Why Did Holdings of Highly-Rated Securitization Tranches Differ So Much Across Banks?

Isil Erel, Taylor Nadauld and René M. Stulz*

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Abstract

We provide estimates of holdings of highly-rated securitization tranches of American bank holding companies ahead of the credit crisis and evaluate hypotheses that have been advanced to explain these holdings. Our broadest estimates include CDOs as well as holdings in off-balance-sheet conduits. While holdings exceeded Tier 1 capital for some large banks, they were economically trivial for the typical U.S. bank. The banks with high holdings were not riskier before the crisis using conventional measures, but their performance was poorer during the crisis. We find that holdings of highly-rated tranches are explained by a bank's securitization activity. Theories of highly-rated tranches that are unrelated to a bank's securitization activity, such as "bad incentives," "bad governance," or "bad risk management" theories, have no support in the data.

*Respectively, assistant professor, Fisher College of Business, Ohio State University, assistant professor, Brigham Young University, and Everett D. Reese Chair of Banking and Monetary Economics, Fisher College of Business, Ohio State University, NBER, and ECGI. We are grateful to John Sedunov for research assistance and to Viral Acharya, Andrew Ellul, Sam Hanson, George Pennachi, Andrei Shleifer, Philip Strahan, Michael Weisbach, participants at the NBER Summer Institute and the Federal Bank of Chicago Annual Banking Conference, and seminar participants at Duke University, University of Alberta, University of Arizona, and University of Texas at Austin for useful comments. We would like to thank Andrew Ellul and Vijay Yerramilli for sharing their Risk Management Index (RMI) data with us.

So-called toxic assets held by U.S. banks were at the heart of the financial crisis of 2007-2008. A mainstream view of the role of these assets is that their loss in value led these banks to have low capital, which forced them to raise more capital, to cut back on new loans, and to engage in fire sales (see Brunnermeier (2009)). The most visible and controversial policy initiative of the U.S. Treasury to deal with the crisis, the Troubled Asset Relief Program (TARP), started as an attempt to fund the purchase of toxic assets from banks. Though a vigorous debate has been taking place on why banks held these assets, to our knowledge, there are no rigorous estimates of the holdings of these assets across banks before the crisis, and there is no systematic investigation of the various theories that have been advanced to explain these holdings. In this paper, we estimate holdings of assets that became toxic by U.S. bank holding companies and investigate which of the various theories proposed to explain these holdings are consistent with the empirical evidence. We find that there was substantial cross-sectional variation in such holdings across banks and that this variation is explained by the securitization activities of banks.

At least in the early phases of the crisis, the bulk of the assets that are considered to have become toxic were highly-rated securities issued in securitizations involving subprime and alt-A mortgages. This definition includes AAA, AA, and A tranches of mortgage-backed securities (MBSs), collateralized debt obligations (CDOs), and other asset-backed securities (ABSs). For short, we will call these securities highly-rated securitization tranches. Banks made other losses; in particular, they made losses on non-prime mortgages and on highly levered loans held on their books. However, early on, the largest bank write-downs came from mark-to-market losses on highly-rated securitization tranches. For instance, in Q4 2007, Citibank had write-downs of $18 billion. All but $1 billion of these write-downs came directly or indirectly from highly-rated tranches of securitizations.[1] Since banks such as Citibank also made losses on their off-balance-sheet vehicles that held such tranches, our broadest measure includes holdings in the structured investment vehicles sponsored by banks.

[1] Bloomberg reports the dollar amount of write-downs by quarter and security type for large financial institutions.

We are able to provide estimates of holdings of highly-rated tranches from 2002 to 2008 for U.S. bank holding companies.[2] These estimates involve some crucial assumptions. However, our various approaches to estimate these holdings give similar overall results. Strikingly, there is large variation in holdings of highly-rated tranches across banks. The median holdings of highly-rated tranches normalized by total assets are less than 0.2%. Obviously, for the typical bank, these holdings were not material. The mean across banks was about 1.4% in 2006. Again, average holdings of highly-rated tranches across banks were not threatening. Banks with large trading portfolios (more than $1 billion of trading assets and trading assets representing more than 10% of total assets) had higher holdings. The average on-balance-sheet holdings represented about 5% of assets as of 2006 for these banks. Adding off-balance sheet holdings increases the holdings of banks with large trading portfolios to 6.6% of their total assets. However, holdings vary substantially across large banks. Citigroup recorded the largest amount of write-downs among bank holding companies. We find that our broadest estimate of its holdings of highly-rated tranches, including off-balance sheet holdings, amounts to 10.7% of assets at the end of 2006 or roughly $201 billion.

It has been common for observers to argue that investing in the highly-rated tranches was a form of excess risk-taking by banks. With this view, we would expect riskier banks to have larger investments in highly-rated tranches. Using common risk measures, we investigate whether the banks that had high holdings of highly-rated tranches were riskier ahead of the crisis than other banks. We find no evidence that the risk of a bank ahead of the crisis was related to its holdings of highly-rated tranches when we control for bank characteristics. Without such controls, a bank's leverage ratio, measured as total assets to Tier 1 capital, was higher for banks with higher holdings of highly-rated tranches. In contrast, market leverage, stock return volatility, earnings volatility, and distance-to-default (z-score) were not different for banks with higher holdings of highly-rated tranches whether we control for bank characteristics or not.

[2] Though investment banks eventually reported information on their holdings of highly-rated tranches, they did not have reporting requirements that make it possible to consistently identify such holdings before the crisis. Consequently, investment banks are not included in the main analyses of the paper. In Appendix 2, we provide some estimates of highly-rated tranches in 2006 or 2007 from their annual statements for the six largest investment banks as of 2006.

However, banks with larger holdings of highly-rated tranches performed more poorly during the crisis. We find that banks in the top quintile of highly-rated tranches holdings are associated with about 14% lower excess returns, on average.

To understand why holdings of highly-rated tranches varied so much across banks, we identify a number of possible determinants of the holdings of highly-rated tranches from the ongoing debate as to why banks held these tranches. These determinants are not mutually exclusive. All determinants could potentially affect the holdings of a particular bank. From the literature, we would expect banks engaged in securitizations to invest in securities issued from securitizations to show that they have skin in the game (De Marzo (2005), Shleifer and Vishny (2010), Gennaioli, Shleifer, and Vishny (2012)). We would also expect such banks to have inventories of such securities from the process of creating, marketing, and making a market for these securities. Banks with securitization activities would also be better placed to assess the expected return and risk of highly-rated tranches and, therefore, securitization-active banks would be more comfortable with holding them for investment. Finally, commentators have argued that some banks were stuck with securities they could not sell in 2007. We find strong evidence that banks engaged in securitizations held more highly-rated tranches before the crisis and that their holdings of these tranches increased with their securitization activities in the years before the crisis.

Banks could hold the highest-rated tranches of securitizations with lower regulatory capital than the underlying loans, making it advantageous for them to hold loans in the form of securitizations (see Acharya and Richardson (2009) among others). They could also hold these tranches in off-balance sheet conduits and structured investment vehicles (SIVs), where the capital requirements were even less (Acharya, Schnabl, and Suarez (2010)). However, as the value of these tranches held in conduits fell, some banks had to put them on their balance sheet. Finally, highly-rated tranches have high yields compared to other securities with similar capital requirements (Coval, Jurek, and Stafford (2009)). The regulatory treatment of off-balance sheet and on-balance sheet highly-rated tranches suggests that banks would, everything else equal, favor holding highly-rated tranches instead of the underlying assets and holding these tranches off balance sheet. In its most naïve form, the regulatory-arbitrage hypothesis would

suggest that all banks should hold highly-rated tranches of securitizations if regulatory capital requirements are binding. If one believes that sponsoring a SIV is only feasible for large banks, then again, one would expect all large banks to sponsor SIVs. This naïve view of the regulatory arbitrage does not hold in the data. Our results are consistent with more sophisticated views of the regulatory-arbitrage hypothesis. For instance, if the banks that engaged in securitizations were the ones for which regulatory arbitrage was most valuable, the fact that banks with more securitization activity held more highly-rated tranches is consistent with regulatory arbitrage.

Many observers have argued that holdings of highly-rated tranches resulted from inappropriate incentive systems that made it advantageous for managers and/or traders to take excessive risks (e.g., Rajan (2010)), such as investing in assets that subsequently became toxic. Blinder sums up this argument as follows: "Give smart people go-for-broke incentives and they will go for broke. Duh."[3] In some cases, these bad incentives might have been the result of internal accounting mechanisms and/or economic capital attribution that did not properly account for the cost of holding these highly-rated tranches. Therefore, it was advantageous to hold these securities for some types of bonus schemes (see UBS (2008)). In addition, some argue that fees generated through securitization activities created incentives for executives to securitize too many assets. According to this view, executives involved in these securitizations benefited from making deals rather than from placing them, in which case the bank would be stuck with tranches that could not be sold. Research on the role of incentives is intrinsically limited because data is not available for incentives for traders who are not top executives of banks. With our data for top executives, we find no evidence that banks with high holdings of highly-rated tranches had executives with poorer incentives to maximize shareholder wealth or greater incentives to take risks.

The Financial Crisis Inquiry Commission reached the conclusion that "dramatic failures of corporate governance and risk management at many systematically important financial institutions were a key cause

[3] See Alan S. Blinder, *Crazy Compensation and the Crisis*, The Wall Street Journal, May 28, 2009. Fahlenbrach and Stulz (2011) show, however, that banks whose CEOs had incentives better aligned with those of the other shareholders did not perform better during the crisis.

of this crisis."[4] The banks' exposures to highly-rated tranches appear prominently in the commission's argument. Others have also argued that risk management failed to perceive the risk of the highly-rated tranches correctly (see e.g., Bernanke (2010)). Based on the reasoning of these observers, had banks properly understood their risk, banks would not have held highly-rated tranches in the amounts they did.[5] However, ex post adverse outcomes are not evidence of risk management failures (Stulz (2010)), so that it does not logically follow from the poor performance of the highly-rated tranches that risk management failed. Consequently, a test of the risk management failure hypothesis has to focus on information available at the time the decisions to hold these securities were made and on the risk management process at that time. Measuring the quality of risk management is a notoriously difficult task (Stulz (2010)). Ellul and Yerramilli (2012) have constructed an index that they believe measures the centrality and independence of risk management within banks. Using that index, we find no relation between holdings of highly-rated tranches and the centrality and independence of risk management.

Lastly, there has been much discussion that too-big-to-fail banks had incentives to take more risks and that this mechanism can explain holdings of highly-rated tranches. It is argued by some that banks that are assessed to be too-big-to-fail have a lower cost of funds for risky assets because the market does not expect them to be allowed to fail (Carbo-Valverde, Kane, and Rodriguez-Fernandez (2010)). Therefore, these banks can make profits from investing in risky assets because doing so does not increase their cost of funding to the same extent it would for a bank that is not too-big-to-fail. From this perspective, highly-rated tranches of securitizations would have been risky securities that such banks would have found to be profitable to hold. Because of how they are engineered, these securities pay off fully in most states of the world, but pay poorly in states of the world where public support of financial institutions is most likely, namely in systemic crises. Bank size could explain holdings of highly-rated securities for other reasons, however. For instance, one would expect considerable economies of scale in

[4] Financial Crisis Inquiry Commission (2011), p. xvii.

[5] For instance, Krishnamurthy states that "There are risk control checks and balances in any firm, starting with a senior risk management committee and going down to the head trader in a particular asset class. In every one of these steps there was an under-pricing and under-appreciation of the risk." (see Kellogg Insight, Debt markets during the crisis, April 2011).

investing in these securities as assessing their fundamental value can require access to expensive databases and may involve the use of complicated valuation models. Further, asset-backed commercial paper (ABCP) programs and SIVs require a minimum scale, so that we would expect them to be used more among large banks. We find that large banks invested more in highly-rated tranches than small banks did. However, holdings of these tranches did not increase in bank size for large banks, but did increase with securitization activity. Finally, there is wide variation in holdings of highly-rated tranches among the largest banks.

In the next section, we develop possible explanations for banks' holdings of highly-rated tranches and present the testable implications of each theory. In Section 2, we explain how we construct our estimates for highly-rated tranches for depository banks and summarize these estimates. In Section 3, we investigate whether the banks with greater investments in highly-rated tranches were riskier before the crisis and whether their performance differed during the crisis. We test the implications of the various theories in Section 4 and conclude in Section 5.

Section 1. Theories of Holdings of Highly-Rated Tranches.

In Fama (1985), banks' cost of funding is a market cost of funding, but they face a cost of doing business, the cost of the reserves they have to maintain. So, to remain in business, banks have to charge an above-market rate to their lenders. This well-known result poses a paradox when considering banks' holdings of highly-rated tranches. If banks pay a market rate of return on their sources of finance and earn a market rate of return on their investments in securities, how can it be a positive NPV project for banks to hold securities? Whereas it is intuitive that a bank might monitor lenders and that this monitoring could create value, it is not intuitive that securities are more efficiently held by banks than by investors.

In the context of Fama (1985), if a bank believes that securities are properly priced, we would only expect the bank to hold securities to address unexpected liquidity demands from depositors and borrowers or as part of an inventory if it makes a market in these securities. However, the value of securities held as a liquidity buffer should be positively, rather than negatively, correlated with liquidity shocks. As a result,

we would expect banks to hold safe securities for liquidity purposes or even, if possible, securities that have high payoffs in states of the world with a systemic liquidity shock. From this perspective, holding highly-rated tranches for liquidity purposes made sense only if these securities were viewed as safe assets that are robust to systemic liquidity shocks. We would expect there to be economies of scale in the size of the liquidity buffer as liquidity demands on a large bank would be more predictable than on a small bank.

We now consider the determinants of holdings of highly-rated tranches discussed in the introduction and derive testable hypotheses. For ease of presentation, we classify these determinants into five groups.

1.1. Securitization by-product.

As argued by Shleifer and Vishny (2010), in the presence of asymmetric information regarding the quality of the loans, banks must retain some portion of the loans securitized.[6] Traditional signaling theories further conclude that, in the presence of asymmetric information regarding asset quality, agents with an information advantage must retain assets of the lowest quality if the signal is to be viewed as credible. A "skin-in-the-game" explanation for the retention of the AAA, AA, and A-rated assets that we measure can be motivated through a catering argument. That is, BHCs originate securitizations containing tranches with payoff structures that cater to specific investor preferences. For example, junior tranches cater to correlation traders betting on the survival or default of a junior tranche as a function of collateral correlation (see Nadauld, Sherlund, and Vorkink (2011)). Senior tranches cater to institutional investors with a mandate to invest in high credit-quality assets. If BHCs are indeed catering to the high credit-quality demands of institutional investors, signaling might still be required. Also, the fraction of tranches that were highly-rated in securitizations was extremely large, so that even if BHCs had held onto the most junior tranche, their holdings might not have been sufficient to provide comfort to institutional investors.[7]

[6] The requirement that securitizing banks retain a portion of the securitization is not derived explicitly in Shleifer and Vishny (2010). Rather, they rely on a prior literature in making this assumption. Prior literature proves theoretically the "skin-in-the-game result" in the presence of asymmetric information and provides empirical evidence in support of the result (see Gorton and Pennacchi (1995), Sufi (2007), and Holmstrom and Tirole (1997)).
[7] Nadauld and Sherlund (2010) show that over 80% of the value-weighted bonds in subprime RMBS deals received a AAA rating, with close to 90% rated at least A.

Further, the capital requirements for holding the riskiest tranches are extremely high as the risk weight for more junior tranches can exceed 100%. Therefore, holding highly-rated tranches for signaling purposes could be more efficient even if the impact of the signaling is not as strong as it would be holding more junior tranches.

The skin-in-the-game hypothesis considered here is broader than the one that is typically discussed in the context of specific deals. At the deal level, a bank has skin in the game if it retains part of the deal. However, securitizing banks can also be viewed as having skin in the game for securitization in general. From this perspective, holding highly-rated tranches may have amounted to signaling to market participants that these tranches had extremely low risk. The narrow skin-in-the-game explanation is inherently un-testable with the existing data. The highly-rated tranches held by a bank could be issued by that bank but they could also be issued by other banks. We have not seen any public data that would enable us to assess whether banks hold tranches that they issued.

Securitization activity could be associated with higher holdings for reasons other than to have skin in the game. A bank that is active in the securitization market as an issuer has a pipeline of deals. If it produces CDOs, it will have an inventory of ABSs. As it issues CDOs and other ABSs, the bank will have tranches that it sells immediately and others that it does not. It may take time to make a market for tranches. Consequently, we would expect holdings of highly-rated tranches to increase over time as the securitization activity increases. However, it is also possible that banks were stuck with highly-rated tranches that they could not sell as the market turned in 2007. We call this hypothesis the "hung deals" hypothesis, in that the banks wanted to sell the securities but could not sell them without making a loss, which led them to hold on to them. As the securitization activity slowed in 2007, holdings of highly-rated tranches should have increased to the extent that banks found it difficult to sell these tranches and failed to stop their production quickly enough. Also, banks that securitize more could feel more comfortable with holding highly-rated tranches because they believe that they understand them better. A bank that is selling these securities might be more likely to consider them to be good investments for itself and would have the personnel to assess them. Finally, and perhaps more importantly, banks might use securitization

for regulatory arbitrage and might hold highly-rated securities for the same purpose, so that an association between securitization and holdings of highly-rated securities would arise as a result of engaging in regulatory arbitrage.

We have the following predictions for the relation between securitization and holdings of highly-rated tranches:

(Securitization H1; activity) Holdings of highly-rated tranches as a fraction of a bank's assets were higher for banks engaged in securitization activity.

(Securitization H2; cumulative activity) Holdings of highly-rated tranches for banks active in securitization increased over time as each securitization would require skin in the game.

(Securitization H3; hung deals) Holdings of highly-rated tranches for firms active in securitization increased in 2007 to the extent that securitization activity did not slow down fast enough and banks were stuck with highly-rated tranches that they intended to sell.

1.2. Regulatory arbitrage.

Banks that do not have regulatory-capital slack will always choose to organize their activities in a way that, everything else equal, minimizes the use of regulatory capital. U.S. capital regulations, starting in 2002, reduced the capital requirement for banks' holdings of highly-rated tranches. Before the change in regulation, banks holding highly-rated tranches had to set aside 8% regulatory capital if these securities were not held in their trading books. Trading books were subject to different regulatory capital requirements and these capital requirements were less onerous. Strikingly, with the regulations introduced in 2002, a bank that made subprime loans was better off holding them on its books as securities issued against the subprime loans as collateral than holding the loans directly.[8] Further, the bank was even better off holding the securities in an off-balance-sheet conduit or SIV. It is important to note, however, that regulatory arbitrage made it advantageous for banks to hold highly-rated tranches of securitizations if they

[8] See Goldman Sachs, Global Markets Institute, Effective Regulation: Part 1, March 2009, for an example.

benefitted from making the loans used as collateral in the first place since, otherwise, the more advantageous treatment of highly-rated tranches did not make them positive NPV projects. Further, the highly-rated tranches had higher yields than other securities that had similar capital requirements (see Coval et al. (2009), and Iannotta and Pennacchi (2011)). To the extent that these higher yields were the result of greater exposures to priced risks, holding these securities enabled banks to take more risk than if they held lower-yielding securities with the same regulatory-capital requirements. These regulatory capital benefits would not have been consequential for banks with a large excess amount of regulatory capital. In addition, small banks would not have found it beneficial to use securitization to reduce regulatory capital charges because of the fixed costs of securitization. Lastly, since 2002, banks use less regulatory capital when holding highly-rated tranches (with 20% or 50% risk weight) than comparably-rated corporate bonds (with 100% risk weight), so that the regulatory capital regime has a strong bias in favor of highly-rated tranches.

Banks differ in the extent to which they optimize their use of regulatory capital. While some banks have large amounts of excess regulatory capital, others do not. Their business model makes it optimal for some banks to have more capital than required. However, it is also possible that some banks are more intent in maximizing the size of their balance sheet for a given amount of regulatory capital. We would expect banks that were more intent on taking advantage of regulatory-arbitrage opportunities to have grown their balance sheet when capital requirements for highly-rated tranches changed in 2002.

It follows that:

(Regulatory Arbitrage H1) Banks that are more constrained in regulatory capital and larger banks have greater holdings of highly-rated tranches as a fraction of assets.

(Regulatory Arbitrage H2) Banks that engage in more regulatory arbitrage activities have more highly-rated tranches.

1.3. Bad incentives.

Rajan (2006) raised concerns about the incentives in place in the financial industry and how they might lead to excessive risk-taking even before the crisis. A key characteristic of highly-rated tranches before the financial crisis is that they had a higher yield than similar highly-rated assets. Such a difference can arise in efficient markets simply because some assets have more systematic risk than others. For instance, these assets might have poor returns when the economy performs particularly poorly (see Coval and Stafford (2009)). If incentives are set properly, executives or traders should not benefit from investing in correctly priced assets that have a higher return only because they have more systematic risk. However, if incentives are set improperly, it is possible for executives or traders to benefit from profits generated by investing in such assets. First, traders whose performance is judged on profit and loss (P&L), taking into account regulatory capital used and the bank's cost of funds have incentives to invest in highly-rated tranches. Banks' P&L increases by the positive carry of these assets and charges for regulatory capital are low. Second, executives whose performance is assessed by the ROE of their bank also benefit from investing in highly-rated tranches as long as the yield on these securities exceeds the cost of holding these assets. Therefore, we have the following predictions:

(Bad incentives H1) Banks with trading operations and poor incentives invest more in highly-rated tranches.

(Bad incentives H2) Banks more focused on ROE hold more highly-rated tranches.

1.4. Risk management failure.

There are at least two different arguments related to risk-management failures. One argument is that bank risk management failed to correctly assess the risks of the highly-rated tranches, perhaps because of model mistakes. Another argument is that the risk management function at certain banks did not have enough influence to limit the holdings of highly-rated tranches at the level thought to be appropriate given their assessed risk. While the wrong-model argument cannot be investigated with publicly available data,

the latter argument about the role of risk management can be evaluated. With this argument, we would expect banks where the risk-management function was less central and less independent to have fared more poorly as a result of having larger holdings of highly-rated tranches. This argument reflects, however, a simplistic view of risk management since, for instance, an institution where the chief financial officer (CFO) plays a central role in risk management (e.g., Goldman Sachs) might appear to have a less powerful chief risk officer (CRO) even though risk management was more central to the organization. Nevertheless, with this hypothesis, we expect:

(Poor risk management) Banks where risk management was less central and less independent held more highly-rated tranches.

1.5. Good deals.

A possible explanation for holdings of highly-rated tranches is that bank managers believed that they were "good deals," investments with high risk-adjusted expected returns. They could have conjectured that the higher yield of these securities compared to similarly-rated securities was due to market mispricing, was compensation for the complexity of the securities, or was compensation for systematic risk that they felt was overstated. Managers could have believed that they were well equipped to assess these securities, so that they did not have to be compensated to hold them. Irrespective of why the banks felt that investing in these securities created value for shareholders, we would expect that managers with stronger incentives to create value for shareholders would hold more of these securities if they were generally perceived to be priced inefficiently and if investing in these securities required more effort than investing in more standard securities. With this view, we have the following testable hypothesis:

(Good deal H1) Managers of banks that invest more in highly-rated tranches of securitizations have stronger incentives to maximize shareholder wealth.

1.6. Too-big-to-fail.

To the extent that a bank is viewed as too-big-to-fail, its cost of funds does not reflect the full extent of the risks it takes. The proponents of the too-big-to-fail view argue that, since a too-big-to-fail bank does not pay for some of the risks it takes, the bank has incentives to take more of the risks it does not fully pay for. If a bank that is viewed as too-big-to-fail is expected to be bailed out whenever it makes large losses, the bank can increase its value by generally taking more total risk. If, instead, such a bank is likely to be bailed out only in systemic crises, it has incentives to take on more risks that have poor payoffs in systemic crises. Highly-rated tranches of securitizations were not risky securities that banks would have used to increase their overall riskiness since these securities were designed to pay off fully in most states of the world. As a result, too-big-to-fail banks would have had incentives to hold highly-rated tranches only if too-big-to-fail is believed to imply a greater probability of being bailed out in a systemic crisis but not otherwise:

(Too-big-to-fail H1) Banks deemed too-big-to-fail invested more in highly-rated tranches of securitizations than other banks.

The too-big-to-fail hypothesis ignores the possibility that a too-big-to-fail bank could be subject to more regulatory scrutiny, so that it might be limited in its risk taking. Further, such a bank can have high franchise value, which also would limit its risk taking.

Section 2. Estimated holdings of highly-rated tranches.

In this section, we explain first how we estimate holdings of highly-rated tranches and then provide data on our estimates.

2.1. Methods to estimate holdings of highly-rated tranches.

Our primary data source is the Consolidated Financial Statements for bank holding companies (BHCs), form FR Y-9C, published quarterly by the Board of Governors of the Federal Reserve System. We focus on the cross-section of BHCs that are publicly traded in the United States and have data as of December 31, 2006. We drop all BHCs with missing data on total assets or with total assets less than $1 billion and end with a final sample of 231 banks as of December 31, 2006, the date we focus on in the majority of our estimations.[9] The total sample period over which we calculate holdings of highly-rated tranches covers March 2002 through December 2008. It starts in 2002 because this is the first year that capital requirements on securitization tranches were calculated based on credit ratings.

Our variable of interest is designed to measure holdings of what we call highly-rated tranches, which are highly-rated non-government and non-agency securities issued in securitizations and held on BHC balance sheets. Examples include highly-rated tranches of subprime residential mortgage-backed securities (RMBSs), commercial mortgage-backed securities (CMBSs), collateralized loan obligations (CLOs), collateralized bond obligations (CBOs), and collateralized debt obligations (CDOs). Bank holding companies did not explicitly report holdings of these securities in their consolidated financial statements during our sample period. Our approach is to "back out" the amount of highly-rated tranches banks held on their balance sheets using data from the regulatory-capital portion of the consolidated financial statements (schedule HC-R of the form FR Y-9C). Under risk-based capital guidelines, BHCs are required to hold regulatory capital against each asset, including securities, with the amount of capital determined by the type of the asset and/or the riskiness of the asset in the case of the securitization tranches. For example, government securities usually require zero risk-weighting while agency-sponsored securities are generally assigned a 20% risk weight by virtue of their implicit government guarantees.

[9] We drop BHCs that are not in the top tier of the multi-tiered BHCs to avoid double counting. We also drop 3 BHCs that are insurance companies, 2 BHCs that are mortgage brokers, 2 BHCs that are credit card companies and one asset-management BHC that is an outlier in our sample.

Securitization tranches with a credit rating of AA or AAA are assigned a 20% capital charge while tranches with credit ratings of A require a 50% capital charge.

Our approach is to identify the amount of securities in the 20% and 50% risk-weight categories that are not government or agency-affiliated. Reporting guidelines name the specific types of securities that are to be included in each risk-weight category and instruct BHCs to account for securities at historical cost, as opposed to fair value. For example, the total amount of held-to-maturity securities (line item 35 in Schedule HC-R) in the 20% risk-weight category contains various securities issued or guaranteed by the government or government-sponsored agencies and reported in Schedule HC-B.[10] The key to our measure of highly-rated tranches is that BHCs are instructed to also include "all other residential MBS," "commercial mortgage pass-through securities," "other commercial MBS," "asset-backed securities," and "structured financial products" that represent the amortized cost of securities rated AAA or AA in this 20% risk category. Thus, the residual amount of securities included in the 20% risk category that are not affiliated with the government or government-sponsored agencies represent the amount of AAA or AA-rated private-label structured debt held by BHCs. The instructions for assets to be included in the 50% risk category are similar but for A-rated securities. Taken together, the 20% and 50% risk-weighted residuals represent the portion of highly-rated (AAA, AA, or A rated) non-government, non-agency securities held on BHC balance sheets. In other words, they represent the holdings of highly-rated tranches that we seek to measure. We provide the details of the construction of the residual measures, including the relevant FR Y9-C codes, in data Appendix 1. It is important to note that corporate bonds, irrespective of the credit ratings of the issuers, belonged to the 100% risk-weight category and therefore holdings of corporate bonds cannot be mistaken for holdings of highly-rated tranches.

Many of the highly-rated tranches with 20% or 50% risk weights are accounted for as available-for-sale (AFS) or held-to-maturity (HTM) securities. However, some highly-rated tranches, especially in the

[10] These securities are securities issued by government-sponsored agencies (line item 2b), residential mortgage pass-through securities issued by FNMA and FHLMC (line item 4a2), securities issued by states or political subdivisions in the U.S. (Item 3), and other MBSs (collateralized by MBSs) issued or guaranteed by agencies (line items 4b1 and 4b2)).

case of the largest banks, are held separately in a BHC's trading account. Identifying these securities in the trading accounts is difficult because, for regulatory-capital purposes, banks with large trading operations do not report individual risk-weighted trading assets.[11] Rather, they compute a value-at-risk (VaR) for their entire trading operation. For the banks that are subject to the market risk capital guidelines, we are unable to use the residual approach to back out holdings of highly-rated tranches in trading books. To capture holdings of securitization tranches, we use the total amount of line items that are recorded as trading assets (in Schedule HC-D) and represent non-government, non-agency mortgage-backed securities. This approach captures the private-label securitization tranches with mortgage collateral in a BHC's trading account, but without differentiating the credit quality of these securitization tranches.[12] Adding the mortgage-backed securitization tranches from the trading account to the 20% and 50% AFS and HTM residual results in our primary (first) measure of highly-rated tranches, which we refer to as the "Highly-Rated Residual" hereafter. This measure overstates holdings of highly-rated tranches of MBSs because it includes lower-rated tranches held in the trading book, but it understates holdings of highly-rated tranches of CDOs because the data available from the trading book contain only MBSs.

Our primary analysis investigates the holdings of highly-rated tranches before the crisis started. We therefore focus on holdings as of December 31, 2006. Beginning in June 2008, BHCs have been required to explicitly report the amount of CDOs held in their trading accounts if the BHC reported a quarterly average for trading assets of $1 billion or more in any of the four preceding quarterly reports. We supplement our December 2006 estimates of highly-rated tranches by adding the amount of CDOs

[11] Bank holding companies are subject to "market risk capital" guidelines if their trading assets exceed 10% of total assets or if their trading assets exceed $1 billion.

[12] Nadauld and Sherlund (2010) show that over 80% of the value-weighted bonds in subprime RMBS deals received a AAA rating, with close to 90% rated at least A. Although we cannot use the residual approach to identify the holdings of highly-rated tranches in trading assets, it is likely that these securities were highly rated. This is especially true in light of the fact that correlation traders in hedge funds were frequent purchasers of the lowest rated (residual) tranches in securitization deals.

reported in June 2008 to our first measure, "highly-rated residual," as of December 2006.[13] It is likely that the June 2008 values of CDOs under-report the value of CDOs held on BHCs' balance sheets as of 2006 because the value of CDOs were written down in the fall of 2007 and early 2008. To account for this possibility, we create our third measure by adding the amount of CDO write-downs (downloaded from Bloomberg) for the time period (December 31, 2006 through the June 30, 2008) to the June 2008 CDO holdings of the relevant banks.

Banks held highly-rated tranches not only on their balance sheets but also in off-balance-sheet conduits and structured investment vehicles (SIVs).[14] As the crisis evolved, banks had to take some of the securities held by SIVs back on their balance sheet. It is therefore plausible that SIVs were one way for banks to hold highly-rated securities. Our fourth measure of highly-rated tranches also adds assets held in these conduits and SIVs, utilizing the data set provided by Acharya, Schnabl, and Suarez (2010). To the extent that conduits and SIVs held other securities besides highly-rated tranches, adding the holdings of conduits and SIVs to our on-balance sheet measure of highly-rated tranches represents an upper bound of a bank's total highly-rated tranches holdings.

In summary, our residual approach yields four separate measures of highly-rated tranches. The first is the "Highly-Rated Residual," which includes 20% and 50% risk-weighted residuals as well as MBS Trading. The second measure, constructed to account for the CDOs held in trading assets, adds 2008 CDOs to our first measure ("highly-rated residual + CDOs" hereafter). The third one, which also adds the CDO write-downs, is named the "highly-rated residual + CDOs and writedowns." Finally, the last residual-based measure is called "highly-rated residual + CDOs and writedowns + conduits and SIVs" since it also adds the holdings that are not on the balance sheet.

Our final measure of highly-rated tranches holdings, which we call the "bottom-up highly-rated tranches" measure, is borrowed from Cheng, Hong, and Scheinkman (2010). This measure is basically the sum of each line item from the AFS, HTM, and trading asset accounts that correspond to non-

[13] Only four banks in our final sample held enough CDOs in their trading portfolio to warrant explicit reporting of the amount in the June 2008 FR-Y9C.
[14] There are eleven banks with conduits and SIVs in our estimation sample.

government, non-agency sponsored securities. It includes "other mortgage-backed securities" and "asset-backed securities" from the AFS and HTM securities (Schedule HC-B). Non-government, non-agency mortgage-backed securities from trading assets (Schedule HC-D) are also added. Data Appendix 1 provides the detailed data fields associated with the construction of this bottom-up measure. While the measure explicitly assesses the amount of non-government, non-agency securities held on BHCs' balance sheets, it does not capture the credit quality of these assets. Like our first measure, the bottom-up measure is constructed using data reported at the end of 2006 and therefore does not include CDO holdings in trading accounts. It does not include off-balance sheet exposures either.

A concern is that banks might have taken positions in highly-rated tranches through credit derivatives or might have hedged cash positions through credit derivatives. The data on credit derivatives does not distinguish between credit derivatives on corporate names versus credit derivatives on RMBSs and CDOs. However, the extent of the potential problem is limited since in 2006 only 20 bank holding companies bought protection and only 15 bank holding companies sold protection. In total, 15 bank holding companies were net buyers of protection. Among the top three banks, Citigroup and JPMorgan Chase were net buyers of protection while Bank of America was a net seller. From the 10-Ks, it appears that banks buying protection were heavily focused on hedging their corporate loan book.

2.2. Estimates of holdings of highly-rated tranches.

Our analysis in this paper focuses on the holdings of highly-rated tranches at the bank level. We always normalize the holdings by bank assets. However, before turning to normalized holdings, it is useful to briefly discuss the dollar amount of holdings within our sample. Figure 1 shows the evolution of total holdings of highly-rated tranches using our primary "highly-rated residual" measure. At the end of 2006, the last year before the crisis, the banks in our sample held $228 billion of highly-rated tranches. The holdings of these tranches increased dramatically since the start of our sample in 2002. In 2002, the total holdings of highly-rated tranches were $64 billion. The total holdings keep increasing after the end of 2006, experiencing an especially sharp increase in the last quarter of 2007.

The December 2006 estimate of $228 billion arising from our primary "highly-rated residual" approach should be viewed as a lower bound, given that the sample only includes banks that are publicly traded in the U.S. Relaxing the publicly-traded requirement increases the sample size from the 231 banks employed in our regressions to a sample of 439 banks. The "highly-rated residual" measure totals $349 billion in the larger sample of 439 banks. A widely used estimate of holdings of private label MBS by banks and thrifts is by Lehman Brothers. According to that estimate, the banks and thrifts in the top 50 in terms of non-agency MBS holdings held $314 billion in non-agency MBSs in mid-2007.[15] Finally, when we consider the highly-rated holdings in off-balance sheet conduits and SIVs, an estimated $255.7 billion for 14 banks, we arrive at an upper-bound estimate which totals $604.7 billion.[16]

Table 1 shows data on our estimates of holdings of highly-rated tranches by BHCs. We first show summary statistics for our primary "highly-rated residual" measure (see Panel A). In contrast to our other measures (except for the bottom-up measure), this measure is available consistently from 2002. The median holdings of highly-rated tranches (as a ratio of total assets) are 0.15%. Such holdings are of trivial importance for a bank. So, for the typical bank, holdings of highly-rated tranches were not a material concern.[17] However, the mean holdings of highly-rated tranches are 1.13%, almost ten times the median. Such a result implies that some banks have large holdings of highly-rated tranches compared to the typical bank. The 90th percentile of holdings of highly-rated tranches is 3.13%.

In 2006, only 54 of the BHCs in our sample reported trading assets. Of these banks, 14 had trading assets in excess of $1 billion and in excess of 10% of the bank's assets. These "large trading banks" had holdings of highly-rated tranches using our narrowest measure averaging to 4.75%. One way to understand the economic importance of such holdings is that the Basel I accord required banks to have

[15] Lehman Brothers, Fixed Income U.S. Securitized Products Research, "Who owns residential credit risk," September 7, 2007.

[16] The total sample of 439 bank holding companies includes 14 banks with reported conduits in the Acharya, Schnabl, and Suarez (2011) sample. In finalizing our estimation sample, which contains 231 publicly-traded U.S. depository bank holding companies, we remove 3 of these banks (Capital One, Countrywide, and State Street) because they are not depository institutions.

[17] Note that the typical bank does not have a trading book. Consequently, for the typical bank, our estimate of highly-rated tranches is unbiased.

capital equal to 8% of risk-weighted assets, half of it in Tier 1 capital. Banks usually hold more regulatory capital than required. But if a large trading bank has an average risk weight of 50%, a 50% loss on highly-rated tranches would be enough to almost wipe out its Tier 1 required capital.[18] In contrast, the mean of the holdings of highly-rated tranches for the banks that did not report trading assets was 0.78%. We show the holdings of the 25 banks receiving the largest dollar amounts of TARP funds. At the end of 2006, the average holdings of these banks were 3.27%, so that these banks on average held more than the 90th percentile of highly-rated holdings. We also present the holdings of the three largest banks. While these holdings are large for Citigroup at 4.78%, they are below the mean for both Bank of America (1.04%) and JP Morgan Chase (0.63%).

Panel A also reports information on holdings of highly-rated tranches using our narrowest measure for other years, from 2002 to 2008. Neither the mean nor the median changes noticeably during that period of time. The mean increases from 1.29% in 2002 to 1.50% in 2005. After 2005, the mean falls, reaching 1.13% in 2008. For the large trading banks, the mean increases more noticeably and drops more sharply after peaking in 2006. However, there are only 14 large trading banks in 2006. The number of large trading banks falls to 12 by the end of 2007. The large decrease in highly-rated tranches for large trading banks in 2007 is due to the merger of the Bank of New York and Mellon. Both banks have high holdings, but the resulting entity is not in our sample for 2007 as it is not alive at the end of 2006. If we look instead at the holdings of banks alive both at the end of 2006 and of 2007, the mean holdings of highly-rated tranches is 2.94% at the end of 2006 and 3.07% at the end of 2007. The three largest banks have a different pattern. Citibank's holdings more than double over time and reach a peak in 2007. In contrast, neither Bank of America nor JP Morgan Chase exhibits much of an increase in holdings until 2007 and 2008. The holdings of JP Morgan Chase increase from 1.06% in 2006 to 2.55% in 2008. We are unable to ascertain the extent to which this increase results from the acquisitions of Bear Stearns and Washington Mutual in 2008.

[18] If a bank has an average risk weight of 50%, it holds Tier 1 capital corresponding to 2% of assets. Hence, if the bank holds 4.57% of assets in highly-rated tranches, a 50% loss is 2.27% of assets, which exceeds Tier 1 capital.

The next panel of Table 1 uses information on CDO holdings. While it is reasonable to add this information to our measure of highly-rated tranches at the end of 2006, it would make little sense to add the same information to earlier years as banks were in the process of increasing their holdings of CDOs before the end of 2006. CDO holdings do not affect the median and have a trivial effect on the mean because only six banks report holdings of CDOs in excess of $1 billion, the reporting threshold. The holdings of highly-rated tranches for the banks with large trading books increase only by 0.01%. Panel C adds information on write-downs. Taking into account write-downs has no impact on most banks. However, the holdings of highly-rated tranches for Citibank increase further to 5.68%. The holdings of Bank of America increase to 1.88%. Finally, the holdings of JP Morgan Chase remain under 1%.

Panel D also adds assets held in conduits and SIVs, a total value of $214.1 billion for eleven banks. This measure is only available for the end of 2006. Mean holdings for the full sample increase slightly, from 1.33% to 1.51%. The increase is much larger for large trading-asset banks (from 4.99% to 6.59%), especially for Citigroup (from 5.75% to 10.67%), Bank of America (1.96% to 5.08%), and JP Morgan Chase (from 1.09% to 4.25%). To put these numbers in perspective, it is useful to note that Citi had a ratio of common stockholders' equity to assets of 6.30% at the end of 2006 (Citigroup's 10-K for 2007, p. 3). Consequently, a loss of 60% on the highly-rated tranches would have wiped out Citi's common equity.

The final panel of Table 1 shows our estimates using the bottom-up approach. There is no meaningful difference between these estimates and the estimates using our preferred measure of Highly-Rated Residual for most banks. When we turn to the large trading banks, the bottom-up measure has a mean that is higher by 0.29% in 2006. The two methods yield different estimates for Citibank and Bank of America. For Citibank, the bottom-up method has an estimate that is lower by 0.89%. For Bank of America, the difference of 0.79% is in the opposite direction.

The dollar holdings of highly-rated tranches were highly concentrated. This concentration may not be surprising since bank assets are highly concentrated as well. Using our narrow measure, we find that half of the holdings of the banking sector in our sample were held by the three banks with the largest assets

and these banks also held half of the assets of the banking sector. Further, the top five banks by assets held 60% of the holdings.

In summary, for most banks, holdings of highly-rated tranches as a proportion of assets were less than 1% of assets. These holdings were small for some large banks – such as JP Morgan. But the average holdings of highly-rated tranches by the banks with large trading assets were more than three times greater than the average holdings of these tranches by all banks. The average total securities holdings of banks with large trading assets were only 24% higher than the average securities holdings of the banks without large trading assets. Consequently, it is quite clear that banks with large trading assets allocated much more of their securities holdings to highly-rated tranches.

Section 3. Bank risk and holdings of highly-rated tranches.

In this Section, we first examine whether the banks with higher holdings of highly-rated tranches were riskier before the crisis using traditional measures of bank risk. We then turn to assessing whether the banks with higher holdings performed worse during the crisis.

Section 3.1. Holdings of highly-rated tranches and bank risk before the crisis.

We investigate whether holdings of highly-rated tranches are positively correlated with generally used proxies for bank risk. If holdings of highly-rated tranches were a reflection of a bank's willingness to take more risk, we would expect a bank with larger holdings to be riskier along a number of different dimensions.

In Panel A of Table 2, we present results using the "highly-rated residual" measure of highly-rated tranches as of 2006 year end. Our first measure of risk is the bank z-score. The bank z-score is introduced by Laeven and Levine (2009) and is measured as the ratio of the return on assets plus the capital-asset ratio divided by the standard deviation of the return on assets. In other words, it is a measure of distance-to-default. The numerator is measured as of 2006 while the volatility in the denominator is calculated using the prior six years' return on assets. A higher distance-to-default means that a larger negative return

is required to render the bank insolvent. Regression (1) shows that there is no relation between the z-score and holdings of highly-rated tranches when we regress holdings of highly-rated tranches on the z-score alone. Regression (2) adds several control variables to the regression. We control for bank attributes such as the bank's returns over the previous year and the market-to-book ratio. The size of a bank's other securities holdings can also be related to the risk of a bank. In particular, a more traditional bank that takes deposits and makes loans will have fewer securities. Therefore, we control for "other" holdings of held-to-maturity and available-for-sale securities and "other" trading securities.[19] We also include two control variables for bank size. We allow the slope in the relation between highly-rated holdings and bank asset size to differ for assets above $50 billion as a simple way to make it possible for the regression to capture the influence of too-big-to-fail on holdings.[20] These controls are admittedly limited, but we want to give the regression the best chance to show that there is a correlation between holdings of highly-rated tranches and risk-taking in general. We do not show the estimated coefficients of the control variables in Table 2 as our focus is on the correlation between highly-rated tranches and the risk measures. Including these control variables in regression (2), the z-score is not correlated with holdings of highly-rated tranches.

Regressions (3) and (4) show the relation between holdings of highly-rated tranches and the standard deviation of the return on assets. There is no relation between holdings of highly-rated tranches and that proxy for risk with or without our control variables. The same result obtains when we use the standard deviation of the stock return during the year 2006 in regressions (5) and (6). We turn next to four measures of leverage. The first measure of leverage is simply market leverage, defined as the ratio of book value of liabilities to the summation of that and the market value of equity. We find no significance using that measure in regressions (7) and (8). The same result holds for book leverage, measured as the ratio of assets minus book value of equity to assets, in regressions (9) and (10). We use two measures of

[19] The term "other" securities generally refers to holdings of government, agency, and non-highly-rated private-label securities. The appendix contains a precise description of securities included in our measures of "other" H.T.M. and A.F.S. securities and "other" Trading securities.
[20] Banks with assets greater than $50 billion are treated differently under Dodd-Frank.

leverage involving regulatory capital. The first measure is a version of the regulatory leverage ratio and uses the ratio of assets to Tier 1 capital. We find a positive relation between holdings of highly-rated tranches and that leverage ratio in regression (11). Such a result might reflect regulatory arbitrage since a bank that wants to increase its size given its regulatory capital could do so by shifting holdings from loans and corporate bonds to highly-rated securitization tranches. But this relation becomes insignificant when we add our controls in regression (12).

In regressions (13) and (14), we use a regulatory measure of risk, namely the ratio of risk-weighted assets to Tier 1 capital. For a given asset size and regulatory capital, a bank that holds riskier assets with higher regulatory weights would have a larger amount of risk-weighted assets. Hence, riskier banks should have a higher ratio of risk-weighted assets to capital. The coefficient for this risk proxy is not significantly different from zero and its sign is even negative when we include control variables.

So far, we have seen no evidence that riskier banks held more highly-rated tranches. Derivatives can be used by banks to hedge their credit exposures. We therefore proceed with one last experiment, which is whether banks that held more highly-rated tranches hedged less with credit derivatives. We construct a measure of the difference between protection bought and protection sold divided by assets. As discussed before, the data does not distinguish between derivatives where the underlying is highly-rated tranches or a corporate name. Based on a review of some 10-Ks, most of the net protection bought for hedging seems to be related to corporate names. We regress holdings of highly-rated tranches on this measure. In regression (15), we find that banks that bought more protection in the credit derivatives markets had larger holdings of highly-rated tranches. The coefficient stops being significant when we add our control variables in regression (16). Lastly, we use the ratio of short-term wholesale funding as a fraction of total assets as another measure of risk. The results are presented in columns (17) and (18) of the Table 2. Neither coefficient is significant.

In Panel B of Table 2, we present results for these risk proxies using our broadest measure of highly-rated tranches, "highly-rated residual + CDOs and writedowns + conduits and SIVs," as the left-hand-side variable. In specifications without control variables, both measures of regulatory capital (Assets/Tier 1

Capital and Risk-Weighted Assets/Tier 1 Capital) and Short-term Wholesale Funding/Assets have positive and significant coefficients while the "Stock Return Volatility" variable has a negative and significant coefficient. In specifications including control variables, we find no significance.

A concern with our control variables is that they themselves might reflect risk taking, so that both the dependent and the independent variables could be functions of a bank's risk taking. To alleviate this concern, we re-estimated our regressions with only the number of employees as a control variable. The number of employees controls for size, but it is unlikely to reflect a bank's risk taking. We find that our results remain similar to those with the control variables, in that none of the risk proxies is related to holdings of highly-rated tranches.

Overall, there is no systematic evidence that banks that held more highly-rated tranches were riskier ahead of the crisis. Without controlling for other bank characteristics, there is some evidence that these banks had more regulatory leverage and more short-term funding. However, this evidence no longer holds as soon as we control for a small set of bank characteristics.

Section 3.2. Holdings of highly-rated tranches and bank returns during the crisis.

Banks with higher holdings of highly-rated tranches did not appear to have higher risk before the crisis. We now turn to whether they had higher risk ex post, in that they performed worse during the crisis. We do not investigate whether higher holdings caused worse performance, but rather whether banks that had higher holdings also performed worse ex post or not. We calculate each bank's buy-and-hold excess return over the equally-weighted market return for the time period from July 1, 2007 through December 31, 2008. We then regress these buy-and-hold returns on the four different BHC-specific measures of highly-rated tranches holdings as of December 31, 2006. To account for potential nonlinearities in the relation between these holdings and returns, we sort firms into quintiles based on their holdings and construct dummy variables for banks in each quintile. The quintile with the lowest amount of highly-rated holdings serves as the base group. We expect banks in the highest quintiles of

highly-rated tranches holdings as of December 2006 to be associated with lower returns during the subsequent financial crisis.

We control for bank attributes such as the bank's market capitalization, prior returns, market-to-book, and a regulatory-capital leverage measure (the ratio of assets to Tier 1 capital), which are likely to influence stock returns. Again, we control for "other" securities' holdings of held-to-maturity and available-for-sale securities and "other" trading securities in all regressions. We include as independent variables measures of a bank's real estate as well as commercial and industrial (C&I) loan exposure in the form of mortgage and C&I loans, scaled by total assets. Banks also had unused commitments to make residential and commercial real-estate loans. Following Loutskina and Strahan (2011), we control explicitly for such unused loan commitments.

We present the results in Table 3. Firms in the top quintile of highly-rated tranches holdings are associated with about 14% lower returns, on average. For banks in the top quintile, the average of the ratio of holdings of highly-rated tranches to equity market capitalization at the end of 2006 is 29.63% (the median is 17.02%). The lower returns we document are therefore consistent with the size of the holdings and the magnitude of losses on highly-rated tranches that have been documented. For instance, the on-the-run ABX index for AAA tranches fell by more than 50% during that period of time, so that a bank holding 29.63% of its capitalization in highly-rated tranches would have lost at least 15% of its equity market capitalization. The negative coefficient on the top quintile is statistically significant for all measures of highly-rated tranches except for the bottom-up measure. The impact of highly-rated tranches holdings on returns is lower for banks that have low holdings. Banks in the 2nd highest quintile of holdings experienced 2 to 3% higher returns than the banks in the top quintile did. The coefficient on these banks is not statistically different from zero for all measures except for the measure that includes holdings in conduits and SIVs as the dependent variable (in Column 4). The coefficients on the lower quintiles are never statistically significant.

As in Loutskina and Strahan (2011), unused loan commitments have a significantly negative impact on returns. As expected, banks with higher exposures to real estate through mortgage and C&I loans had

significantly negative returns. Other HTM and AFS securities are associated with larger returns, as are firms with higher market-to-book ratios. Prior returns, market capitalization, and assets over Tier 1 capital do not have significant coefficients explaining returns. Taken together, these results provide evidence that our constructed measures of highly-rated tranches holdings are associated with bank stock return performance. Such a result would follow if the performance of these highly-rated tranches was unexpected. It would also follow if holdings of highly-rated tranches were associated with bank attributes that generally were correlated with poor crisis performance.

Section 4. Why Did Banks Hold Highly-Rated Tranches?

In this section, we investigate to what extent the cross-sectional variation in holdings of highly-rated tranches is consistent with the hypotheses developed in Section 1 using the estimates of highly-rated tranches presented in Section 2. Our typical approach is to estimate regressions where the dependent variable is highly-rated tranches held by a bank, normalized by its assets. When we can, we address the relevant endogeneity issues. We also are able to present falsification tests in some cases. However, not all sources of endogeneity can be addressed, so that our regressions do not establish causality. Rather, they document correlations. If a relevant correlation is consistent with an hypothesis developed in Section 2, this hypothesis gains credibility. If it is not, the burden of proof should shift to those who favor that hypothesis to show why it should be taken seriously despite our finding.

In all regressions, we control for the return of the bank in 2005-2006, the market-to-book ratio, assets over Tier 1 capital, and the holdings of other securities as of 2006. For the holdings of other securities, we consider separately other securities held to maturity and available for sale as well as other trading securities. Since these holdings exclude the highly-rated tranches, there is no mechanical relation between these holdings and holdings of highly-rated tranches. Panel B of Appendix 1 provides the details of the construction of the explanatory variables used in this section.

Section 4.1. Bank size and holdings of highly-rated tranches

Several hypotheses presented in Section 1 predict a relation between bank size and holdings of highly-rated tranches. In particular, the too-big-to-fail hypothesis predicts that banks above a given size would hold more highly-rated tranches. Further, banks need a minimum scale to engage in securitization. Therefore, we begin by investigating the relation between bank size and holdings of highly-rated tranches. Table 4 shows the medians of highly-rated tranches holdings for vigintiles. We focus on medians because a few banks are clearly outliers in some vigintiles and influence the mean. While the median does not increase monotonically with size across vigintiles, the highest median is for the banks in the twentieth vigintile, corresponding to the largest banks, for all measures. Median holdings exceed 1% only among the three largest vigintiles. The difference in median holdings between the largest banks and the next largest banks is most dramatic for our broadest measure which includes holdings in conduits and SIVs. For that measure, the median for the largest banks is 4.67% while it is 1.61% for the next largest banks. The last column of Table 4 shows the holdings of agency mortgage-backed securities. These holdings are much higher than the holdings of highly-rated private-label tranches for each vigintile. Further, there is no consistent relation between size and holdings across size vigintiles for agency securities.

Table 5 presents the results of regressions of holdings of highly-rated tranches on various measures of size. We do not show the estimates for the control variables. Panel A reports estimates for all measures using the piecewise nonlinear approach already used in Section 3.1. The first variable, named "$0-50 Billion," captures the relation between holdings of highly-rated tranches and assets for the first $50 billion worth of assets. As briefly discussed before, all BHCs with less than $50 billion in assets take the value of their asset size while BHCs with assets greater than $50 billion take the value of $50 billion. The second variable, which is named ">$50 Billion," takes a value of 0 for all BHCs with less than $50 billion in assets while it takes the actual asset size minus $50 billion for BHCs with greater than $50 billion worth of assets. In this way, the estimated coefficients on the piece-wise specification are additive and hence the sum of the two coefficients estimates the relation between asset size and holdings of highly-rated tranches. We see banks' holdings of highly-rated tranches increase as their size grows, but only up

to $50 billion. For banks that have more assets than $50 billion, the fraction of assets held in highly-rated tranches does not increase with size beyond the fraction held by banks with $50 billion of assets.

An obvious concern is that asset size could be endogenous. As a bank switches from corporate bonds to highly-rated tranches, it will see its asset size increase if it makes full use of its existing regulatory capital. In Panel B, we use the number of employees as our measure of size since none of the theories we discussed in Section 2 imply that holding more highly-rated tranches is associated with having more employees. We see that holdings of highly-rated tranches increase with the number of employees, but do not increase more for banks with more than 10,000 employees.

With any attempt to estimate a nonlinear relation, one has to be concerned about whether the results are sensitive to the formulation. We do not tabulate the result, but when we use $100 billion as the inflexion point, we find that holdings increase with asset size less than $100 billion but not with assets larger than $100 billion. Next, in Panel C, we allow for a formulation with two inflexion points, one at $50 billion and one at $250 billion. We see no evidence that holdings increase more with assets for banks with holdings in excess of $250 billion; further, we find that holdings decrease significantly when assets range between $50 billion and $250 billion for four of our measures. A final exercise using asset size is to use an indicator variable for banks with assets in excess of $50 billion or of $100 billion. When we use the indicator variable at $50 billion, our results show a positive and weakly significant relationship with our "bottom up" measure of holdings, but not for the other measures of holdings (results presented in Panel D of Table 5). When we use the indicator variable for banks with assets in excess of $100 billion, we find that the coefficient on our broadest measure of holdings is positive and statistically significant at the 10% level but the coefficients for the other measures are not significantly different from zero. Results are presented in Panel E of Table 5.

An alternative approach to identify banks for which too-big-to-fail is relevant is to use the banks that were required to perform stress tests at the beginning of 2009. Panel F of the table shows that these banks did not hold more highly-rated tranches than other banks.

In summary, there is a relation between size and holdings of highly-rated tranches. However, that relation is nonlinear and there is no evidence that it is stronger for the largest banks. For most regressions, the results are insensitive to the measure of holdings we use. Therefore, for most measures, there is no evidence that more systemically important or so-called too-big-to-fail banks held more highly-rated tranches as a fraction of their assets. In regressions using indicator variables for assets in excess of $50 billion or in excess of $100 billion, these indicator variables are not significant for most of our measures. There is, however, some evidence that banks with more than $100 billion of assets held more highly-rated tranches when we use the broader measure which treats SIVs as holdings of highly-rated tranches. This evidence suggests that off-balance sheet vehicles may have played a unique role in holdings of highly-rated tranches.

4.2. Securitization by-product hypothesis.

We test whether securitization-active banks held more highly-rated tranches as of December 31, 2006. We define a BHC as being securitization-active if the outstanding principal balance of assets sold and securitized with servicing retained or with recourse or other seller-provided credit enhancements is non-zero in any of the years 2003, 2004, 2005, or 2006. According to this definition, 49 BHCs in our sample are active in securitization. We estimate highly-rated tranches holdings as a function of the securitization-active indicator, the piece-wise size variables, and the standard set of controls employed in previous tables. Results are presented in Table 6.

We produce results for the "highly-rated residual" and "highly-rated residual + CDOs and writedowns + conduits and SIVs" measures of highly-rated tranches and report them in columns (1) and (2). We find that securitization active banks hold more highly-rated tranches. The coefficient on the indicator variable is 0.015 in the first specification, so that these banks hold 1.5% more of their assets in the form of highly-rated tranches. Such an effect is economically significant since the standard deviation of highly-rated tranches holdings is 3.1%. The estimated coefficients on the step-wise size variables are diminished but not wholly subsumed by the presence of the securitization-active indicator, suggesting that

securitization activity is not a manifestation of asset size alone. The results in the second specification, when the dependent variable includes CDOs, write-downs, and off-balance sheet conduits, are similar to those reported in column (1). The regression estimates for other measures – that are not reported – are very similar to those reported in columns (1) and (2). Also, in Regression (3) of Table 6, we provide a falsification test. The securitization hypothesis does not predict a relation between securitization activity and holdings of agency mortgage-backed securities. We therefore regress the ratio of total agency holdings to assets on the control variables and on the securitization-active indicator. The coefficient on the securitization active indicator is not statistically significantly different from zero in explaining agency securities.

The measure of securitization we use is a measure based on a bank's own securitization activities. Alternatively, we could use a measure of participation of banks in the underwriting of securitizations. To do so, we create an indicator variable for any BHC which shows up in the underwriter League Tables of any type of securitizations including subprime RMBSs, CLOs, CBOs, and CDOs ("Securitization-league-table Indicator").[21] Out of 231 banks in our December-2006 sample, 10 banks meet the criterion. We show the regression estimates with this measure in columns (4) and (5) of Table 6. We find that these estimates are positive but not statistically significant. In regressions (6) and (7), we use the rank of the underwriter in the League Tables, with the minimum of one and maximum of 10. Banks not in the securitization league table take a value of zero. The coefficient is positive in both specifications and it is statistically significant when we use our broadest measure of holdings on the left hand side.

One concern with the securitization results presented thus far is that the securitization-active indicator variable could be correlated with bank characteristics that are not controlled for in regressions (1) and (2). To address this possibility, we estimate regressions of changes in highly-rated tranches on changes in the level of securitization activity since 2002. The use of changes has the advantage of helping account for the possibility of an omitted variable bias in the estimates on the securitization-active indicator reported in

[21] Data source is Moody's eMaxx Data Services.

columns (1) and (2) of Table 6. Pervasive unobserved attributes at the bank level are less likely to be correlated with time-series changes in the variables of interest. Consequently, we expect the relation between the changes to be a more precise estimate of the true relationship between securitization activity and holdings of highly-rated tranches.

For the regressions using changes in holdings of highly-rated tranches, we can only use our narrow measure as the other measures are not available consistently over time (except for the bottom-up measure). For that purpose, we run regressions of the year-over-year change in holdings of these tranches on the year-over-year changes in the outstanding principal balance of assets sold or securitized (with servicing retained or with recourse). We use quarterly data from the first quarter of 2002 to the last quarter of 2006 and normalize the change in the highly-rated holdings or outstanding balance of securitizations from t-4 to t using assets as of t-4. Results are reported in column (8) of Table 4. Standard errors are corrected for clustering of observations at the bank and quarter level. The coefficient on the ratio of the change in securitization over lagged assets is positive and significant at the 10% level. In regression (9), the last regression of the table, we focus on the outstanding principal balance of only mortgages sold or securitized and find similar results.

Figure 1 shows that the aggregate dollar holdings of highly-rated tranches experienced an especially sharp increase from the last quarter of 2006 to the last quarter of 2007. This increase is supportive of the hypothesis that banks accumulated highly-rated tranches rapidly as the market turned because they had trouble selling these tranches. However, even though the aggregate amount of highly-rated tranches increased the most from 2006 to 2007, total assets increased as well, so that the large dollar increase is not accompanied by a noticeable increase in percentage holdings. Consequently, the evidence on percentage holdings does not support the view that banks accumulated holdings at a rapid pace in 2007. Their behavior is consistent with having kept their allocation to highly-rated tranches roughly constant.

Finally, given our results, the increase in holdings of highly-rated tranches should be concentrated among securitization-active banks. In Figure 2, we plot the holdings of highly-rated tranches through time separately for securitization-active banks and non-securitization active banks. In 2006, securitization

active banks had highly-rated tranches holdings of 3.1% in comparison to holdings of 0.8% for other banks. For the securitization-active banks, holdings of highly-rated tranches increased from 2.1% of total assets in Q1 2002 to 3.3% in Q1 2007, while highly-rated holdings for the non-active banks remained virtually unchanged over the same period. A formal test of the 1.2% difference in highly-rated holdings between Q1 2002 and Q1 2007 for securitization-active banks yields a t-statistic of 1.30.

As discussed in Section 1, the traditional skin-in-the-game hypothesis would suggest that banks engaged in securitization would hold the most junior tranches of their securitizations. We used the BHC data to try to estimate the holdings of lower-rated tranches. The estimates we obtained suffer from a number of drawbacks that lead us not to present them. However, no matter what choices we make in constructing these estimates, holdings of lower-rated tranches were economically trivial for banks – they could have lost all their investment and not be meaningfully affected – and holdings of highly-rated tranches dwarf holdings of lower-rated tranches.

Our analysis is strongly supportive of the hypothesis that banks engaged in securitization held more highly-rated tranches (Securitization H1) and the hypothesis that holdings of highly-rated tranches increased over time with securitization activity (Securitization H2). We find at best weak evidence that holdings of highly-rated tranches for firms active in securitization increased more in 2007 (Securitization H3).

4.3. Regulatory arbitrage.

Acharya and Richardson (2009) argue that BHCs find it advantageous to hold highly-rated assets as a form of regulatory capital arbitrage. Regulatory arbitrage occurs because banks have to hold less regulatory capital if, for example, mortgage loans on the balance sheet are transformed into AAA-rated bonds via securitization. Also, as discussed earlier, regulatory arbitrage might have favored holdings of highly-rated tranches simply because they had higher yields than other securities with similar capital requirements. With this view, we could see the type of relation between securitization and holdings of highly-rated tranches documented in the previous section. Transforming mortgages into highly-rated

securities can also result in a cheaper source of funding for BHCs through asset-backed commercial paper (ABCP) programs, where commercial paper is issued at a lower cost since it is collateralized by highly-rated securities (see Acharya, Schnabl, and Suarez (2010)). Finally, Acharya, Schnabl, and Suarez (2010) show that structured investment vehicles (SIV) were a form of regulatory arbitrage that enabled banks to hold various assets, including highly-rated tranches, with almost no regulatory capital. To implement this regulatory arbitrage, banks did not have to hold highly-rated tranches on their balance sheet. However, it might be that banks that engaged in regulatory arbitrage through SIVs held more highly-rated tranches as an inventory available for their SIVs.

We find that 11 bank holding companies sponsored conduits or SIVs in our estimation sample.[22] To investigate the regulatory-arbitrage hypothesis, we first test whether a "Conduit Dummy" identifying these banks is correlated with holdings of highly-rated tranches. As shown in column (1) of Table 7, the coefficient on the indicator variable for conduits is not statistically different from zero when we use the "Highly-Rated Residual" measure of holdings. Not surprisingly given the result in column (1), the coefficient is significant in regression (2), when we use our broadest measure, which adds the holdings of off-balance sheet conduits to on-balance sheet holdings of highly-rated tranches. In other words, holdings of highly-rated tranches through conduits did not substitute for on-balance sheet holdings but were incremental. It is important, however, to note that our measure of holdings through conduits is an upper bound as not all conduit assets were highly-rated tranches.

We examine next whether BHCs' issuance or sponsoring of asset-backed commercial paper is related to their holdings of highly-rated tranches. We construct an indicator variable for all BHCs active in the ABCP market, either through direct issuance or through sponsoring credit enhancements in ABCP issuance. Since banks with conduits have ABCP programs, there is considerable overlap between the ABCP indicator variable and the conduit indicator variable. We estimate regressions that explain holdings of highly-rated tranches as a function of this indicator variable ("ABCP Activity Indicator"), the piece-

[22] Out of 11 BHCs that sponsored off-balance sheet conduits in general, only one, Citigroup, was affiliated with SIVs as a specific type of conduit.

wise asset size variables, and a set of other controls. The ABCP indicator variable is equal to one if the BHC engaged in any ABCP activity in years 2003-2006. In our sample, there are 15 BHCs that are active in the ABCP market in 2006.

The results presented in regressions (3) and (4) of Table 7 show that the existence of an ABCP program is not helpful to explain the cross-section of holdings of highly-rated tranches. The coefficients on the ABCP indicator variable are insignificant and are of little magnitude economically. The remaining control variables are mostly consistent with results in previous tables. Estimates of the coefficient on asset size for the first $50 billion of asset size remain quantitatively similar to previous tables but are not significant in the ABCP specification. If the existence of an ABCP program is a good proxy for a bank's propensity to engage in regulatory arbitrage, that propensity does not seem to explain holdings of highly-rated tranches.

We develop an alternative measure of a BHC's propensity to engage in regulatory arbitrage that does not rely on ABCP activity. In March 2001, the Federal Reserve allowed BHCs to incorporate credit ratings in calculating regulatory capital for holdings of securities issued through securitizations. Prior to the rule change, capital charges on such securities were dictated by asset type rather than credit quality. For example, mortgage-backed securities issued or guaranteed by Fannie Mae carried a 20% risk-weighting (so that the capital set aside was 20% of 8%, or 1.6%, in comparison with 8% for corporate loans) capital charge, but non-agency mortgage-backed securities that were viewed as having similar risk carried a greater capital charge. Following the rule change, the regulatory capital charge became a function of the securities' credit rating rather than asset class. AAA-rated and AA-rated securitizations became associated with a 20% risk-weighting, A-rated securitizations a 50% risk-weighting, BBB-rated securitizations a 100% risk-weighting, and BB-rated securitizations a 150% risk-weighting. Thus, following the rule change, securitized assets with poor credit quality became more expensive from a regulatory standpoint.

The rule change of March 2001 provides an opportunity to identify BHCs with a propensity to engage in regulatory arbitrage. We consider whether a BHC's use of regulatory-capital arbitrage opportunities

arising from the ratings-based capital change has any power in predicting its holdings of highly-rated tranches in subsequent years. To do so, we calculate the change in leverage, namely the change in assets over Tier 1 capital, for each BHC in our sample from the fourth quarter of 2000 to the fourth quarter of 2002 and hypothesize that BHCs with the largest change in leverage surrounding the event are those with a higher propensity to engage in regulatory capital arbitrage. This test assumes that banks took active steps to increase their leverage as a result of lower capital requirements.

Columns (5) and (6) of Table 7 regress the holdings of highly-rated tranches in December 2006 as a function of the change in leverage from 2000 Q4 to 2002 Q4. If banks that took advantage of the change to increase their leverage are those that engage in regulatory arbitrage, we should see a positive relation between holdings of highly-rated tranches and the change in leverage around the regulatory change. The change-in-leverage variable is positively related to holdings of highly-rated tranches, but the coefficient is not statistically significant.

There has been much discussion that the market risk amendment to the Basel Accord allows banks to hold highly-rated tranches in their trading book with very little regulatory capital compared to banks that can only hold the tranches in their banking book. However, as discussed earlier, banks with a trading book might have been holding more highly-rated tranches to have an inventory for market-making purposes. The final two regressions of Table 7 use an indicator variable ("Market Risk Equivalent Bank Indicator") for banks that had the right to use their own value-at-risk model to satisfy capital requirements on their trading book.[23] We find no evidence that these banks held more highly-rated tranches. We estimate (but do not tabulate) the same regression without the size variables. Without the size variables, the indicator variable is significant but the R-squared of the regression drops by half. The significance of the size variables is not affected by the presence of the market risk indicator and the inclusion of the market risk indicator has only a trivial impact on the R-squared.

[23] A BHC is subject to the market risk capital guidelines, and thus able to use its own estimates of value-at-risk in calculating capital requirements, if it's consolidated trading activity, defined as the sum of trading assets and liabilities for the previous quarter, equals: (1) 10% or more of the BHCs total assets for the previous quarter, or (2) $1 billion or more. The Federal Reserve may include or exempt a BHC as it feels appropriate. Our Dec. 2006 sample of 231 BHCs includes 14 BHCs that meet the market risk capital guidelines.

With the regulatory arbitrage hypothesis, we would expect banks with higher leverage to have larger holdings of highly-rated tranches as such banks would be expected to take more advantage of investments that economize regulatory capital. However, as seen in Tables 2, 6 and 7, Assets/Tier 1 Capital does not have a significant coefficient when we include other explanatory variables, which implies that banks that are more constrained in regulatory capital do not seem to be holding more highly-rated tranches (Regulatory Arbitrage H1).

Finally, we consider the possibility of BHCs having engaged in regulatory arbitrage through the securitization channel itself. From a regulatory capital standpoint, it is cheaper for banks to hold a portfolio of mortgages in the form of highly-rated securitizations than to hold an unsecuritized portfolio of mortgages. This is because AAA-rated securitizations, for example, carry a 20% risk-weighting while unsecuritized subprime mortgages carry a much larger risk weight. As such, it could be that securitization activity is an efficient mechanism to transform an expensive portfolio, from a regulatory standpoint, into a cheaper portfolio.

We provide two pieces of evidence that indicate that banks engaged in securitization did not engage more aggressively in regulatory arbitrage on their balance sheets than other banks to reduce their regulatory capital requirements (as opposed to the off-balance sheet mechanisms documented by Acharya, Schnabl, and Suarez (2010)). First, we examine whether levels of regulatory capital were overly aggressive among securitization-active banks. For each BHC, we calculate the regulatory "cushion," which is the ratio of Tier 1 capital to risk-weighted assets, minus the regulatory Tier 1 requirement of 4%. We plot the results in Figure 3. While securitization-active BHCs do, on average, exhibit a lower regulatory capital cushion, the cushion is not close to the regulatory boundary, nor does it change through time as would be expected of a BHC wanting to push the boundaries of regulatory capital through increased securitization activity.

A second piece of evidence comes from examining the ratio of total assets to risk-weighted assets. In order to control for bank size, we create a size-based matched sample of securitization-active and non-securitization active banks and plot the ratio of total assets to risk-weighted assets in Figure 4. A

securitization-driven regulatory arbitrage hypothesis predicts that securitization-active banks would amass more total assets for a given level of risk-weighted assets than non-securitization active banks. Figure 4 demonstrates that the data do not support this view. Rather, securitization active banks have a lower ratio of total assets to risk-weighted assets than their counterparts of roughly equal size. Taken together, we interpret the results as being consistent with the view that securitization activity itself, without associated off-balance sheet activity, was not the primary mechanism facilitating regulatory capital arbitrage. Consequently, overall, our evidence provides little support for the hypothesis that banks that engage more in regulatory arbitrage activities have larger holdings of highly-rated tranches on their balance sheet (Regulatory Arbitrage H2). But our evidence is consistent with the view that the use of off-balance sheet vehicles to hold highly-rated tranches to take advantage of lower capital requirements led to higher holdings of highly-rated tranches.

4.4. Incentives.

The poor-incentives hypothesis argues that banks had compensation plans that made it advantageous for managers and traders to play the carry trade, holding positions in highly-rated tranches while borrowing at the firm's cost of funds. These incentives could be bad at lower levels of a bank – say at the trader level – or at the top level. We examine both possibilities.

We would expect that poor incentives are more likely to exist in banks with poor governance. Consequently, banks with poor governance would be more likely to be banks with greater holdings of highly-rated tranches. To test this hypothesis, the first regression of Table 8 uses a "Governance Index" that contains 41 firm-level attributes from RiskMetrics as of 2006 and that increases with the protection of minority shareholders (see Aggarwal, Erel, Ferreira, and Matos (2011) for a detailed explanation of the index). We find no relation between holdings of highly-rated tranches and a bank's governance index.

The data on compensation contracts below the top five officers of banks is not available. However, it is often argued that there is an incentive problem with traders' compensation, since generally they receive a share of the profits they generate but do not have to pay for the losses they generate. Consequently, if

the hypothesis is correct, we would expect the problems to arise in banks that have trading operations. Regressions (7) and (8) of Table 7 show, however, that there is no evidence that banks with larger trading portfolios have more highly-rated tranches. In unreported results, we also re-estimated the regressions of Table 7 with an indicator variable for any bank with non-zero trading assets and still find no significance for the trading-asset indicator variable.

We construct several measures of chief risk officer (CEO) compensation and test whether these measures can explain differences in holdings of highly-rated tranches (see Panel B of Appendix 1 for a detailed description of the managerial-compensation measures). Our first measure calculates the elasticity of total managerial compensation to a BHC's return on equity (ROE), where the ROE is calculated as net income divided by total common equity as of fiscal year end.[24] ROE is a performance measure that is not risk adjusted and it does not account for the cost of equity. Therefore, a bank's ROE can be increased through carry-trade positions and with leverage. This elasticity measure is designed to capture the relationship between total managerial compensation and firm performance. Highly-rated tranches had higher yields than other similarly rated securities. Hence, to the extent that these tranches bolster non-risk-adjusted firm performance, managers with a higher elasticity of compensation to non-risk-adjusted performance would find it advantageous to hold more highly-rated tranches relative to managers whose compensation is less sensitive to non-risk-adjusted performance.

The second regression of Table 8 reports estimates of a regression of holdings of highly-rated tranches on measures of the elasticity of managerial compensation to performance. The elasticity variable named "High-Compensation Elasticity" is equal to one for firms with above-median elasticity of the CEO's total compensation to changes in bank ROE. The relationship between holdings of highly-rated tranches and compensation elasticity is negative and the estimate lacks statistical significance.

We also consider alternative measures of managerial compensation. A regression of highly-rated tranches on managers' "Compensation Residual" (see Cheng, Hong, and Sheinkmann (2010)) and control

[24] The numerator of the compensation-ROE elasticity is calculated as the change in compensation from 2001-2006 divided by 2001 levels of compensation. The denominator is calculated as the change in ROE from 2001-2006 divided by 2001. ROE Details are provided in the data appendix.

variables is presented in column (3) of Table 8. Compensation residual, a measure of excess compensation, is constructed by computing the natural logarithm (log) of average total compensation from 2003 to 2006. This log average compensation is then regressed on the log of the firm's 2006 market cap. The residual from this regression, estimated in 2006, serves as the compensation residual variable in our cross-sectional regressions of highly-rated holdings in 2006. The coefficient on the residual is positive but insignificant.

Regression (4) in Table 8 uses another measure of managerial compensation, the bonus-to-salary ratio. This "Bonus-per-Salary" variable is calculated as the ratio of the CEO's total bonus to his base salary. The results indicate virtually no statistically significant relationship between "Bonus-per-Salary" and holdings of highly-rated tranches.

Finally, there has been much criticism of the impact of options on risk-taking incentives (see, for instance, Bebchuck and Spamman (2010)). We test whether banks where the CEO's compensation exhibited more option-like features (more sensitivity to volatility) held more highly-rated tranches. The coefficient on "Equity Risk" in column (5) is negative with a t-statistic of -0.65. There is therefore no evidence supporting the view that option-like compensation led to more risk taking through holdings of highly-rated tranches. The standard set of control variables exhibits their usual signs, magnitudes, and significance in all specifications.

Regressions (6) and (7) of Table 8 investigate the relation between holdings of highly-rated tranches and equity incentives of CEOs. The coefficients on our estimates of equity incentives of CEOs are insignificant. In other words, the banks of CEOs with more incentives to maximize shareholder wealth did not hold more or fewer highly-rated tranches than other banks.

One concern is that, given the sample size and possible errors of measurement in incentive measures, our approach does not have enough power to find a role for incentives. If we take leverage to be a measure of risk taking, we can estimate our regressions using leverage as the dependent variable. We show the results in Table 9. We see that leverage is significantly negatively related to the elasticity of compensation with respect to ROE. This result is surprising and worth exploring more, but our focus is

not on explaining leverage. We also find a surprising negative relation between leverage and equity risk, the sensitivity of managerial compensation to the volatility. Finally, more as we would expect, there is a significant negative relation between leverage and managerial ownership or sensitivity of managerial wealth to the stock price. The other regressions do not have significant coefficients on the compensation variables. Nevertheless, these regressions show that managerial ownership seems to have a relation with risk-taking for our sample banks.

In summary, our results are not supportive of the "incentives" hypotheses. These results cannot be wholly attributed to our incentive proxies being inadequate since we find that some of them are related to leverage. Further, these proxies have been widely used in the literature and found to be significantly related to a variety of firm policies and to firm valuation.

4.5. Risk management failure.

To investigate whether there is evidence supporting the risk management failure hypothesis, we use the index developed by Ellul and Yerramilli (2012) to measure the centrality and independence of risk management within banks. The Risk Management Index (RMI) is available for 61 banks in our sample. Smaller banks typically do not have disclosures on the risk management function. The index is a function of whether a bank has a chief risk officer (CRO), whether the CRO is an officer, whether the CRO is one of the top five most highly paid executives, the ratio of the pay of the CRO to the pay of the CEO, the bank's board has an experienced risk committee, the frequency of meetings of the risk committee, and whether the key management-level risk committee reports directly to the board. As the RMI increases, the authors conclude that risk management is more central and more independent in a bank. The last regression presented in Table 8 shows that the index has a negative coefficient, but it is not significant. The interpretation of this result, in our admittedly small sample, is that there is no evidence that the organization of risk management was related to holdings of highly-rated tranches.

Section 5. Conclusion.

In this paper, we estimate holdings of highly-rated tranches of U.S. commercial banks. We use five different approaches to estimate these holdings on balance sheet as well as off balance sheet and the different approaches lead to similar conclusions. Using a sample of 231 publicly-traded U.S. bank holding companies, we find that there is considerable cross-sectional variation in holdings of highly-rated tranches of securitizations and that the bulk of the dollar holdings were held by some large banks. The holdings of highly-rated tranches were economically trivial for the typical bank before the credit crisis. The average of the holdings across the banking sector was only 1.3% of assets, but the average of the holdings for the banks with large trading positions was almost 5% or even 10% when we include holdings in off-balance-sheet conduits and SIVs. Yet, even among these banks, there was wide dispersion in holdings. For instance, our estimate of holdings that ignores off-balance sheet holdings for JP Morgan Chase is less than 1% of assets, but Citigroup had holdings in excess of 5%. When we take into account off-balance sheet holdings, Citigroup's holdings increase to 11% while JP Morgan Chase holds 4%.

We find that the variation in holdings of highly-rated tranches is explained by the securitization activities of banks. We provide a number of reasons why banks engaged in securitization would have invested more in highly-rated tranches. For such banks, holding highly-rated tranches could be a way to show that they had skin-in-the-game. Also, banks engaged in securitizations had to hold highly-rated tranches as a part of the securitization activities, as these banks made markets in highly-rated tranches or held these tranches as inventories. Furthermore, banks that were involved in securitization would be better placed to assess the pricing and risk of highly-rated tranches, so that investing in these securities was likely cheaper and easier for such banks. Consistent with the hypothesis that banks engaged in securitization held more highly-rated tranches, we find that banks that were active in securitization between 2003 and 2006, through either origination or providing credit enhancements, held 1.5% larger amounts of highly-rated tranches as a fraction of total assets as of December 31, 2006 than the other banks did. Further, we find that holdings of highly-rated tranches increased over time for banks as their securitization activities increased. Although our empirical evidence strongly supports the hypothesis that

banks engaged in securitizations held more highly-rated tranches, due to data limitations, we cannot distinguish among the various reasons why securitization- active banks held more highly-rated tranches.

We investigate many of the other hypotheses that have been advanced to explain holdings of highly-rated tranches by banks. In regressions, we find that the fraction of a bank's assets invested in highly-rated tranches increases with asset size up to some threshold. For the largest banks, this fraction does not increase with asset size. This evidence suggests that the most systemically important banks did not invest a larger fraction of their assets in highly-rated tranches than the largest banks not considered systemically important. We find similar results using the number of employees instead of bank assets.

To the extent that regulatory arbitrage motivates banks to securitize, the relation we find between securitization and holdings of highly-rated tranches could be evidence of the role of regulatory arbitrage in holdings of highly-rated tranches. While we find that banks engaged in regulatory arbitrage through SIVs held more highly-rated tranches, we do not find support for other implications of the regulatory arbitrage hypothesis. In particular, there is no evidence that banks with ABCP programs held more highly-rated tranches. If banks that engage the most in regulatory arbitrage are banks that have less slack in terms of regulatory capital than other banks, we show that banks that engaged in securitization do not meet that criterion. It is often argued that banks used the more advantageous capital requirements of the trading book for the purpose of regulatory arbitrage. However, controlling for size, we do not find that these banks with large trading books held more highly-rated tranches of securitizations. Lastly, we explore the "bad incentives" and "risk management failure" explanations for holdings of highly-rated tranches. We find that holdings of highly-rated tranches are unrelated to an index of governance quality of banks. Further, there is no evidence that banks where compensation was more focused on ROE, where bonuses were high relative to salary, where option compensation was more important, and where unexplained compensation was high held more highly-rated tranches. Finally, CEO equity incentives do not appear to be related to holdings of highly-rated tranches. Consequently, it is not the case that banks where CEOs had greater incentives to maximize shareholder wealth differed in their holdings of highly-rated tranches. Using an index of risk management centrality and independence developed by Ellul and

Yerramilli (2012), we find no evidence of a relation between holdings of highly-rated tranches and risk management centrality and independence. It is important to note that our results on incentives cannot be explained by a lack of power alone. Several of our incentive measures are useful to explain the leverage of banks and hence to explain their risk-taking.

We find that there is a strong correlation between a bank's securitization activity and its holdings of highly-rated tranches. This correlation holds both in cross-sectional regressions and in panel regressions. Our investigation provides little support for explanations for the holdings of highly-rated tranches that do not use securitization as a motivation for these holdings.

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Appendix 1 – Panel A: Dependent Variables

Our main data source is the Consolidated Financial Statements for Bank Holding Companies, the form FR Y-9C. We focus on Schedules HC-B (Securities), HC-D (Trading Assets), and HC-R (Regulatory Capital) to construct our main variables of interest. Below we list their definitions with references to schedules and data mnemonics in the form FR Y-9C.

Variable Name	*Schedule*	*Data Mnemonic*
Highly-Rated Residual: Sum of non-government or non-agency mortgage-backed securities (MBSs) as well as asset-backed securities (ABSs) that are rated in the highest three investment-grade (e.g., AAA, AA, or A) categories and non-government, non-agency MBSs in trading securities. The measure includes held-to-maturity (HTM) and available-for-sale (AFS) securities with 20% or 50% risk weight minus securities in 20% or 50% risk-weight category that are issued or guaranteed by the government or government-sponsored agencies. All values are at amortized costs, except for MBSs from trading assets that are recorded at fair values.	Schedules from Form FR Y-9C as of December 2006: HC-R Item 35 (Column D) + Item 35 (Column E) + Item 36 (Column D) + Item 36 (Column E) - HC-B Item 2b (Columns A+C) – Item 4a2 (Columns A+C) – Item 4b1 (Columns A+C) – Item 4b2 (Columns A+C) - Item 3 (Columns A+C) + HC-D Item 4c	bhc21754+bhc51754 bhc21773+bhc51773 -bhck1294-bhck1297 -bhck1703-bhck1706 -bhck1714-bhck1716 -bhck1718-bhck1731 -bhck8496-bhck8498 +bhck3536
Highly-Rated Residual + CDOs: Sum of the "Highly-Rated Residual" and the CDO amounts reported under trading assets in June 2008.	Highly-Rated Residual + Schedule HC-D (from Form FR Y-9C as of June 2008) Item 5a+ Item 5b	Highly-Rated Residual + bhckf649 + bhckf650
Highly-Rated Residual + CDOs and Writedowns: Sum of "Highly-Rated Residual + CDOs" and the writedowns on CDOs between December 2006 and June 2008.	Highly-Rated Residual + CDOs +CDO Writedowns from Bloomberg	Highly-Rated Residual + CDOs + CDO Writedowns from Bloomberg
Highly-Rated Residual + CDOs and Writedowns: + Conduits and SIVs: Sum of "Highly-Rated Residual + CDOs and Writedowns" and the holdings in off-balance-sheet conduits and SIVs.	Highly-Rated Residual + CDOs and Writedowns + Holdings in Conduits and SIVs from Acharya, Schnabl, and Suarez (2010).	Highly-Rated Residual + CDOs and Writedowns + Holdings in Conduits and SIVs from Acharya, Schnabl, and Suarez (2010).

Bottom-up Highly-Rated Tranches: Total value of MBSs that are not issued or guaranteed by the government or government-sponsored agencies plus ABSs, using HTM securities at amortized costs and AFS and trading securities at fair values. Note that there is no ABS data for trading securities so the ABS part includes only HTM and AFS securities.	Schedules from Form FR Y-9C as of December 2006: HC-B Items 4a3 (Columns A+D) + 4b3 (Columns A+D) + Item 5 (Column A+D) + HC-D Item 4c	bhck1709+bhck1713 +bhck1733+bhck1736 +bhckC026+bhckC027 +bhck3536

Appendix 1 – Panel B: Independent Variables

Variable Name	*Data Source and Algebraic Expression or Data Mnemonic*
$0-50 Billion and > $50 Billion: A piece-wise linear specification breaking up the asset size into two separate variables. The "$0-50 Billion" variable captures the first $50 Billion worth of assets. In constructing this variable, each BHC in our sample takes the value Min{BHC asset size, $50 Billion}. The ">$50 Billion" variable captures asset size in excess of $50 Billion. In constructing this variable, each BHC in our sample takes the value Min{0, BHC asset size - $50 Billion}.	Schedule HC: bhck2170
$0-50 Billion, $50-$250 Billion, and > $250 Billion: A piece-wise linear specification breaking up the asset size into three separate variables. The "$0-50 Billion" variable captures the first $50 Billion worth of assets. In constructing this variable, each BHC in our sample takes the value Min{BHC asset size, $50 Billion}. The "$50-$250 Billion" variable captures the asset size in excess of $50 Billion but less than $250 Billion. In constructing this variable, each BHC in our sample takes the value of Min{0, $250 Billion - $50 Billion}. The ">$250 Billion" variable captures the asset size in excess of $250 Billion. In constructing this variable, each BHC in our sample takes the value Min{0, BHC asset size - $250 Billion}.	Schedule HC: bhck2170
>$50 Billion Indicator: One for banks with assets in excess of $50 Billion, zero otherwise.	Schedule HC: bhck2170
>$100 Billion: One for banks with assets in excess of $100 Billion in assets, zero otherwise.	Schedule HC: bhck2170
$0-10,000 Employees and > $10,000 Employees: A piece-wise linear specification breaking up the impact of the employee count into two separate variables. The "$0-10,000 Employees" variable captures the first 10,000 employees. In constructing this variable, each BHC in our sample takes the value Min{BHC number of employees, 10,000}. The ">10,000" variable captures the count in excess of 10,000 employees. In constructing this variable, each BHC in our sample takes the value Min{0, BHC number of employees – 10,000}. 10,000 employees represent the 90th percentile in the distribution of total employees in the cross-section of banks in our sample.	Schedule HC: bhck4150

ABCP Activity Indicator: Equal to one if a bank has any Asset Backed Commercial Paper (ABCP) activity during the years 2003-2006. A bank is ABCP active if the maximum amount of its credit exposure arising from credit enhancements provided to asset-backed commercial paper conduit structures in the form of standby letters of credit, subordinated securities and other credit enhancements is not zero. Note that we also include the amount of unused commitments to provide liquidity to conduit structures.	Schedule HC-S: Variable equal to 1 if bhck806 + bhck808 > 0 in any year 2003-2006
Assets/Tier 1 Capital: Total assets divided by BHC Tier 1 capital.	Schedule HC-R: bhck2170/bhck8274
Bonus-per-Salary: The ratio of total managerial bonuses divided by total managerial salary.	Execucomp
Book leverage: Calculated as 1 – (book value of equity/assets) as of 2006.	Schedule HC: 1 – (bhck3210/bhck2170)
C&I Loans: Commercial and industrial loans, scaled by total assets.	Schedule HC-C: (bhck1763+bhck1764)/bhck2170
CEO Ownership %: Total CEO ownership divided by total shares outstanding as of year-end 2006. Total ownership is calculated as the sum of delta weighted options and shares owned (both unrestricted and unvested restricted stock).	Execucomp and Compustat
Change in Leverage, 2000 Q4 – 2002 Q4: The change in Tier 1 leverage from 2000 Q4 to 2002 Q4. In March 2001 banks began incorporating a loan's credit rating into calculations of risk-based capital. Prior to the rule change, risk-based capital was calculated based on asset type rather than explicit asset risk, as measured by credit ratings. Firms experiencing the largest increase in leverage surrounding the ratings-based rule change are identified as firms likely to have been engaging in regulatory capital arbitrage.	As of 2002 Q4: (bhck2170/bhck8274)/(bhck2170(t-8)/bhck8274(t-8))
Compensation Residual: This variable is constructed by computing the log of average total executive compensation from 2003-2006, which is regressed on the log of firms' 2006 market cap. The residual from this regression, estimated in 2006, serves as the compensation residual variable in the cross-sectional regressions estimated in 2006.	Execucomp and Compustat For the banks that are not covered in Execucomp, we hand-collected data from their proxy statements.
Conduit Indicator: One if the BHC is identified as having sponsored a conduit, zero otherwise.	Acharya, Schnabl, and Suarez (2011).

Dollar Gain from +1%: The change in CEO wealth per 1% increase in shareholder wealth. It is calculated as market cap * .01 * delta-weighted ownership.	Execucomp and Compustat For the banks that are not covered in Execucomp, we hand-collected data from their proxy statements.
Equity Risk (%): The percent change in CEO wealth that results given a change in volatility of 1%. The variable is created by calculating the change in option value given a 1% change in volatility. The change in option value for a given change in volatility is then divided by the sum of the value of the delta-weighted option portfolio, stock holdings, and preferred share holdings of the CEO.	Execucomp and Compustat For the banks that are not covered in Execucomp, we hand-collected data from their proxy statements.
Governance Index: Index of 41 firm-level attributes from RiskMetrics. The index increases with the protection of minority shareholders and incorporates measures of board structure, anti-takeover provisions, auditor selection as well as compensation and ownership structure.	RiskMetrics: Governance index from Aggarwal, Erel, Ferreira, and Matos (2011)
High-Compensation Elasticity: The elasticity of the CEO's total compensation to changes in bank ROE. Total compensation comprised of the following: Salary, Bonus, Other Annual, Total Value of Restricted Stock Granted, Total Value of Stock Options Granted (using Black-Scholes), Long-Term Incentive Payouts, and All Other Total. Return on Equity is calculated as: Net Income / Common Equity Total as of Fiscal Year End. Bonus elasticity is computed using only the total dollar amount of bonuses paid to the CEO. In our regression framework, we create an indicator variable equal to one for BHCs with above-median levels of comp/ROE elasticity.	Execucomp and Compustat For the banks that are not covered in Execucomp, we hand-collected data from their proxy statements.
Log Market Cap: Log of December 2006 market capitalization.	CRSP: Market price * shares outstanding
Log Market-to-Book: Log of the ratio of December 2006 market capitalization to 2006 fiscal year-end book value of equity.	CRSP and Compustat: (Market price*shares outstanding)/book value of equity, fiscal year end.
Log Z-score: Log[(ROA + Capital Ratio)/sigma(ROA)]. ROA and Capital Ratio in the numerator are calculated as of 2006. Sigma ROA is calculated using quarterly data from 2000-2005.	ROA: (bhck4340/bhck2170) Cap. Ratio: (MarketCap2006/bhck2170)

Market Leverage: Calculated as 1 – [market value of equity/(market value of equity + book value of liabilities)] as of 2006. Market value of equity calculated as 2006-year end stock price*shares outstanding	CRSP: Market price * shares outstanding Book liabilities: Schedule HC: bhck2948 for book value of liabilities.
Market Risk Equivalent Bank Indicator: Equal to one for any BHC that is subject to the market risk capital guidelines. A BHC is subject to the market risk capital guidelines, and thus able to use estimates of V.A.R. in calculating capital requirements, if it's consolidated trading activity, defined as the sum of trading assets and liabilities for the previous quarter, equals: (1) 10% or more of the BHCs total assets for the previous quarter, or (2) $1 Billion or more.	Schedule HC-R: Variable equal to 1 if bhck1651 > 0 as of December 31, 2006.
(Mortgage Sec. $$_t$$ - Mortgage Sec. $$_{t-4}$$)/Assets$$_{t-4}$$: Year-over-year change (sampled quarterly) in the total amount of the outstanding principle balance of 1-4 family residential loans and home equity loans sold and securitized with servicing retained or with recourse or other seller-provided credit enhancements.	Schedule HC-S: The $ amount of mortgage securitization activity is calculated as (bhckb705 + bhckb706).
Mortgage Loans: Sum of all loans secured by real estate, scaled by total assets.	Schedule HC-C: bhck1410/bhck2170.
Net Derivatives/Assets: The sum of beneficiary credit derivatives – guarantor credit derivatives (all in notional amounts), scaled by total assets. Beneficiary and guarantor credit derivatives are calculated as the sum of CDS, total return swaps, credit options and "other."	Schedule HC-L: [(bhckc969 + bhckc971 + bhckc973 + bhckc975) - (bhckc968 + bhckc970 + bhckc972 + bhckc974)] /bhck2170 Schedule HC: (bhdmb993 + bhckb995 + bhck3548)/bhck2170
"Other" H.T.M. and A.F.S. Securities (Gov., Agency, & Lower-rated Private-Label H.T.M. and A.F.S. Securities): The portion of Held-to-Maturity and Available-for-Sale securities held on BHC balance sheets that are government or agency securities. This variable also captures the portion of non-highly rated non-agency, non-government (private-label) securities. It is calculated as the difference between the total HTM and AFS securities on BHCs balance sheet and the total "highly-rated residual" HTM and AFS securities on BHCs balance sheet.	HC-B item 8 (column A and D) – Highly-Rated Residual (see construction in Appendix A) + HC-D item 4c: (bhck1754+bhck1773) – Highly-Rated Residual (see Appendix A) – bhck3536.
"Other" Trading Securities (Gov., Agency, & Lower-Rated Private Label Trading Securities): The portion of trading assets on BHCs balance sheet that are not included in the highly-rated residual. This includes all government and agency securities as well as non-highly rated private-label securities	HC-D item 12 (Column A) – item 4c (Column A): bhck3545 – bhck3536.

held on the trading book. It is calculated as the difference between total BHC trading assets and the "all other MBS" portion of trading assets.	
Prior Returns: BHC buy-and-hold returns calculated from January 2005- January 2006.	CRSP
Ratio of total agency holdings to assets: The sum of all agency-issued securities held as H.T.M., A.F.S., and in the trading book, scaled by total assets.	Schedule HC: (bhck1289 + bhck1293 + bhck1294 + bhck1298 + bhck1698 + bhck1703 + bhck1709 + bhck1714 + bhck1718 + bhck1702 + bhck1707 + bhck1713 + bhck1717 + bhck1732 + bhck3532 + bhck3534 + bhck3535)/bhck2170
ROA Volatility: Standard deviation in ROA using quarterly data from 2000-2005.	ROA: (bhck4340/bhck2170)
Risk Management Index (RMI): It is an index that measures the strength of operational risk management at the largest publicly listed bank holding companies (BHCs) in the U.S. It is constructed by taking the first principal component of the five key risk management variables: a dummy variable that identifies whether the chief risk officer (CRO) is an executive officer at the BHC or not; a dummy variable that identifies if the CRO is among the top five highest paid executives at the BHC or not; the ratio of the CRO's total compensation to the CEO's total compensation; a dummy variable that identifies whether at least one of the grey or independent directors serving on the board's risk committee has banking experience; and a dummy variable identifying if the BHC's board risk committee met more frequently during the year compared to the average board risk committee across all BHCs. See Ellul and Yerramilli (2012) for a detailed description of these variables.	Ellul and Yerramilli (2012)
Risk-weighted assets/Tier 1 Capital: Risk-weighted assets divided by BHC Tier 1 capital.	Schedule HC-R: bhckA223/bhck8274
(Sec. $\$_t$ – Sec. $\$_{t-4}$)/Assets$_{t-4}$: Year-over-year (sampled quarterly) change in the total amount of the outstanding principle balance of assets sold and securitized with servicing retained or with recourse or other seller-provided credit enhancements.	Schedule HC-S: The $ amount of securitization activity is calculated as (bhckb705 + bhckb706 + bhckb707 + bhckb708 + bhckb709 + bhckb710 + bhckb711).
Securitization-active Indicator: Total outstanding principal balance of assets sold and securitized	Schedule HC-S:

with servicing retained or with recourse or other seller-provided credit enhancements. The securitization active dummy variable is equal to one for banks that have any positive amount of securitization activity in the years 2003-2006.	Variable equal to 1 if (bhckb705 + bhckb706 + bhckb707 + bhckb708 + bhckb709 + bhckb710 + bhckb711) > 0 in any year 2003-2006.
Securitization-league-table Indicator: Equal to one for any BHC that was involved in the underwriting of any type of securitization, including subprime RMBS, CLOs, CBOs, and CDOs.	Moody's eMaxx Data Services
Securitization-league-table Rank: Equal to zero for all banks in the sample, except the top-ten banks in the securitization league table, which take the value of their league-table rank, in reverse order. (e.g., Citigroup, the top securitization-producing bank in the sample takes the value 10, Bank of America 9, JPMorgan 8, etc.)	Moody's eMaxx Data Services
Short-term Wholesale Funding/Assets: The sum of time deposits of $100,000 or more + commercial paper + federal funds purchased and securities sold under agreements to repurchase + other borrowed money with a remaining maturity of 1 year or less+ trading liabilities, scaled by total assets	Schedule HC: (bhcb2604 + bhck2309 + bhdmb993 + bhckb995 + bhck2322+ bhck3548)/bhck2170
Stock Return Volatility: Volatility of weekly stock returns calculated using January-December 2006 sample.	CRSP
Unused Loan Commitments: Unused portion of residential and commercial real estate loan commitments.	Schedule HC-L: (bhck3814+bhck3816)/bhck2170.

Appendix 2 – Investment Banks

As discussed in the introduction, stand-alone investment banks did not have to report the information that we use in this paper to estimate holdings of highly-rated tranches by banks. Investment banks did report some information about exposures to securitizations and to subprime mortgages in their annual statements. However, the reporting format was specific to each bank. We collected information for 2006. Some of that information was only made available in filings for the 2007 reporting year. A brief summary of available information on holdings of highly-rated tranches is as follows:

1) Bear Stearns. Bear Stearns reports data on retained interests in its own securitizations. It states that "Retained interests in securitizations are generally not held to maturity and typically are sold shortly after the settlement of a securitization." (2007 10-K). On November 30, 2006, Bear Stearns had AAA-rated retained interests in non-agency securitizations of $1.5 billion. In addition, it had $2.6 billion on non-AAA rated non-agency retained interests. The 10-K also reported AAA-rated CDO exposure as $755 million. Separately, it reported subprime mortgage exposure for November 30, 2007. It had $1 billion of subprime investment-grade securitizations. But, Bear Stearns' overall subprime exposure was negative $582 million because it had a short position in ABS CDSs. Bearn Stearns also reported securitizations that did not qualify for sale treatment and hence were on the balance sheet. The total for mortgage securitizations and CDOs as of November 30, 2006 was $30 billion, but its exposure to loss was $800 million. Finally, Bear Stearns was involved in $13.8 billion of off-balance sheet ABCP activity.
2) Goldman Sachs. In the 2007 10-K, the bank said that the fair value of retained interests from mortgage-backed securities, as of 2006, was $4 billion. It had another $2 billion of retained interests in CDOs and CLOs. In addition, the firm had purchased interests in residential mortgage securitizations of $8 billion "purchased in connection with secondary market-making activities." It also had holdings that were not consolidated in the balance sheet for mortgage CDOs of $26 billion and of corporate CDOs and CLOs of $11 billion. However, the purchased and retained interests associated with these securitizations were only $2 billion. Further, it had exposure

through derivatives on these securitizations of $10 billion. The bank also reported its subprime exposure for November 2007, which was $2 billion. Its Alt-A exposure was around $6 billion. Furthermore, the bank reported amounts held in securities that may be more difficult to fund on a secured basis in times of stress in its 2007 10-K. For example, it held $41 billion of mortgage and other asset-backed loans and securities as of November 2006. As of November 2007, it reported level 3 "loans and securities backed by residential estate" for $2 billion.

3) Lehman Brothers. In its 2007 10-K, Lehman provided an estimate of its holdings of mortgage and asset-backed securities as of November 30, 2006. The total amount, which included whole loans and servicing, was $52 billion. Securities amounted to $10 billion. Investment-grade retained interest in securitizations were $5.3 billion for residential and asset backed while it was $0.6 billion for commercial mortgage loans and MBSs. Using data on agency securitizations, it follows that holdings of private-label investment-grade securitizations were $3.4 billion. A separate table provides exposure to subprime mortgages. The total was $6.9 billion, of which $1.8 billion corresponds to retained interests in securitizations. In its fair value table for 2007, Lehman reports holdings of $89 billion of mortgage and asset-backed securities. These holdings include holdings of agency mortgage-backed securities. Lehman was also involved in $2.1 billion worth of off-balance sheet ABCP activity.

4) Merrill Lynch. It reported total U.S. subprime exposures of $2.7 billion at the end of 2007, but it also made losses in 2007 of $3.1 billion on subprime exposures. In addition, it had Alt-A exposures of $2.7 billion. The bank had retained interest on residential mortgage loans of $2.8 billion at the end of 2007. Its exposure to securitizations that were consolidated on its balance sheet for real estate was $4.3 billion in 2006 and $16.3 billion in 2007, but investors had no recourse to Merrill. It reports a long exposure in super-senior CDOs of $30.4 billion and a short exposure of $23.6 billion as of 2007. However, in addition, it made losses of $14.6 billion on CDOs in 2007, so that an estimate of its end of 2006 exposure is $21 billion. Acharya, Schnabl,

and Suarez (2011) also report that Merrill Lynch had $6.8 billion worth of off-balance sheet ABCP activity.

5) Morgan Stanley. It showed retained interests from private label residential mortgage securitizations of $3.2 billion at the end of November 2007. Of these, $1.2 billion were non-investment grade. Securitizations that were consolidated in the balance sheet are for $5.9 billion, with an exposure of $1.75 billion. In a conference presentation, Morgan Stanley showed net subprime exposure of $10.4 billion at the end of the third quarter of 2007, most of which was written down the next quarter. Further, it had $14 billion of other mortgage net exposure and $36 billion of net CMBS exposure. Based on one of the tables in 2007 10-K, the bank's net subprime exposure was $6.1 billion as of November 30, 2007. It had a long exposure of $11.1 subprime exposure in loans, total return swaps, and CDS, but most of that exposure was from $7.8 billion in ABS CDS. It reported CDO subprime exposure of negative $5 billion. Its holdings of CDOs amounted to $1 billion, but it had a net short derivatives position of $6 billion. In another table, however, it reports that the net total U.S. subprime trading exposure was $1.8 billion. Three of the investment banks, Goldman Sachs, Merrill Lynch, and Morgan Stanley, had assets in excess of $1 trillion at the end of 2007. The assets of Bear Stearns were $395 billion and those of Lehman Brothers were $691 billion. Our estimates of the non-agency securitization exposures of the investment banks are not equivalent to those of the bank holding companies. Nevertheless, three facts are worth noting. First, the net exposures to securitizations are not higher than the holdings of bank holding companies with large trading assets. Second, the investment banks focus much more on net exposures, so that long holdings are likely to be substantially larger than the long holdings of bank holding companies. Third, derivatives play a large role in the exposures of investment banks.

Figure 1. Dollar Amounts of Holdings of Highly-Rated Tranches.

This figure plots the aggregate, nominal U.S. dollar amount of holdings of highly-rated tranches through time. Our sample runs from 2002-2008 and includes all U.S. publicly-traded bank holding companies (BHCs). The plot is created using the "Highly-Rated Residual" measure of highly-rated holdings. See Appendix 1-Panel A for a description of this variable.

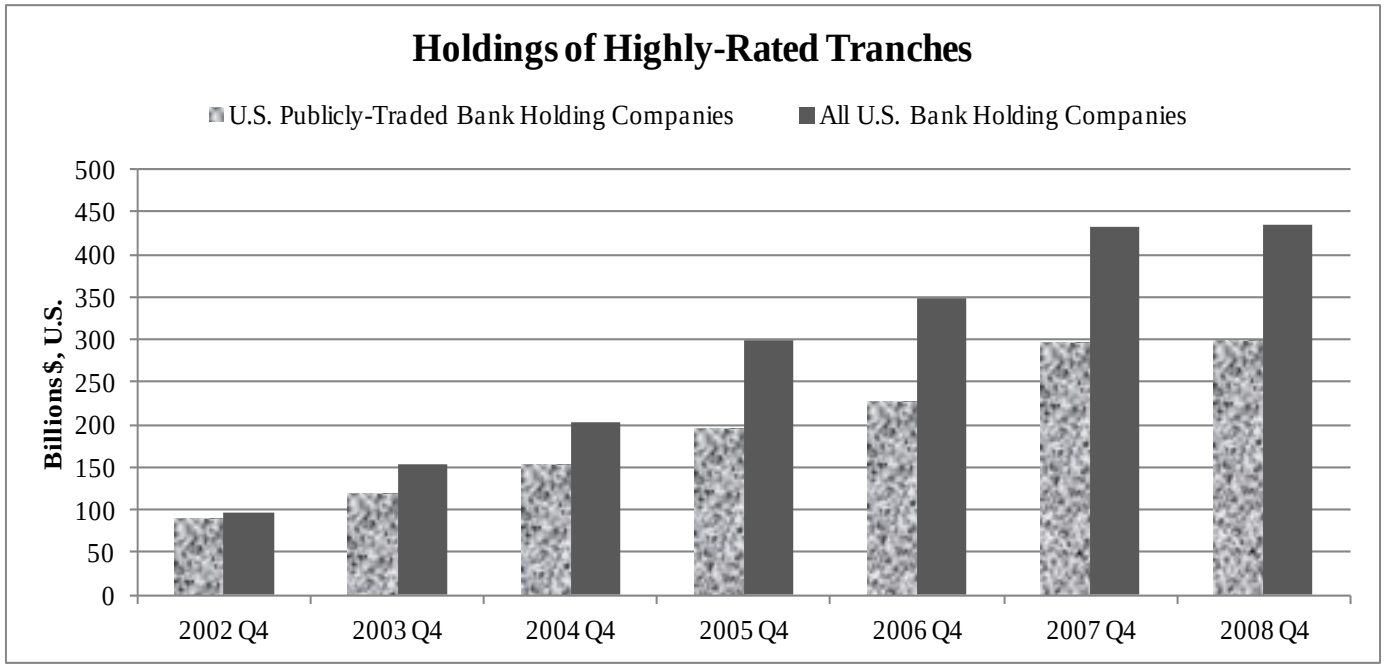

Figure 2. Time Series Plot of Holdings of Highly-Rated Tranches as a Percent of Total Assets.

This figure plots the holdings of highly-rated tranches as a percent of total assets through time. The sample includes all U.S. publicly-traded bank holding companies (BHCs). Banks are deemed "securitization-active" if the outstanding principle balance of assets sold and securitized with servicing retained or with recourse or other seller-provided credit enhancements is greater than zero in any quarter between the years 2003-2006. Forty-six banks meet this criterion as of January 2002. The remaining banks are characterized as "Non-securitization active."

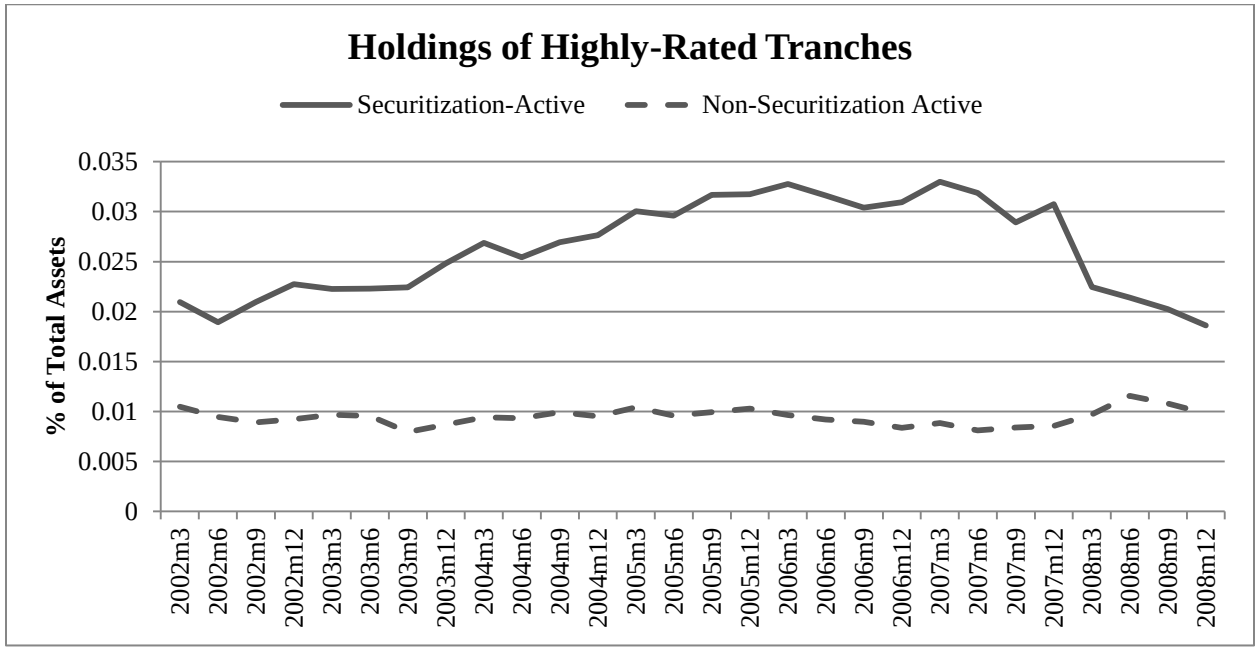

Figure 3. Time Series Plot of Regulatory "Cushion."

This figure plots the regulatory "cushion" of all U.S. publicly-traded bank holding companies (BHCs). The regulatory cushion is calculated as the ratio of Tier 1 capital to risk-weighted assets, minus 4%. Banks are deemed "securitization-active" if the outstanding principle balance of assets sold and securitized with servicing retained or with recourse or other seller-provided credit enhancements is greater than zero in any quarter between the years 2003-2006. Forty-six banks meet this criterion as of January 2002. The remaining banks are characterized as "Non-securitization active."

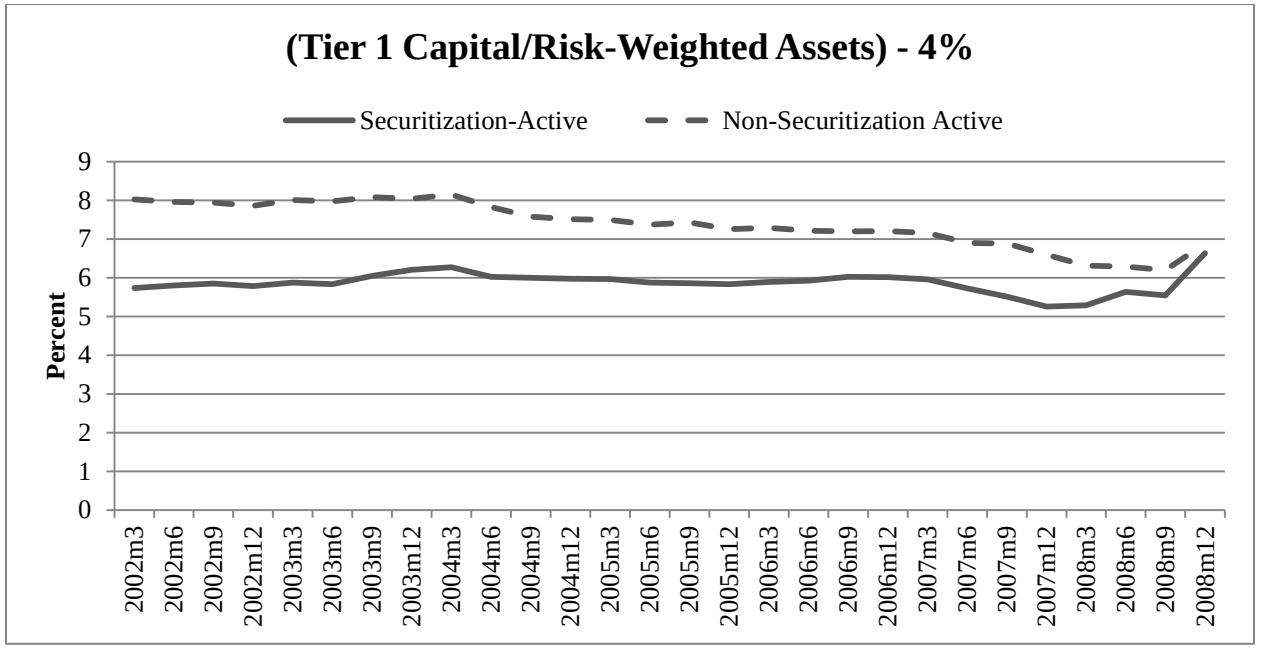

Figure 4. Time Series Plot of Total Assets to Risk-Weighted Assets.

This figure plots the ratio of total assets to risk-weighted assets using a sample of U.S. publicly-traded bank holding companies (BHCs). The sample includes all securitization-active BHCs and a size-based matched sample of non-securitization active BHCs. Banks are deemed "securitization-active" if the outstanding principle balance of assets sold and securitized with servicing retained or with recourse or other seller-provided credit enhancements is greater than zero in any quarter between the years 2003-2006.

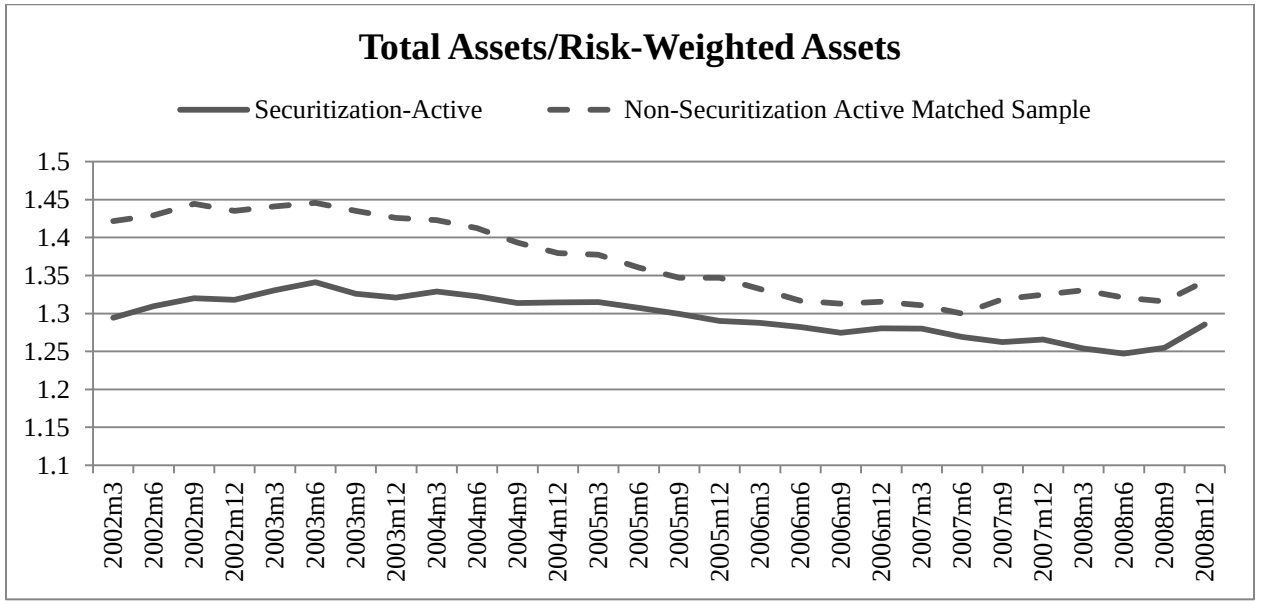

Table 1. Documenting the Holdings of Highly-Rated Tranches Among U.S. Bank Holding Companies.

This table reports summary statistics of some measures of holdings of highly-rated tranches: "Highly-Rated Residual", "Highly-Rated Residual + CDOs", "Highly-Rated Residual + CDOs and Writedowns," "Highly-Rated Residual + CDOs + Writedowns + Conduits and SIV's," and "Bottom-up Highly-Rated Tranches." See Appendix 1 for the definition of the variables. The full sample includes all U.S. publicly-traded bank holding companies (BHCs). Large trading-asset banks are defined as BHCs with trading assets in excess of $1 Billion or BHCs whose trading assets represent greater than 10% of total assets. Non-zero trading asset banks are defined as banks with trading assets greater than $0 and less than $1 Billion (or with trading assets representing less than 10% of total assets). Non-trading asset banks are defined as banks with no trading assets. 25 TARP Banks are the ones that received the largest dollar amounts of TARP funds. Beginning in the second quarter of 2008, BHCs with trading assets in excess of $1 Billion have been required to report the amount of CDOs and ABSs held in their trading portfolio. Panel B reports statistics for the residual measure plus these CDOs as of 2008. In Panel C, we also include write-downs on CDOs from Bloomberg covering 2006 onwards. Panel D includes the total amount of assets held in off-balance sheet conduits and SIV's, as reported by Acharya, Schnabl, and Suarez (2011). Panel E reports "Bottom-up Highly-rated Tranches," based on a measure borrowed from Cheng, Hong, and Scheinkman (2010).

	Full Sample				Large Trading-Asset Banks		Non-Zero Trading Asset Banks		Non Trading-Asset Banks		25 TARP Banks	Citigroup	B of A	JPMorgan Chase
Year	Obs	Mean	Med	90th %tile	Obs	Mean	Obs	Mean	Obs	Mean	Mean			
Panel A: "Highly-Rated Residual"														
2002	169	1.29%	0.10%	3.59%	13	3.05%	35	1.68%	121	0.99%	1.77%	1.96%	1.29%	0.00%
2003	184	1.27%	0.06%	3.40%	13	3.77%	37	1.71%	134	0.91%	2.24%	2.26%	0.79%	0.20%
2004	205	1.37%	0.02%	3.85%	14	3.76%	36	2.38%	155	0.92%	2.84%	2.74%	0.94%	0.88%
2005	218	1.50%	0.10%	4.48%	14	4.70%	37	3.11%	167	0.88%	3.69%	3.54%	1.43%	0.80%
2006	231	1.31%	0.15%	3.13%	14	4.75%	40	2.49%	177	0.78%	3.27%	4.78%	1.04%	0.63%
2007	224	1.27%	0.20%	3.04%	12	3.18%	47	2.26%	165	0.85%	2.60%	5.06%	1.73%	1.57%
2008	220	1.13%	0.11%	3.12%	11	2.42%	47	1.52%	162	0.93%	1.92%	4.39%	2.55%	2.03%
Panel B: "Highly-Rated Residual + CDOs"														
2006	231	1.31%	0.15%	3.13%	14	4.76%	40	2.49%	177	0.78%	3.30%	4.79%	1.05%	0.67%
Panel C: "Highly-Rated Residual + CDOs and Writedowns"														
2006	231	1.33%	0.15%	3.14%	14	4.99%	40	2.52%	177	0.78%	3.42%	5.75%	1.96%	1.09%
Panel D: "Highly-Rated Residual + CDOs + Writedowns + Conduit's and SIV's"														
2006	231	1.51%	0.16%	3.73%	14	6.59%	40	2.96%	177	0.78%	4.81%	10.67%	5.08%	4.25%
Panel E: "Bottom-Up Highly-Rated Tranches"														
2002	169	1.11%	0.04%	3.49%	13	2.01%	35	1.56%	121	0.89%	1.36%	1.18%	1.37%	0.18%
2003	184	1.01%	0.01%	3.15%	13	2.95%	37	1.53%	134	0.67%	1.85%	1.04%	0.84%	0.26%
2004	205	1.14%	0.01%	2.64%	14	3.09%	36	2.31%	155	0.69%	2.49%	1.25%	0.52%	0.35%
2005	218	1.26%	0.01%	3.26%	14	4.14%	37	2.80%	167	0.68%	3.23%	1.85%	1.18%	0.78%
2006	231	1.28%	0.09%	3.17%	14	5.04%	40	2.47%	177	0.72%	3.31%	3.89%	1.83%	0.64%
2007	224	1.23%	0.14%	3.15%	12	3.56%	47	2.13%	165	0.80%	2.42%	4.69%	2.56%	1.51%
2008	220	1.03%	0.17%	3.24%	11	2.37%	47	1.32%	162	0.85%	1.81%	3.89%	3.19%	2.40%

Table 2. Bank Risk and Holdings of Highly-Rated Tranches.

This table documents the relationship between holdings of highly-rated securitization tranches and various proxies for bank risk as of Dec 2006. The left-hand-side variable is the "Highly-Rated Residual" in Panel A and "Highly-Rated Residual + CDOs and Writedowns + Conduits and SIVs" in Panel B. Risk proxies are the banks' z-score, ROA volatility, stock return volatility, market or book leverage, two regulatory measures of leverage, net derivatives as a fraction of total assets, and short-term wholesale funding as a fraction of total assets. Appendix 1 outlines the construction of the measures of highly-rated holdings as well as the definitions of the main explanatory variables and control variables. Heteroskedasticity-robust *t-statistics* are in parentheses. The symbols ***, ** and * indicate significance at the 1, 5, and 10% levels, respectively.

		Measures of Holdings of Highly-Rated Tranches			
		Highly-Rated Residual		Highly-Rated Residual + CDOs and Writedowns + Conduits and SIVs	
		Panel A		*Panel B*	
	Regressions	Without Controls	With Controls	Without Controls	With Controls
Log z-score	(1)-(2)	-0.000	0.002	-0.002	0.001
		(-0.0498)	(0.277)	(-0.474)	(0.171)
Adjusted R-squared		-0.005	0.137	-0.004	0.222
ROA Volatility	(3)-(4)	1.719	-1.399	2.065	-1.517
		(0.663)	(-0.457)	(0.788)	(-0.503)
Adjusted R-squared		-0.001	0.139	-0.003	0.223
Stock Return Volatility	(5)-(6)	-1.279	1.372	-2.106*	1.677
		(-1.161)	(0.671)	(-1.799)	(0.840)
Adjusted R-squared		0.000	0.149	0.006	0.236
Market Leverage	(7)-(8)	-0.086	0.533	-0.123	0.578
		(-0.100)	(0.628)	(-0.138)	(0.676)
Adjusted R-squared		-0.004	0.146	-0.004	0.233
Book Leverage	(9)-(10)	0.059	0.091	0.057	0.105
		(0.652)	(0.920)	(0.596)	(1.044)
Adjusted R-squared		-0.002	0.149	-0.003	0.236
Assets/Tier 1 Capital	(11)-(12)	0.003**	0.002	0.005***	0.002
		(2.193)	(1.269)	(2.914)	(1.266)
Adjusted R-squared		0.044	0.154	0.079	0.239
Risk-weighted Assets/Tier 1 Capital	(13)-(14)	0.001	-0.003	0.003**	-0.002
		(0.993)	(-1.482)	(2.151)	(-1.172)
Adjusted R-squared		-0.001	0.158	0.017	0.238
Net Derivatives/Assets	(15)-(16)	1.332*	0.757	1.823	0.838
		(1.726)	(1.227)	(1.601)	(1.178)
Adjusted R-squared		0.043	0.156	0.068	0.243
Short-term Wholesale Funding/Assets	(17)-(18)	0.037	-0.024	0.086**	-0.026
		(1.152)	(-0.435)	(2.110)	(-0.463)
Adjusted R-squared		0.001	0.147	0.017	0.234
Observations		204-225			

Table 3. Holdings of Highly-Rated Tranches and Bank Holding Company Stock Returns.

This table documents the relationship between BHC stock returns and holdings of highly-rated tranches as of Dec 2006. The dependent variable is buy-and-hold excess return over the equally-weighted market return from July 1, 2007 through December 31, 2008. Each regression uses a different measure of highly-rated holdings. Appendix 1 outlines the construction of the measures of highly-rated holdings as well as the definitions of the main explanatory variables and control variables. Heteroskedasticity-robust *t-statistics* are in parentheses. The symbols ***, ** and * indicate significance at the 1, 5, and 10% levels, respectively.

	Measures of Holdings of Highly-Rated Tranches				
	"Highly-Rated Residual"	"Highly-Rated Residual + CDOs"	"Highly-Rated Residual + CDOs and Writedowns"	"Highly-Rated Residual + CDOs and Writedowns + Conduits and SIVs"	"Bottom-Up Highly-Rated Tranches"
	(1)	(2)	(3)	(4)	(5)
80th %tile - 100th%tile Highly-Rated Tranche Holdings Indicator	-0.134**	-0.134**	-0.138**	-0.143**	-0.080
	(-2.249)	(-2.249)	(-2.301)	(-2.338)	(-1.227)
60th %tile - 80th%tile Highly-Rated Tranche Holdings Indicator	-0.107	-0.107	-0.114	-0.127*	-0.064
	(-1.439)	(-1.439)	(-1.535)	(-1.738)	(-0.912)
40th %tile - 60th%tile Highly-Rated Tranche Holdings Indicator	-0.096	-0.096	-0.088	-0.075	-0.010
	(-1.467)	(-1.467)	(-1.354)	(-1.174)	(-0.165)
20th %tile - 40th%tile Highly-Rated Tranche Holdings Indicator	-0.095	-0.095	-0.095	-0.095	0.086
	(-0.999)	(-0.999)	(-0.992)	(-0.996)	(0.862)
0%tile - 20th%tile Highly-Rated Tranche Holdings (Omitted Group)					
Unused Loan Commitments	-1.363**	-1.363**	-1.362**	-1.357**	-1.268**
	(-2.396)	(-2.396)	(-2.383)	(-2.378)	(-2.191)
Mortgage Loans as % of Total Assets	-0.786**	-0.786**	-0.784**	-0.789**	-0.805**
	(-2.266)	(-2.266)	(-2.283)	(-2.284)	(-2.243)
C&I Loans as % of Total Assets	-0.808*	-0.808*	-0.818*	-0.838**	-0.851**
	(-1.921)	(-1.921)	(-1.970)	(-2.031)	(-2.065)
"Other" H.T.M. and A.F.S. Securities	0.604	0.604	0.609	0.599	0.616
	(1.441)	(1.441)	(1.459)	(1.421)	(1.413)
"Other" Trading Securities	-2.645*	-2.645*	-2.616*	-2.598*	-2.558*
	(-1.764)	(-1.764)	(-1.766)	(-1.706)	(-1.712)
Log Market Cap	-0.005	-0.005	-0.004	-0.002	-0.008
	(-0.227)	(-0.227)	(-0.190)	(-0.104)	(-0.397)
Prior Returns	0.149	0.149	0.150	0.151	0.156
	(0.960)	(0.960)	(0.968)	(0.975)	(1.008)
Market-to-Book	0.116***	0.116***	0.115***	0.115***	0.110***
	(3.223)	(3.223)	(3.217)	(3.226)	(3.046)
Assets/ Tier 1 Capital	0.002	0.002	0.002	0.002	0.001
	(0.151)	(0.151)	(0.166)	(0.149)	(0.0926)
Constant	0.437	0.437	0.420	0.394	0.485
	(0.745)	(0.745)	(0.716)	(0.677)	(0.785)
Observations	218	218	218	218	218
Adjusted R-squared	0.235	0.235	0.236	0.237	0.225

Table 4. Median Holdings of Highly-Rated Tranches by Size Vigintiles

This table reports how median holdings of highly-rated tranches change across size vigintiles as of December 2006. Each column uses a different measure of holdings: “Highly-Rated Residual,” “Highly-Rated Residual + CDOs,” “Highly-Rated Residual + CDOs and Writedowns,” “Highly-Rated Residual + CDOs + Writedowns + Conduits and SIV’s,” “and Bottom-up Highly-Rated Tranches.” See Appendix 1 for the definition of the variables.

Median Holdings of Highly-rated Tranches by Size Vigintile						
Size Vigintile	"Highly-Rated Residual"	"Highly-Rated Residual + CDOs"	"Highly-Rated Residual + CDOs and Writedowns"	"Highly-Rated Residual + CDOs and Writedowns + Conduits and SIVs"	"Bottom-Up Measure"	Ratio of Total Agency Holdings to Assets
	(1)	(2)	(3)	(4)	(5)	(6)
1	0.00%	0.00%	0.00%	0.00%	0.00%	10.63%
2	0.00%	0.00%	0.00%	0.00%	0.00%	11.23%
3	0.76%	0.76%	0.76%	0.76%	0.47%	12.56%
4	0.00%	0.00%	0.00%	0.00%	0.07%	11.99%
5	0.03%	0.03%	0.03%	0.03%	0.00%	12.18%
6	0.18%	0.18%	0.18%	0.18%	0.11%	15.97%
7	0.05%	0.05%	0.05%	0.05%	0.00%	8.05%
8	0.05%	0.05%	0.05%	0.05%	0.00%	12.18%
9	0.00%	0.00%	0.00%	0.00%	0.00%	12.90%
10	0.01%	0.01%	0.01%	0.01%	0.00%	14.44%
11	0.00%	0.00%	0.00%	0.00%	0.00%	10.50%
12	0.10%	0.10%	0.10%	0.10%	0.01%	8.50%
13	0.31%	0.31%	0.31%	0.31%	0.12%	13.58%
14	0.82%	0.82%	0.82%	0.82%	0.33%	12.69%
15	0.72%	0.72%	0.72%	0.72%	0.59%	13.15%
16	0.01%	0.01%	0.01%	0.01%	0.00%	17.62%
17	0.34%	0.34%	0.34%	0.34%	0.45%	13.84%
18	1.54%	1.54%	1.54%	1.54%	1.52%	11.96%
19	0.87%	0.87%	1.34%	1.61%	0.85%	9.07%
20	1.82%	1.82%	1.91%	4.67%	1.98%	10.03%

Table 5. Holdings of Highly-Rated Tranches and Bank Asset Size.

This table tabulates the results of an OLS regression of our measures of highly-rated holdings on measures of bank size and control variables. Panels A and C include piece-wise linear specifications of bank asset size as a measure of bank size. Panel B includes a piece-wise linear specification of total bank employees as a measure of bank size. Panels D and F use an indicator variable for BHCs with asset size larger than $50 billion and $100 billion, respectively. Panel F uses a Stress-Test Bank dummy. Control variables included in all regressions but not reported below are the banks' stock returns over the previous year, market-to-book ratio, and total assets normalized by its Tier 1 capital as well as "other" securities' holdings of held-to-maturity and available-for-sale securities and "other" trading securities. Appendix 1 outlines the construction of these measures of highly-rated holdings as well as the definitions of the main explanatory variables and control variables. Heteroskedasticity-robust *t-statistics* are in parentheses. The symbols ***, ** and *indicate significance at the 1, 5, and 10% levels, respectively.

	Measures of Holdings of Highly-Rated Tranches				
	"Highly-Rated Residual"	"Highly-Rated Residual + CDOs"	"Highly-Rated Residual + CDOs and Writedowns"	"Highly-Rated Residual + CDOs and Writedowns + Conduits and SIVs"	"Bottom-Up Highly-Rated Tranches"
	(1)	(2)	(3)	(4)	(5)
Panel A					
$0-50 Billion	0.763**	0.765**	0.776**	0.996***	0.855***
	(2.453)	(2.462)	(2.498)	(2.982)	(2.797)
>$50 Billion	-0.066	-0.066	-0.059	-0.050	-0.064
	(-1.612)	(-1.634)	(-1.445)	(-1.045)	(-1.616)
Controls	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.154	0.158	0.160	0.239	0.174
Panel B					
0 - 10,000 Employees	0.004**	0.004**	0.004**	0.005***	0.004***
	(2.367)	(2.376)	(2.406)	(2.877)	(2.687)
> 10,000 Employees	-0.000	-0.000	-0.000	-0.000	-0.000
	(-1.219)	(-1.255)	(-1.069)	(-0.695)	(-1.281)
Controls	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.134	0.138	0.143	0.225	0.155
Panel C					
$0-50 Billion	0.929**	0.920**	0.949**	1.231***	1.025**
	(2.232)	(2.212)	(2.291)	(2.863)	(2.517)
$50 - $250 Billion	-0.207*	-0.197	-0.206*	-0.248*	-0.208*
	(-1.677)	(-1.598)	(-1.675)	(-1.956)	(-1.719)
> $250 Billion	-0.030	-0.033	-0.022	0.001	-0.027
	(-0.592)	(-0.648)	(-0.435)	(0.0120)	(-0.561)
Controls	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.156	0.158	0.163	0.249	0.179
Panel D					
> $50 Billion Indicator	0.016	0.016	0.016	0.022	0.022*
	(1.332)	(1.352)	(1.353)	(1.600)	(1.772)
Controls	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.042	0.045	0.051	0.113	0.053
Panel E					
> $100 Billion Indicator	0.025	0.026	0.026	0.037*	0.028
	(1.345)	(1.371)	(1.385)	(1.726)	(1.487)
Controls	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.050	0.054	0.060	0.132	0.054
Panel F					
Stress-Test Bank	0.003	0.003	0.003	0.011	0.006
	(0.178)	(0.176)	(0.186)	(0.531)	(0.360)
Controls	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.039	0.042	0.048	0.107	0.037

Table 6. Securitization Activity and Holdings of Highly-Rated Tranches.

This table tabulates the results of an OLS regression of our measures of highly-rated holdings on variables measuring a bank's securitization activity. "Securitization-active Indicator" variable in Columns (1) - (3) is equal to one if the outstanding principle balance of assets sold and securitized with servicing retained or with recourse or other seller-provided credit enhancements is greater than zero. "Securitization-league-table Indicator" in Columns (4) and (5) is equal to one for any BHC that was involved in the underwriting of any type of securitization. "Securitization-league-table Rank" in Columns (6) and (7) is equal to the rank of BHC in the League Tables of the securitization underwriting, with the minimum of 1 and maximum of 10. The dependent variable in Columns (8) and (9), "(Highly-Rated Residual $\$_t$ – Highly-Rated Residual $\$_{t-4}$)/$Assets_{t-4,}$" measures year-over-year *changes* in the amount of holdings of highly rated tranches, sampled quarterly from 2002 Q1 through 2006 Q4 (see Appendix 1 – Panel A for a detailed description of the construction of the "Highly-Rated Residual" variable). The variable "(Sec. $\$_t$ – Sec. $\$_{t-4}$)/$Assets_{t-4}$" in Column (5) is sampled quarterly and is calculated as the year-over-year change in the total amount of the outstanding principle balance of assets sold and securitized with servicing retained or with recourse or other seller-provided credit enhancements. The variable "(Mortgage Sec. $\$_t$ - Mortgage Sec. $\$_{t-4}$)/$Assets_{t-4}$" in Column (6) is sampled quarterly and is calculated as the year-over-year *change* in the amount of the outstanding principle balance of mortgage assets (1-4 family residential loans and home-equity lines of credit) sold and securitized with servicing retained or with recourse or other seller-provided credit enhancements. Control variables are defined in Appendix 1. The sample contains the cross-section of publicly traded U.S. BHCs with relevant data as of Dec 2006. Heteroskedasticity-robust *t-statistics* are in parentheses. Standard errors used to compute the T-statistics reported in columns 7 and 8 are clustered by year-quarter and by Bank. The symbols ***, ** and * indicate significance at the 1, 5, and 10% levels, respectively.

	Measures of Holdings of Highly-Rated Tranches								
	"Highly-Rated Residual"	"Highly-Rated Residual + CDOs and Writedowns + Conduits and SIV's"	Ratio of Total Agency Holdings to Assets	"Highly-Rated Residual"	"Highly-Rated Residual + CDOs and Writedowns + Conduits and SIVs"	"Highly-Rated Residual"	"Highly-Rated Residual + CDOs and Writedowns + Conduits and SIVs"	(Highly-Rated Residual $\$_t$ - Highly-Rated Residual $\$_{t-4}$)/$Assets_{t-4}$	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Securitization-active Indicator	0.015**	0.017**	-0.009						
	(2.196)	(2.428)	(-0.605)						
Securitization-league-table Indicator				0.014	0.020				
				(0.446)	(0.569)				
Securitization-league-table Rank						0.010	0.013*		
						(1.484)	(1.859)		
(Sec. $\$_t$ - Sec $\$_{t-4}$)/$Assets_{t-4}$								0.003*	
								(1.69)	
(Mortgage Sec. $\$_t$ - Mortgage Sec. $\$_{t-4}$)/$Assets_{t-4}$									0.003*
									(1.96)
$0-50 Billion	0.523*	0.719**	-0.499	0.708**	0.916***	0.656**	0.852***	0.147*	0.147*
	(1.907)	(2.378)	(-1.223)	(2.149)	(2.677)	(2.132)	(2.659)	(1.66)	(1.67)
>$50 Billion	-0.068*	-0.053	-0.024	-0.065*	-0.048	-0.097**	-0.092*	-0.010	-0.010
	(-1.670)	(-1.101)	(-1.138)	(-1.673)	(-1.081)	(-2.272)	(-1.921)	(1.11)	(1.11)
"Other" H.T.M. and A.F.S. Securities	0.031	0.028		0.030	0.029	0.033	0.032	-0.001	-0.001
	(1.243)	(1.167)		(1.334)	(1.285)	(1.390)	(1.374)	(0.14)	(0.14)
"Other" Trading Securities	0.386	0.426		0.315	0.323	0.208	0.187	0.053	0.053
	(1.093)	(1.047)		(0.970)	(0.906)	(0.790)	(0.677)	(1.14)	(1.14)
Prior Returns	-0.004	-0.001	-0.063	-0.005	-0.003	-0.008	-0.006	-0.007*	-0.007*
	(-0.398)	(-0.115)	(-1.442)	(-0.519)	(-0.272)	(-0.769)	(-0.590)	(1.87)	(1.87)
Market-to-Book	0.004*	0.004*	0.017**	0.004	0.003	0.004*	0.004	0.003**	0.003**
	(1.838)	(1.663)	(2.210)	(1.609)	(1.377)	(1.778)	(1.625)	(2.42)	(2.43)
Assets/ Tier 1 Capital	0.002	0.002	0.004	0.002	0.002	0.001	0.001	0.000	0.000
	(1.416)	(1.438)	(1.131)	(1.132)	(1.103)	(0.977)	(0.910)	(1.17)	(1.17)
Constant	-0.027	-0.031	0.127	-0.020	-0.023	-0.025	-0.029	-0.001	-0.001
	(-1.199)	(-1.353)	(1.555)	(-0.842)	(-0.926)	(-1.158)	(-1.346)	(0.21)	(0.22)
Observations	225	225	225	225	225	225	225	3723	3724
Adjusted R-squared	0.176	0.264	0.023	0.154	0.242	0.182	0.284	0.023	0.023

Table 7. Regulatory Capital Arbitrage and Holdings of Highly-Rated Tranches.

This table tabulates the results of an OLS regression of our measures of highly-rated holdings on proxies identifying banks that are likely to engage in regulatory-capital arbitrage activities. These proxies are an off-balance sheet Conduit indicator, an Asset-backed Commercial Paper (ABCP) Activity indicator, change in leverage around the regulation change in March 2001, and an indicator variable for banks that are subject to market-risk-equivalent capital rules. The construction of each of these variables, dependent variables, and controls is detailed in Appendix 1. The sample contains the cross-section of publicly traded U.S. BHCs with relevant data as of December 2006. Heteroskedasticity-robust *t-statistics* are in parentheses. The symbols ***, ** and * indicate significance at the 1, 5, and 10% levels, respectively.

	Measures of Holdings of Highly-Rated Tranches							
	"Highly-Rated Residual"	"Highly-Rated Residual + CDOs and Writedowns + Conduits and SIVs"	"Highly-Rated Residual"	"Highly-Rated Residual + CDOs and Writedowns + Conduits and SIVs"	"Highly-Rated Residual"	"Highly-Rated Residual + CDOs and Writedowns + Conduits and SIVs"	"Highly-Rated Residual"	"Highly-Rated Residual + CDOs and Writedowns + Conduits and SIVs"
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Conduit Indicator	0.012	0.052*						
	(0.446)	(1.911)						
ABCP Activity Indicator			0.008	0.036				
			(0.349)	(1.401)				
Change in Leverage, 2000 Q4 - 2002 Q4					0.002	0.001		
					(1.342)	(0.817)		
Market Risk Equivalent Bank Indicator							0.015	0.010
							(0.576)	(0.354)
$0-50 Billion	0.694**	0.692*	0.684*	0.662	0.747*	1.009**	0.632	0.909**
	(1.976)	(1.960)	(1.679)	(1.614)	(1.949)	(2.482)	(1.582)	(2.208)
>$50 Billion	-0.068*	-0.060	-0.065	-0.046	-0.065	-0.049	-0.066*	-0.050
	(-1.675)	(-1.440)	(-1.648)	(-1.056)	(-1.622)	(-1.052)	(-1.667)	(-1.061)
"Other" H.T.M. and A.F.S. Securities	0.029	0.030	0.028	0.026	-0.001	-0.002	0.028	0.026
	(1.227)	(1.243)	(1.151)	(1.065)	(-0.0331)	(-0.0604)	(1.163)	(1.066)
"Other" Trading Securities	0.359	0.312	0.349	0.275	0.356	0.393	0.322	0.383
	(1.079)	(0.924)	(1.069)	(0.815)	(1.023)	(0.980)	(1.047)	(1.030)
Prior Returns	-0.005	-0.006	-0.005	-0.005	-0.011	-0.003	-0.005	-0.002
	(-0.515)	(-0.611)	(-0.490)	(-0.499)	(-0.806)	(-0.246)	(-0.460)	(-0.145)
Market-to-Book	0.004	0.004	0.003	0.003	0.007	0.006	0.003	0.003
	(1.607)	(1.613)	(1.500)	(1.257)	(1.408)	(1.113)	(1.493)	(1.225)
Assets/ Tier 1 Capital	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
	(1.212)	(1.159)	(1.320)	(1.395)	(0.818)	(0.923)	(1.290)	(1.281)
Constant	-0.020	-0.018	-0.020	-0.020	-0.017	-0.027	-0.020	-0.025
	(-0.861)	(-0.783)	(-0.858)	(-0.825)	(-0.491)	(-0.754)	(-0.874)	(-1.012)
Observations	225	225	225	225	140	140	225	225
Adjusted R-squared	0.153	0.290	0.152	0.265	0.141	0.227	0.156	0.238

Table 8: Incentives and Holdings of Highly-Rated Tranches.

This table tabulates the results of an OLS regression of our measures of highly-rated holdings on various proxies of managerial incentives. The construction of each dependent and independent variable is detailed in Appendix 1. The sample contains the cross-section of publicly traded U.S. BHCs with relevant data as of Dec 2006. Heteroskedasticity-robust *t-statistics* are in parentheses. The symbols ***, ** and * indicate significance at the 1, 5, and 10% levels, respectively.

	"Highly-Rated Residual" Measure of Holdings of Highly-Rated Tranches							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Governance Index	-0.013							
	(-0.688)							
High-Compensation Elasticity		-0.005						
		(-1.181)						
Compensation Residual			0.001					
			(0.692)					
Bonus-per-Salary				-0.002				
				(-0.677)				
Equity Risk (%)					0.009			
					(0.472)			
Dollar Gain from +1%						-0.000		
						(-0.0473)		
CEO Ownership %							0.009	
							(0.631)	
Risk Management Index								-0.019
								(-0.597)
$0-50 Billion	0.796**	0.819**	0.783**	0.846**	0.766**	0.761**	0.787**	0.917
	(2.372)	(2.512)	(2.463)	(2.463)	(2.382)	(2.379)	(2.450)	(1.173)
>$50 Billion	-0.067	-0.066	-0.067	-0.062	-0.068*	-0.068*	-0.067*	-0.054
	(-1.622)	(-1.617)	(-1.640)	(-1.585)	(-1.681)	(-1.677)	(-1.654)	(-1.171)
"Other" H.T.M. and A.F.S. Securities	0.026	0.028	0.025	0.027	0.024	0.024	0.026	0.022
	(1.047)	(1.098)	(1.009)	(1.074)	(0.886)	(0.864)	(0.999)	(0.232)
"Other" Trading Securities	0.393	0.368	0.371	0.440	0.366	0.367	0.372	0.139
	(1.109)	(1.044)	(1.065)	(1.262)	(1.070)	(1.070)	(1.070)	(0.621)
Prior Returns	-0.005	-0.004	-0.003	-0.002	-0.005	-0.006	-0.004	-0.026
	(-0.497)	(-0.411)	(-0.295)	(-0.187)	(-0.397)	(-0.431)	(-0.349)	(-0.651)
Market-to-Book	0.004	0.004	0.004	0.004*	0.006*	0.006*	0.004	0.005
	(1.591)	(1.516)	(1.370)	(1.794)	(1.736)	(1.748)	(1.606)	(0.704)
Assets/Tier 1 Capital	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.007
	(1.263)	(1.260)	(1.352)	(1.459)	(1.497)	(1.441)	(1.415)	(1.107)
Constant	-0.013	-0.019	-0.026	-0.028	-0.034	-0.032	-0.027	-0.067
	(-0.651)	(-0.853)	(-1.112)	(-1.180)	(-1.185)	(-1.119)	(-1.104)	(-0.792)
Observations	222	219	218	214	192	192	212	61
Adjusted R-squared	0.150	0.161	0.157	0.160	0.158	0.158	0.157	0.039

Table 9: Incentives and Bank Leverage.

This table tabulates the results of an OLS regression of bank leverage, defined as assets over Tier 1 Capital, on various proxies of managerial incentives. The construction of each dependent and independent variable is detailed in Appendix 1. The sample contains the cross-section of publicly traded U.S. BHCs with relevant data as of Dec 2006. Heteroskedasticity-robust *t-statistics* are in parentheses. The symbols ***, ** and * indicate significance at the 1, 5, and 10% levels, respectively.

	Tier 1 Leverage (Assets/Tier 1 Capital)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Governance Index	-2.067						
	(-1.537)						
High-Compensation Elasticity		-0.662***					
		(-2.822)					
Compensation Residual			0.071				
			(0.272)				
Bonus-per-Salary				-0.103			
				(-0.640)			
Equity Risk (%)					-3.823**		
					(-2.052)		
Dollar Gain from +1%						-0.000***	
						(-3.584)	
CEO Ownership %							-3.463**
							(-2.349)
$0-50 Billion	50.103***	44.553***	41.027***	44.476***	38.706***	39.442***	38.892***
	(4.989)	(4.937)	(4.268)	(3.970)	(3.915)	(4.000)	(3.992)
>$50 Billion	2.482*	2.602*	2.655*	2.860*	2.606*	2.587*	2.649*
	(1.760)	(1.684)	(1.861)	(1.898)	(1.779)	(1.791)	(1.820)
"Other" H.T.M. and A.F.S. Securities	2.622	3.050*	2.733	2.743	2.592	2.515	2.457
	(1.536)	(1.799)	(1.600)	(1.616)	(1.449)	(1.405)	(1.446)
"Other" Trading Securities	5.452	3.889	5.290	7.940	5.408	5.878	4.854
	(0.557)	(0.377)	(0.532)	(0.677)	(0.522)	(0.578)	(0.478)
Prior Returns	-2.717***	-2.212***	-2.724***	-2.437***	-2.406***	-2.420***	-2.465***
	(-3.138)	(-2.683)	(-3.337)	(-2.827)	(-2.672)	(-2.704)	(-2.820)
Market-to-Book	0.027	-0.048	0.204	-0.028	-0.063	-0.034	-0.054
	(0.0901)	(-0.156)	(0.882)	(-0.0940)	(-0.267)	(-0.146)	(-0.186)
Constant	15.352***	14.000***	13.774***	13.985***	14.095***	14.086***	14.181***
	(12.99)	(16.04)	(15.02)	(14.46)	(13.48)	(13.57)	(14.82)
Observations	222	219	218	214	192	192	212
Adjusted R-squared	0.262	0.279	0.264	0.261	0.287	0.296	0.271