a lender of last resort (LoLR), where banks can have incentives to hold low levels of liquidity and rely on the LoLR for liquidity.

### *Liquidity Hoarding*

Inefficiencies may arise if banks do not hold sufficient levels of liquidity; however, another reason that interbank markets may not function efficiently is that banks may hoard liquidity rather than lend it to each other (Diamond and Rajan 2011; Gale and Yorulmazer 2013). This can be caused by credit risk associated with the borrowing banks. Furthermore, it may arise from a precautionary motive in which banks prefer to hold on to cash if they are worried about future liquidity shocks and their access to markets when they need the liquidity, as well as the speculative motive in which they prefer to carry cash to take advantage of potential fire sales in the future.<sup>9</sup>

<sup>9</sup> Malherbe (forthcoming) studies a model in which markets may be illiquid because of adverse selection. Anticipating a market “dry-up,” agents engage in liquidity hoarding that worsens the adverse selection problem and makes the market dry-up more severe. Also, see Chapter 7 of Holmström and Tirole (2011), which uses the model described in Malherbe. There is substantial evidence that banks did in fact build up cash positions during the recent crisis (Acharya and Merrouche 2013; Heider, Hoerova, and Holthausen 2008; Ashcraft, McAndrews, and Skeie 2011). Afonso, Kovner, and Schoar (2011) document that while rates spiked and terms became more sensitive to borrower risk, borrowing amounts remained stable in the U.S. federal funds market during the Lehman episode. They argue that it is likely the market did not expand to meet the additional demand, which is consistent with hoarding.

### *Contagion through Interlinkages*

While the interbank market can act as a device for coinsurance against uncertain liquidity shocks and provide incentives for peer-monitoring, it can also serve as a channel through which problems in one bank can spread to other banks with significant contagion effects (Allen and Gale 2000).<sup>10</sup> Thus, while interlinkages can act as shock absorbers and allow risk sharing among banks for random liquidity shocks, they can also act as shock transmitters and lead to the spreading of losses through the banking system, resulting in contagion.<sup>11</sup>

### 3.4 Liquidity and Fire-Sale Externalities

When a firm experiences financial difficulties and needs to sell assets, it is likely that other firms operating in the same industry would experience similar problems or may not have enough resources to purchase these assets (Shleifer and Vishny 1992).<sup>12</sup> This, in turn, can result in fire sales, in which the prices of the assets fall below their fundamental value. Furthermore, the prices are determined by the amount of available cash to purchase those assets, resulting in cash-in-the-market prices (Allen and Gale 1994, 1998).<sup>13</sup> What may be of particular interest in the case of banks is that bank loans are usually specific arrangements between the bank and the borrower and may not be easily marketable.<sup>14</sup>

Fire sales can create externalities, in which an agent liquidates assets and the resulting fire-sale prices can have adverse effects on agents with similar asset holdings and can lead to further fire sales and further disruptions. Cifuentes, Ferrucci, and Shin (2005) build a model of the interbank market, where banks are subject to regulatory solvency constraints, and sales by distressed institutions depress the market price for

<sup>10</sup> Also, see Nier et al. (2007) for an analysis of contagion through interlinkages.

<sup>11</sup> A series of empirical papers—Sheldon and Maurer (1998) for Switzerland, Furfine (1999) for the United States, Upper and Worms (2002) for Germany, and Wells (2002) for the United Kingdom, to cite only a few—analyze the potential for failures resulting from these interlinkages.

<sup>12</sup> Also see Williamson (1988). There is strong empirical support for this idea, as shown, for example, by Pulvino (1998) for the airline industry, and by Acharya, Bharath, and Srinivasan (2007) for the entire universe of defaulted firms in the United States over the period 1981–99 (see also Berger, Ofek, and Swary [1996] and Strömberg [2000]).

<sup>13</sup> Also see Allen and Gale (2004a, 2004b, 2005). These ideas have been further developed by Bernardo and Welch (2004) and Morris and Shin (2004) to explain financial market runs. Brunnermeier and Pedersen (2005) use similar arguments to investigate strategic behavior among traders.

<sup>14</sup> See James (1991) for evidence.

assets. An initial shock may force some banks to liquidate some of their illiquid assets to satisfy the regulatory solvency constraints. Marking-to-market of the asset book can induce a further round of endogenously generated sales of assets, depressing prices further and inducing further sales. Therefore, contagious failures can result from small shocks through asset prices. Even though the origin of the initial failures can be insolvency, through depressed asset prices, the initial effect can be magnified and spread to the rest of the system (Diamond and Rajan [2001a, 2001b], Gorton and Huang [2004], Allen and Gale [2004a, 2004b, 2005]—to cite a few).

### 3.5 How Have Governments Attempted to Protect against These Vulnerabilities?

To mitigate the fragility of financial intermediaries and strengthen the stability of financial institutions, policymakers have designed and implemented various strategies over time. While some of these guidelines aim directly at the liability side of banks' balance sheets, such as capital requirements and deposit insurance, others target the asset side of the balance sheets, such as liquidity and reserve requirements, and asset restrictions as applied to money market funds.

Some of the important policies that aim at promoting stability are as follows:

- deposit insurance,
- lender of last resort,
- supervision,
- capital requirements,
- reserve requirements,
- liquidity requirements,
- transparency and disclosure requirements.

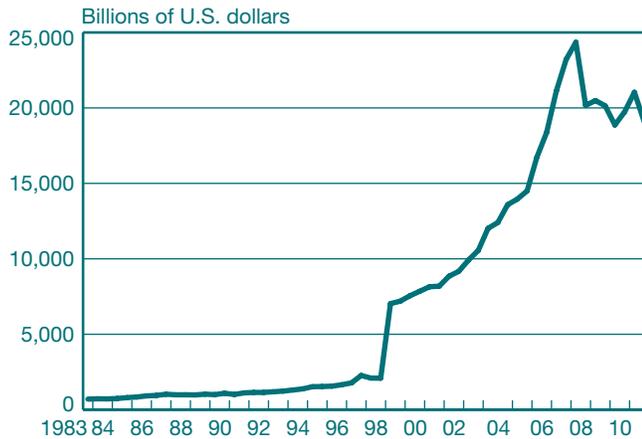
While there is an extensive literature on each of these policies, in this article we focus on the question of how the financial system has evolved and whether these policies are sufficient and effective in the new world.

## 4. HOW HAS THE WORLD CHANGED LEADING UP TO THE CRISIS?

In this section, we look at some of the changes that have taken place in the financial sector in recent decades, and how those changes have affected the stability of financial intermediation.

CHART 1

### Aggregate International Claims



Source: Bank for International Settlements, International Banking Statistics.

For example, some activity has shifted to less regulated parts of the financial system, which has likely weakened the effectiveness of existing regulations. Furthermore, some of the changes in the funding structure of financial intermediaries, for example, dependence on short-term wholesale funding, may have increased the fragility of the financial system. Next, we discuss the changes in the financial system that had significant effects on the stability of the financial system and the effectiveness of the policies in place.<sup>15</sup>

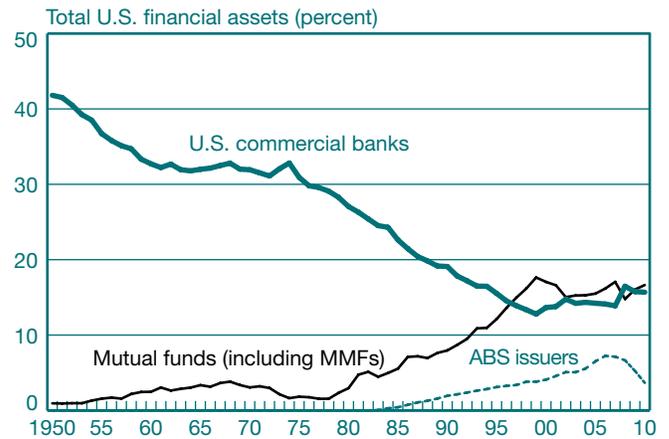
#### 4.1 Banks Are More Vulnerable

Equity capital can act as a buffer against losses and can induce prudent risk management by increasing banks' "skin in the game" (Gale 2004; Gale and Özgür 2005). One interesting observation is the historical decline in commercial banks' equity as a percentage of assets in the United States, as illustrated by Berger, Herring, and Szegö (1995) for the period 1840-1993. In 1840, equity funded more than 50 percent of banks' assets, whereas the ratio fell steadily for about a century and settled in the 6 to 8 percent range from the mid-1940s to the 1990s.

<sup>15</sup> The second article in this special issue (Yorulmazer 2014) provides case studies that focus on disruptions in some major markets and the difficulties experienced by financial institutions, with a discussion of the policy responses.

CHART 2

### Commercial Banks versus Mutual Funds (including MMFs) and ABS Issuers



Source: Federal Reserve Flow of Funds.

#### 4.2 Globalization of Financial Intermediation

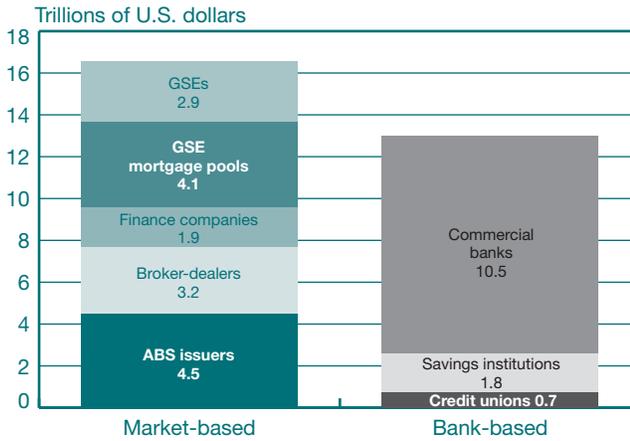
Another factor is the globalization of banking. Chart 1, taken from Cetorelli and Goldberg (2012), shows the aggregate international claims of Bank for International Settlements (BIS) reporting country banks, where international claims comprise both cross-border claims and local foreign claims. The increase in the aggregate international claims shows clearly the globalization trend in the banking industry.

#### 4.3 Financial Intermediation Is Less Bank-Centric Now

An additional interesting development in the financial sector is the shift from bank-based activities to market-based activities. The following discussion is mostly based on Adrian and Shin (2009) and Cetorelli, Mandel, and Mollineaux (2012).

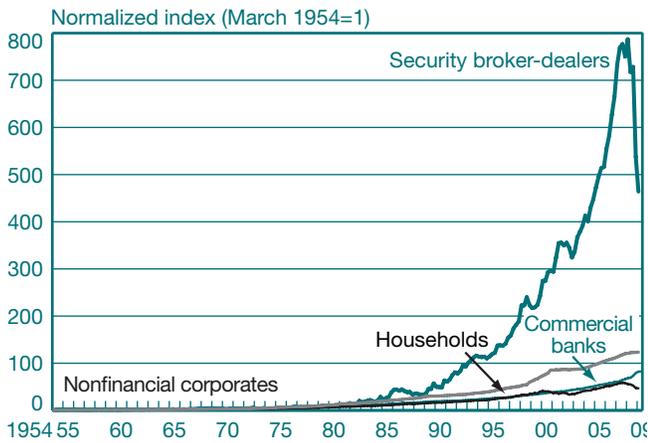
Chart 2 shows the trend for banks' share of financial sector assets since the 1950s. The chart also illustrates the growth of nonbank intermediaries that compete with banks on both sides of the balance sheet. For instance, on the liability side, mutual funds and, more recently, money market mutual funds (MMFs) have grown substantially. Similar trends are observable for entities that may compete with banks on the asset side, such as asset-backed securities (ABS) issuers lately.

CHART 3  
Total Market-Based and Bank-Based Assets  
at 2007:Q2



Source: Federal Reserve Flow of Funds.

CHART 4  
Growth of Assets of Four Sectors  
in the United States

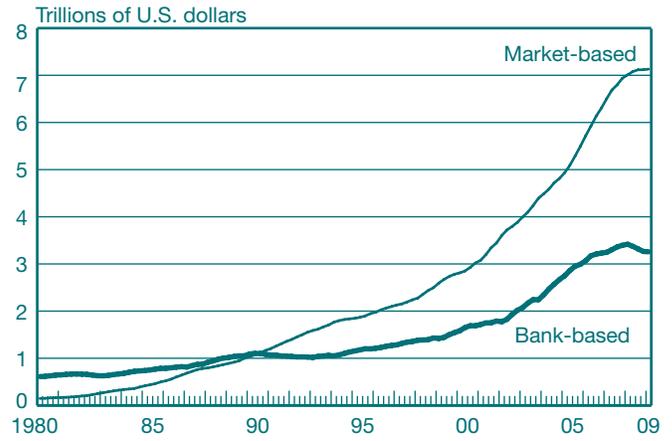


Source: Federal Reserve Flow of Funds.

Before the financial crisis, the integration of banking with capital markets was an important trend in the financial system. The growing use of capital markets to supply credit was particularly important, especially in the United States. While banks were traditionally the dominant suppliers of credit, their role has been increasingly supplanted by market-based institutions—especially those involved in the securitization process.

Chart 3, taken from Adrian and Shin (2009), compares total assets held by banks with the assets of securitization

CHART 5  
Market-Based and Bank-Based Holdings  
of Home Mortgages



Source: Federal Reserve Flow of Funds.

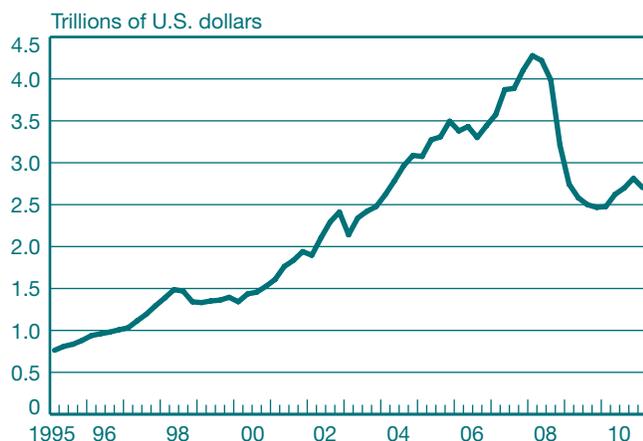
pools or at institutions that fund themselves mainly by issuing securities, showing that by the end of the second quarter of 2007, the “market-based assets,” were substantially larger than bank assets.

The growing importance of the market-based system is evident in Chart 4, from Adrian and Shin (2009), which tracks the assets held by four sectors in the United States—the household sector, nonfinancial corporate sector, commercial banking sector, and the security broker-dealer sector.

The rapid expansion in broker-dealers’ assets can mostly be explained by the changing structure of the U.S. financial system and, in particular, by the changing nature of the residential mortgage market and the growing importance of securitization. Until the early 1980s, banks were the dominant holders of home mortgages, but bank-based holdings were overtaken by market-based holders. In Chart 5, taken from Adrian and Shin (2009), “bank-based holdings” comprise the holdings of commercial banks, savings institutions, and credit unions. Market-based holdings are the remainder—the government-sponsored-enterprise (GSE) mortgage pools, private label mortgage pools, and the GSE holdings themselves. By 2008, market-based holdings constituted two-thirds of the \$11 trillion total of home mortgages.

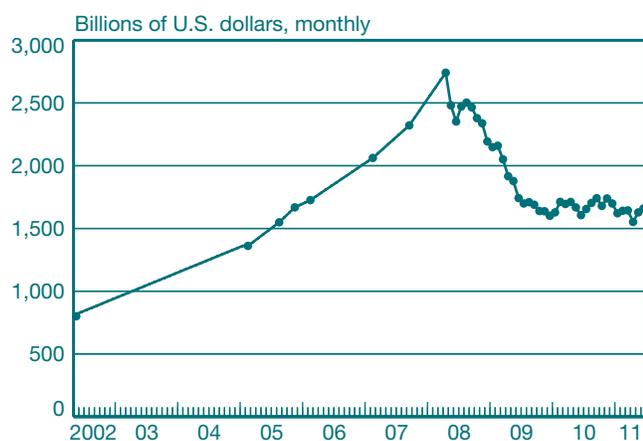
This shift from the bank-based to market-based parts of the financial system may have a significant effect on the scope, strength, and efficiency of existing policies, since a significant part of the financial activity may now take place in the less regulated parts of the financial system.

CHART 6  
Total Primary Dealer Repo Activity



Source: Federal Reserve Flow of Funds.

CHART 7  
Aggregate Value of the Tri-Party Repo Market

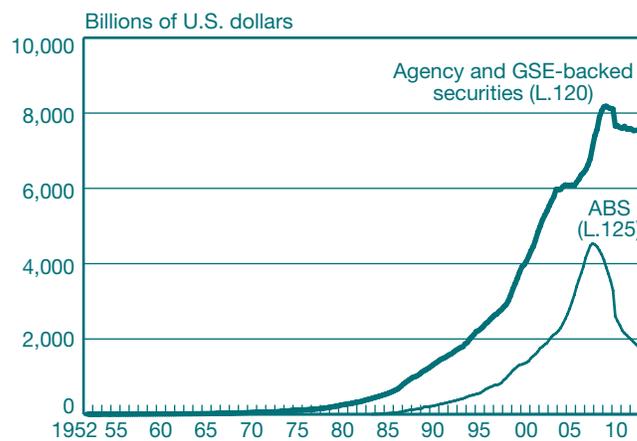


Source: Federal Reserve Bank of New York.

## 4.4 The Rise of Repo

Another important change in the financial sector is the growing importance and size of the repo market. Chart 6 shows the total primary dealer repo activity, while Chart 7, taken from Copeland, Martin, and Walker (2010), depicts the total size of the tri-party repo market. Gorton and Metrick (2010) estimate the size of the overall repo market to be around (or larger than) \$10 trillion. During the financial crisis, repo markets

CHART 8  
Importance of Securitization



Source: Federal Reserve Flow of Funds.

experienced disruptions that contributed to the near-failure or failure of some major financial institutions.<sup>16</sup>

## 4.5 Securitization

Related to the earlier discussion, another notable issue is the importance of securitization (Chart 8). Academic studies identify the effects of securitization in weakening incentives to monitor loans because they are no longer on the balance sheets of the financial institutions that originate them (Parlour and Plantin 2008). Therefore, securitization is one issue that one should think about carefully when designing new rules to strengthen overall financial stability.

Banking and financial intermediation has gone through significant changes in recent decades—banks are much more reliant on wholesale funding, and much more international (making resolution of insolvency much more difficult). These changes pose important challenges for policymakers to improve and design a framework for supervision and regulation that would address important issues that have been raised by the current crisis.

<sup>16</sup> The second article in this special issue (Yorulmazer 2014) provides a case study on the disruptions in repo markets and the policy responses in the crisis of 2007-09.

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## 5. CONCLUSION

This article provides a review of the literature on the stability of banks and other financial intermediaries. In particular, it presents a discussion of the fragility associated with financial intermediaries that perform liquidity and maturity trans-

formation and the factors that affect such fragility. It also discusses developments in the financial sector that affect the stability of financial intermediaries. In sum, this article offers a framework that the other two articles in this special issue (Yorulmazer 2014; Eisenbach et al. 2014) build upon.

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