



## Balance Sheet Adjustment

Zhiguo He  
University of Chicago

In Gu Khang  
Northwestern University

Arvind Krishnamurthy  
Northwestern University and NBER

Paper presented at the 10th Jacques Polak Annual Research Conference  
Hosted by the International Monetary Fund  
Washington, DC—November 5–6, 2009

**The views expressed in this paper are those of the author(s) only, and the presence of them, or of links to them, on the IMF website does not imply that the IMF, its Executive Board, or its management endorses or shares the views expressed in the paper.**

# Balance Sheet Adjustment

*Zhiguo He, In Gu Khang and Arvind Krishnamurthy,<sup>1</sup>*

*October 28, 2009*

We measure how securitized assets, including mortgage-backed securities and other asset-backed securities, have shifted across financial institutions over this crisis and how the availability of financing has accommodated such shifts. Sectors dependent on repo financing – in particular, the hedge fund and broker-dealer sector – have reduced asset holdings, while the commercial banking sector, which has had access to more stable funding sources, has increased asset holdings. These findings are important to understand the role played by the government during the crisis as well as to understand the factors determining asset prices and liquidity during the crisis.

---

<sup>1</sup> Booth School of Business, University of Chicago, Kellogg School of Management, Northwestern University and Kellogg School of Management, Northwestern University and NBER. We thank participants in the finance bag lunch seminar at Northwestern University for their comments. We also thank Ayhan Kose, Pierre-Olivier Gourinchas and David Lucca for helpful comments.

We have seen a massive restructuring of financial sector balance sheets over the last two years, and will likely continue to do so over the next year(s). The impetus for this restructuring has been the deterioration in financing conditions in debt and equity markets as well as the loss of liquidity in the secondary markets for many assets. The objective of this paper is to take stock of this restructuring process with an eye toward understanding how assets and financing have shifted across different institutions in the marketplace.

The most apparent aspect of this restructuring is the “deleveraging” phenomena. Haircuts in the repo market (i.e the market for security loans) have risen dramatically during this crisis. Table 5 below illustrates this rise. The higher haircuts reflect a tightening of credit conditions. For a hedge fund that is financing asset holdings in the repo market, mechanically, a rise in haircuts that is not offset by an infusion of equity capital will cause the fund to liquidate assets. That is, the rise in haircuts will force the hedge fund to reduce its leverage and asset holdings. This deleveraging process has occurred in many parts of the financial system and has been commented on extensively by regulators and academics (see for, example, Adrian and Shin, 2009, Brunnermeier, 2009).

In equilibrium, if some entity deleverages, the assets must be purchased by another entity. That is, deleveraging is far from a complete description of the balance sheet adjustments taking place. In this paper, we are interested in understanding the magnitude of the asset sales implied by this deleveraging as well as shedding some light on the potential buyers of these assets. How much assets have been sold by deleveraging institutions? Who are the potential buyers? How have they financed the purchase? What is the impact on their leverage?

In answering these questions, we inevitably run into the part played by the government. That is, the government balance sheet is integrally involved in the aggregate balance sheet adjustments. In some markets, the government has directly purchased assets, while more typically the government has either extended loans or invested equity capital in financial institutions. How have these activities supported balance sheet adjustment? Which of the margins – asset purchase, equity injection, and lending – has been quantitatively more important? Our results also shed light on this question.

Finally, and this is a question which we will come to in taking stock of our results, what factors have determined asset prices and risk premia? On the one hand, deleveraging by some institutions should cause asset prices to fall. But, to understand how much asset prices fall due to forced sales from the deleveraging institutions, we need to understand not only who the buyers are, but also the factors that determine the buyers’ valuations. Shedding light on who has bought assets and how they have financed this purchase can help to answer this question.

# 1. Markets and Institutions

## a. Mortgage and Credit Markets

Table 1 lists the type of assets markets that are the focus of this study. The table covers the securitized debt markets for mortgage and credit assets. We are interested in understanding how the securities in Table 1 have been bought and sold across the financial marketplace. Falling real estate prices and declining corporate profitability and household income have contributed to losses on all of these assets (see Table 3 for estimates of losses).

Mortgage and Credit Related Securities	Outstanding
Total ABS (including auto, credit card, home equity, manufacturing, student loans, CDOs of ABS)	2480
ABS CDOs	400
Mortgage Related	8990
Agency GSE MBS	6094
Non-Agency MBS	2897
Corporate Bonds	6043
Asset-Backed Commercial Paper	1250
Total for Securities	17513

**Table 1: Mortgage and Credit Securities (\$ billions)**

Source: SIFMA (Q1 2008), Acharya, Schnabl, and Suarez (2009)

Note: ABS = asset-backed securities; CDO = collateralized debt obligation; GSE = government-sponsored enterprises; MBS = Mortgage-backed securities

The typical security is an asset that is backed by a pool of loans originated by some financial institution, but which has subsequently been sold by the financial institution and is being held by another entity. Table 1 reports nearly \$9 tn of mortgage-backed securities (MBS), where the backing is a pool of residential loans. This category is further subdivided into agency GSE and non-agency. The GSE backed mortgage pools are insured by a government agency and are therefore the lowest risk mortgage-backed securities. There are just over \$6tn of this class of mortgage-backed securities. At the other end of the spectrum, the ABS CDOs are among the most risky of the securities. These securities pool risky tranches from other asset-backed

securitizations and further tranche them into asset-backed securities. While there are only \$400 bn of these securities, the losses and liquidity problems are most pronounced in this category.

The corporate bond category includes high-grade corporate bonds that have not been much affected by this crisis. It also includes asset-backed commercial paper (ABCP) which has also played an important role in the crisis (see Acharya, Schnabl, and Suarez, 2009). The dynamic in the ABCP market is a microcosm of the deleveraging in the financial markets. In the crisis, investors reduce their willingness to provide credit to ABCP. As a result, the amount of outstanding ABCP has shrunk by nearly \$650bn. In most cases, commercial banks have purchased the assets/loans underlying ABCP.

In addition to the securities listed in Table 1, it is worth noting that there is nearly \$12 tn of loans that have remained in the portfolios of commercial banks. These loans have also contributed to some of the losses suffered by the financial sector. We do not directly focus on these loans because they do not have secondary asset markets and are therefore only indirectly involved in the balance sheet adjustments of the financial sector.

The total in Table 1 is just over \$17.5 tn of assets. This number provides a sense of the (large) magnitude of the shock that has affected the financial sector and the scale of the asset adjustments that we attempt to document.

## **b. Financial Institutions**

The debt instruments in Table 1 are held by a number of financial institutions. Table 2 provides a sense of the main financial institutions in the U.S, and the size of these institutions as measured by total assets. We focus on five major categories of asset holders: commercial banks, broker/dealers, hedge funds, GSEs, and insurance companies.

Financial Institution	Total Assets
Commercial Banks	11192
Insurance Companies	6308
GSEs	3174
Brokers and Dealers	3092
Hedge Funds	3406

**Table 2: Financial Institution Assets (\$ billions)**

Sources: Flow of Funds of Federal Reserve 2007, He and Krishnamurthy (2008)

## a. Losses

Table 3 gives a breakdown of the losses suffered, by financial sector, as of early 2009. Note that in most cases the losses are as reported by the firms. For firms that are not subject to mark-to-market accounting (commercial banks), it is likely that losses in Table 3 are an underestimate of true losses. This concern plausibly also applies to the mark-to-market firms since in many cases the market for asset-backed securities essentially vanished causing the firms to mark-to-model. However, as we explain in the next section, the mis-marks will not appreciably change our results.

Financial Institution	Total Losses
Commercial Banks	500
Insurance Companies	207
GSEs	153
Brokers and Dealers	100
Hedge Funds	170

**Table 3: Financial Institution Losses (\$ billions)**

Sources: Bloomberg WDCI (2009), Hedge Fund Flow Report by Barclay Hedge (2009)

## 2. Methodology

Our aim is to understand how assets have shifted across the financial system and the role of external financing in supporting this restructuring. We examine the main holders of assets from Table 2 and try to estimate purchases/sales of mortgage and credit assets.

Suppose that at date  $t$  we can compute the total mortgage and credit assets held by a sector as  $A_t$ . Moreover, suppose we can measure the repayment/maturity rate of these assets, net of the new issuance rate, as  $f$  (in percentage). Then, as an accounting identity:

$$A_{t+1} - A_t(1-f) = \text{Purchases} - \text{Losses} \quad (\text{eq. 1})$$

Since we can measure losses from Table 3, we can estimate the purchases made by a given sector.

We use an  $f$  of 0% in the computations we detail in the next section. This is largely for simplicity's sake. We report numbers using 7% and 12% later in the paper with 7% being our

preferred estimate of  $f$ . These numbers are drawn from Bloomberg.<sup>2</sup> We report the purchases number for each sector. We measure the change from 2007 Q4 to 2009 Q1. This time period spans 2008 which is the period of greatest balance sheet adjustment. It stops just before the improvement in market conditions which began in April 2009.

We roughly check whether the sum of purchases across the sectors is zero, as would be implied by market clearing. We cannot overemphasize however the roughness of this computation. There are serious measurement issues that we run into in our exercise. While we feel comfortable on the coarse magnitudes of our results, they are not so precise that that the sum will be zero.

Here are some of the main measurement issues that we face:

1. For a precise computation, the assets under consideration in eq 1 should be to the same asset. That is, the requirement that the sum of purchases equal zero applies to a single class of mortgage-backed securities. We will group a large class of mortgage and credit assets together in our computations, which creates some imprecision in our estimates. We do this because we do not have precise breakdowns of asset holdings by financial institution. On other hand, as suggested in tables 1, 2, and 3, the numbers involved in our computation and the world are on the order of trillions of dollars, so that it is plausible that even the rough measures that we perform are interesting and informative.
2. There are double counting issues that affect our computations. Here is a typical example: Suppose that a bank makes a \$100 repo loan to a hedge fund that uses the \$100 to buy an MBS. Suppose that the hedge fund liquidates the MBS back to the bank. Now, we will measure hedge fund assets to fall by \$100. We will measure total bank assets (MBS + Repo Loan) to remain the same. In this case, the sum of assets across the bank and hedge fund falls by \$100. We deal with this problem in two ways. First, we avoid measuring repo as an asset on any balance sheet. That is, this problem is most pronounced for repo transactions and we will exclude repo from our computations. Second, where possible we focus only on direct holdings of asset-backed securities. In such a case, taking the example, we would see MBS rise by \$100 in the bank.

---

<sup>2</sup> Bloomberg reports the aggregate repayment rate across a large (>\$3tn) sample of ABS and MBS of 17% in the year 2008. They also report that that the aggregate rate of new issuance is 10%. These numbers lead to our choice of 0%, 7%, and 12% as possible net repayment rates.

3. There is widespread concern among many observers that assets on financial institutions' balance sheets are not appropriately marked to true values. Suppose commercial banks improperly mark-to-market. For example suppose banks mark their books at  $t+1$  at \$100 too high a value and also report losses that are \$100 too small. Then, note that eq. 1 will imply that,

$$100 + A_{t+1} - A_t(1 - f) = \text{Purchases} - (\text{Losses} - 100),$$

so that the \$100 mis-mark cancels out. As long as the book mark and the reported losses apply to the same set of assets, our computation will not be affected by this issue. In practice, there may be cases where the latter caveat does not apply, but this logic does suggest that the mark-to-market problem which may be severe in the world is less severe for our exercise.

### 3. Purchases/Sales

#### a. Hedge Funds

Table 4 lists the equity capital (or what the industry refers to as assets under management, AUM) of the hedge fund sector by various investment strategies over the current financial crisis. We select three of these strategies - distressed securities, fixed income, and macro - to be particularly relevant to estimating the industry's holding of mortgage and credit assets. We also include a fraction of the multi-strategy and sector specific funds' capital as part of the total capital related to investments in mortgage and credit assets<sup>3</sup>.

The total capital for mortgage and credit assets, based on this computation, is \$514bn in December 2007, when the total capital of the hedge fund industry is at its peak, and \$257bn in March 2009, when the total capital is at its lowest. These numbers imply that \$257bn has gone towards equity capital redemptions and trading losses.

We are interested in the gross sale (purchase) of mortgage and credit assets by the hedge fund sector. To get to this number, we have to estimate the leverage supported by the hedge fund sector. According to Hedge Fund Research, the industry average for leverage ratio was close to 2.8 in 2007<sup>4</sup>. If we assume this number applied equally to the credit/mortgage related

---

<sup>3</sup> To determine the fraction of multi-strategy, we assume constant proportionality and assign the proportion of the combined AUM of distressed securities, fixed-income, and macro in relation to the industry total AUM excluding multi-strategy, other, and sector specific for both times. To determine the fraction of sector specific strategy, we assume that it is proportional to the share of two industries in GDP, real estate and finance.

<sup>4</sup> See Figure 3 in Andrew Lo's Written Testimony for Hearing on Hedge Funds, November 2008.

segments of the hedge fund universe, we find that total credit and mortgage assets held in the sector was \$1,439bn in 2007. The industry average leverage ratio for all of 2008 is estimated to be 2.3. Applying this number to the 2009 equity capital of \$257bn, implies total assets held of \$591bn.

Strategy	4 <sup>th</sup> Qtr 2007	1 <sup>st</sup> Qtr 2009	Redemptions and Trading Losses
Convertible Arbitrage	42	11	31
Distressed Securities	176	69	107
Emerging Markets	353	125	228
Equity Strategies	538	303	235
Event Driven	162	57	105
Fixed Income	160	69	91
Macro	91	61	30
Merger Arbitrage	39	5	34
Multi-Strategy	224	122	102
Other	61	20	41
Sector-Specific	130	58	72
<b>Hedge Fund Industry</b>	<b>1975</b>	<b>973</b>	<b>1002</b>

**Table 4: Equity Capital (or Assets under Management) of Hedge Fund Industry (\$ billions)**

Sources: Hedge Fund Flow Report by Barclay Hedge (2008, 2009)

There are reasons to think that the fall in leverage from 2.8 to 2.3 understates the true change in leverage to early 2009. The 2.3 leverage number is for all of 2008, and the hedge fund sector was worst hit in the fall of 2008. Thus, a second way to get at the change in leverage is to look at repo haircuts. Table 5 reports how repo haircuts have evolved over the crisis. The haircuts on AAA rated Collateralized Mortgage Obligations went from 10% in 2007 to 30% in early 2008 to 40% in early 2009. The increase through 2008 into 2009 should be expected to decrease leverage even further.

We do the following computation to reflect this rise in haircuts. We ask, what does final 2008 year-end leverage have to be in order to match two facts: (1) Haircuts double over the year 2008; and (2) The average leverage ratio over the year 2008 is 2.3. The answer is a leverage ratio of 1.7. From this number, the total assets held in early 2009 is \$437bn.

To recover net purchases, as in eq. 1 we further need an estimate of losses on these assets. The Hedge Fund Flow Report by Barclay Hedge (2008) estimates that of the \$1tn of reduction in equity capital in Table 4, the breakdown between trading losses and redemptions is 66.3% and

33.7%.<sup>5</sup> Applying this proportion to the drop of mortgage/credit segment equity capital from Q4 2007 to 2009 Q1, which is \$257bn estimated above, implies losses of \$257bnX66.3%=\$170bn. Thus, the hedge fund sector must have sold between \$678bn and \$832bn of assets.

<u>Security</u>	Spring 2007	Spring 2008	Fall 2008	Spring 2009
US Treasuries (short-term)	2%	2%	2%	2%
US Treasuries (long-term)	5	5	6	6
Agency Mortgage-Backed Securities	2.5	6	8.5	6.5
Corporate Bonds	5	10	20	20
A-/A3 or above				
Collateralized Mortgage Obligations (CMOs) AAA	10	30	40	40
Asset Backed Securities (ABS)	10	25	30	35
AA/Aa2 and above				

**Table 5: Evolution of Repo Haircuts in the Crisis**

Source: Krishnamurthy (2009)

## **b. Brokers and Dealers**

Table 6 provides data on the main brokers and dealers in the US as of 2007. Trading assets held by these entities totaled near \$2.5tn. We analyze in further detail the behavior of three of these firms, Goldman Sachs, Merrill Lynch, and Morgan Stanley. We restrict attention to these three firms because of data availability issues. Our strategy is to estimate asset changes from the SEC filings of these firms and then make assumptions to apply this to the entire industry.

<sup>5</sup> This estimate is based on the surviving funds, who lost \$161bn by redemption and lost \$317bn from asset trading.

The flow of funds of the Federal Reserve is another data source for understanding the change in the broker/dealer sector. While our computations result in a similar picture as painted by the flow of funds, the advantage of our computations is that the SEC filings allow a more detailed breakdown of asset holdings than is provided in the flow of funds.

<b>Year End 2007</b>	<b>Total Assets</b>	<b>Trading Assets</b>
Goldman Sachs	1120	453
Merrill Lynch	1045	375
Morgan Stanley	1020	235
Citigroup Global Markets	664	274
Bank of America Securities	922	308
JP Morgan Investment Bank	612	423
Lehman Brothers	691	313
Bear Stearns	395	138
<b>Total</b>	<b>6469</b>	<b>2519</b>

**Table 6: Trading Assets of Broker/Dealers<sup>6</sup> (\$ billions)**

Source: SEC Filings of the above-listed Broker/Dealers

Table 7 reports the trading assets for three firms in November 2007, February 2008 and March 2009. These dates span the period when most of the balance sheet adjustment takes place. We compute the trading and mortgage related assets by summing reported holdings of non-Agency mortgage-backed securities, asset-backed securities, and credit market securities. We exclude the Agency MBS holdings in this computation because they are grouped with government debt and other Agency debt in the reported balance sheets. As a result, we underestimate the total credit and mortgage assets, but include the most risky assets. Finally, note that the trading asset account is treated as fair-value mark-to-market accounting.

From Table 7, we compute the fall in assets from November 2007 to March 2008 to be \$180bn. We scale this number up based on the proportions from Table 5, where the three firms make up approximately 35% of the total assets of the US brokers and dealers. This computation gives a fall in assets of \$514bn. Finally, from Table 3, we note that broker/dealers have lost \$100bn on mortgage/credit assets, implying that net sales are \$414bn from the broker/dealer sector.

<sup>6</sup> Due to cross holdings of assets across the investment banks, this figure is likely considerably higher than the total assets held by the entire broker/dealer sector.

	<b>Assets</b>	<b>Nov 2007</b>	<b>Feb 2008</b>	<b>March 2009</b>
Goldman Sachs	Trading Assets	453	499	350
	Credit and Mortgage Related	132	142	62
Morgan Stanley	Trading Assets	375	446	259
	Credit and Mortgage Related	148	161	83
Merrill Lynch	Trading Assets	235	232	158
	Credit and Mortgage Related	173	160	128
<b>Total Credit and Mortgage Related Assets</b>		<b>453</b>	<b>463</b>	<b>273</b>

**Table 7: Trading Assets of Investment Banks<sup>7</sup> (\$ billions)**

Source: SEC Filings of the above-listed Broker/Dealers

### c. Insurance Companies

Table 8 gives data on the insurance sector, which is another important holder of mortgage/credit assets. We choose the 8 largest insurance companies and examine their holdings of mortgage and other ABS positions, as reported on SEC filings. We do not include the corporate bond holdings because insurance companies hold a large number of corporate bonds, most of which are likely to be low risk. We have also excluded the holdings of Agency backed MBS. Again, both of these assumptions are likely to understate the total change in holdings.

The fall in holdings including AIG is \$124 bn. If we exclude AIG, the fall is \$35bn. AIG in some sense is not the typical insurance company, and as events have revealed, had a business model which had elements of a broker/dealer.

From the flow of funds of the Federal Reserve, the total assets of the insurance sector as of Q4 2007 are \$6364bn. The total assets of the insurance companies in Table 8 are \$1772 bn (\$692 bn excluding AIG), for the same time period. We scale our estimated change up to reflect the whole insurance sector. This gives \$447bn (\$324bn excluding AIG). To the extent that the large

<sup>7</sup> Goldman Sachs and Morgan Stanley, being non-bank-holding companies until late 2008 and not bound by the regulations for the bank-holding companies, used to file with the SEC according to a fiscal year that ends in November in every calendar year. On the other hand, Merrill Lynch, irrespective of its status as a non-bank-holding company, has been filing with the SEC following the same fiscal year schedule as any other bank-holding companies.

insurance companies were plausibly more involved in “toxic” securities, our scaling-up procedure overstates the fall in assets. From Table 3, we see that the insurance sector has lost \$200bn on mortgage/credit assets. Thus we estimate that this sector is a net seller of \$245bn (\$124bn) of mortgage/credit assets. Given that this is a relatively small change on a large holding of total assets (i.e. \$6tn), it also seems plausible that the true description of the insurance sector (other than AIG) is that it has not sold assets but has merely held a portfolio that has fallen in value.

	<b>Q4 2007</b>	<b>Q1 2009</b>
Liberty Mutual	13.5	12.6
Berkshire Hathaway	3.6	2.8
AIG	134.5	45.4
Allstate	23.3	11.6
Travelers	7.1	5.9
CAN Insurance	11.4	7.3
Hartford Financial Services	29.3	13.3
Progressive	2.5	2.1
<b>Total</b>	<b>225</b>	<b>101</b>

**Table 8: Mortgage and ABS Holdings of Top 8 Insurance Companies (\$ billions)**

Source: SEC Filings

#### **d. Commercial banks**

Table 9 provides data on the changes in the asset side of commercial bank’s balance sheet from 2007 to 2009. We measure the asset holding changes from 2007 Q4 to 2009 Q1. The data is from the Flow of Funds of the Federal Reserve. Note that this data is backfilled to reflect the effect of mergers. There was a significant amount of bank merger activity in 2008. Also, we exclude the data for bank holding companies, since the largest part of the assets of holding companies is equity in a commercial bank (i.e. the data is L109 minus L112).

Unlike the other balance sheets we have examined the commercial bank balance sheets grow by close to \$1.7tn (11.1tn minus 9.4tn). This is despite losses of \$500bn suggesting that the banking sector has accumulated assets, in contrast to other financial sectors.

	<b>4<sup>th</sup> Qtr 2007</b>	<b>1<sup>st</sup> Qtr 2009</b>
Cash and Reserves	76	813
Securities	2253	2419
Loans and Leases	6807	7031
Other assets	243	800
<b>Total Financial Assets</b>	<b>9379</b>	<b>11063</b>

**Table 9: Assets of Commercial Banks (\$ billions)**

Source: Flow of Funds of Federal Reserve (L109 minus L112)

Table 10 presents in further detail the changes in holdings of mortgage and asset-backed securities broken down by type of banking institution. The Agency and GSE-backed holdings of MBS clearly increase across most categories. The U.S. chartered commercial banking sectors position of ABS increase while the holdings of private MBS falling slightly. The ABS holdings are from FDIC data. We are unable to see the detailed holdings of private MBS and ABS for the other institutions from the flow of funds. Figure 1 graphs the total holdings over the 2008 year. There is a significant rise in the second quarter of 2008 and again the last quarter of 2008. These periods match up with turmoil in the financial sector more broadly (Bear Stearns in March/April and Lehman/AIG in September/October), suggesting that the banking sector grew especially when other sectors may have suffered.

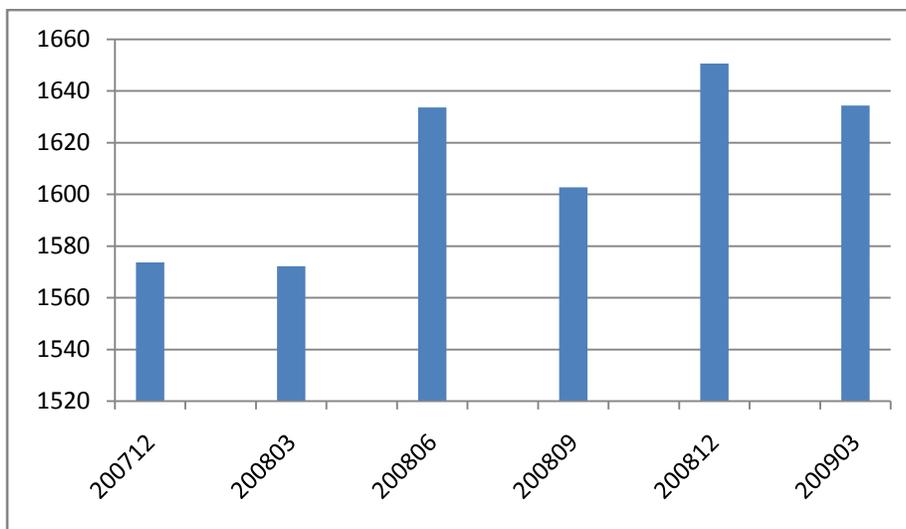
We use Table 10 to provide two estimates of the acquisitions by the banking sector. First, the total increase in securities across all categories is \$115bn. From Table 3, the losses reported by the commercial banking sector totals \$500bn. If we assign all of these losses to the mortgage assets, we find that the sector purchases \$615bn of mortgage/credit assets. This number is probably an overestimate however because it is unlikely that all \$500bn of the losses relate to these assets. Moreover, this calculation mixes the Agency-backed and privately-backed securities, while it is interesting to understand the dynamics in these asset types separately.

Second, if we focus on just the U.S. chartered commercial banking sector, the total holding of ABS and private MBS rises from \$356 billion to \$377 billion. The IMF Global Financial Stability Report of October 2008 reports estimated losses on the outstanding stock of ABS and ABS CDOs of 33%. They report loss rates on CMBS of 17%. Taking these numbers as representative of losses on private securitized assets, we assume that these securities fall in value by 20% between Q4 2007 and Q1 2009. Then, we find that the banking sector purchased \$92 billion of private asset-backed securities.

	4 <sup>th</sup> Qtr 2007	1 <sup>st</sup> Qtr 2009
US Chartered Commercial Banks		
ABS	84	140
MBS		
Agency and GSE-backed	929	1085
Privately Issued	272	237
Savings Institutions		
MBS		
Agency and GSE-backed	169	175
Privately Issued	111	47
Foreign Banking Offices		
Agency and GSE-backed Securities	57	45
Bank Holding Companies		
Agency and GSE-backed Securities	10	22
Banks in US Affiliated Areas		
Agency and GSE-backed Securities	27	23
<b>Total Securities</b>	<b>1659</b>	<b>1774</b>

**Table 10: Holdings of Securities by Commercial Banks (\$ billions)**

Sources: Flow of Funds of Federal Reserve, FDIC Statistics on Depository Institutions Report



**Figure 1: Total MBS Holdings of Banking Sector (\$ Billions)**

Source: Flow of Funds of Federal Reserve

An important aspect of bank behavior as it relates to deleveraging is in the ABCP market. As detailed by Acharya, Schnabl, and Suarez (2009), the commercial banking sector had provided an explicit or implicit liquidity guarantee on nearly \$1.25 tn of ABCP. This amount includes the SIVs where the banks had offered only implicit guarantees. The outstanding amount of ABCP shrinks to \$650bn by the end of 2008, with ABCP investors exiting their investments. Acharya, Schnabl, and Suarez report that these investors only lost 1.7% on the ABCP, which suggests that the bulk of risks and losses remain on bank portfolios. It is unclear to us from the SEC filings whether these assets remain on bank portfolios in the form of securities or loans. The latter would be likely if the sponsoring bank simply made a loan to the ABCP vehicle. For our purposes, this suggests that by excluding loan expansion in the calculation we are likely to underestimate the commercial banks' balance sheet growth in absorbing the troubled assets. In other words, this interesting phenomenon is relevant for our analysis because it is deleveraging-induced growth in bank assets.<sup>8</sup>

#### e. **Foreign Investors**

Table 11 provides data on foreign holdings of asset backed securities. The data is from the U.S. Treasury Report on Foreign Portfolio Holdings of U.S. Securities. Unfortunately the data does not allow for a sampling in Q1 2009. The U.S. Treasury Report on Recent Net Foreign Purchases of U.S. long-term Securities reports that net sales of corporate bonds (including non-Agency Asset Backed Securities), over the six-month period from October 2008 to March 2009 totaled \$24.4bn. But this data also suggests a downsizing of asset backed securities positions.

One problem with this data is that it describes the winding down of an asset-backed conduit, say located in the Cayman Islands, as a decrease in foreign asset holdings. However, economically, such a decrease is not meaningful as, for example, it may not reflect a foreign portfolio investor selling asset backed securities. We are uncomfortable drawing any conclusion from Table 11 further than foreign investors are downsizing.

---

<sup>8</sup> Ivashina and Scharfstein (2009) discuss another source of growth in bank assets. They document that many firms draw down credit lines during the turmoil of the fall of 2008, causing bank loans to rise. They stress that these loan increases are "involuntary" rather than voluntary. Likewise, the behavior of banks in the ABCP market can also be viewed as involuntary.

	6/30/2007	6/30/2008
<b>Total:</b>		
Agency MBS	570	773
Non-Agency MBS	594	458
Other Non-Agency MBS	308	301
<b>Of Which, Foreign Official Holdings:</b>		
Agency MBS	236	435
Non-Agency MBS	26	18
<b>Other Non-Agency MBS</b>	18	23

**Table 11: Foreign Holdings of Asset Backed Securities (\$ billions)**

Source: U.S. Treasury Report on Foreign Portfolio Holdings of U.S. Securities

## f. Summary

Table 12 summarizes our results. The computations we have described so far are in the 0% column. Our preferred numbers are under the 7% repayment scenario which accounts for some repayment on the asset-backed securities as well as some new issuance.

	0%	7%	12%
Hedge Funds	-832	<b>-731</b>	-659
Broker/Dealers	-414	<b>-324</b>	-259
Insurance Companies	-245	<b>-185</b>	-148
Commercial Banks			
All Securitized Assets	615	<b>731</b>	814
Privately-backed Assets	92	<b>117</b>	135
<b>Total (for securitized assets)</b>	<b>-876</b>	<b>-512</b>	<b>-252</b>

**Table 12: Alternative Repayment Scenarios (\$ billions)**

The sum across the four sectors we have described is a net sale of \$512bn, or \$1126 bn if we use the privately-backed asset computation for the banking sector. This is the “hole” in our

computations. On the other hand, we have thus far neglected the government sector and they have surely played a role in absorbing some assets sales. In the next sections, we delve more into the role of the government.

Only the commercial banking sector stands out as a net buyer based on our computations. Most of the sectors are net sellers. Again, we do not know if the banking sector bought the assets sold by other sectors. What we do know is that the sector grows at a time that everyone else is downsizing. This is circumstantial evidence that the banking sector may have absorbed some asset sales. Anecdotally, the only case where deleveraging and transfer to the banking sector is widely understood to have happened is through ABCP facilities. It also seems likely that some asset transfer occurred as borrowers (say a hedge fund) defaulted on a bank loans collateralized by securitized assets, so that the bank kept the underlying collateral. In the next sections, we will also document why the banking sector may have behaved differently than the other parts of the financial system

## 4. Government

### a. Federal Reserve/Treasury

	Maximum Total Assets	First Loss Borne by Insured Party	% Exposure of Remainder	Net Maximum Exposure
Maiden Lane (Bear Stearns)	30	1	100%	29
Maiden Lane II (AIG)	20	0	100%	20
Maiden Lane III (AIG)	30	5	100%	25
Citigroup	306	29	90%	249
Bank of America	118	10	90%	97
<b>Total</b>	<b>504</b>	<b>44</b>		<b>421</b>

**Table 13: Federal Reserve/Treasury**

Source: Caballero and Kurlat (2009)

Table 13 provides data on an important intervention of the government in the banking system. The table is reproduced from Caballero and Kurlat (2009).

The three Maiden Lane facilities work as follows. A collection of “toxic” assets have been removed from a financial institution (AIG or Bear Stearns) and placed in an entity where the

government has an equity interest. As a result, JP Morgan (in the case of Bear Stearns) and AIG do not bear all of the risk associated with losses on the underlying assets. The Maiden Lane facilities essentially remove the economic risks associated with some assets from financial institutions' balance sheets.

The Citigroup and Bank of America facilities are much larger in size and arose as an attempt to stabilize these institutions. A large collection of toxic assets have been "ring-fenced" but remain on the banks' balance sheets. The government shares in any gains/losses in the ring-fenced assets. Again, the economic risks of these assets have been partly transferred to the government. However, for accounting purposes, these assets remain on the banks' balance sheets.

The interventions as reflected in Table 13 do not directly identify the government as an asset purchaser. In the biggest cases, the assets remain on banks' balance sheets and are therefore reflected in previous computations. However, the fact that the government has accepted some of the risk and losses associated with bank assets may still be important. The banks have not been forced to sell these assets as a result. Moreover, one can argue that the banks' capacity to carry risky assets on balance sheet has expanded as a result. In either case, this intervention underscores that the banking sector is different from other sectors and helps to understand the differential behavior as documented in Table 12.

## **b. Federal Reserve Purchase of MBS**

The Federal Reserve has purchased Agency mortgage-backed securities directly in the secondary market. This program was initiated in the fall of 2008 and as of March 25, 2009, the Federal Reserve had purchased \$246bn of MBS debt. This purchase can go some way to explaining the \$514 bn hole in Table 12. However, note that the government has only been active in the Agency MBS market --- which is the low risk segment of the MBS market -- it has not purchased any non-Agency debt.

## **c. Government-Sponsored Enterprises<sup>9</sup>**

Table 14 reports balance sheet data on the GSEs from the monthly volume reports they publish. These numbers also match up well with their SEC filings. The table reports the holdings of

---

<sup>9</sup> Includes Federal Home Loan Banks, Fannie Mae, and Freddie Mac. Note, the loans made by Federal Home Loan Banks are not reflected in Table 11.

Agency and non-Agency MBS for each entity and total. We have also reported the total amount of MBS that the agencies have guaranteed at each data. As real estate prices fall, it is likely that the agencies will suffer losses on the guarantees that they have written.

Total holdings of Agency MBS rise by \$168 bn. Holdings of non-Agency MBS falls by \$56 bn, for a total change of \$112 bn. These figures also help to fill the hole in our computation. From Table 3, the GSE losses are reported as \$153 bn. Thus, the GSEs can account for a net purchase of \$265bn.

However, one caveat here is that it is well known that the GSEs have been purchasing securities in the primary market, thereby supporting residential loans. Thus, it is likely that much of this increase reflects actions in the primary market rather than the absorption of asset sales by hedge funds or broker/dealers.

	4 <sup>th</sup> Qtr 2007	1 <sup>st</sup> Qtr 2009
Fannie Mae		
Agency MBS	289	314
Non-Agency MBS	112	97
GSE Guaranteed Securities	2422	2640
Freddie Mac		
Agency MBS	405	548
Non-Agency MBS	234	192
GSE Guaranteed Securities	1382	1380
Total		
Agency MBS	694	862
Non-Agency MBS	346	290
GSE Guaranteed Securities	3804	4020

**Table 14: Government-Sponsored Enterprises (\$ billions)**

Source: Monthly Volume Summaries from Fannie Mae and Freddie Mac (2007 and 2009)

## 5. Liabilities

### a. Repo and Deposits

Table 15 presents data on adjustments on the liability side. The top panel provides a picture of changes in the repo market. The total value of repo financing to commercial banks and

broker/dealers has fallen by close to \$1.5tn. However, keep in mind that measured changes in repo volume is most subject to the double counting problems we have discussed earlier.

The contraction in repo financing is consistent with the rise in repo haircuts (Table 4). It is also consistent with the deleveraging of the broker/dealer sector and the hedge fund sectors. These sectors are heavily dependent on repo financing for carrying out their trading operations. Thus the contraction in repo should be expected to affect these sectors strongly. Note that almost any buyer who is depended on repo financing is likely to have suffered during the crisis. For example, while we have not included private equity funds, it is likely that any such investors wishing to purchase ABS will also be limited by the lack of repo financing.

The bottom panel of Table 15 presents data on the banking sector and provides another data point explaining why the banking sector is different. Note that checkable deposits and small time and savings deposits rise by nearly \$800bn. On the other hand large time deposits fall by \$200bn. It is likely that the bulk of the former category consists of FDIC insured deposits. Thus, the access to a deposit base and the insurance provided by the government through the FDIC serves as a source of debt financing to the banking sector that cannot be replicated by another part of the financial system.

	Q4 2007	Q1 2009
<b>Repo Agreements and Fed Funds</b>		
Liabilities		
Commercial Banks	1327	463
Broker/Dealers	1223	419
Assets (main holders)		
Rest of the World	1100	583
Mutual Funds	713	603
<b>Bank Financing</b>		
Checkable Deposits	587	666
Small Time and Savings Deposits	4078	4755
Large Time Deposits	1927	1725
Corporate Bonds	688	1216

**Table 15: Money Market (\$ billions)**

Source: Flow of Funds of Federal Reserve (\$ Billions)

The last line in Table 15 shows that corporate bonds outstanding rises by \$528 bn. Much of this rise is due to the FDIC's Temporary Liquidity Guarantee Program (TLGP). The TLGP allows banks to issue senior unsecured debt with a maximum three year term. The FDIC insures default on these bonds for a fee of 25 – 50 basis points. These bonds are also a source of debt financing

that is unique to the banking sector. The bulk of bond issues tied to TLGP occur in the 4Q 2008 and 1Q 2009. As of March 31, 2009 banks had issued \$336bn of bonds under this program.

## **b. Liquidity Constraints?**

One important point to keep in mind with reference to banks' access to financing is that they did not face (or run up against) explicit quantity limits. That is, the total limit of the FDIC program is \$769 bn and banks have never reached more than 50% of that cap. In addition, banks have had access to Federal Reserve discount window loans throughout the crisis and have used such access in moderation. From a pure liquidity standpoint, the commercial banking sector has had access to financing. We cannot say the same for other sectors of the financial system. Yet, banks have as a choice not saturated their government financing. We will return to this discussion when discussing bank objectives in the next section.

## **c. Institution Balance Sheets**

Tables 16-19 provided further detail on the liabilities four financial institutions. Tables 16 and 17 cover the commercial banks Bank of America and JP Morgan/Chase. For both banks, deposits increase significantly between 2007 Q4 and 2008 Q4 before leveling off. For JP Morgan, which is widely perceived to be the stronger of the two banks, Fed Funds & Repos rise across all dates.

Tables 18 and 19 are for two investment banks, Goldman Sachs and Morgan Stanley. The liabilities contract over the November 2007 to November 2008 period for both banks. Most of this contraction can be linked to forms of secured short-term debt financing. Collateralized financing (including repos) and trading liabilities fall dramatically. In addition, the item for payables to customers/counterparties falls dramatically. Much of this item is a reflection of "haircuts" that the investment bank is keeping on behalf of a repo counterparty (typically, a hedge fund). When the repo market contracts, the quantity of such funds is also contracted. The tables also reveal a difference in patterns across the stronger and weaker bank. Goldman Sachs, perceived to be the stronger of the two banks, increases its liabilities between November 2008 and March 2009. The repo liabilities in particular increase. These comparisons should also give a sense that while the broad pattern we have outlined in the aggregate data is present in every institution, there are more detailed patterns that affect the behavior of any one financial institution.

	4 <sup>th</sup> Qtr 2007	4 <sup>th</sup> Qtr 2008	1 <sup>st</sup> Qtr 2009
Total Deposits	794	955	947
Interest-Bearing Deposits	608	733	706
Fed Funds & Repos	170	145	112
Trading Liabilities	78	76	49
Other Borrowed Funds	103	111	143
Subordinated Debt	21	25	24
All Other Liabilities	38	27	22
<b>Total Liabilities</b>	<b>1204</b>	<b>1339</b>	<b>1298</b>

**Table 16: Balance Sheet of Bank of America N.A. (\$ billions)**

Source: FDIC Statistics on Depository Institutions Report

	4 <sup>th</sup> Qtr 2007	4 <sup>th</sup> Qtr 2008	1 <sup>st</sup> Qtr 2009
Total Deposits	772	1056	980
Interest-Bearing Deposits	634	835	770
Fed Funds & Repos	120	181	243
Trading Liabilities	144	142	112
Other Borrowed Funds	90	142	131
Subordinated Debt	27	28	28
All Other Liabilities	61	68	62
<b>Total Liabilities</b>	<b>1213</b>	<b>1617</b>	<b>1557</b>

**Table 17: Balance Sheet of JP Morgan Chase Bank (\$ billions)**

Source: FDIC Statistics on Depository Institutions Report

	Nov 2007	Nov 2008	Mar 2009
Unsecured short-term borrowing	72	53	45
Bank Deposits	15	28	45
Payables to Broker/dealers	8	9	15
Payables to Customers/Counterparties	310	245	205
Collateralized Financing:			
Securities Loaned	29	17	19
Repos	159	63	133
Other Secured Financing	66	39	40
Trading Liabilities	215	176	147
Other liabilities and Accrued expenses	39	23	25
Unsecured long-term borrowings	164	168	189
<b>Total Liabilities</b>	<b>1077</b>	<b>820</b>	<b>862</b>

**Table 18: Balance Sheet of Goldman Sachs (\$ billions)**

Source: Goldman Sachs SEC Filings

	Nov 2007	Nov 2008	Mar 2009
Unsecured short-term borrowing	34	10	3
Bank Deposits	31	43	60
Payables to Broker/dealers	10	3	2
Payables to Customers/Counterparties	288	123	122
Collateralized Financing:			
Securities Loaned	110	15	19
Repos	163	102	70
Other Secured Financing	28	13	11
Trading Liabilities	134	119	100
Other liabilities and Accrued expenses	25	16	12
Unsecured long-term borrowings	191	163	182
<b>Total Liabilities</b>	<b>1014</b>	<b>607</b>	<b>577</b>

**Table 19: Balance Sheet of Morgan Stanley (\$ billions)**

Source: Morgan Stanley SEC Filings

## 6. Conclusions

The conclusions we draw from the data is that the contraction in repo market financing hit the non-bank financial sector and caused deleveraging. The government has purchased some of these assets, particularly in the Agency backed MBS market. The government has also indirectly helped the banking sector absorb troubled assets. It has done this through one-off structures where risk is removed from bank balance sheets. It has also done this through offering debt guarantees which allow the banking sector to more freely raise financing.

How accurate is our analysis and what have we missed out? We think that while the numbers we have provided are imprecise – i.e. it is unlikely that the hedge fund sector has sold exactly \$731 bn of securitized assets – we think they are still informative of the adjustments that have taken place during this crisis. The shocks that have affected the financial sector are so severe that one does not need fine-tuned computations to get a sense of the scale of adjustment. Moreover, while we have not considered all potential buyers, it is still likely that the commercial banking sector and the government are the only meaningful buyers in the asset market. It is only the commercial banking sector which has had access to stable funding through the crisis. Almost any other sector – e.g., private equity funds – will have to rely on repo financing to buy securities, and the contraction in repo will hinder such buying activity.<sup>10</sup> Thus, while such activity has been present, it is likely to be quantitatively small.<sup>11</sup>

An important conclusion we reach is that a leveraged-buyer (i.e. the banking sector) is the marginal buyer and price setter during crises. In many theoretical analyses of crises, shocks to the financing provided to the intermediary sector causes the intermediary sector to sell assets to non-leveraged sectors. Commonly, this non-leveraged sector is unmodeled or thought of as the household sector and intermediary leverage is interesting only in so far as it triggers forced asset sales. However, the data from this paper suggests that in this crisis where buyers are also

---

<sup>10</sup> As an example, news reports suggest that BlackRock Asset Management purchased asset-backed securities during the crisis. From their SEC filings, BlackRock's assets under management in Fixed Income funds decreases from \$513 billion to \$474 billion from Q4 2007 to Q1 2009. Similarly there are news accounts of private equity funds pursuing purchases of commercial banks (e.g., <http://www.nytimes.com/2009/08/27/business/27bank.html>). Note that this is not purchases of asset-backed securities, but purchases of banks. Moreover, it seems possible that the interest driving these purchases is the access to stable funding enjoyed by the banking sector.

<sup>11</sup> Another possible sector we have left out of the analysis are long-only investors, such as private pension funds. The flow of funds reports total assets of pension funds of around \$5tn. However the bulk of these assets are in corporate equities or mutual funds. The increase in holdings of GSE securities (which includes both MBS and straight Agency debt) plus all corporate and foreign bonds over the relevant period is about \$70bn. Note that this figure likely includes a majority of debt securities which are not of interest for our analysis.

intermediaries, their leverage and financing structure is central to understanding the dynamics of the crisis. He and Krishnamurthy (2008,2009) build models that derive asset prices based on the pricing condition of a leveraged buyer.

In this crisis, we view the banking sector as the marginal buyer rather than the government. That is, the government has purchased assets through “market orders” and helped banks buy assets, but it is the banks themselves who ultimately make the balance sheet decision. Moreover, unlike any other sector the banking sector has had the freedom to purchase or downsize, independent of considerations regarding lack of debt financing. In this context, it is interesting to ask how leverage and government-debt guarantees enter the pricing and lending decisions of the marginal buyer.

There are two prominent theories from corporate finance on how offering government debt financing can affect bank behavior. The risk-shifting theory is that banks exploit the guarantee, turning risk-loving, and purchase the riskiest assets. This theory seems inconsistent with the facts on a few accounts. First, even in their security purchases, banks have concentrated on buying the lower risk Agency-backed MBS, rather than on seeking out the riskiest ABS to purchase. Second, the liquidity problems and apparent high market prices of risk seem most pronounced on the riskiest assets. Yet, if banks had strong reasons for buying and trading the riskiest assets, these assets would have the lowest risk premia and the least liquidity problems. Finally, risk-shifting incentives would lead banks to saturate the debt guarantees, but the data on the FDIC’s TLGP discussed in Section 5.b suggest otherwise.

The second theory on debt involves costs of financial distress: Banks are risk-averse in the sense that they make decisions to reduce the likelihood of bankruptcy, trying to avoid either the costs of financial distress (from the institution’s view) or the sizable reputation/human-capital loss in the case of job loss (from the manager’s view). Before reviewing this theory, it is useful to look at data on the extent of leverage in the banking sector.

Table 20 provides data on the top 19 commercial banks in the US as of 2009 Q1 (as listed by Bloomberg WDCI). The equity capital from FDIC data is measured as \$762 bn. However, as Acharya, Gujral and Shin (2009) have stressed, much of the equity capital raised in 2008 from the U.S. Treasury was in the form of hybrid debt (preferred stock) rather than common equity, so that it would be inappropriate to call this true equity capital. We adjust the equity capital for such preferred stock and estimate the true capital of the banking sector to be \$625bn.

At this true capital, leverage is 12.2. In fact, it is likely that leverage is even higher. As we have noted earlier, it is likely that banks have overestimated the market value of their assets. Suppose we lower the value of assets by \$200bn – a modest figure – then measured leverage rises to 17. If we lower the value of assets by \$400bn, then measured leverage rises to 30!

These computations suggest that the banking sector has carried much higher leverage in this crisis than is commonly assumed.

	<b>1<sup>st</sup> Qtr 2009</b>
Total Assets	7608
Total Liabilities	6845
Equity Capital	763
Preferred Stock (including TARP)	138
“True” Capital	625
Leverage	12.2
Leverage if true Assets lowered by 200	17
Leverage if true Assets lowered by 400	30

**Table 20: Top 19 Commercial Banks (\$ billions)**

Source: FDIC

Such high leverage coupled with the costs of financial distress we have discussed can explain why banks may not have saturated their access to cheap financing. If a bank were to borrow more to purchase some assets (or make a loan), then the bank leverage will rise even further, leaving the bank with a higher probability of distress. This theory can thus explain why banks have not fully availed themselves of government funding, even if such funding is “cheap.”

In this scenario, any debt-financed asset purchase that increases the cost of distress will be shunned. In particular, purchasing real estate risks, given a pre-existing portfolio of real estate risks, will be viewed negatively. Thus, this theory can help to explain the lack of liquidity and the high risk premia on the riskiest assets. Note that this does not mean that banks do not absorb asset-sales, it rather says that banks require high risk premia to purchase such assets. Finally, this theory can shed light on evidence of a bank credit crunch. As Ivashina and Scharfstein (2009) document, new bank lending to firms has fallen sharply in the crisis. However, if banks fear financial distress, they may restrict the supply of such new loans. Alternatively, they may raise lending standards/interest rates so much that lending falls in equilibrium.

We thus reach a conclusion that is more nuanced than prevailing wisdom. Deleveraging has affected some sectors. But, somewhat counterintuitively, leverage – importantly of the marginal buyers – has risen in this crisis rather than fallen.

## References

Acharya, Viral, Irvind Gujral, and Hyun Song Shin (2009), Dividends and Bank Capital during the Financial Crisis of 2007-2009, Working paper, NYU Stern.

Acharya, Viral, Philipp Schnabl, and Gustavo Suarez (2009), Securitization without risk transfer, Working paper, NYU Stern.

Adrian, Tobias and Hyun Song Shin (2009), Liquidity and leverage, *Journal of Financial Intermediation* 10, 28-53.

Brunnermeier, Markus (2009), Deciphering the liquidity and credit crunch 2007-08, *Journal of Economic Perspectives* 23, 77-100.

Caballero, Ricardo and Pablo Kurlat (2009), The “surprising” origin and nature of financial crises: A macroeconomic policy proposal, Working paper, MIT.

He, Zhiguo and Arvind Krishnamurthy (2008), Intermediary asset pricing, Working paper, University of Chicago and Northwestern University.

He, Zhiguo and Arvind Krishnamurthy (2009), A model of capital and crises, Working paper, University of Chicago and Northwestern University.

Hedge Fund Flow Report, (2008, 2009), Barclay Hedge.

Ivashina, Victoria and David Scharfstein (2008), Bank lending during the financial crisis of 2008, Working paper, HBS.

Krishnamurthy, Arvind (2009), How Debt Markets have Malfunctioned in the Crisis, forthcoming, *Journal of Economic Perspectives*.

Lo, Andrew (2008), Hedge funds, systemic risk, and the financial crisis of 2007-2008, Prepared for the U.S. House of Representatives, Committee on Oversight and Government Reform.