The Role of Repurchase Agreements and Securities Lending in Distressed Financial Institutions

by

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The role of repurchase agreements and securities lending in distressed financial institutions

Abstract

The purpose of this paper is to illustrate the role that repurchase agreements and securities lending played in the 2007-2008 financial crisis. We examine the related literature to understand what has already been written about short-term secured funding and drive the expectations for our analysis. We use Bear Stearns and AIG as illustrative case studies of the effects of short-term collateralized lending. Our approach is to lay out the failure of Bear Stearns through a historical case study. We then follow with an analysis of its positions in holding repurchase agreements and to what extent those repurchase agreements had on the run on the bank. We find that these repurchase agreements left Bear Stearns largely exposed to a systemic shock and exacerbated the speed of its failure. This systemic shock is characteristic of a market freeze--where short-term debt cannot be rolled over on a secured basis due to fears about the quality of collateral and counterparty default. We then illustrate a mini-case of AIG and its securities lending business that parallels the repo lending that occurred with Bear Stearns, finding that AIG took on systemic exposure to a wide swath of AAA-rated tranches and mortgage-related investments, which quickly became illiquid and subject to a market freeze of a different sort. We focus our analysis on market freezes during the financial crisis of 2007-2008 and find that the timing overlap between being overweight on positions with exposure to systemic risk (whether that be repo funding or AAA-rated mortgage-backed securities) and a systemic market freeze can lead to the failure of financial institutions like Bear Stearns and AIG. We finally look at the some of the parallels that exist between the two cases and finish with our conclusions.

1. Introduction

1.1 Motivation

The financial crisis of 2007-2008 highlighted periods of severe illiquidity. To understand what happened during these episodes of illiquidity, it is necessary to recognize that banking was driven by securitization and that much of the funding that drove modern banking existed as short-term collateralized borrowing. Funding through overnight repurchase agreements (repo) became the dominant form of collateralized borrowing for many banks. Securities lending operates similarly to repos and was another form of short-term collateralized borrowing. By focusing on repurchase agreements and securities lending, we can get a better grasp of the funding mechanics that modern banks relied on and the interrelationships with securitized products during the recent financial crisis.

1.2 Method

The goal of this paper is to analyze and explain the role of repurchase agreements and securities lending in distressed financial institutions. We first examine some of the related literature on short-term collateralized funding to get a sense of what has already been written about the topic. This literature will drive our expectations for our analysis of secured rollover funding. We use Bear Stearns and AIG as illustrative case studies that feature overnight repo funding and securities lending as central pieces to their liquidity crises respectively. We believe there are useful lessons to be learned about the context of short-term collateralized lending in the financial crisis by analyzing both real world examples.

First, we will start with a case study of Bear Stearns, highlighting their liquidity crisis day-by-day. We then turn to their historical holdings of repo and how their liquidity was managed,

followed by an analysis of the role of repos in Bear Stearns's liquidity crisis. We find that shortly before their failure, Bear Stearns changed their funding structure such that they became more reliant on overnight repo funding and less reliant on unsecured short-term borrowings. Repo reliance had two effects: it increased systemic risk exposure to a potential shock in overnight lending and created liquidity risk by adding more leverage and maturity mismatch. We conclude that an erosion of confidence triggered Bear Stearns's initial liquidity issues, which quickly became self-fulfilling as investors ran. Over-reliance on repo funding exacerbated this liquidity crisis and the speed of the run, ultimately leading to the near-collapse of Bear Stearns.

Next, we conduct a case study of AIG's securities lending business. We observe the historical developments during the firm's crisis and then analyze the cause of this crisis. We find that AIG used securities lending as a means to expand their portfolio of residential mortgage-backed securities (RMBS). Securities lending created systemic exposure through an unhedged long position in RMBS and created liquidity risk by increasing leverage and maturity mismatch. When the market for mortgage-backed securities (MBS) became illiquid in 2008, AIG found itself too exposed to MBS, took losses, and could not shore enough capital to meet its lenders' collateral demands.

We then turn to the systemic events or market freezes that triggered the liquidity crises of both Bear Stearns and AIG. We find that in general, the timing of each firm's failure coincided with a period of market stress, while they had too much exposure to funding and assets with systemic risk. The market freeze for Bear Stearns's overnight funding is a bit more difficult to illustrate compared to AIG's market freeze because Bear Stearns suffered a funding shortage that was

primarily directed at itself and not at other firms. We also find that the freeze in market liquidity in RMBS not only affected AIG, but also contributed to the freeze of funding liquidity that affected Bear Stearns.

Next, we find parallels in both cases. While repo funding and securities lending led to very different types of systemic risk exposure (in funding risk and asset risk) and that the market freezes were quite dissimilar, both types of collateralized funding led to excessive exposure to systemic events and liquidity risks such that both firms were too leveraged and undercapitalized to respond to a systemic shock.

Finally we conclude with our closing remarks.

1.3 Repurchase Agreements (Repo)

A repurchase agreement (repo) is a form of short-term collateralized funding. Borrowers such as investment banks may enter into agreements with dealers to sell securities they own in exchange for cash with an agreement to repurchase those securities on a future date for the same amount of cash, plus interest. Repos allow financial institutions to borrow cash short-term (usually overnight) to fund large securities inventories. For lenders, repos allow them to deposit large amounts of cash secured against collateral. The repo market was estimated to be nearly $12 trillion, although it is difficult to quantify its exact size.[1] Many investment banks relied on overnight repos for daily funding, and these transactions were considered relatively low risk so long as the quality of collateral was high.

1.4 Securities Lending

[1] Gorton, Gary. "Questions and Answers about the Financial Crisis." Yale and NBER, 2010.

Similar to repurchase agreements, securities lending involves lending out securities short-term to borrowers (usually short sellers) in exchange for cash collateral. To close the transaction, the borrowers return the securities and receive their cash back. Securities lenders typically invest the cash collateral received to earn a small additional yield on their portfolio. Securities lending has been considered by the Federal Reserve as a traditionally low risk activity due to its collateralized nature and is typically used by large institutional investment managers.

2. Literature Review

Since the financial crisis of 2007-2008, several papers have been written that explore short-term collateralized funding and liquidity risks.

Acharya, Gale, and Yorulmazer (2009) develop a model of a market freeze in short-term collateralized funding by exploring the relationship between the debt capacity of assets, their rollover frequency, and the frequency of information. Based off this model, they imply that short-term debt only has a small financing cost in good times, but liquidity can quickly disappear in the bad state of the world. Over-reliance on short-term debt creates maturity mismatch which creates exposure to a low probability, high magnitude funding risk. It is suggested that borrowers complement their short-term financing with longer term debt and equity to offset this funding risk.[2]

Gorton and Metrick (2009) argue that the growth of securitization and repo funding principally contributed to the financial crisis of 2007-2008. They suggest the spread of the crisis from

[2] Acharya, Viral, Douglas Gale, and Tanju Yorulmazer. "Rollover Risk and Market Freezes." New York University, London Business School, and Federal Reserve Bank of New York, 2009.

subprime assets to non-subprime assets led to increased withdrawals in the form of higher repo haircuts and the refusal to accept certain forms of collateral. They conclude that subprime mortgages contributed to the financial crisis because of unknown exposure by counterparties to subprime risks, creating fears that liquidity would dry up for non-subprime related collateral, and leading to illiquidity in the repo market.

Pedersen (2009) analyzes the recent financial crisis through the lens of liquidity risk and the effect of forced selling on asset prices. He suggests that during a liquidity crisis, central banks should use collateralized loans at lower haircuts than what otherwise would be obtainable to ease liquidity, consistent with the actions of the Federal Reserve in AIG's crisis.[3] Huang and Ratnovski (2008) examine the "dark side" of short-term wholesale funding and study the effect of runs based on noisy signals, pointing to the run on Bear Stearns's repo funding.[4]

Nelson (2009) finds that securities lending during the financial crisis of 2007-2008 was characterized by impaired cash collateral pools and that the securities in these pools were impacted by a combination of credit and liquidity issues. He finds that lending large quantities of securities was not a risk-free way to generate profit, that impairment of collateral pools constrained lenders from reducing their lending balances or exiting their lending programs, and that maturity mismatch exacerbated the situation.

2.1 Expectations

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[3] Pedersen, Lasse H. "When Everyone Runs for the Exit." Thesis. New York University, CEPR, and NBER, 2009. *International Journal of Central Banking* 5.4.

[4] Huang, Rocco, and Lev Ratnovski. "THE DARK SIDE OF BANK WHOLESALE FUNDING." Federal Reserve Bank of Philadelphia and IMF, 2008.

Based off the preceding literature, we believe that repos and securities lending contributed to systemic risk and played a key liquidity role in the crisis that followed in 2007-2008. Furthermore, there is an important relationship between the liquidity of the underlying collateral and short-term funding that needs to be further explored. These expectations will drive our analysis going forward.

3. Bear Stearns: A Case Study on Repurchase Agreements

3.1 Overview of the Collapse

The first signs of trouble for Bear Stearns occurred in June 2007, when two of the investment banks' hedge funds suffered major losses in the CDOs they were invested in, which had exposure to mortgage-backed securities and investors demanded additional collateral to be posted. The firm pledged $3.2 billion in collateralized loans to save the first fund, the Bear Stearns High-Grade Structured Credit Fund, and worked with a consortium of banks to inject an additional $2 billion in loans to save the second fund, the Bear Stearns High-Grade Structured Credit Enhanced Leverage Fund.[5] This rescue marked the largest since the $3.6 billion rescue of Long-Term Capital Management in 1998 and reflected the beginning of troubles associated with the decline in asset values of mortgage-backed securities that characterized much of the financial crisis of 2007-2008.

In the week of March 10 to March 14, 2008, Bear Stearns faced a week of liquidity pressures and rapidly deteriorating investor confidence, which drove the investment bank to the brink of insolvency. Rumors intensified at the beginning of the week, which speculated that Bear Stearns

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[5] Creswell, Julie, and Vikas Bajaj. "$3.2 Billion Move by Bear Stearns to Rescue Fund." *The New York Times*. 32 June 2007. Web. 03 May 2010. <http://www.nytimes.com/2007/06/23/business/23bond.html?_r=1>.

had liquidity problems. These rumors became self-fulfilling on Wednesday and Thursday when prime brokerage clients began to pull money out of their accounts, counterparties refused to trade, and overnight lenders demanded more collateral and/or refused to roll their financing. This simultaneous flight of liquidity pushed Bear Stearns into near-bankruptcy and forced the US Federal Reserve and Treasury Department to broker a deal between the firm and J.P. Morgan Chase, which eventually offered to buy Bear Stearns at $2 a share (this was later changed to $10 a share in the following week).

Run on the Bank

The stress that led to the failure of Bear Stearns was important because it represented a modern day bank run. Rather than depositors scrambling to withdraw their funds, Bear Stearns suffered a crisis of confidence, where all clients and lenders simultaneously withdrew their cash and refused to do business with the firm. Bear Stearns suffered primarily on two fronts: the first, where prime brokerage clients withdrew their cash that the firm managed, and the second, the focus of this paper, where overnight lenders refused to roll their lending into the next day. With their immediate cash on hand being drained by the demands of prime brokerage clients and seeing no overnight funding to fund the next day's demands for cash and day-to-day obligations, Bear Stearns suffered a rapid flight of liquidity over the course of two to three days that threatened to the drive the firm into bankruptcy. On average, Bear Stearns borrowed about $75 billion daily to finance its business, mostly through the repo market.[6] The risk was that much of this funding could disappear overnight (i.e. repo counterparties refuse to accept Bear Stearns's

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[6] Cohan, William D. *House of Cards: a Tale of Hubris and Wretched Excess on Wall Street*. New York: Doubleday, 2009: p 41.

collateral for their cash), and the firm would be faced with a massive funding shortage, with only about $18 billion in its emergency liquidity pool (which was already being drained by fleeing prime brokerage accounts) to cover that shortage.

Week of Turmoil

What follows is a day-by-day account of the run on Bear Stearns that occurred between Monday, March 10 and Friday, March 14, 2008, and its eventual sale to J.P. Morgan Chase on Sunday, March 16, 2008.

Monday, March 10, 2008

Moody's, a ratings agency, downgrades fifteen mortgage-related bonds, causing Bear Stearns's stock to fall 11% Monday morning. Rabobank Group refuses to roll over a $500 million loan due later in the week. Rumors begin spreading amongst other investment banks, the financial press, and clients that Bear Stearns might be facing liquidity issues. Allegedly, a federal regulator from the Office of the Comptroller of the Currency began placing calls to several banks asking what their exposure to Bear Stearns was. This continued to fuel rumors about Bear Stearns's liquidity position. Put options on Bear Stearns stock rose to 158,599, seven times the twenty-day average. Credit default swaps on Bear Stearns's debt began to peak at $700,000 per $10 million of debt on March 10.[7]

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[7] Cohan, William D. *House of Cards: a Tale of Hubris and Wretched Excess on Wall Street*. New York: Doubleday, 2009: p 19.

Sidel, Robin, Greg Ip, Michael M. Phillips, and Kate Kelly. "The Week That Shook Wall Street: Inside the Demise of Bear Stearns." The Wall Street Journal, 18 Mar. 2008. Web. 3 May 2010. <http://online.wsj.com/public/article_print/SB120580966534444395.html>.

Tuesday, March 11, 2008

ING Group NV, pulls $500 million in short-term financing from Bear Stearns early Tuesday morning. That same morning, the Federal Reserve announces the Term Securities Lending Facility (TSLF), which allowed securities firms to borrow $200 billion of Treasury securities against pledged collateral of other agency debt and mortgage-related bonds for up to 28 days. This was supposed to help troubled investment banks reduce their exposure to mortgage-backed securities, but may have been interpreted by the market as a sign that Bear Stearns, which had high exposure to these mortgage-backed securities, was in trouble (Bear Stearns had $16 billion in CMBS, $15 billion in prime and Alt-A mortgages, $2 billion in subprime mortgages).[8] An e-mail reportedly sent by Goldman Sachs to a hedge fund implied that the firm would no longer stand in for its trades with Bear Stearns as a counterparty. The e-mail sparked a series of rumors that spooked more hedge fund clients, leading to withdrawals from prime brokerage accounts at Bear Stearns during the evening. These fleeing prime brokerage clients included two major hedge funds, Renaissance Technologies and Highbridge Capital Management.[9]

Wednesday, March 12, 2008

In addition to withdrawals from prime brokerage accounts, Bear Stearns faced increasing pressure from repo dealers. After Monday and Tuesday, the top twenty repo dealers had began asking for more collateral to secure the same amount of financing and believed Bear Stearns owed them $1.5 billion more collateral. At the end of the day, $20 billion of the $75 billion in overnight repo funding was pulled, while Bear Stearns only had about $18 billion of cash on

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[8] Brunnermeier, Markus K. "Deciphering the Liquidity and Credit Crunch 2007–2008." Princeton University, 2009. *Journal of Economic Perspectives* 23.1 (2009): 77-100: p 17.

[9] *Ibid. 7*

hand to make up for this funding gap. Two major repo dealers, Fidelity Investments and Federated Investors, had refused to continue financing $6 billion and $4.5 billion daily, respectively.[10]

Thursday, March 13, 2008

Bear Stearns's liquidity and cash position continued to rapidly deteriorate. More prime brokerage clients continued to flee, demanding more withdrawals of cash, and without recourse to additional repo financing, Bear Stearns faced the prospect of paying the billions of dollars it owed the very next morning. According to the SEC, Bear Stearns's cash holdings had shrunk from $18 billion in the morning, to about $2 billion at the end of the day. Bear Stearns had effectively run out of money by Thursday afternoon. That evening, management contacted officials at the Federal Reserve Bank of New York to work on a financing solution for the liquidity shortage.[11]

Friday, March 14, 2008

The Federal Reserve Bank of New York along with J.P. Morgan Chase reached an agreement to provide Bear Stearns with emergency financing as needed of up to 28 days secured against Bear Stearns's assets. J.P. Morgan Chase was selected to provide financing because it acted under the Federal Reserve's supervision as a commercial bank (having access to its discount window) and

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[10] Cohan, William D. *House of Cards: a Tale of Hubris and Wretched Excess on Wall Street*. New York: Doubleday, 2009: p 32-33.

Sidel, Robin, Greg Ip, Michael M. Phillips, and Kate Kelly. "The Week That Shook Wall Street: Inside the Demise of Bear Stearns." The Wall Street Journal, 18 Mar. 2008. Web. 3 May 2010. <http://online.wsj.com/public/article_print/SB120580966534444395.html>.

[11] *Ibid.*

was the clearing bank for Bear Stearns, so it had better knowledge about the quality of Bear Stearns's collateral.[12] While shares of Bear Stearns initially rallied because of this announcement, shares quickly plummeted into a free-fall reflecting the market sentiment that the Federal Reserve's emergency action was further proof of Bear Stearns's worsening condition.

In response to the emergency financing, three major ratings agencies, including Standard & Poor's, Moody's, and Fitch, substantially downgraded their credit ratings on Bear Stearns's long-term debt and suggested further downgrades were possible (S&P cut their rating to BBB). The ratings downgrades effectively shut down the remainder of Bear Stearns's repo financing. Major repo dealers would not and could not lend overnight to Bear Stearns anymore, as they are mandated to only lend to investment-grade firms. By early afternoon, customers had fled, counterparties would no longer trade, and overnight financing disappeared. Bear Stearns, even with the emergency funding, had run out of money again. Finally that evening, Bear Stearns management were informed that the emergency loan facility provided by the Federal Reserve and J.P. Morgan Chase would only last until Sunday evening, leaving the company to find a strategic alternative over the weekend.[13]

Sunday, March 16, 2008

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[12] Brunnermeier, Markus K. "Deciphering the Liquidity and Credit Crunch 2007–2008." Princeton University, 2009. *Journal of Economic Perspectives* 23.1 (2009): 77-100: p 18.

[13] Cohan, William D. *House of Cards: a Tale of Hubris and Wretched Excess on Wall Street*. New York: Doubleday, 2009.

Sidel, Robin, Greg Ip, Michael M. Phillips, and Kate Kelly. "The Week That Shook Wall Street: Inside the Demise of Bear Stearns." The Wall Street Journal, 18 Mar. 2008. Web. 3 May 2010. <http://online.wsj.com/public/article_print/SB120580966534444395.html>.

An announcement is made Sunday evening that J.P. Morgan Chase will be acquiring Bear Stearns for $2 a share, guaranteeing the trading obligations of Bear Stearns and its subsidiaries, and that the Federal Reserve will provide a $30 billion loan for the transaction secured primarily against the mortgage-related assets of Bear Stearns. Shortly afterwards, another announcement is made indicating that the Federal Reserve will now open its discount window to allow securities firms to participate in overnight lending secured against investment-grade collateral for an initial period of six months.[14]

3.2 Historical Positions in Repurchase Agreements

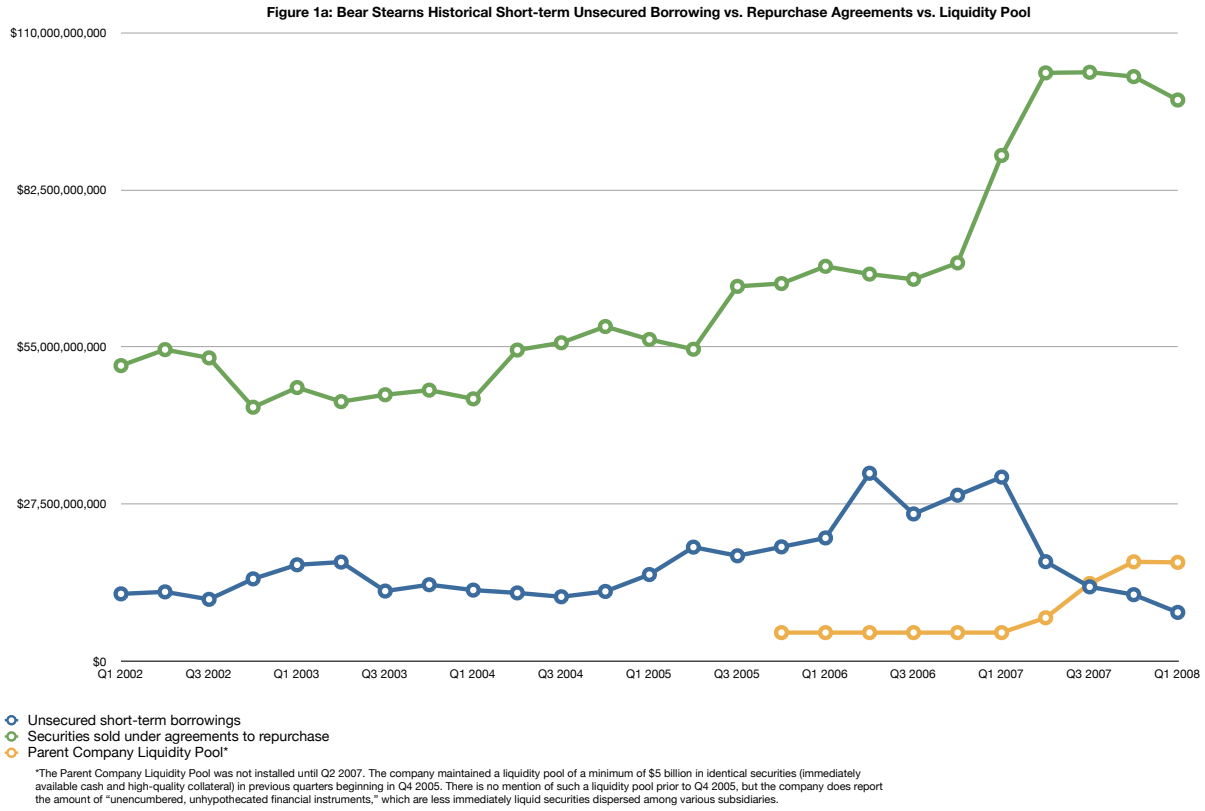
The liquidity crisis Bear Stearns faced over the period of March 10 to March 14, 2008 illustrated a run on bank from many stakeholders: prime brokerage customers, trading counterparties, and short-term lenders. Two primary sources were responsible for much of the liquidity drain: prime brokerage clients withdrawing cash from their accounts and repo dealers who lent overnight or on a very short-term basis demanding additional collateral or outright refusing to roll over funding into the next day. We focus on the latter in this paper and examine the effect that repurchase agreements had in the collapse of Bear Stearns.

We begin by analyzing Bear Stearns's historical holdings in repurchase agreements since 2005 on a quarter-by-quarter basis. As illustrated in **Figure 1a**, the number of "Securities sold under agreements to repurchase" under the liabilities section of their Form 10-Q balance sheet from Q1 2002 to Q1 2008 shows a general upward trend on a quarterly basis. Holdings of repurchase agreements average around $49.18 billion between Q1 2002 and Q2 2004, increase to an average

[14] *Ibid.*

of $62.29 billion between Q2 2004 and Q4 2006, and dramatically increase to an average of $99.07 billion between Q1 2007 and Q1 2008. This shows a 59% increase in the average holdings of repurchase agreements between the last two ranges (Q2 2004 - Q4 2006 and Q1 2007 - Q1 2008).

Figure 1a:[15]



An explanation of this increase in repo funding can be found in Bear Stearns's Form 10-K. The company states:

"the Company modified its general funding structure, beginning in late 2006, consistent with the following elements: ...Increased use of secured funding given the view that secured funding is inherently less credit sensitive and thus more stable due to the collateralized nature of the borrowing...Reduced reliance on short-term unsecured

[15] See 8. Appendix

funding sources, thereby lessening both exposure to rollover risk and dependence on any large, single short-term unsecured creditor..."[16]

Indeed, we see in **Figure 1a** that during the same period that Bear Stearns increased their repo borrowing, they decreased their short-term unsecured borrowings 40% from Q4 2006 to Q2 2007 (from $29 billion in Q4 2006 to $17.4 billion in Q2 2007). The company reasons:

"In aggregate, usage of short-term unsecured debt has declined in recent periods given the emphasis on greater use of secured funding with a significant term component...Reduced reliance over the last twelve months on more credit sensitive, potentially less stable short-term unsecured funding is positive to the firm's liquidity profile and was accomplished intentionally concurrent with the desired shift in funding framework."[17]

In short, Bear Stearns shifted their funding structure away from unsecured short-term borrowings towards more secured short-term funding to mitigate the liquidity risk of a sudden loss of unsecured debt.

Figure 1b is a scaled version of **Figure 1a**. It shows Bear Stearns's historical positions in short-term unsecured borrowings, repurchase agreements, and the size of the Parent Company Liquidity Pool scaled against the firm's total assets for each quarter between Q1 2002 to Q1 2008. We find that the scaled version shows an interesting difference from the previous findings from **Figure 1a.** Scaled against total assets, the company's holdings of repurchase agreements are at their highest in 2002 and the large growth in repurchase agreements in 2007 only brings the company's repo funding back near its 2002 highs. There seems to be a lull in repo funding in the quarters between 2003 and 2006. This can be explained by the growth of Bear Stearns's assets during this period as repo funding was kept stable, giving some intuition to management's decision to increase repo borrowings in 2007 and 2008. Perhaps, because of the growth of assets

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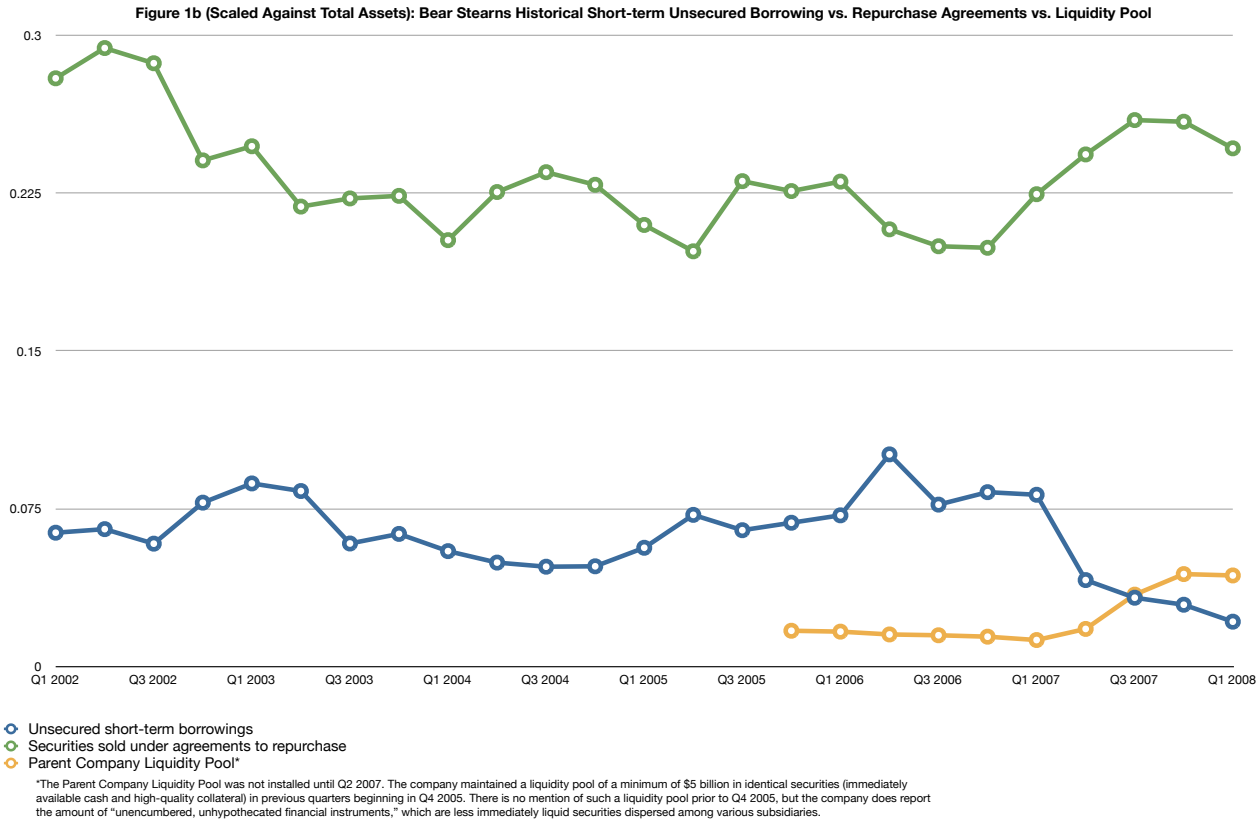
[16] "Bear Stearns SEC Filing Form 10-K 2007" US Securities and Exchange Commission, 2010 : p 48.

[17] "Bear Stearns SEC Filing Form 10-K 2007" US Securities and Exchange Commission, 2010: p 49.

relative to outstanding repo holdings, management believed they needed to grow their repo holdings as total assets grew in order to match the levels in 2002. Much like **Figure 1a**, beginning in the 2007, the scaled figures still show an increase in repo funding and a simultaneous decrease in short-term unsecured funding. We can infer that Bear Stearns was just as reliant and exposed to overnight repo funding as a percentage of assets in 2002 as they were in 2007-2008. The difference is that 2007-2008 marked a period of systemic stress that was not present in 2002, leading to devastating results. This points to the importance of timing: the risk of losing secured funding only materialized in the bad state of the world in 2007-2008 and was not apparent in 2002.

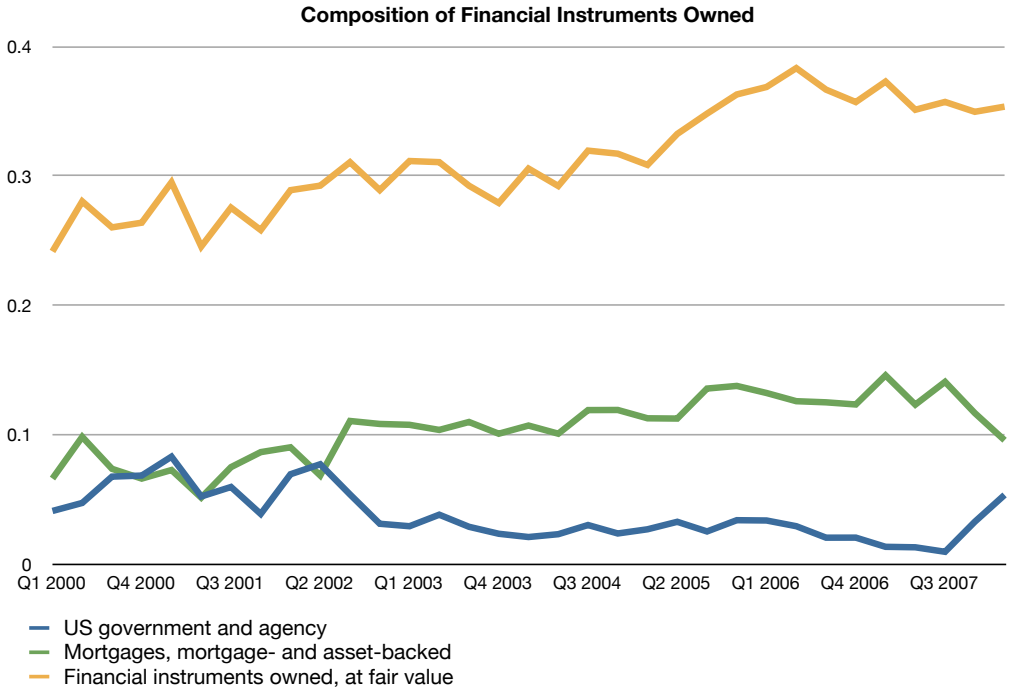
Figure 1b:[18]



[18] See 8. Appendix

Now that we have an idea of the overall amount repo funding, we will look into the composition of Bear Stearns's repo collateral. While the firm does not explicitly disclose the asset breakdown of securities sold in repos, we can look elsewhere. The firm does disclose the asset composition of financial instruments owned. Because the mechanics of repos necessitates selling inventories of securities for cash, we can infer that the firm used some of those financial instruments owned to enter repos. Thus, the composition of financial instruments owned may act as a rough proxy for the assets used as repo collateral. **Figure 1c** illustrates the asset breakdown of financial instruments owned by comparing the amount of US government and agency debt held against mortgages, mortgage- and asset-backed securities scaled over total assets from Q1 2000 to Q1 2008.

Figure 1c:[19]

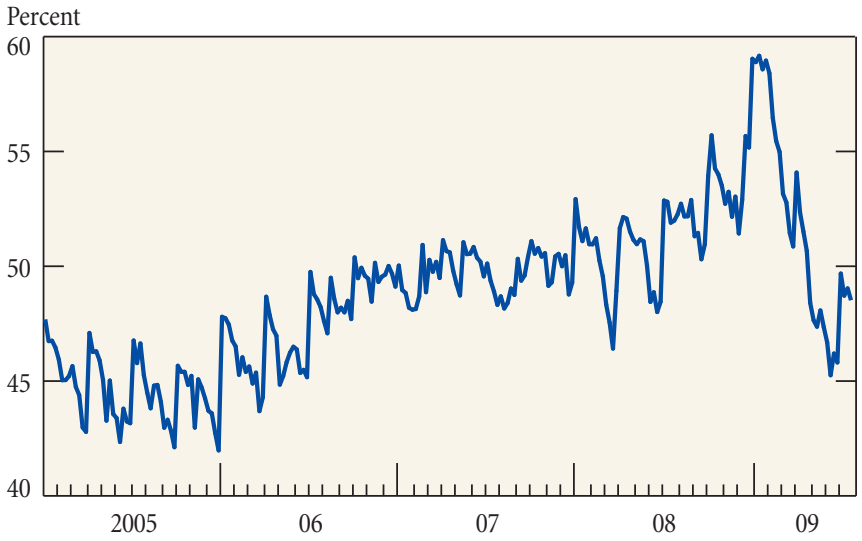


[19] *Ibid.*

We observe that the firm had similar amounts of both asset classes from 2000 to 2002, but began carrying more mortgage and asset-backed securities and decreasing their holdings of US government and agency debt from 2003 to 2007. Holdings of mortgage and asset-backed securities reach their highest levels between 2006 and 2007 while government and agency debt are at their lowest in the same period. The shift in financial instruments owned points to the possibility that the firm used more mortgage and asset-backed collateral and less Treasuries and agency debt to secure their repo agreements. Additionally, **Figure 1d** illustrates an increase in the use of less liquid collateral in the primary dealers' repo transactions over a similar period where Bear Stearns had the highest gap between their holdings of mortgage and asset-backed securities and government and agency debt. These observations are consistent with reports that the firm used some 71% of its mortgage holdings as collateral for repos before it collapsed.[20] While there is no definitive figure that captures a drift in the composition of Bear Stearns's repo collateral, **Figure 1c** and **Figure 1d**, along with personal reports support the assumption that the firm used riskier collateral as they increased their repo funding and provides additional evidence of the firm's direct holdings in mortgage-related assets.

[20] Cohan, William D. "The Rise and Fall of Jimmy Cayne." FORTUNE, 25 Aug. 2008. Web. 3 May 2010. <http://money.cnn.com/2008/07/31/magazines/fortune/rise_and_fall_Cayne_cohan.fortune/index3.htm>.

Figure 1d:[21]



Sources: Federal Reserve Bank of New York; authors' calculations.

Notes: The chart reports repo transactions secured by less liquid collateral as a percentage of repo transactions secured by liquid collateral. Less liquid collateral includes corporate securities and mortgage-backed and other asset-backed securities.

3.3 Liquidity Management Strategy

The shift from short-term unsecured borrowing to secured borrowing in the earlier figures was followed by the concurrent installation of the Parent Company Liquidity Pool beginning in Q2 2007 as illustrated in **Figure 1a**. This gives us insight into the firm's strategy against a liquidity crisis. Management defines this liquidity pool as "cash deposits and money market instruments that are held at the Parent Company level and high-quality collateral (corporate bonds, municipal bonds, equity securities) that is owned by subsidiaries and explicitly pledged to and segregated for the benefit of the Parent Company."[22] Before being expressly called the "Parent Company Liquidity Pool," the company had always kept a minimum reserve of $5 billion of these

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[21] Adrian, Tobias, Christopher R. Burke, and James J. McAndrews. "The Federal Reserve's Primary Dealer Credit Facility." Federal Reserve Bank of New York, 2009. *Current Issues in Economics and Finance* 15.4 (2009).

[22] "Bear Stearns SEC Filing Form 10-Q 2Q 2007" US Securities and Exchange Commission, 2010: p 49.

securities since Q4 2005. The Parent Company Liquidity Pool differs from "unencumbered, unhypothecated financial instruments," which management regularly reports in their financial statements, because it acts as an immediately available source of cash and high-quality, liquid securities, while unencumbered, unhypothecated financial instruments (while usually greater in value) can be dispersed among various subsidiaries and are thus less liquid and not as immediately available. At its highest average level from Q3 2007 to Q1 2008, this liquidity pool was in excess of the average amount of short-term unsecured borrowing ($16.1 billion and $11 billion respectively), but vastly short of outstanding repos. Thus, we can imply that the liquidity pool was primarily meant to shield against a sudden loss of short-term unsecured funding, as indicated by the shift in funding structure away from unsecured and towards more secured funding sources during the same period.

Management believed that the company's primary liquidity risk was the evaporation of short-term unsecured funding and adjusted their funding structure and liquidity pool accordingly in early 2007. Yet as seen in the events of March 2008, secured overnight funding was just as vulnerable to a liquidity crunch and literally disappeared overnight. The average of $99.07 billion between Q1 2007 and Q1 2008 held in repurchase agreements was obviously not adequately shielded by the $12.18 billion average held in the Parent Company Liquidity Pool during the same period. In-person accounts state that during the liquidity crisis of March 2008, the company only had about $17 billion in cash to account for roughly $75 billion in daily borrowings.[23]

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[23] Cohan, William D. *House of Cards: a Tale of Hubris and Wretched Excess on Wall Street*. New York: Doubleday, 2009: p 32-36.

3.4 Analysis of the Role of Repo

Bear Stearns's funding structure discussed above points to two observations about their liquidity management strategy:

1) Management overweighted the risk of losing unsecured short-term financing

2) Management overvalued the benefits of secured short-term financing through repurchase agreements as a result of the former

These two observations drove the increased exposure to overnight repo financing and the comparatively insufficient Parent Company Liquidity Pool (which covered short-term unsecured debt, but could not cover the large amount of repo funding) in the periods before Bear Stearns's collapse. While repos are generally considered safe due to the collateralized nature of the agreements (e.g. high quality collateral is pledged in exchange for cash and can be seized and liquidated in the event of a counterparty default), they are not risk-free. First, the short-term nature of repos creates maturity mismatch, where long-term assets are backed by short-term liabilities, increasing liquidity risk. Second, borrowing cash in large quantities to fund investments adds more leverage, another liquidity risk. More importantly, repos carry rollover risk that is characterized by Viral Acharya in a recent *Financial Times* article as being systemic in nature: "the only time rolling over repos becomes untenable is when the financial sector is experiencing systemic stress so that repo lenders become concerned about counterparty risk and forced selling of collateral in crowded and illiquid markets."[24] By relying on repo financing as its

[24] Acharya, Viral, and Arvind Krishnamurthy. "Why Bankers Must Bear the Risk of 'too Safe to Fail' Assets." Financial Times, 17 Mar. 2010. Web. 3 May 2010. <http://www.ft.com/cms/s/0/9575ec0a-31e6-11df-a8d1-00144feabdc0.html>.

primary source of funding, Bear Stearns exposed itself to enough systemic risk that it would not survive a major systemic shock.

This is essentially what happened during its liquidity crisis in March 2008. Asset values of collateral fell, particularly that of mortgage-related securities. Bear Stearns's mortgage-related exposure on their books and in their repo collateral helped trigger concerns about the firm's solvency as the smallest, most leveraged investment bank. As customers and counterparties fled for fear that liquidity rumors about Bear Stearns might be true, and repo lenders increased haircuts and stopped accepting mortgage-related collateral, this liquidity drain created a real bank run that forced other clients and counterparties to withdraw as well. While the withdrawals from prime brokerage accounts depleted its immediate cash position, Bear Stearns needed overnight repo funds to continue to finance its day-to-day activities and meet the payment demands of investors and counterparties. The evaporation of such overnight funding meant that Bear Stearns would not survive a stressed liquidity environment. The loss of repo funding became the primary liquidity shock that led to the collapse of Bear Stearns by nature of its over-reliance on overnight lending. This systemic event was essentially a total market failure or market freeze for Bear Stearns; the firm did not have any sources of financing outside of an emergency government rescue. Interestingly, the firm was adequately capitalized throughout its crisis, but simply lacked the liquidity resources to survive. Consistent with the expectations driven by our literature review, Bear Stearns's reliance on repo funding created exposure to a low probability systemic event and exacerbated the liquidity pressures during its collapse.

We now focus on the case of AIG. While not an investment bank, AIG engaged in a similar form of short-term collateralized borrowing as Bear Stearns, yet accumulated exposure to a different type of systemic risk.

4. AIG: A Case Study on Securities Lending

While much literature on the government bailout of AIG has focused on its credit default swaps (CDS) business, there has been substantially less coverage on its securities lending business, which suffered large losses on mortgage-related holdings in its portfolio and whose liquidity pressures forced a second government bailout in October 2008.

On October 8, 2008, the Federal Reserve Board authorized the Federal Reserve Bank of New York to loan AIG up to $37.8 billion in exchange for investment-grade, fixed-income securities. The Fed's action followed the $85 billion credit facility set up on September 16, 2008 in response to increasing liquidity pressures from AIG's securities lending operations run by AIG Investments. (AIG Investments was a subsidiary of American International Group (AIG) that managed assets for AIG's insurance units and external investors).[25]

Like other insurance companies, AIG invested their insurance premiums in a large portfolio of corporate bonds and other securities, which they lent out to borrowers (such as banks and brokerages) in exchange for cash collateral, which was invested to gain a small yield for AIG and the securities borrowers. Since securities lending is a low margin business, in order to generate large profits off of fees and low yields, AIG greatly expanded their securities lending business

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[25]"FRB: Press Release--Board Authorizes Federal Reserve Bank of New York to Borrow Securities from Certain Regulated US Insurance Subsidiaries of AIG." Board of Governors of the Federal Reserve System, 8 Oct. 2008. Web. 3 May 2010. <http://www.federalreserve.gov/newsevents/press/other/20081008a.htm>.

"FRB: Press Release--Federal Reserve Board, with Full Support of the Treasury Department, Authorizes the Federal Reserve Bank of New York to Lend up to $85 Billion to AIG." Board of Governors of the Federal Reserve System, 16 Sept. 2008. Web. 3 May 2010. <http://www.federalreserve.gov/newsevents/press/other/20080916a.htm>.

and invested the larger amounts of cash collateral received into riskier, higher yielding assets like mortgage-related securities to generate additional income. The size of AIG's securities lending portfolio grew largest in 2006 and 2007. AIG ramped up its collateral investments in asset-backed securities, mostly in mortgage-related assets, during this same period.

However, in mid-2007, the market for mortgage-related securities began showing signs of severe weakness. By late 2007, investment managers at AIG became worried about the firm's exposure to mortgage-related securities and began reducing their securities lending portfolio as the value of mortgage-related assets continued plummeting. In September 2008, AIG received access to a $85 billion credit facility from the Federal Reserve in response to a major liquidity crisis, where creditors demanded large amounts of collateral as a result of credit ratings downgrades from major ratings agencies. During this period, AIG drew upon $11.5 billion from the facility to return cash collateral owed to securities lending borrowers. Shortly after, many more borrowers concerned about AIG's credit continued demanding their cash back after returning borrowed securities. Because much of that cash was tied-up in mortgage-related investments whose market had become largely illiquid and the balance of cash collateral had shrunk from fleeing securities borrowers, AIG could not raise enough cash to meet borrowers' immediate demands and had to receive a second bailout of $37.8 billion from the Federal Reserve Bank of New York. In December, the Federal Reserve and AIG set up a joint entity to purchase residential mortgage-backed securities (RMBS) for $20.8 billion at fair value ($19.8 billion loaned from the Fed and $1 billion cash from AIG; $39.3 billion face value of RMBS) held in the securities lending

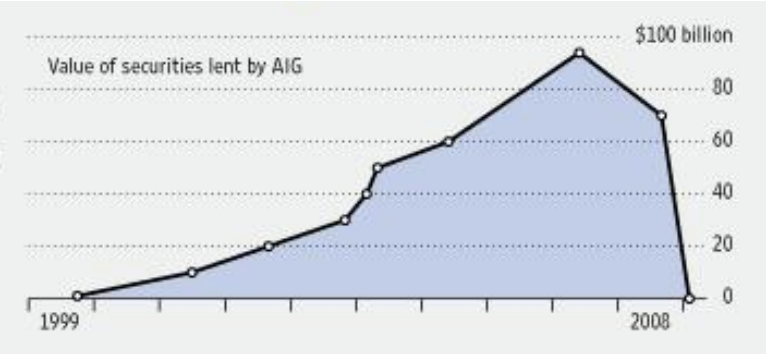
program. The proceeds from the sale would go back to the Fed to close out the Securities Lending Agreement installed on October 8, 2008 and shut down the securities lending business.[26]

4.1 AIG's Failure: Why It Happened

Securities lending is traditionally a low margin business, but AIG was determined to make it profitable. There are two ways to increase profit: expand the underlying portfolio such that sheer volume compensates for low yields, and invest the cash collateral into riskier securities that provide a marginally higher return. AIG did both: they dramatically expanded their securities lending portfolio in a few years and invested the majority of their cash collateral into highly-rated RMBS. In fact, management would admit that much of AIG's overall RMBS exposure was driven by securities lending.

At its height, the securities lent by AIG were valued at $94 billion in mid-2007 from $1 billion in 1999. Depicted in **Figure 2a** below.

Figure 2a:[27]

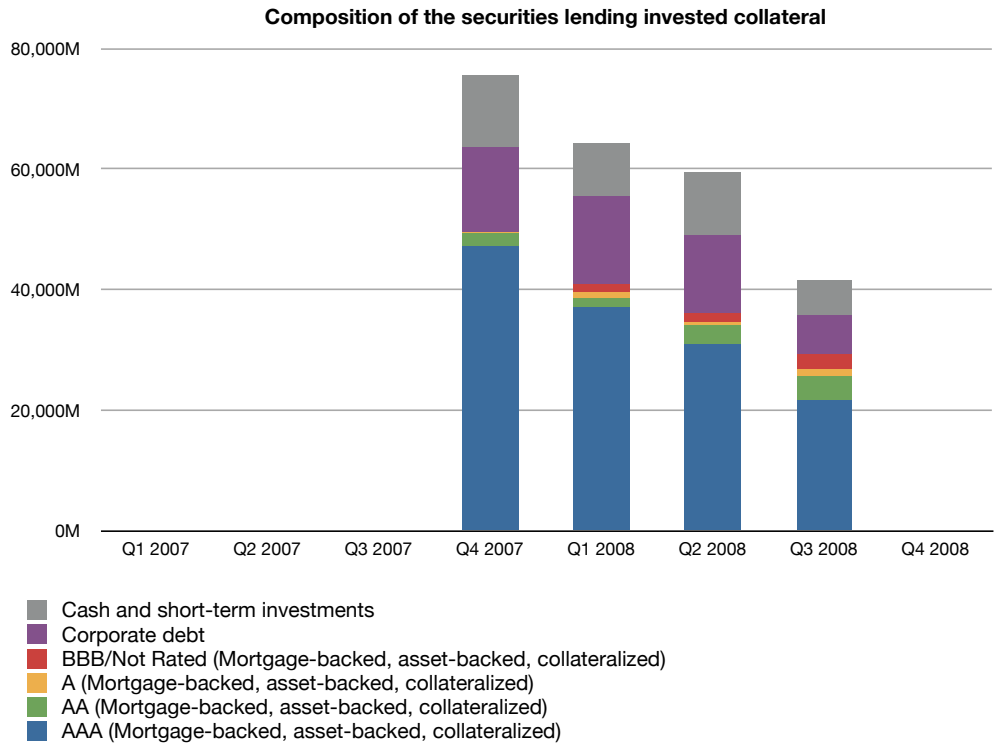


[26] "AIG RMBS LLC Facility: Terms and Conditions." Federal Reserve Bank of New York, 16 Dec. 2008. Web. 3 May 2010. <http://www.newyorkfed.org/markets/rmbs_terms.html>.
Barth, James R., Tong Li, and Triphon Phumiwasana. *The U.S. Financial Crisis: Credit Crunch and Yield Spreads*. Auburn University and Milken Institute, 2009.

[27] Ng, Serena, and Liam Pleven. "An AIG Unit's Quest to Juice Profit --- Securities-Lending Business Made Risky Bets; They Backfired on Insurer." The Wall Street Journal, 5 Feb. 2009. Web. 3 May 2010.

In **Figure 2b** below, we observe that much of the invested collateral is composed of mortgage-backed assets, the majority of which is AAA-rated.

Figure 2b:[28]



Note: Breakdown of the securities lending portfolio by asset type was not disclosed in Form 10-K and 10-Q filings prior to Q3 2007.

The combination of securities lending's low margin nature and management's desire to squeeze greater earnings from this business led to an investment decision that left AIG with a large, unhedged exposure to RMBS. Management believed that they had found a relatively risk-free, but higher yielding asset to invest in by emphasizing that the majority of their RMBS

[28] See 8. Appendix

investments were AAA and AA-rated. What they had in fact, done, was severely overlook the systemic risk of such securities. While the default rates on AAA-rated tranches of mortgage-backed assets are usually low and are backed by a diversified pool of mortgages, they are still not immune to a nationwide housing collapse. In other words, their risk is systemic in nature, and an overly large position in these assets left AIG vulnerable to a market-wide shock. When this shock occurred, management continued to believe that the price declines were only temporary and that such prices were "dislocated." They were willing to use a buy-and-hold strategy and wait for prices to correct. However, asset prices continued to fall, and AIG's refusal to liquidate mortgage-related assets created further losses.

4.2 The Role of Securities Lending on AIG

Securities lending had three key effects on AIG:

1) It led to systemic risk exposure through AIG's large long position in RMBS (as discussed above)
2) Increased leverage
3) Contributed to maturity mismatch with long-term assets and short-term liabilities

By facilitating AIG's RMBS investments with borrowed cash, securities lending acted as another form of leverage for AIG. These mortgage-related investments also typically had longer maturities (3 to 5 years) compared to AIG's securities lending payables, which had tenors between one day to six months. Such a maturity mismatch leads to liquidity risk, where the company may not be able to liquidate long-term assets fast enough to cover the short-term claims coming due or if that funding is not rolled over. All three effects of securities lending--systemic risk exposure from RMBS, increased leverage, and maturity mismatch--can exacerbate the

severity of a liquidity crisis in the worst-case scenario (i.e. a systemic downturn). AIG encountered a systemic shock in fall 2008 where the RMBS market suffered broadly, the company wrote down the value of much of their invested collateral (most being RMBS), and when asked to return their cash collateral by borrowers (whose contracts are short-term), was not be able to liquidate their RMBS holdings at prices sufficient to meet the value of payables owed. This inability to exit their lending program because of impaired cash collateral pools is consistent with the situation described by Nelson (2009) and showed that securities lending was not a risk-free way to way to generate profit.

It is important to observe that the business of securities lending did not necessarily cause AIG's liquidity crisis per se. The primary mistake was in their investment decision, to overweight their portfolio in highly rated RMBS and underestimate the systemic risk of such securities. In fact, competitors with similar securities lending operations invested more conservatively, usually in low yield Treasuries and short-term commercial paper. While the low margin nature of securities lending encouraged AIG to expand the volume of their portfolio and invest in riskier securities, and while the company did use securities lending as a conduit to increase their leverage and maturity mismatch profile, securities lending itself did not create AIG's systemic risk exposure and liquidity risks directly. It was their investment decisions and imprudent application of the securities lending model that escalated these risks. Had AIG invested in Treasuries and short-term securities instead and had they adequately set aside liquidity reserves to meet potential demands for cash collateral, the outcome may have been very different. Securities lending did appear to contribute, however indirectly, to AIG’s systemic exposure to AAA-rated RMBS and increased the liquidity risks of the firm, as we expected in the literature review.

5. Market Freezes

Following our discussion of Bear Stearns and AIG, we turn our analysis toward systemic risk events. As discussed in the previous cases' analyses, the risk of short-term secured lending and AAA-rated mortgage-related securities is systemic in nature. Thus, it is important to focus on the different instances of systemic breakdowns or in other words, market freezes that shut down the liquidity of both firms. The Bear Stearns case offers an example of a funding market freeze in March 2008 where collateral could not be rolled over on a short-term basis. The following AIG case illustrates a different example of a freeze, where the asset market for highly rated mortgage-backed securities became illiquid during autumn 2008. We find that the timing overlap between having large positions in funding or investments with systemic exposure and a market freeze may have led to the collapse of both firms. Therefore, it is useful to take a macro-perspective in looking at a few of the market freezes that occurred during the financial crisis of 2007-2008. We define a market freeze as a systemic event that is characterized by a period of high illiquidity. This is intentionally broad in order to include different types of markets, whether they be financing markets or asset markets.

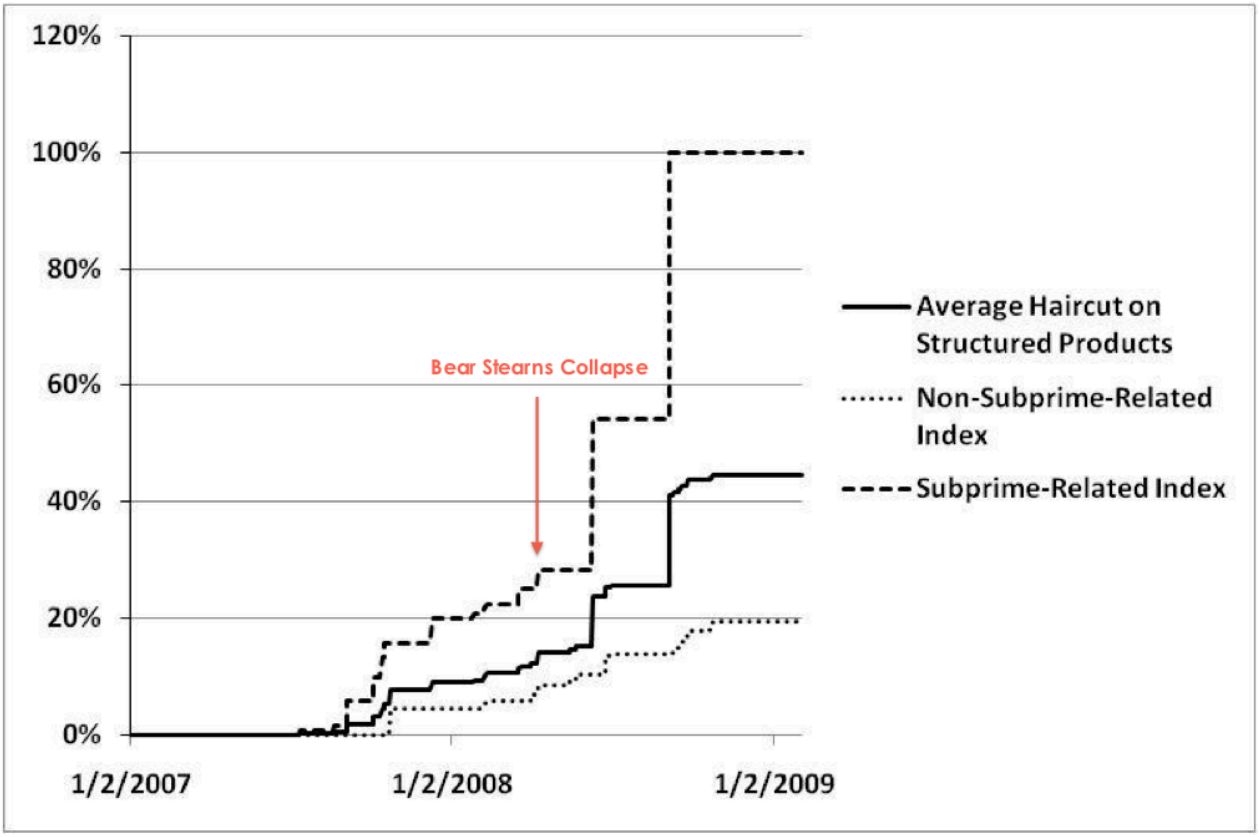
5.1 Funding Freeze

First, we focus on the market freeze of the repo funding market during March 2008 as it relates to Bear Stearns.

Figure 3a shows the repo haircuts on structured debt between 2007 and 2009. A haircut refers to the discount applied to the security bought in a repurchase agreement. For example, a bank can sell a security with a market value of $100 to a repo dealer for $95 in cash (with an agreement to

repurchase later for $95 plus interest). The $5 discount equals a haircut of 5%. This haircut reflects the risk that the counterparty may default and the purchaser has to sell the asset (often in adverse markets) to reclaim the cash collateral. Thus the haircut reflects risk or uncertainty about future asset prices. Increasing haircuts can be interpreted as withdrawals of cash.[29] For instance, if the 5% haircut in the previous example is increased to 10%, the bank forced to raise an additional $5 of collateral and must find some way to finance this, presumably through asset sales.

Figure 3a:[30]



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[29] Gorton, Gary. "Questions and Answers about the Financial Crisis." Yale and NBER, 2010.

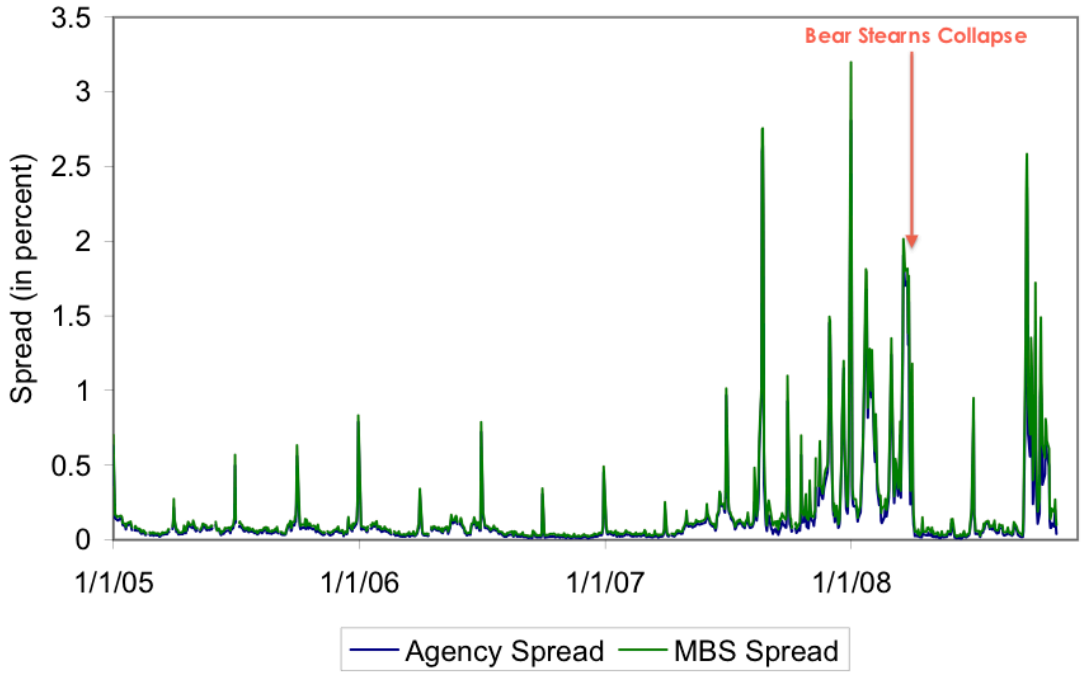
[30] Gorton, Gary, and Andrew Metrick. "Haircuts." Yale and NBER, 2009.

We will use repo haircuts as a proxy for illiquidity in the market for repo financing. Normally repo haircuts are 0%. This was not the case during the financial crisis of 2007-2008 as seen in **Figure 3a**. We observe that average repo haircuts began rising during the onset of the crisis in the summer of 2007 and rose dramatically as the crisis intensified during the summer and fall of 2008, leading to widespread liquidity fears in the banking system. In Bear Stearns's case, average repo haircuts were around 10% during March 2008 when they experienced their liquidity crisis. Subprime-related repo haircuts were above 20% during the same period and suffered more liquidity pressure compared to other structured products (haircuts of 100% meant the collateral was no longer accepted). This is important because Bear Stearns used much of their mortgage-related assets as repo collateral. Their holdings of repurchase agreements peaked during the second half of 2007 and into 2008 as average repo haircuts began increasing during the same period. We also see that the timing of Bear Stearns's failure does not occur on a very noticeable spike in the figure. Bear Stearns suffered a repo run directed at themselves in particular, so overall repo haircuts may not capture the lack of funding for one institution.

Figure 3b shows repo spreads, particularly between agency MBS repo rates and the overnight Treasury repo rate between 2005 and late 2008. The repo rate is the additional rate of interest charged when cash collateral is returned and can be used as a proxy for counterparty or default risk.[31]

[31] Gorton, Gary, and Andrew Metrick. "Securitized Banking and the Run on Repo." Yale and NBER, 2009.

Figure 3b:[32]



Note: The figure plots the overnight agency and agency MBS repo spreads to the overnight Treasury repo rate from January 3, 2005 to October 31, 2008.

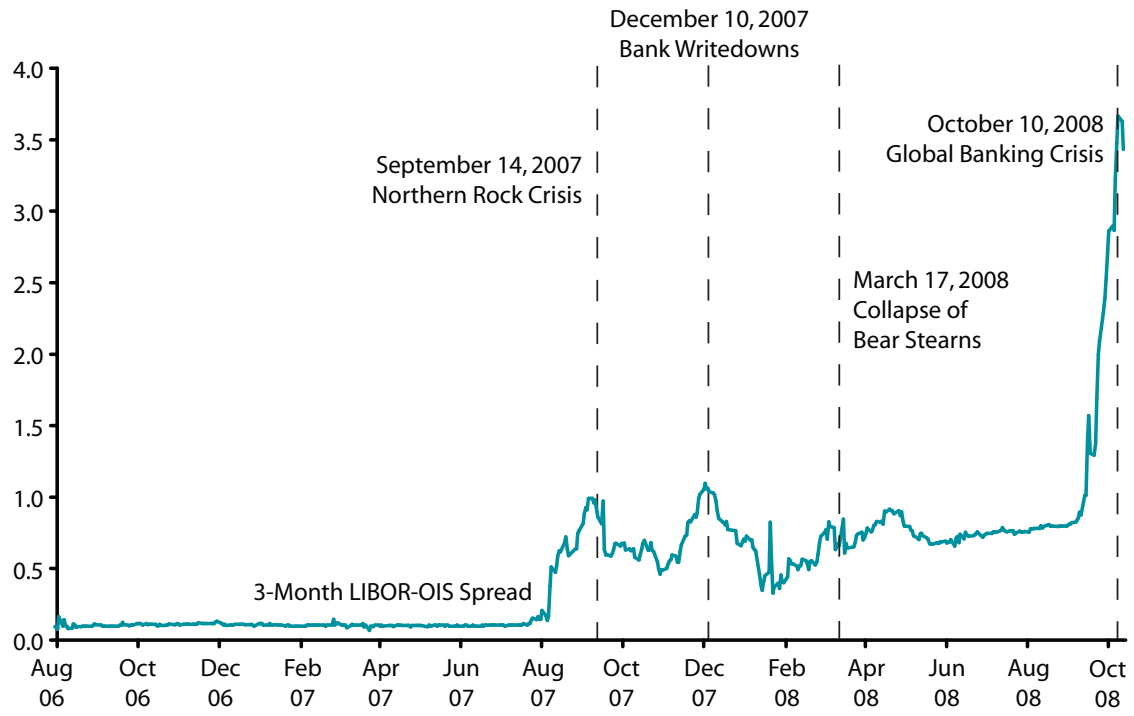
We observe that the repo market for MBS collateral was particularly stressed during March 2008 when Bear Stearns collapsed, though spreads were also high before their liquidity crisis.

Figure 3c shows us the 3-Month LIBOR-OIS spread. LIBOR, or the London interbank offered rate, is the rate charged for unsecured loans between banks. OIS refers to the overnight index swap rate, which references a daily overnight rate. The LIBOR can represent credit risk and expected future overnight rates, whereas the OIS can measure expectations of the federal funds rate. The spread between the two rates is used as a proxy to measure counterparty risk between

[32] Fleming, Michael J., Warren B. Hrung, and Frank M. Keane. "Repo Market Effects of the Term Securities Lending Facility." 2008.

banks and represents potential illiquidity in the repo market. We see that there is a spike of illiquidity during period when Bear Stearns collapsed.[33]

Figure 3c:[34]



There are a few observations about this funding market freeze and the timing of Bear Stearns's liquidity crisis. Based off of the previous charts, we see that Bear Stearns did collapse during a period of market stress. However, the firm was still operating in the periods of stress shortly before its collapse. It still held significant amounts of repurchase agreements beginning in Q2 2007, but its liquidity crisis quickly emerged and intensified during the week of March 10 to

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[33] Gorton, Gary, and Andrew Metrick. "Securitized Banking and the Run on Repo." Yale and NBER, 2009.

[34] Sengupta, Rajdeep, and Yu Man Tam. "The LIBOR-OIS Spread as a Summary Indicator." Federal Reserve Bank of St. Louis, 2008. *Economic SYNOPSES* 25.

March 14, 2008. The market freeze which shut down Bear Stearns's repo funding that occurred during this week also did not affect other banks. There are two explanations: market sentiment may have triggered the timing and target (such as rapidly spreading rumors in the previous case), and the dynamics of a bank run cause it to happen very quickly, not over a prolonged, observable period of time. The firm became the sole target of a crisis of confidence that triggered a liquidity run. This was a market freeze or a systemic event in the sense that all available funding sources had froze for Bear Stearns, particularly for its overnight repo funding, but did not freeze up for other firms. For secured, overnight funding to become unavailable, there has to be a major crisis of confidence where all lenders fear that the firm cannot survive the next day and that they will be forced to sell collateral in illiquid markets; for such collective fear to materialize, there needs to be a systemic crisis. Our key takeaway is that Bear Stearns was hit by a market freeze that shut down their overnight repo funding, but did not significantly affect other banks and did not occur earlier in similar periods of market stress. This market freeze was driven by a collective loss of confidence that crystallized and became self-fulfilling during that week in March 2008.

5.2 Asset Freeze

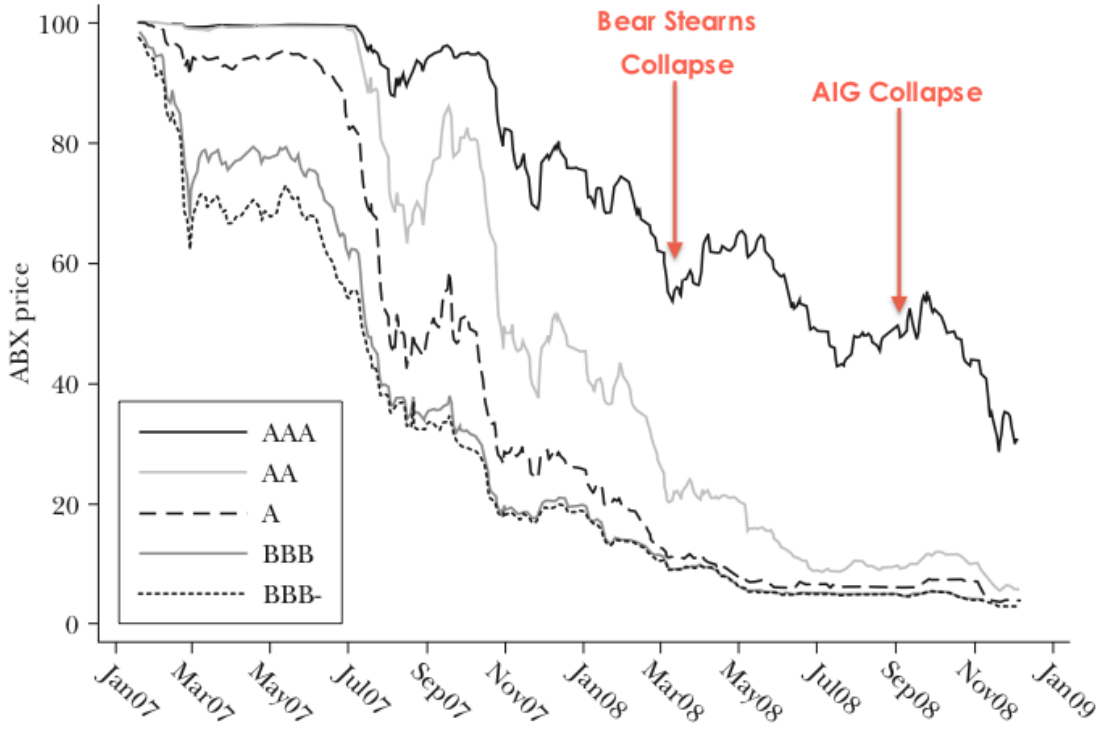
We now focus on the market freeze of the mortgage-backed securities market during September to October 2008 as it relates to AIG.

Figure 4a shows us the prices of the ABX index, an index of the price of credit default swaps that insure subprime RMBS, during 2007-2009. As the price of this index declines, the cost of insuring the underlying RMBS goes up. Though not all of AIG's RMBS exposure was subprime,

at least one-fifth of their RMBS holdings were subprime, so this figure can give us insight into a large source of the losses on AIG's RMBS portfolio.

Figure 4a:[35]

Decline in Mortgage Credit Default Swap ABX Indices
(the ABX 7-1 series initiated in January 1, 2007)



Source: LehmanLive.

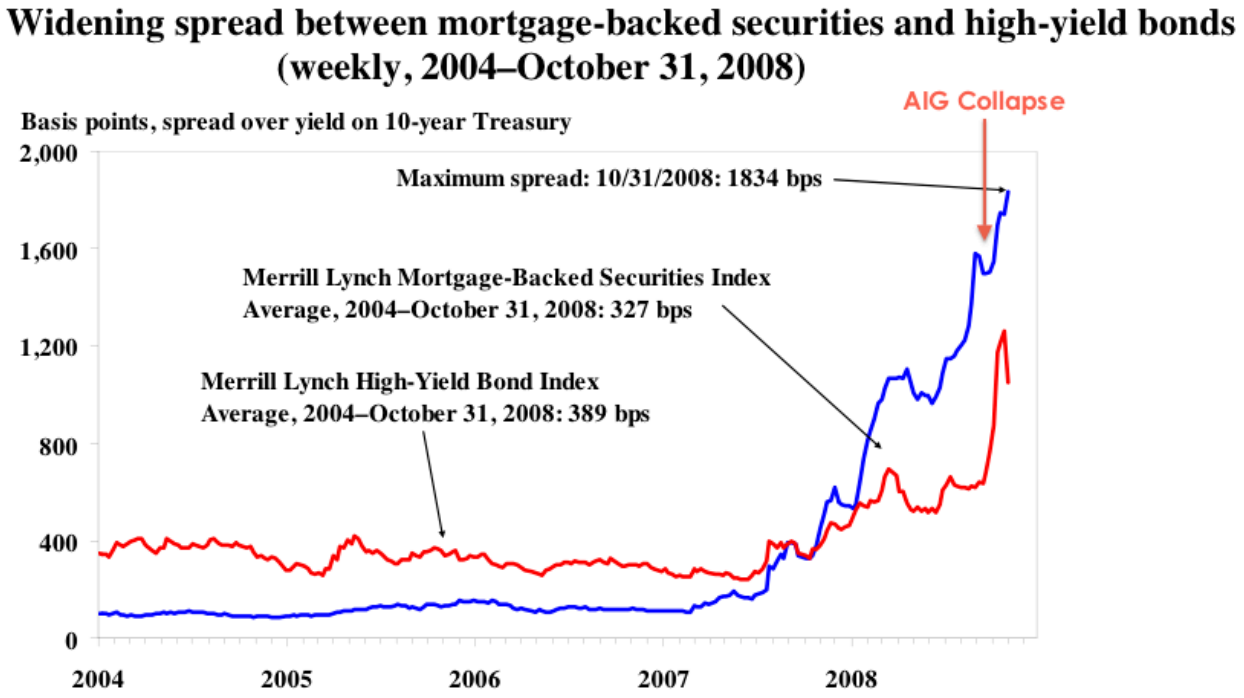
We observe that there is a marked decrease in prices of AAA-rated tranches prior to September and October 2008 when AIG received government funding. These price declines seem to correspond with AIG's losses on their RMBS holdings which triggered their liquidity crisis. Note

[35] Brunnermeier, Markus K. "Deciphering the Liquidity and Credit Crunch 2007–2008." Princeton University, 2009. *Journal of Economic Perspectives* 23.1 (2009): 77-100.

the erosion in AAA-rated tranches shortly before early March 2008, when Bear Stearns experienced losses on mortgage-related agency bonds.

Figure 4b shows us the spreads of MBS versus high-yield debt between 2004 and 2008.

Figure 4b:[36]



We observe that the MBS spread increases significantly during late 2008, consistent with the period where AIG experienced their liquidity crisis.

Figure 4c shows the Case-Shiller Index through the end of 2008, which tracks US national home prices.

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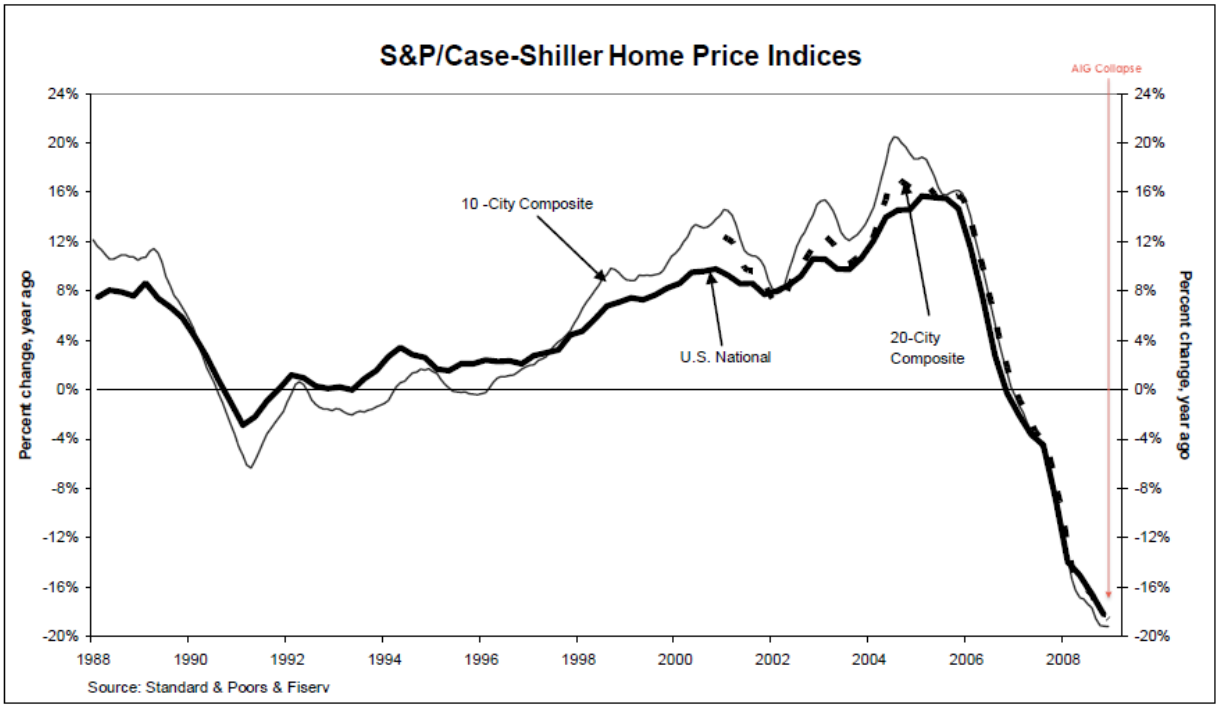
[36] Barth, James R., Tong Li, and Triphon Phumiwasana. "The U.S. Financial Crisis: Credit Crunch and Yield Spreads." Auburn University and Milken Institute, 2009.

Figure 4c:[37]



The figure shows us that home prices fell to their lowest levels during 2008. This national decline in home prices drove mounting losses in RMBS including AAA-rated tranches backed by diversified pools and provides evidence of an underlying source of systemic stress.

The preceding charts clearly show the stress that mortgage-backed securities and the national housing market underwent during late 2008, illustrating the market freeze of mortgage-related assets that led to AIG's failure. This was a case of bad timing: AIG had too much exposure to RMBS investments when the market for such securities froze. Unlike the Bear Stearns case, the effects of this market freeze were felt broadly. Anyone who had large exposures to mortgage-related assets suffered. The US government rescued Fannie and Freddie Mac, Lehman Brothers filed for bankruptcy, and Merrill Lynch was acquired by Bank of America.

[37] "S&P Case-Schiller Home Price Index." December 2008.

We find that both Bear Stearns and AIG were caught with large systemic risk exposure during market freezes that led to the failures of both firms. The market freeze that occurred during September and October 2008 for mortgage-backed securities clearly coordinates with the timing of AIG's liquidity crisis as a result of losses on its RMBS portfolio. However, it is more difficult to see the market freeze that affected Bear Stearns's repo funding. Bear Stearns suffered from a funding freeze during March 10 to March 14, 2008 that largely targeted the firm in isolation rather than all firms. This freeze was precipitated by a collective loss of confidence by lenders and counterparties which is difficult to illustrate in aggregate. We do see that Bear Stearns did collapse during a period of increased stress in the repo market, particularly for MBS collateral. Because their funding freeze happened in isolation, Bear Stearns's liquidity crisis may have only been represented by a small bump in the overall market for repo funding. We observe that the timing between AIG's large exposure to RMBS and Bear Stearn's heavy reliance on overnight repo funding and episodes of stress in the mortgage-related and repo markets seems to coordinate with the timing of the failures of each firm respectively.

Brunnermeier (2009) categorizes the two market freezes discussed above as "funding liquidity" and "market liquidity." In Bear Stearns's case, the inability to roll overnight repo financing was a freeze in obtaining funding liquidity. Brunnermeier states that difficulties in funding liquidity can be related to market liquidity. AIG's inability to meet its collateral obligations by selling RMBS at depressed prices was caused by a freeze in the market liquidity of mortgage-related securities. The market liquidity of these mortgage-related assets did in fact deteriorate prior to March 2008 as illustrated in **Figure 4a**. Because Bear Stearns held large positions in MBS and used it for

repo collateral, the market illiquidity for these securities can explain the loss of confidence that caused the firm's funding liquidity to freeze.

6. Parallels

The Bear Stearns and AIG cases share similarities in some ways. Both institutions underestimated systemic risk and took overly large positions in such risk: Bear Stearns on the funding side with their reliance on overnight repo financing, and AIG on the investment side with their large holdings of AAA-rated RMBS. Both companies had extensive maturity mismatch, which increased liquidity risk. Quite simply, both institutions found themselves too highly leveraged, too highly exposed to a systemic event, and had insufficient liquidity resources to cover their financing when the systemic shock hit. While the Bear Stearns case was a story on the run on the repo, the firm still suffered from the mortgage-related problems that plagued AIG. From the earliest signs of trouble at the two collapsed Bear Stearns hedge funds in summer 2007 marking the start of stress in the MBS market, to the utter loss in confidence by clients, counterparties, and creditors, in part, because of the firm's exposure to MBS, and to the refusal of repo dealers in accepting MBS collateral from Bear Stearns, starting the eventual run on the repo. And while the AIG case was a story on securities lending leading to a massive position in mortgage-related assets and the subsequent liquidity crisis as those assets became illiquid, AIG experienced a similar margin run and loss of confidence that affected Bear Stearns. As AIG suffered write downs in their mortgage-related holdings during September 2008, and subsequently had their credit ratings downgraded, creditors and CDS counterparties demanded collateral. Securities borrowers followed suit, returning borrowed securities and demanding their cash collateral before fleeing. AIG was too undercapitalized and lacked the liquidity resources to

meet the simultaneous demands for collateral and required the US government's rescue. We find that the systemic risk and liquidity crises that both firms experienced are consistent with our expectation that repos and securities lending can create exposures to systemic risk and play a liquidity role. Furthermore, this parallel analysis allows us to see the relationship between underlying collateral and short-term funding. In Bear Stearns's case, MBS collateral helped trigger the initial run on the repo which led to the freeze in its funding. With AIG, poorly invested cash collateral in RMBS led to the credit issues caused its liquidity run.

7. Conclusion

Our paper examines the role of repurchase agreements and securities lending through case studies of Bear Stearns and AIG. We find that repo financing and securities lending exposed Bear Stearns and AIG to systemic risk. Reliance on overnight repo financing exposed Bear Stearns to a systemic event where a market freeze in funding liquidity drove the firm to failure. On the other hand, securities lending allowed AIG to build large long position in AAA-rated RMBS, which exposed the firm to a market freeze in asset liquidity. The lack of market liquidity for RMBS prevented AIG from selling those assets at acceptable levels to meet collateral demands, which also stemmed from their losses in RMBS.

In examining these particular market freezes, we find that AIG suffered from a market freeze that affected all RMBS investors, while Bear Stearns's market freeze was more acutely directed at the firm itself. We observe that the asset freeze that created illiquidity in the MBS market may have contributed to the eventual funding freeze that hit Bear Stearns through its exposure to mortgage-

related assets. In the end, both firms were simply caught with too much systemic exposure during a market shutdown.

Ultimately, both cases were stories of liquidity, or rather, a lack of. While repo financing and securities lending are functionally similar, each led to positions in different types of systemic risk: funding risk and asset risk. Yet both types of collateralized borrowing allowed both firms to increase leverage and maturity risk. These two factors exacerbated the liquidity crises of both firms and likely contributed to the bank run dynamics that sped up their failures. The systemic and liquidity risks resulting from our analysis of repo borrowing and securities lending are largely consistent with the initial expectations set up in the literature review. The interrelationship between collateral and short-term funding is interesting: both firms had exposure to MBS through their repo and cash collateral and subsequently suffered funding pressures because of the freeze in the MBS market.

7.1 Key Findings

We break down our key findings for both cases below.

Repurchase agreements and securities lending facilitated:

- Systemic risk exposure in overnight collateralized funding and AAA-rated mortgage-related assets
- Liquidity risk by encouraging leverage and maturity mismatch

Large positions in systemic risk exposed both firms to low probability systemic events or market freezes. The timing of these market freezes was important: systemic risk was greatly amplified during the bad states of the world and was hidden during the good states (see **Figure 1b**).

Collateral investments in mortgage-related assets created exposure to asset illiquidity. Finally, by the nature of repo financing and securities lending, when the liquidity crises did occur, they were sped up because of increased leverage and maturity mismatch risk. These findings illustrate an important lesson: while much of modern bank funding had relied on short-term collateralized borrowing with relatively few problems, such funding can lead to too much exposure to a catastrophic event. Managers must therefore be able to guard against the systemic risk of "safe" sources of funding and assets in both the good and bad states of the world.

8. Appendix

Figure 1a Data:[38]

Absolute Dollar Amounts	Q1 2002	Q2 2002	Q3 2002	Q4 2002	Q1 2003	Q2 2003	Q3 2003	Q4 2003	Q1 2004	Q2 2004	Q3 2004	Q4 2004
Unsecured short-term borrowings	$11,788,603,00	$12,133,491,00	$10,828,978,00	$14,409,826,00	$16,874,248,00	$17,354,152,00	$12,276,317,00	$13,387,662,00	$12,445,140,00	$11,951,756,00	$11,276,500,00	$12,210,832,00
Securities sold under agreements to repurchase	$51,763,228,00	$54,563,923,00	$53,107,651,00	$44,469,414,00	$47,916,320,00	$45,453,097,00	$46,654,896,00	$47,464,156,00	$45,935,573,00	$54,487,569,00	$55,763,958,00	$58,604,250,00
Parent Company Liquidity Pool												

Q1 2005	Q2 2005	Q3 2005	Q4 2005	Q1 2006	Q2 2006	Q3 2006	Q4 2006	Q1 2007	Q2 2007	Q3 2007	Q4 2007	Q1 2008
$15,168,509,00	$19,968,705,00	$18,453,452,00	$20,015,727,00	$21,578,993,00	$32,906,461,00	$25,781,755,00	$29,062,714,00	$32,229,638,00	$17,424,064,00	$13,013,016,00	$11,643,000,00	$8,538,000,000
$56,338,454,00	$54,628,782,00	$65,640,629,00	$66,131,617,00	$69,149,832,00	$67,784,627,00	$66,873,544,00	$69,749,675,00	$88,568,018,00	$103,029,370,0	$103,130,600,0	$102,373,000,0	$98,272,000,00
			$5,000,000,000	$5,000,000,000	$5,000,000,000	$5,000,000,000	$5,000,000,000	$5,000,000,000	$7,600,000,000	$13,600,000,00	$17,400,000,00	$17,300,000,00

[38] "Bear Stearns SEC Filing Form 10-K 2000-2007." US Securities and Exchange Commission, 2010.

"Bear Stearns SEC Filing Form 10-Q 2000-2008." US Securities and Exchange Commission, 2010.

Figure 1b Data:[39]

Scaled by Assets	Q1 2002	Q2 2002	Q3 2002	Q4 2002	Q1 2003	Q2 2003	Q3 2003	Q4 2003	Q1 2004	Q2 2004	Q3 2004	Q4 2004
Unsecured short-term borrowings	0.063669253	0.065364607	0.058464535	0.077952292	0.087081173	0.083469286	0.058544238	0.063099313	0.054908849	0.049470259	0.047514166	0.0477079
Securities sold under agreements to	0.27956884	0.293942556	0.286722729	0.240564512	0.247276757	0.218618435	0.222491433	0.223710132	0.202671037	0.225532897	0.23496457	0.228967667
Parent Company												
Total Assets	$185.154B	$185.628B	$185.223B	$184.854B	$193.776B	$207.911B	$209.693B	$212.168B	$226.651B	$241.595B	$237.329B	$255.95B

Q1 2005	Q2 2005	Q3 2005	Q4 2005	Q1 2006	Q2 2006	Q3 2006	Q4 2006	Q1 2007	Q2 2007	Q3 2007	Q4 2007	Q1 2008
0.056508443	0.072146069	0.064856665	0.068398213	0.071924537	0.10088426	0.077015564	0.082933821	0.081694965	0.041162084	0.032770867	0.029448961	0.021398764
0.209882086	0.19737143	0.230701132	0.225986517	0.230482008	0.20781335	0.199765444	0.199038777	0.22450023	0.243393483	0.259715288	0.25893485	0.246298826
			0.017086118	0.016665406	0.015328944	0.014936059	0.014268079	0.012673888	0.017954011	0.034249078	0.044010299	0.043358939
$268.429B	$276.782B	$284.527B	$292.635B	$300.023B	$326.18B	$334.76B	$350.433B	$394.512B	$423.304B	$397.091B	$395.362B	$398.995B

Figure 1c Data:[40]

	Q1 2000	Q2 2000	Q3 2000	Q4 2000	Q1 2001	Q2 2001	Q3 2001	Q4 2001	Q1 2002	Q2 2002	Q3 2002	Q4 2002	Q1 2003	Q2 2003	Q3 2003	Q4 2003
US government and agency	0.041	0.047	0.068	0.068	0.083	0.052	0.06	0.039	0.069	0.077	0.054	0.031	0.029	0.038	0.029	0.023
Mortgages, mortgage-and asset-backed	0.066	0.098	0.074	0.066	0.073	0.051	0.075	0.087	0.09	0.068	0.111	0.108	0.108	0.104	0.11	0.101
Financial instruments owned, at fair value	0.242	0.28	0.26	0.264	0.295	0.245	0.276	0.258	0.289	0.293	0.311	0.289	0.312	0.311	0.292	0.279

Q1 2004	Q2 2004	Q3 2004	Q4 2004	Q1 2005	Q2 2005	Q3 2005	Q4 2005	Q1 2006	Q2 2006	Q3 2006	Q4 2006	Q1 2007	Q2 2007	Q3 2007	Q4 2007	Q1 2008
0.021	0.023	0.03	0.024	0.027	0.033	0.025	0.034	0.034	0.029	0.02	0.02	0.013	0.013	0.009	0.033	0.053
0.107	0.101	0.119	0.119	0.113	0.112	0.136	0.138	0.132	0.126	0.125	0.123	0.146	0.123	0.141	0.117	0.096
0.306	0.292	0.32	0.317	0.309	0.333	0.348	0.363	0.369	0.383	0.367	0.357	0.373	0.351	0.357	0.35	0.354

[39] *Ibid.*

[40] *Ibid.*

Figure 2b Data:[41]

	Q4 2007	Q1 2008	Q2 2008	Q3 2008
AAA (Mortgage-backed, asset-backed, collateralized)	47,180M	37,052M	30,933M	21,660M
AA (Mortgage-backed, asset-backed, collateralized)	2,226M	1,605M	3,170M	4,036M
A (Mortgage-backed, asset-backed, collateralized)	22M	936M	437M	1,140M
BBB/Not Rated (Mortgage-backed, asset-backed, collateralized)	82M	1,339M	1,640M	2,410M
Corporate debt	14,140M	14,481M	12,905M	6,517M
Cash and short-term investments	12,012M	8,848M	10,445M	5,748M

[41] "AIG SEC Filing Form 10-K 2000-2008." US Securities and Exchange Commission, 2010.

"AIG SEC Filing Form 10-Q 1999-2008." US Securities and Exchange Commission, 2010.

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