Preliminary draft: Please do not cite or circulate without authors' permission.

The Behavior of Intoxicated Investors: The role of institutional investors in propagating the crisis of 2007-2008*

This Draft: June 9, 2010

Alberto Manconi — INSEAD

Massimo Massa — INSEAD

Ayako Yasuda — UC Davis

Abstract: Using a novel data of institutional investors' bond holdings, we examine a transmission of the crisis of 2007-2008 from the securitized bond market to the corporate bond market via joint ownership of these bonds by investors. We posit that, ceteris paribus, corporate bonds held by investors with high exposure to securitized bonds *and* liquidity needs experience greater selling pressure and price declines (yield increases) at the onset of the crisis. We further test predictions of a model of dynamic asset liquidation: investors with large enough future liquidity shocks hold on to liquid assets, and instead sell assets that have relatively high temporary price impacts of trading. Mutual funds with higher sensitivity of pay to performance held higher portions of their portfolios in securitized bonds prior to the crisis. Post-crisis, these funds did not sell securitized bonds on average and instead sold corporate bonds to meet their liquidity needs. Shorter-horizon mutual funds liquidated greater portions of their corporate bond holdings and in particular lower-rated bonds. Furthermore, corporate bond yield spreads widened more for those bonds whose mutual fund holders' portfolios were more heavily exposed to securitized bonds, and particularly more so for lower-rated bonds. Selling pressure on corporate bonds came primarily from mutual fund investors with high exposure; in contrast, insurance companies sold little regardless of their exposure as long as they were above the minimum capital ratio threshold. These findings suggest that performance-sensitive and short-horizon mutual funds played a role in transmitting the crisis from securitized bonds to corporate bonds.

JEL classification: G1, G2

Keywords: crisis transmission; securitized debt; corporate bonds.

* We thank Brad Barber, John Chalmers, Joe Chen, Diane Del Guercio, Doug Diamond, Roger Edelen, Alessandro Gavazza, Gary Gorton, Zhiguo He, Chester Spatt, and the conference and seminar participants of the NBER Working Group on the Systemic Causes and Effects of the Credit Crisis, the 2010 FIRS Conference (Florence), European Central Bank, INSEAD, UC Davis, UC San Diego (Rady), and University of Oregon (Lundquist) for suggestions and comments. We gratefully acknowledge the financial support from the INSEAD/Wharton Alliance. An earlier draft of this paper was titled "The role of institutional investors in propagating the financial crisis". All errors and omissions are our own. Alberto Manconi, INSEAD, Boulevard de Constance, 77305, Fontainebleau, France, Tel: +33-(0)1-60712544, Fax: +33-(0)1-60724045, email: alberto.manconi@insead.edu; Massimo Massa, INSEAD, Boulevard de Constance, 77305, Fontainebleau, France, Tel: +33-(0)1-60724481, Fax: +33-(0)1-60724045, email: massimo.massa@insead.edu; and Ayako Yasuda, UC Davis, Graduate School of Management, 3206 Gallagher Hall, Davis CA, 95616-8609, tel:(530) 752-0775, fax: (530) 752-2924, asyasuda@ucdavis.edu.

Introduction

There is a widespread concern that the overhang of impaired, hard-to-value assets on banks' balance sheets has prolonged the current credit crisis and the ensuing economic downturn. Much less discussed is the question of whether non-bank fixed-income investors, in particular bond mutual funds and insurance companies that hold the majority of corporate debt securities, have had exposure to the same impaired or "toxic"[1] assets. If so, have these institutional investors played a role in the transmission of financial shocks from the securitization market to other sectors? Have their portfolio choices exacerbated the financial crisis's impact on the real economy? Would their behavior have been altered under different regulatory policies? These are the questions we aim to examine in this paper.

What started as a series of negative news about the deteriorating health of subprime mortgage markets in late 2006 developed into a full-fledged crisis in August 2007, when "liquidity abruptly dried up for many firms and securities markets".[2] Securitized bonds – mortgage-backed securities (MBS), asset-backed securities (ABS), collateralized-debt-obligations (CDO) and so forth – displayed sharp drops in their resale values. As the ability of many financial institutions (e.g., investment banks, hedge funds, and off-balance SIVs of commercial banks) to fund their balance sheets depended on liquid secondary markets for these securitized bonds, this set off a catastrophic chain of events that eventually led to the sale of Bear Stearns, the bankruptcy of Lehman Brothers, and government bailouts of many remaining financial institutions in 2008.[3]

Since a large sum of taxpayer money has been spent to rescue the banks, it is easy to see why there is a public outcry about the apparent ineffectiveness of the capital injection in letting the credit flow again to the real economy. However, such ineffectiveness should have been foreseen from and can be directly related to the shift from the traditional lend-and-hold model of banking to the originate-and-distribute model where banks held only a fraction of the loans they originated. At the same time, bond financing became a more common source of external financing for (especially large) corporations.[4] In both cases, institutional investors such as mutual bond funds and insurance companies either directly — bond financing — or indirectly — by investing in securitized loans — increasingly supplied the majority of capital. In fact, some argue that these

[1] There is no exact agreed-upon definition of what constitutes a "toxic" asset in the discussion of crisis. We use the definition "no-agency, securitized bonds" to capture a class of assets that have become impaired during the crisis.
[2] See Getter et al. (2007).
[3] See Gorton (2008), Gorton (2009), Gorton and Metrick (2009), and Brunnermeir (2009) for informative readings.
[4] For large representative firms, about two thirds of their total debt is attributable to corporate bonds and less than one third to bank loans (Massa, Yasuda and Zhang, 2009).

investors' strong demand for relatively safe debt instruments fueled the credit expansion and securitization boom in the U.S. in 2003-2006.[5] Thus, their financial conditions and constraints could become as important financial bottlenecks as those of traditional banks on the road to the economic recovery, at least for large firms. For this reason, to fully understand the crisis and the way it has been transmitted to the real economy, it is important to look at the role of institutional investors.

Unlike many previous studies that examine whether skewed incentives of originators or sellers (e.g., banks, mortgage banks, and investment banks) contributed to the unsustainable boom and the subsequent collapse of the market for securitized bonds,[6] we instead concentrate on the economic incentives of third-party buyers of these assets. To the best of our knowledge there is very scarce evidence on this side of the equation. Some argue that these investment managers' hunger for high-rated bonds with competitive yields pushed the credit bubble, rather than banks pulling them in. Therefore, the primary goal of our study is to examine the role of institutional debt investors (e.g., bond funds and insurance companies) in propagating financial market instability. More specifically, we aim to study how the crisis episode in which one asset class (securitized bonds) experiences an extreme market turmoil accompanied by very low liquidity affects the portfolio decisions of institutional investors holding this class of assets as well as others.

We focus on a potential transmission mechanism in which institutional investors play a central role. The mechanism is based on the effect of liquidity shocks on "open-end" institutional investors investing in securitized bond markets. Institutional investors (e.g., mutual funds) that grant withdrawal rights to clients are subject to runs, much like traditional banks (e.g., Bernardo and Welch, 2005). The desire of these investors to hold liquid – and potentially high return – assets joint with the widespread belief that the secondary markets for securitized bonds would remain liquid induced them to load up on these securitized bonds prior to the onset of the crisis.[7] Indeed, one private estimate puts these institutional investors' collective exposure higher than that of banks.[8] Once the crisis hit, these investors, left with significant exposure to the now more illiquid asset class, had to decide how to rebalance their portfolios. Mutual funds, facing the

[5] See Holmstrom (2009), Caballero et al. (2009), and Nini (2009).
[6] See Mian and Sufi (2008, 2009), Keys et al. (2009), among others.
[7] Shleifer and Vishny (2009), Gorton and Metrick (2009) and others describe an eco-system of the so-called "shadow banking system" where broker-dealer banks actively supported liquidity of securitized bonds by acting as market makers and at the same time funded their balance sheets in the repo market using the same bonds as collateral.
[8] Blundell-Wignall (2007) quotes a private investment bank estimate where insurance companies and asset managers together are shown to have delta-adjusted exposure to 28.6% of existing CDOs, whereas hedge funds and banks split the remaining exposure at 46.5% and 24.9%, respectively.

possibility of massive withdrawals following bad performance, would have to meet the redemption claims by liquidating some of their assets. Reluctant to sell the more illiquid, "toxic" assets and book losses at fire sale prices (thereby exacerbating the investor flight), they would instead sell other, less illiquid assets, such as corporate bonds.

In contrast, insurance companies (and pension funds) — who face longer-term investors and are equipped with long lock-ups, penalties for early withdrawals, and predictable payout schedules — were less pressured to sell than mutual funds, especially in the event of temporary deviations of prices from fundamentals. However, for these institutional investors capital regulations made it expensive to hold lower-rated bonds.

Thus, we expect that, while in the case of mutual funds the investor horizon would determine their reaction, in the case of insurance companies regulatory capital constraints would affect their portfolio decisions should downgrades occur.

This therefore offers us a unique event to test how different classes of institutional investors subject to different demand conditions and regulatory constraints would react to the crisis. More importantly, this also offers us a unique opportunity to look at the transmission mechanism from the securitization market to other, seemingly unrelated asset classes such as corporate bonds.

Indeed, for both classes of institutional investors, transmission operates through the joint management of both securitized bonds and corporate bonds by the same managers.[9] In cases of mutual funds, for example, a drop in the resale value of one subclass of assets in the portfolio and the ensuing reduction in the value of the portfolio induces the investor to rebalance his portfolio, for example to prepare for potential redemption requests. The key question is which assets the investor would choose to sell. Scholes (2000) suggests that an investor holding both liquid and illiquid assets in his portfolio would sell first the most liquid assets. This predicts sales of high-rated corporate bonds first and then lower-rated ones.

However, this behavior is myopic in the sense that it does not account for the inter-temporal implications of selling the liquid assets first. Indeed, if the market conditions deteriorate further and the investor faces redemption calls in the future, having sold liquid assets first leaves the portfolio more exposed to future negative shocks. Recent developments in the theory of dynamic asset liquidation in a multi-period setting identify specific conditions under which a contagion

[9] In case of mutual funds, both bond funds and blend funds manage large portfolios of fixed income securities (plus equity in case of blend funds), and fund managers shift in and out of different subcategories of bonds. In case of insurance companies, while they hold both equity and bonds, the portfolios are usually managed separately for fixed incomes and equity.

occurs as functions of investor- and bond characteristics (e.g., Brown et al., 2009). The main predictions are that (i) investors who face liquidation problems at the onset of the crisis will not sell the (now illiquid) securitized bonds and instead sell other assets that have lower permanent price impact of trading; and (ii) investors with large enough future liquidity shocks hold on to liquid assets, and instead sell assets that have relatively high (temporary) price impact of trading.

We use a novel data of quarterly portfolio holdings of securitized bonds and corporate bonds by institutional investors from 1998 to 2008. While no public data or systematic studies exist to the best of our knowledge, these investors are thought to hold significant amounts of securitized debt as part of their debt portfolios. Indeed, our results confirm that they have accumulated significant exposure. Moreover, these are the very same institutional investors who buy and hold the overwhelming majority of corporate bonds. This suggests that studying the determinants of their actions, both in the pre-crisis period where they made initial purchase decisions, and in the crisis period where they faced decisions whether and when to dispose of these securitized bonds (or alternatively corporate bonds), could shed light on the causes and effects of the credit crisis that we are in today. Importantly, there are meaningful variations across these institutional investors in terms of their managerial incentives, their affiliations with participants in the securitized bond markets, and their institutional arrangements with end investors (e.g., fund investors and insurance account holders).

We collect information on mutual funds at the individual fund level, and on insurance companies at the company level. The empirical analysis is conducted both at the investor level and at the *individual corporate bond* level. That is, we examine (i) investors' portfolio choices as functions of their attributes (e.g., horizon, performance sensitivity of pay, affiliation with banks and big financial groups), as well as (ii) the yield spread changes and net sales of individual corporate bonds as functions of their current bondholders' attributes, such as their exposure to now-illiquid, securitized bonds. For the latter analysis, we control for the issuer firm-fixed effects, and thus are able to isolate the within-issuer variations in selling pressures across bonds.

We start by examining whether and why institutional investors hold securitized bonds in the first place. Indeed, theory suggests that institutional investors with short horizon will not invest in undervalued assets that are not expected to recover in value soon. However, if the assets are already held – for example, because the practice of "rating at the edge" understated the perceived riskiness of these assets – we predict that as the crisis hits, mutual fund investors with prior holdings will choose not to sell these assets immediately, as fire sales and realized losses may trigger large outflows and further exacerbate their liquidity problem. At the same time, having

significant exposure to these now highly illiquid assets may force them to liquidate other assets in order to meet current withdrawal requests or in anticipation of future withdrawal requests. It is therefore important to assess how these institutional investors approached the crisis.

We find that institutional investors' holdings of securitized bonds increased fourfold during the sample period, totaling nearly $2 trillion in 2007. A disproportionate percentage of these were AAA-rated. As a comparison, only 10% of the institutional investors' holdings of corporate bond holdings (around $3 trillion as of 2007) were AAA-rated. Also, overall, the pool of AAA-rated corporate bonds grew much more slowly during the sample period. As a result, there was a sharp increase in their holdings of securitized bonds as percentage of AAA-rated assets during the sample period.

Among mutual funds, the funds with higher sensitivity of pay to performance held higher portions of their portfolios in securitized bonds. We argue that, under a shared belief that securitized bond markets would remain liquid, mutual funds with shorter horizon were incentivized to load up on these assets. This interpretation is consistent with recent empirical evidence on hedge fund behavior at the top of the bubble (e.g., Brunnermeier and Nagel, 2004) as well as anecdotal evidence that highly-rated securitized bonds were favored by institutional investors which are constrained to invest mostly in highly rated assets and which wanted to "spice up" their performance for competitive reasons. Funds affiliated with banks also held more securitized bonds.

After having established that institutional investors had indeed significant exposure to the securitization market prior to the crisis, we then focus on the investors' liquidation problem as the crisis impairs liquidity and resale values of their holdings. Given the different implications of the dynamic liquidation model from the more traditional framework for the transmission of the crisis, we first investigate the hypotheses common to both models and then we proceed with the ones more specific to a particular model. Specifically, a common prediction of both the Scholes and the dynamic liquidation model is that investors faced with a liquidation problem will not sell the most illiquid assets in the initial period. We therefore examine the net sales of assets around the onset of the crisis.

As theory predicts, there is a strong negative relationship between the net percentage changes in portfolio holdings and the liquidity of the asset. Between June 2007 and March 2008, the average mutual fund reduces the holdings of corporate bonds in its portfolio by 16% (6 percentage points in levels). This increases the percentage representation in the portfolio of the securitized bonds by 10% (about 2 percentage points in levels). Over the same period, the average

insurance company reduces the holdings of corporate bonds in its portfolio by 1.3% (0.73 percentage points in levels), increasing the holdings of securitized bonds by 1.5% (0.51 percentage points in levels).

When the subprime-mortgage crisis hit the market in August 2007, mutual funds sold both lower-rated and relatively liquid corporate bonds to meet their increased demand for liquidity. Shorter-horizon mutual funds liquidated greater portions of their corporate bond holdings. Affiliated funds also tended to sell more corporate bonds and hold on to securitized bonds. This may be a signal of better (actual or perceived) information as well as less fear to hold on to these assets as these funds may count on implicit guarantees from the groups they are affiliated with in case of future liquidity needs. Among the longer-horizon investors – i.e., insurance funds – only the funds close to or below the risk-based capital threshold engaged in selling the toxic assets.

We then try to differentiate between the traditional Scholes model and the dynamic liquidation model by further examining the type of corporate bonds that were sold more around the onset of the crisis. We find that, in line with the dynamic liquidation hypothesis, the average investor tended to sell the sub-investment grade bonds more than investment grade bonds. The change in holdings of the investors around the crisis also depended on the investor horizon. One standard deviation shorter horizon translates to an 8% higher sale of corporate bonds in general and to a 27% higher sale of lower-rated corporate bonds.

Next, we turn to the transmission of the shocks from the securitization market to the corporate bond market via corporate bondholders' exposure to securitized bonds. We show that bond yield spreads widened more and net sales were larger for those bonds whose holders' portfolios were more heavily exposed to securitized bonds, and particularly more so for lower-rated bonds. An increase in the holdings of securitized bonds in the portfolio of the average investor from 0% to 50% translates to a 70 bps increase in the yield spread of a corporate bond around the crisis. In line with the dynamic liquidation hypothesis and the previous findings, the effect is sharper for lower-rated bonds. Selling pressure on these lower-rated corporate bonds came primarily from mutual fund investors with high exposure to securitized bonds, while insurance company investors contributed to a lesser degree to the trading volumes during the second half of 2007.

It is important to stress that in our analysis of corporate bond yields (and trading volumes, as discussed below) we include bond issuer dummy variables (firm fixed effect). This is crucial for the identification. Effectively, we compare the yield spread change of a bond held by exposed investors to another bond *issued by the same firm* but held by non-exposed investors, holding any

issuer-specific characteristics (both observable traits, such as credit ratings, as well as unobserved, idiosyncratic traits) constant. This drastically reduces the endogeneity concerns that inclusion of a bond in exposed investors' portfolios could be correlated with some unobserved characteristics about the issuing firm. Our findings support the view that the sharp increase in yield spreads of lower-rated bonds at the start of the crisis is at least partly due to the contagion of the shock from (mostly AAA-rated) securitized bond market to the lower-rated corporate bond market via the joint ownership of both securities by mutual funds. Figure 1 and 2 provide pictorial illustrations of this.

Overall our results show that performance-sensitive and short-horizon mutual fund investors loaded up on securitized bonds (which were highly rated and yielded higher than treasury bonds) during the boom years. When faced with liquidity shocks at the onset of the crisis, these funds sold lower-rated corporate bonds, thereby transmitting the crisis from primarily AAA-rated securitized bonds to lower-rated corporate bonds. In the clearest evidence of the channel, the effects manifested in greater spread increases for individual corporate bonds that are held by investors with heavy exposure to securitized bonds. These results hold even after controlling for unobserved issuer characteristics with firm fixed effects.

We are among the first to theoretically argue and provide evidence for the transmission of the crisis via these investors' joint ownership. We also provide a first detailed empirical analysis of professional investor behavior in the securitized bond market. Our novel dataset allows us to link individual corporate bond performances around the onset of the crisis to their bondholders' exposure to securitized bonds.

In conducting our analysis, we draw on the results of Brown et al. (2009), which study a multi-period liquidation problem for investors with liquidity constraints. We discuss how our hypotheses are related to their analysis as well as the original conjecture made by Scholes in Scholes (2000) in Section 2. We also draw on the literature on limits of arbitrage (e.g., Shleifer and Vishny, 1997; Coval and Stafford, 2007) and use investment horizon as our key measure of the investors' anticipated liquidity needs in the second period.

Our results have also important policy implications. For example, we show that the initial transmission of the crisis from the securitization market to the corporate bond market is primarily caused by actions of short-horizon mutual funds. In contrast, long-horizon mutual funds and insurance companies contributed less to the sales of corporate bonds. This implies that regulations intended to delay panic-induced withdrawals – e.g., lock up clauses – may prevent the

transmission of the crisis. This is in line with anecdotal evidence suggesting that the hedge funds have been able to withstand the withdrawal pressure better.

The remainder of the paper is organized as follows. Section 2 discusses the hypotheses. Section 3 describes the construction of the sample, our key variables and sample summary statistics. Section 4 presents the analysis of investors' demand for securitized bonds prior to the crisis. Section 5 presents the analyses of the transmission mechanism via mutual funds' portfolio decisions around the onset of the crisis in the summer of 2007. Section 6 presents the bond-level analysis of the effects of investors' exposure to securitized bonds on corporate bonds' yields and trading volumes. Section 7 concludes.

2. Hypotheses

We build our empirical hypotheses regarding the mutual funds' liquidation problems on a theoretical work by Brown et al. (2009),[10] which in turns builds on the Scholes conjecture.

The Scholes conjecture states that investors facing an immediate liquidation problem in a one-period setting sell off the most liquid assets to exactly meet the immediate liquidity need. In such a myopic setting, investors do not consider the liquidity needs in the future (second) period. Scholes himself points out that as a result the investor's portfolio becomes much more illiquid than at the beginning of the period. This implies a positive correlation between the drop in the value of securitized bonds and the increase in yields of high quality corporate bonds. That is, it posits a direct transmission of a shock from securitized bonds to the high quality bond segment.

The Brown et al. (2009) model points out that there is a trade-off between selling the more liquid assets first (and thus limiting the immediate loss) and holding on to liquid assets (and thereby protecting against a future liquidity shock) when investors face a multi-period liquidation problem. The model also highlights the importance of differentiating between permanent and temporary impact of trading on prices: "When the expected need for liquidity is large, the investor holds on to assets with a low temporary impact of trading and sells relatively illiquid assets" (Brown et al., 2009). Therefore, an investor with short-term horizon (in the sense of Shleifer and Vishny, 1997) may not necessarily sell the most liquid assets in the first period. In fact, if "there is a high probability of a large future liquidity need, the optimal solution involves retaining assets that have a small temporary impact of trading. In the face of potential future

[10] Also see Carlin et al. (2007).

adversity, there is a high option-value to the temporary component of liquidity. The permanent component of liquidity does not share this feature, so that investors will prefer to sell assets with a low ratio of permanent to temporary price impact in the early stages of a crisis, and to hold on to assets with a high ratio of permanent to temporary price impact to protect themselves against an aggravation of the crisis" (Brown et al., 2009). These key features of the model lead to three predictions that are relevant in the context of mutual funds with exposure to securitized bonds and facing potential withdrawal requests.

First, investors will not sell assets with high permanent price impact. The permanent (as opposed to temporary) price impact is defined in terms of the information asymmetry about the value of the asset. This concept became very relevant during the crisis as the information sensitivity of securitized bonds jumped dramatically at the onset of the crisis, switching from seemingly information-insensitive (simple and transparent) debt that required little research to information sensitive debt with structural, informational, and institutional complexity that few holders were equipped to evaluate. This suggests that investors facing liquidation problems will not prioritize sales of securitized bonds and instead sell other assets with lower permanent price impact of trading, such as corporate bonds.

Hypothesis 1: *Securitized bonds will not be sold at the onset of the crisis.*

Second, the larger the expected liquidity needs in the future, the more investors will liquidate today in a precautionary manner. This implies that the more vulnerable the investors are to the future liquidation problem, the more they liquidate in the first period.

Third, investors' incentive to sell the most liquid assets first depends on their expectation of liquidity needs in the future (second) period. If they expect shocks to be sufficiently large and recur in the future, they may find it optimal to hold on to assets with a low temporary price impact from trading – i.e., more heavily traded, easy-to-dispose assets – and instead sell assets with higher temporary impact of trading on prices. To test these predictions, we need to measure the future liquidity needs of the investors. We employ the investment horizon of the investors as our empirical measure. We argue that this is a good measure for mutual funds, since short-horizon mutual funds are likely to receive larger withdrawal requests as a result of their exposure to (now illiquid) securitized bonds. In this context, the hypothesis that corresponds to the second prediction of the model is thus that, the shorter the horizon, the larger the potential liquidity shock in the second period, and thus the more they liquidate in the first period.

Hypothesis 2: *The investment horizon of mutual funds is negatively associated with the magnitudes of their liquidation decision.*

The hypothesis corresponding to the third prediction of the model is that, the shorter their horizon, the more the investors will liquidate assets with relatively high temporary impact of trading in the first period, and hold on to more liquid assets as a protection.

Hypothesis 3: *The investment horizon of mutual funds is positively associated with the temporary liquidity of the assets they sell.*[11]

These three hypotheses jointly predict that securitized bonds with high permanent price impact of trading will not be sold at the onset of the crisis. At the same time, sub-investment grade bonds will be prioritized for selling, especially by short-horizon mutual fund investors.

We then test the implications for the transmission mechanism. While the simple static Scholes conjecture – selling the most liquid assets in the first period– suggests a transmission of the crisis from the securitization market to the high quality bonds in general, the dynamic liquidation model we focus on posits a direct transmission of a shock from securitized bonds to the lower-rated bond segment. Furthermore, the magnitude of the transmission should be a function of the stock of securitized bonds that the investors accumulated before the crisis. We therefore argue that, the larger the exposure of investors holding a particular asset *and* the higher the temporary price impact of trading, the more they are sold in the first period, and the more negatively the price of the asset is impacted. We examine this hypothesis by constructing holders' exposure measures, yield spread changes, and trading volumes at the individual asset (i.e., corporate bond) level.

Hypothesis 4a: *For a given security, mutual fund investors' portfolio exposure to securitized bonds is positively associated with yield spread changes (negatively associated with asset price changes) and positively associated with trading volumes.*

Hypothesis 4b: *For a given security, mutual fund investors' portfolio exposure to securitized bonds is more positively associated with yield changes and with trading volumes, the lower rated the bond is and more so for short-horizon mutual funds.*

[11] We will measure the temporary price impact of bonds using both bond ratings and actual trade-based metrics. The intuition is that, ceteris paribus, the lower the rating, the higher the price impact of trading is expected to be.

3. Data

3.1 Data Sources

We construct our sample by merging a number of different data sources: the Lipper EMAXX institutional bond holdings database, Thomson Financial's 13f Institutional Holdings, CDA/Spectrum, the CRSP Mutual Funds dataset, and the Mergent FISD Corporate Bond Dataset.

The Lipper EMAXX database contains details of corporate bond and securitized bond (mortgage- or asset-baked securities, collateralized-debt, mortgage, or loan obligations, and their variants) holdings for nearly 20,000 U.S. and European insurance companies, U.S., Canadian, and European mutual funds, and leading U.S. public pension funds. It provides information on quarterly ownership of more than 50,000 fixed-income issuers with over $7 trillion in total par amount from 1998 to 2008. We focus on U.S. institutional investors in the EMAXX database, and their holdings of corporate bonds and structured products (about 1,800 institutional investors every quarter, holding in aggregate a total face value of about $80 billion per institution on average in any given quarter). For these institutions, Lipper EMAXX reports the holdings based on regulatory disclosure to the National Association of Insurers Commissioners (NAIC, for insurance companies) and the Security and Exchange Commission (SEC, for mutual funds), and on voluntary disclosure by the major pension funds. Thomson Financial's 13f dataset contains information on the equity positions of investment companies holding U.S. equities.

3.2 Empirical Proxies

To conduct our analyses we need empirical proxies for investment horizons. An investor has a short investment horizon if his ability to stay invested in a long run is perceived to be low. This may be due to uncertainty about his redemption calls. Investors facing withdrawal calls have to liquidate their positions (e.g., Edelen, 1999). Thus, the more volatile the fund flows, the shorter the average investment horizon of such a fund will be. We therefore use as our first proxy of horizon the volatility of flows. The higher the flow volatility, the lower the horizon should be.

Another determinant of the horizon is the sensitivity of flows to performance (e.g., Shleifer and Vishny, 1997). The more sensitive the fund flows are to performance, the more uncertain the horizon will be. A risk-averse[12] investor will rationally account for the fact that the horizon will

[12] In the case of professional money managers, "risk aversion" may be generated by institutional constraints (e.g., VAR or Value-at-Risk) imposed by the group they belong to, as well as by regulatory capital requirements (Basel II for banks, NAICS for insurance companies, SEC for mutual funds). See Herring and Schuermann (2003) for detailed descriptions of these factors.

depend on his performance. We therefore use as our second proxy of horizon the flow-performance sensitivity. The higher the flow-performance sensitivity, the lower the horizon should be.

We can alternatively measure investment horizon by focusing on the actual trades by the investors. Standard literature (e.g., Chen et al., 2007, Gaspar et al., 2006) suggests that investors who turn over their portfolios more often have a shorter investment horizon. This may be due to the need to face redemptions as well as tax considerations. Long-term investors dislike high turnover portfolios as this can result in undesirable short-term taxable capital gains (Yin, 2005). Conversely, short-horizon investors are more likely to be matched with portfolio managers with high turnover. We therefore use portfolio turnover as our third proxy of investment horizon. The higher the turnover of the portfolio, the shorter the investment horizon of the investor should be.

The construction of flow-performance sensitivity is described in detail in the Appendix and follows Huang et al. (2007).[13] We measure flow volatility as the standard deviation of the fund's flow, over the previous 12 months. We use as the fund's turnover ratio the CRSP Mutual Funds turnover ratio.

We also construct some proxies for investor relationships. Relationships could affect investors' portfolio decisions either through pure information effects or additional incentive effects. The first measure, *Affiliated to commercial banks,* captures affiliation with financial conglomerates that also own the banks that participate in the securitized debt markets and perform due diligence on the instruments. This means that these investors have informational advantage over unaffiliated investors. This measure may however also capture the fact that affiliated investors are less risk averse than unaffiliated investors because they receive implicit buyback guarantees from their affiliate banks in the event of market turmoil. It may also capture any pressure the funds receive from originating affiliate banks to buy their securitized bonds, especially if the banks had trouble selling the bonds to third parties and used their affiliate funds as dumping grounds. The second relationship variable captures affiliation with large asset management groups (*Log*(*Family size*)). In contrast to the first measure, this is a pure information measure.

[13] For factor models used to explain fixed-income returns, see, for example, Litterman and Scheinkman (1991), Knez et al. (1994), Colin-Dufresne et al. (2001), and Chen et al. (2008). We find that our results are not sensitive to alternative model specifications. Gutierrez et al. (2010) also reports that performance measures of bond funds are not sensitive to alternative model specifications.

3.3 Descriptive Statistics

We report descriptive statistics in Table I. Panels A and B report the securitized bond and corporate bond holdings by mutual funds (Panel A) and insurance companies (Panel B). It is striking that securitized bonds held by the sample institutional investors (Panel A-1 and B-1) are overwhelmingly AAA-rated, with just a handful of non-AAA, investment grade tranches, and virtually no junk-rated tranches. In contrast, the vast majority of corporate bonds held by institutional investors (Panel A-2 and B-2) are investment grade but lower than AAA-rated. This is not surprising, as the number of AAA-rated corporate issuers steadily dwindled over the years, from more than 60 in the 1980's to just 6 as of the end of 2008. As we argued above, institutional investors had great appetite for the securitized bonds because the securitization methodology enabled creation of informationally insensitive, highly rated debt in vast quantities. The summary statistics reported here corroborate this view.

Also, comparing Panel A-2 and B-2, we find that mutual funds hold higher a percentage of their portfolios in junk-rated bonds than insurance companies. This is consistent with the fact that risk-based capital regulation makes it expensive for insurance companies to hold low-rated bonds (see, for example, Herring and Schuermann, 2003).

Panel C reports AAA-rated bond holdings as percentage of the total portfolio. For both classes of institutional investors, their holdings of AAA-rated bonds grew sharply, both as percentage of their total portfolios and also in absolute value during the sample period (1998-2008). In the case of mutual funds, it grew from about 3% of total to 12%, while in the case of insurance companies it grew from about 6% to 16%. In both cases, the growth came disproportionately from the growth in securitized bond holdings.

Panel D reports the breakdown of securitized bond holdings by collateral type (residential mortgage-backed securities (RMBS), commercial mortgage-backed securities (CMBS), other asset-backed securities (ABS), and government agency-backed securities (Agency). Panels D-1 and D-3 report the breakdown of all securitized bonds, while Panels D-2 and D-4 report breakdown for AAA-rated bonds only. In general, RMBS is the most common collateral type throughout the sample period, though the portfolios become more diversified among the four collateral types over time. CMBS appears to be more popular among the insurance companies than among mutual funds. The opposite is true for ABS. ABS — i.e., any asset-backed securities other than those backed by mortgages — can be backed by a wide variety of assets, including credit card debt, student loans, auto loans, etc. Finally, agency-backed debt is not a dominant fraction of portfolios – i.e., investors primarily invested in privately issued securitized bonds.

Panel E reports the summary statistics for the main variables used in the analysis. Note that the unit of observations (with NOB = 16252) for Tables II, IV and V is a fund-quarter, whereas the unit of observations (with NOB = 8148) for Tables III, and VI-XI is a corporate bond. For example, *Turnover ratio*, *Flow-performance sensitivity*, and *Flow volatility* in Panel E-1 report the sample statistics (across fund-quarters) for the three proxies of investment horizons for our sample of mutual funds. There is a great amount of variability in these measures – e.g., flow-performance sensitivity ranges from virtually zero sensitivity to the coefficient value of 1.6. That is, one percentage change in alpha percentile ranking results in 1.6% more flows to the fund.

Another variable in Panel E-1, *Affiliated to Commercial Bank*, indicates that about one quarter of the sample funds are affiliated with banks. The variable *No equity* (which equals 1 if the fund does *not* hold equity), indicates that about two thirds of our sample mutual funds are pure bond funds that do not hold any equity, while the remaining one third are blend funds with some holdings of equity. Other variables are standard mutual fund characteristics used in the literature: for definitions of other variables in the table, see the Appendix.

In contrast to Panel E-1 in which variables are defined at the fund level, the variables in Panel E-2 are defined at the level of the individual corporate bonds that are held by our sample funds. For example, the first two variables, *logSale (Jul-Oct 2007)* and *logSale (Jul-Dec 2007)*, measure the log of net sales of a given corporate bond by the sample mutual funds. The next two variables, ΔYS, measure the change in yield spreads of corporate spreads between the pre-crisis 2007 Q2 and the post-crisis 2007 Q3 and 2007 Q4, respectively. On average, bond yield spreads increase by approximately 1% in the first 3 months of the crisis, and nearly 2% in the first 6 months, as indicated by the mean of these variables. The average masks the great variability, however, in that yields of some bonds hardly change while others shoot up sharply.

The variable *Holders' Exposure (to Securitized Bonds)* is a key variable of interest. It measures how much an average mutual fund investor holding corporate bond *i* is exposed to securitized bonds that become illiquid and impaired at the onset of the crisis. The sample statistics indicates that investors' exposure varies widely from none to very high level (over 90%). We similarly measure and report the exposure of the average insurance firm investor holding corporate bond *i* to securitized bonds. It appears that the average exposure is higher for insurance company investors than for mutual funds, but the variance is not larger. In Section 6, we will examine whether the exposure of existing investors to securitized bonds explains some of the increases in corporate bond yields at the onset of the crisis. Other variables are standard bond

characteristics used in the literature. The definitions of the other variables are provided in the Appendix.

4. Horizon and Demand

What determines the overall levels of holdings of securitized debt by institutional bond investors in general, and in particular, mutual funds? As we argued, one of the main features of these securitized debt tranches (especially AAA-rated tranches) was the fact that they offered slightly more attractive yields than treasury bonds of similar ratings and maturity. Indeed, the prevailing rating system understated their risk relative to corporate bonds,[14] while the promised yield made these instruments attractive especially for the investors for whom a higher performance would have been more valuable – i.e., the investors with shorter horizon. And there appeared to be little illiquidity penalty associated with holding these securities prior to the crisis, in light of the fact that investment banks frequently used them as collateral in accessing the repo market, and banks kept them in their off-balance sheet SIVs, which were financed using short-term asset-backed commercial papers.[15]

We therefore expect that, *among mutual funds*, the funds with higher flow-performance-sensitivity, higher turnover or higher volatility of flows would hold more securitized debt. This prediction may be counterintuitive in a simplified, limits-of-arbitrage story as the investors who hold more illiquid assets should be the ones with longer horizon. However, if flows are related to performance, the story changes. In this case, participants, even if aware of a liquidity bubble, may decide to ride the wave rather than betting against,[16] loading up on potentially more risky assets (e.g., Brunnermeier and Nagel, 2004).[17]

We estimate the effects of mutual funds' investment horizon on their portfolio holdings by estimating the following model:

[14] "'Rating at the edge' might also have contributed to favorable ratings of structured products versus corporate bonds; while a AAA-rated bond represents a band of risk ranging from a near-zero default risk to a risk that just makes it into the AAA-rated group, banks worked closely with the rating agencies to ensure that AAA tranches were always sliced in such a way that they just crossed the dividing line to reach the AAA rating." (Brunnermeir, 2009)

[15] See Gorton and Metrick (2009).

[16] "When the music stops, in terms of liquidity, things will be complicated. But as long as the music is playing, you've got to get up and dance. We're still dancing." (Chuck Prince, former CEO of Citigroup, quoted on July 10, 2007, shortly before the onset of the crisis)

[17] Also note that we do not expect mutual funds to hold more securitized bonds than insurance companies, since the mechanism governing insurance companies' decisions to hold securitized bonds is expected to be distinct from that governing mutual fund decisions, as we posit above. Thus, we examine the effect of pay-performance sensitivity, flow volatility, etc., on holdings using only the mutual fund sample. Indeed, as shown in Table I, insurance companies in the aggregate held higher percentage of their portfolios in securitized bonds than mutual funds.

$$H_{it} = \alpha + \beta\, Horizon_{it} + \gamma' x_{it} + \varepsilon_{it} \quad (1),$$

where each observation represents the portfolio composition of a given mutual fund in a given quarter. The dependent variable *H* is alternatively the fraction of the fund's portfolio invested in either securitized bonds or corporate bonds.[18] *Horizon* is our proxy for the investment horizon of the fund – alternatively *Turnover ratio*, *Flow-performance sensitivity*, or *Flow volatility*. *X* is a set of fund characteristics (*Affiliated to commercial bank*, *log(Family Size)*, the fund's flow in the previous quarter (*Past Flow*), the fund's return in the previous quarter (*Fund return*), the equity holdings of the fund's family (*Family equity holdings*), management fees (*Mgmt fee*), *Expense ratio*, *Actual 12b1*, *Average maturity* (of the fund's fixed income holdings), an indicator variable for whether the fund holds equity or not, and the return on the fund's equity holdings (*Equity return*)).

We separately control for the potential information effect – i.e., institutional investors that are affiliated with banks or large financial conglomerates may hold higher portions of their portfolios in securitized bonds because they have superior information about the true quality of these bonds. Alternatively, funds affiliated with banks may be less risk averse than unaffiliated investors to hold these securitized bonds because they receive implicit buyback guarantees from their affiliate banks in the event of market turmoil.

We estimate the model using both Fama-MacBeth cross-sectional regression (with Newey-West standard errors with lag length parameter equal to 1), and a pooled OLS with quarter fixed effects and standard errors clustered around each fund (Petersen, 2009). The sample includes all the mutual funds belonging to the merged Lipper eMAXX-CDA/Spectrum data set, over the period 1998Q1-2007Q2.

The results are reported in Table II. In Panel A, the dependent variable is the fraction of the fund's portfolio represented by securitized bonds, while in Panel B, the dependent variable is the fraction of the fund's portfolio represented by corporate bonds. In columns (1)-(5) the model is estimated using the Fama-MacBeth, while in columns (6)-(10), it is estimated as a pooled OLS.

The results show a strong correlation between the investor horizon and their investments in securitized bonds. The effect is not only statistically significant, but also economically relevant. All else equal, a fund at the top decile of *Flow-performance sensitivity* holds 26% of its portfolio in securitized bonds, while at fund at the bottom decile holds only 22% (similar effects obtain for *Flow volatility* and *Turnover Ratio*).

[18] They are not mere complements of each other, because there is a third component, namely equity.

The fund affiliation also plays a significant role: funds that are affiliated to commercial banks display a higher percentage of securitized bond ownership. This finding is consistent with both (i) inside/higher quality information received by the funds thanks to their affiliation and (ii) implicit guarantees by their affiliate banks effectively subsidizing these funds' holdings in the event of market turmoil. The anecdotal evidence about Citigroup' infusion of cash in its own money market funds to keep them afloat is consistent with this latter interpretation.[19]

Among the control variables, it is interesting to note that funds with higher expense ratios hold more in corporate bonds and less in securitized bonds. One possible interpretation is that individual corporate bonds are considered more information sensitive than securitized bonds because its default risk contains more idiosyncratic risk about the firm. Therefore, funds with more active investment strategies (and higher expenses) gravitate towards corporate bonds, whereas funds with lower expenses choose to hold securitized bonds. Equity focus of fund families is negatively associated with portfolio weights of both corporate bonds and securitized bonds. This may be because prominent pure bond funds tend to be part of fund families that are focused on fixed-income securities (e.g., Pimco).

Overall, these results show that the shorter-horizon mutual funds loaded more heavily on securitized bonds than those with longer-horizon prior to the crisis. We now turn to examine their behavior around the crisis.

5. Selling Behavior around the Crisis and Investor Horizon

5.1 What gets sold around the crisis?

We now consider the first prediction regarding the mutual funds' liquidation problem: they will not sell first the most illiquid assets. We test this prediction by focusing on the sales of securitized bonds and corporate bonds around the crisis and relate them to the liquidity of the asset.

As described in the Introduction, the crisis started in August 2007. Since our observations are quarterly, we examine changes between (i) second quarter of 2007 ending in June and the third quarter of 2007 ending in September, and also between (ii) second quarter of 2007 ending in June and the fourth quarter of 2007 ending in December. Unreported statistics show that, on average, securitized bonds were not sold and that most of the sales took place in corporate bonds. The

[19] While this is not our central question, we examine the post-crisis fund performance and find that bank-affiliated funds underperform as a result of their portfolio decisions that are heavy in securitized bond holdings. This result is consistent with the view that affiliated mutual funds exercised less scrutiny when increasing their holdings of securitized bonds; however, the sample period is quite short for the post-crisis period, and we stress the need to be cautious in making a definitive conclusion on this question.

average mutual fund reduced the holdings of corporate bonds in its portfolio by 16%. This increased the percentage representation in the portfolio of the securitized bonds by about 10%. This is consistent with Hypothesis 1 of the dynamic liquidation problem a-la Brown et al. (2009) as well as the Scholes conjecture. Namely, securities with high permanent price impact of trading/low liquidity (securitized bonds) were not prioritized for sale in the initial period of the crisis.

To investigate the determinants of corporate bond sales more systematically, for a cross-sectional sample of corporate bonds we estimate multivariate regressions of the following form:

$$\log Sale_i = \alpha + \beta\, Quality + \delta \log Hold_i + \gamma' x_i + \varepsilon_i, \qquad (2)$$

where $logSale_i$ is the log-net sales (in thousands of dollars) of corporate bond i by institutional investors between July 2007 and December 2007, $logHold_i$ denotes the log-dollar holding of corporate bond i by institutional investors as of June 2007, and x is a vector of standard bond characteristics. They are: the logarithm of the amount outstanding (*Bond face value*), the logarithm of the number of months to maturity (*log(Months to maturity)*), an indicator variable for whether the bond has covenants (*Covenants*), covenant protection index (*CovIndex*),[20], and indicator variable equal to 1 when the bond does not have a rating, 0 otherwise, an indicator variable equal to 1 when the bond is not held by institutional investors in our data set as of June 2007, as well as bond issuer and issuance year fixed effects. Inclusion of issuer fixed-effects implies that we control for any unobserved firm characteristics that may affect sales of all bonds issued by a given issuer.

Quality denotes one of three proxies for the quality of the bond, which we include one at a time (in specifications (1) –(3)), as well as all three (in specification (4)). The first proxy is the *InvRating*, defined as:

$$\log\left(\frac{1}{1+Rating}\right),$$

where *Rating* is a numerical variable measuring the bond's rating, ranging from 0 (no rating) to 24 (AAA rating or above). The lower the rating, the higher the temporary price impact of trading is, and the larger *InvRating* is. The other two proxies are directly related to how thinly traded the bond is. They are constructed by using data on actual transactions from TRACE. The first is *InvTrades*, the natural logarithm of the inverse the number of trades from TRACE. For each bond,

[20] The construction of the covenant index follows Billet *et al.* (2007).

we consider the mean number of trades per day, between the period January 2007-June 2007. The more illiquid, the larger this variable is. The second is the bond's Amihud illiquidity ratio.[21] The Amihud ratio is defined as the average daily $1000 \times \sqrt{|\Delta P|/\$V}$, where ΔP is the daily percentage change in price ("return") and $\$V$ is the bond's dollar volume of trade. This most directly measures the price impact of daily trading, as normalized by trade volume. Again, the more illiquid the bond, the larger this variable is. We compute the average ratio over the period January 2007-June 2007.

The results are reported in Table III. They show that the sales by institutional investors are concentrated on bonds with lower ratings, as well as on the more liquid bonds. One standard deviation increase (decrease) in the bond's InvRating (Amihud ratio, InvTrades) is associated with a 22% (5%, 3%) higher selling pressure.

These findings are (at least partly) consistent with both the Scholes conjecture and the dynamic liquidation hypotheses. The positive relationship of sales with liquidity is consistent with the Scholes conjecture as well as with the dynamic liquidation hypotheses a-la Brown et al. (2009). In contrast, the negative relationship of sales with ratings is consistent with the dynamic liquidation hypothesis and is not consistent with the Scholes conjecture. To further differentiate between the two hypotheses, we proceed to focus on the investment horizon of the mutual fund investors in the next Section.

5.2 Selling and Investment Horizon around the Crisis

We now link sales to the horizon of the investors and test whether investors with shorter horizon liquidate more in the initial phase of the crisis and also whether they sell low quality bonds more. The Scholes conjecture posits that investors, regardless of their horizon, would always sell the most liquid assets – high quality corporate bonds – to meet their liquidity needs, while the dynamic liquidation hypothesis posits that investors with short investment horizon liquidate more in the first period (Hypothesis 2), and tilt towards liquidating assets with high temporary price impact (Hypothesis 3). We therefore relate the changes in holdings of mutual fund investors around the onset of the crisis to their investment horizon. For Hypothesis 2, we estimate for a sample of mutual funds:

$$\Delta H_i = \alpha + \beta\, Horizon_i + \gamma' x_i + \varepsilon_i, \qquad (3)$$

[21] Amihud (2002).

where ΔH is the change, between 2007Q2 and 2007Q4, in the fraction of the fund's portfolio represented by either securitized bonds or corporate bonds. *Horizon* is our proxy for the fund horizon – *Turnover ratio*, *Flow-performance sensitivity*, or *Flow volatility* – while x is a set of fund characteristics including the control variables from Equation (1), as well as the fraction of securitized bonds in the fund's portfolio. Both *Horizon* and x are expressed in their values as of June 2007.

The results are reported in Table IV. In columns (1)-(5), the dependent variable is the fraction of the fund's portfolio represented by securitized bonds, while in columns (6)-(10), the dependent variable is the fraction of the fund's portfolio represented by corporate bonds. The results show a significant negative (positive) correlation between the horizon length of the investor and the net change the portfolio representation of securitized bonds (corporate bonds). That is, the shorter the horizon, the more the institutional investor reduces his stake in corporate bonds. Magnitude-wise, one standard deviation increase in the Flow-performance sensitivity (Turnover ratio, Flow volatility) is related to a 6% (2%. 4%) higher reduction in corporate bond holdings. Funds that are affiliated to commercial banks or are part of big financial groups tend to sell more corporate bonds and hold on to securitized bonds.

We further examine whether the short-horizon investors sell low quality bonds more by examining their sales of corporate bonds separately for investment-grade and sub-investment grade corporate bonds (Hypothesis 3). We repeat the specification presented in Equation (3) and simply replace the dependent variable with ΔC, the changes in portfolio representations of (i) investment-grade corporate bonds and (ii) sub-investment grade corporate bonds.

The results are reported in Table V. In the odd-numbered columns, the dependent variable ΔC is the fund's excess sales of investment grade bonds, as a fraction of the value of the fund's portfolio as of June 2007. In the even-numbered columns, the dependent variable is the fund's sales of sub-investment grade bonds. The estimates are broadly supportive of the dynamic liquidation hypothesis in that the propensity to liquidate is more sensitive to investment horizon of the investors for low-rated bonds. The impact of investor horizon on the sales of corporate bonds is concentrated among the below-investment grade bonds. One standard deviation increase in Flow-performance sensitivity (Turnover ratio, Flow volatility) tends to increase the sale of sub-investment grade bonds by 27% (30%, 17%) , whereas it has a significantly smaller impact on the sales of investment grade bonds (*F-stat p*-values for the statistical significance of the two coefficients are provided at the bottom of the table). Note also that R-squared is two to five times

larger for the sub-investment grade bonds (even-numbered columns) than for investment grade bonds (odd-numbered columns).

Overall, the results in Table II, IV and V show that (i) short-horizon mutual funds loaded up on securitized bonds and ended up with higher exposure to them by the onset of the crisis, and that (ii) when the crisis hit in August 2007 and securitized bonds became illiquid, they liquidated more than longer-horizon investors in the first months of the crisis, and in particular they reduced their holdings of lower-rated corporate bonds. This is consistent with the predictions of the dynamic liquidation model, where vulnerable investors optimize over multiple periods and as a result may (i) choose to liquidate excessively in the initial period and (ii) hold on to relatively liquid assets when faced with sufficiently large expected future shocks. This is consistent with investors avoiding sales of assets with high permanent price impact of trading.

In untabulated analysis, we find that the average insurance company reduced the holdings of corporate bonds in its portfolio by 1.3%. This increased the percentage representation in the portfolio of the securitized bonds by about 1.5%. Thus, they were neither major net sellers nor purchasers of either asset class at the onset of the crisis. The only exception is a subset of insurance companies whose risk-based capital ratios (RBC ratio) were below the threshold level of 2[22] as of 2007Q2 — these insurance companies sold securitized bonds. Given that downgrades did not occur for most of these bonds until after our sample period, this behavior is consistent with the view that insurance companies' portfolio decisions are based on capital regulation constraints.

6. Effects of Short-Horizon Investors' Exposure to Securitized Bonds on Corporate Bonds

The previous sections show that as the crisis hits the market institutional investors with a short investment horizon hold on to their (now) most illiquid assets – the securitized bonds – and sell the others. In particular, they prioritize the sale of sub-investment grade bonds. We now examine whether corporate bonds that are held by investors with heavy exposure to securitized bonds experience negative shocks at the onset of the crisis. We start by focusing on changes in corporate bond yield spreads (prices) and trading volumes (Hypothesis 4a). Then, we test whether the size of the impact is related to the bond rating (Hypothesis 4b). Finally, we examine whether

[22] NAIC (National Association of Insurance Commissioners) states that insurance companies with the RBC ratio below 2 are subject to supervision by state regulators.

insurance companies act as strategic liquidity providers to offset the sales by short-horizon mutual funds.

6.1 Effects on Corporate Bond Yields

For a cross-sectional sample of corporate bonds, we estimate the following model:

$$\Delta YS_i = \alpha + \beta\, HoldersExposure_i + \gamma\, InvRating_i + \delta\left(HoldersExposure_i \times InvRating_i\right) + \varphi' x_i + \varepsilon_i, \quad (4)$$

where each observation corresponds to a corporate bond with data in the FINRA TRACE data set. The dependent variable ΔYS_i is the change in corporate bond *i*'s yield spread around the crisis. The yield spread is the difference between the bond's yield in the secondary market, as reported by TRACE, and the yield of a Treasury bond of comparable maturity. Data on Treasury bond yields are retrieved from the Federal Reserve Statistical Release.

One of the key implications of the dynamic liquidation model is that, for a sufficiently large expected future liquidity shock, investors optimizing over multiple periods may choose to liquidate in excess of what they need in the initial period. We empirically gauge this magnitude of potential future shocks by creating an exposure measure at the individual bond level ($HoldersExposure_i$). This measure is constructed by first calculating the exposure of the portfolio of each institutional investor to the securitized bonds at the individual mutual fund level, and then weight-averaging this exposure across all the funds holding a particular corporate bond *i*. The larger the exposure of the mutual fund investors holding bond *i* and therefore the higher the potential future shock they face, the more bond *i* is expected to be sold today.

How about insurance company investors? We expect the mechanism governing their portfolio decisions to be distinct. As we argued, they are not subject to runs like mutual funds, with longer lock-up periods and heftier early withdrawal penalties. This makes them less subject to selling pressure in the initial period of the crisis. One the other hand, they are subject to rating-based capital regulation. Downgrades of securitized bonds would thus predict sales by insurance companies. However, in the second half of 2007 — the focus of our analysis — there were only a very small number of downgrades of securitized bonds. Thus, we do not expect insurance companies to liquidate as much as mutual funds during this period. To verify this prediction, we also construct analogous *HoldersExposure* measure for insurance companies and include this variable in one of the specifications.

The dynamic liquidation model also predicts that, for a sufficiently large expected future liquidity shock, investors optimizing over multiple periods may choose to liquidate assets that

have relatively high temporary price impacts in the initial period and hold on to the assets with low temporary price impact to hedge against future shocks. We thus interact the exposure measure ($HoldersExposure_i$) with $InvRating_i$ (as defined before) and include this interaction term as well as $InvRating_i$ itself in the model. The lower the rating, the higher the $InvRating_i$ is, and the more the bond is expected to be sold as a function of the bondholders' exposure to securitized bonds.

We also include a standard set of bond characteristics x, which includes the level of the yield spread of bond i as of June 2007, the bond's liquidity measures (*Amihud ratio* or *InvTrades,* as defined before), an interaction term between *HoldersExposure* and bond liquidity, as well as issuer and issuance year fixed effects. In all specifications, the standard errors are clustered around bond issuers.

There may be concerns that the inclusion of a given corporate bond in a portfolio of high-exposure investors is endogenous. The inclusion of a bond issuer dummy (firm fixed effect) allows us to deal with this issue. Effectively, the use of a firm fixed-effect model allows us to compare the yield spread change of a bond held by exposed investors to another bond *issued by the same firm* but held by non-exposed investors, holding any issuer-specific characteristics (both observable traits, such as credit ratings, as well as unobserved, idiosyncratic traits) constant. This addresses the endogeneity concerns.

Further, since we construct the dependent variable, yield spread, as the yield of the bond in excess of the treasury bond of the same term structure, we are also able to control for any term spread difference that might be present between the exposed and non-exposed bonds of a given issuer. That is, we are able to isolate the variations in spread changes and selling pressures across bonds (holding issuer risk and term structure constant) as functions of bond-specific exposure measures.

We report the results in Table VI. In columns (1)-(4) ΔYS is defined as the change in the bond's yield spread over the period from the last week of June through the last week of October 2007, while in columns (5)-(8) it is the change in the bond's yield spread over the period from the last week of June through the last week of December 2007. The sample includes all bonds in the FINRA TRACE data set with available data on bond characteristics from the Mergent FISD data.

The first coefficient, *HoldersExposure*, is positive and significant, which means that the higher the exposure of the investors holding bond i, the more the yield spread goes up in the months after the onset of the crisis. Comparing the coefficients on *HoldersExposure* between the

left and the right-hand side panel, we also note that they are two to three times larger in the right-hand side panel, which is consistent with the worsening effect of investors' exposure on yields over time. The results are consistent with Hypothesis (4a). An increase in *HoldersExposure* from 0% to 50% is associated with a 70 bps higher increase in the yield spread in the first two quarters of the crisis. Recall that (Table I) on average corporate bond yield spreads increased by approximately 100bps in the first quarter of the crisis, and about 200 bps in the first two quarters of the crisis. This suggests that our findings are large but reasonable.

The third coefficient, the interaction term of *HoldersExposure* and *InvRating*, is also positive and significant. This implies that the lower the rating of the bond, the more its yield increased as a function of its holders' exposure to securitized bonds. The result is consistent with Hypothesis (4b) and suggests that, the sharp increase in yield spreads of lower-rated bonds at the start of the crisis, as depicted in Figure 1, is at least partly due to the contagion of the shock from (mostly AAA-rated) securitized bond market to the lower-rated corporate bond market via the joint ownership of both securities by mutual funds.

We separately control for the effect of rating itself on the yield spread change by including *InvRating* itself in the model (second row). The fact that the coefficient is positive and significant suggests that the lower the rating of the bond, the more the bond yield increased during this period independent of the investors' exposure to securitized bonds. This may be due to overall increased fear of risk or investor panic that is unrelated to the transmission mechanism we examine here. The interaction term between *HoldersExposure* and the bond's overall liquidity measures (Amihud ratio, *InvTrades*), on the other hand, is generally insignificant.

Overall, these results show that there is an incremental effect that comes from the transmission channel that we identify over and above the general unconditional increase in corporate bond yields during this period. The increase in bond yield spreads around the 2007 crisis is most pronounced among the low-rated bonds held by mutual funds with heavy exposure to securitized bonds.

We also augment specification (4) by adding the fraction of securitized bonds held by the insurance companies and the corresponding interaction term with the ratings. Neither coefficient is significant (though positive). This is in line of our expectations, since insurance companies are not expected to be under pressure in the initial period of the crisis when bond ratings are still largely intact.

As an additional robustness check, in Panel B, we estimate an alternative model specification. This is:

$$\Delta YS_i = \alpha + \beta\, ShortExposedHolders_i + \gamma\, InvRating + \delta\left(ShortExposedHolders_i \times InvRating_i\right) + \varphi' x_i + \varepsilon_i \quad (5),$$

where $ShortExposedHolders_i$ is an indicator equal to 1 if the bond i's short-horizon mutual fund holder's exposure to securitized bonds is above the sample median. The idea is to isolate the effect on short-horizon investors' exposure (to securitized bonds) on yield spread changes, rather than the average holder's exposure. We use three proxies of investor horizon, and examine the model using both the change in yield spread between July and October 2007 (columns (1)-(3)), as well as between July and December 2007 (columns (4)-(6)). Positive coefficients on $ShortExposedHolders_i$ itself as well as positive coefficients on its interaction term with $InvRating_i$ indicate that presence of high exposure at these investors with liquidity needs are associated with greater yield spread changes, and especially for lower-rated bonds. In contrast, we find that the insurance company holder's exposure to securitized bonds have no effects on the bond yield spread changes, suggesting they did not contribute to the selling pressure.

In Figure 2, we provide a pictorial illustration of the econometric results presented in Table VI. We plot the cumulative monthly return on a portfolio that is short on corporate bonds whose mutual fund holders have "high exposure" to securitized bonds, and long on a set of issuer- and duration-matched bonds without the exposure. We place a "high exposure" bond in the short portfolio if and only if it has a matching bond satisfying the following criteria: (i) the matching bond is issued by the same issuer firm; and (ii) the time to maturity of the matching bond is between 50% and 150% of the time to maturity of the shorted bond. These matched bonds are then placed in the long portfolio. We then construct the return of a portfolio based on the difference between long portfolio's monthly return minus the short portfolio's monthly return.

The cumulative return on the long-short portfolio hovers around zero from 2004 to 2006, but sharply rises in the second half of 2007. Given that the return on this portfolio is, by construction, independent of changes in the firm-specific risk, we can interpret this sharp rise as due to selling pressure on the exposed bonds by their investors.[23] While this plot is for illustration purpose only,

[23] There may be concerns that the term spread differences between the exposed bond and the matched bond may drive some of these results. In the results reported here, the exposed bonds have on average slightly longer duration (about 8.75 years) than the matched bonds (8.13 years) by the same issuers. To address concerns, we repeated the exercise with a restricted sample where the matched bonds had longer duration than the exposed bonds, and the results were qualitatively unchanged.

the firm fixed effect models presented in Tables VI-VIII allow us to make inferences about statistical significance of this effect.

6.2 Effects on Corporate Bond Trades

While the positive relationship between investors' exposure to securitized bonds and increase in the yield is consistent with selling pressure being exerted on the bond by mutual funds in need of liquidation, we have so far not directly studied whether individual bond sales by mutual funds are a direct function of their exposure. Therefore, we now focus on whether mutual funds' relative trading impact increased around the crisis and whether this increase is related to the fraction of securitized bonds they held. We estimate:

$$\Delta Tr_i = \alpha + \beta\, HoldersExposure_i + \gamma\, InvRating_i + \delta\left(HoldersExposure_i \times InvRating_i\right) + \varphi' x_i + \varepsilon_i, \quad (6)$$

where the dependent variable is defined as:

$$\Delta Tr_i = \frac{\text{Net sales of the mutual funds}}{\text{Total volume of trading from TRACE}}$$

for corporate bond *i*, over the periods July-October 2007 and July-December 2007. This variable proxies the weight of the mutual funds' sales out of all the trades for bond *i*. The dynamic liquidation model predicts that the selling pressure from mutual funds on a bond is higher the more the funds are exposed to securitized bonds *and* the lower the bond rating is. The other variables are defined as in the previous specification.

The results are reported in Table VII. The interaction term coefficient is positive and significant. Thus, the lower the rating of bond *i and* the higher the exposure of its investors to securitized bonds, the higher the mutual funds sales as percentage of the total trading volume for the bond in the initial months of the crisis. One standard deviation increase in *HoldersExposure* is associated with a 50% higher increase in mutual funds' selling pressure for a high yield bond (rating BBB- or below) than for an AAA-rated bond.

In Panel B, we estimate an alternative model specification based on the following:

$$\Delta Tr_i = \alpha + \beta\, ShortExposedHolders_i + \gamma\, InvRating + \delta\left(ShortExposedHolders_i \times InvRating_i\right) + \varphi' x_i + \varepsilon_i \quad (7).$$

This specification is analogous to Equation (5), in Table VI, Panel B.

We find a positive relationship between trading volume and both *ShortExposedHolders* itself as well as its interaction with *InvRating*. This indicates that presence of high exposure at these

investors with liquidity needs are associated with more selling pressure, and especially for lower-rated bonds.

Finally, as a robustness check, we re-estimate specification (6) using as dependent variable log*Vol*, defined as: log*Vol* = log(1 + *Vol*) where *Vol* is the bond's average daily trading volume, expressed in thousands of trades. This variable proxies for the overall trade in the market. *HoldersExposure* and *InvRating* are defined as above, and *x* is a set of standard control variables, including the average weekly log-trading volume as of June 2007, as well as issuer and issuance year fixed effects.

The results are reported in Table VIII. The first row coefficient, *HoldersExposure,* is positive and significant, implying that the higher the bondholders' exposure to securitized bonds, the higher the trading volume of corporate bond *i.* The second row coefficient, *InvRating*, is negative and significant, implying that, unconditionally lower-rated bonds are traded less and thus more illiquid. This finding validates our use of bond rating as a measure of temporary price impact of trading. More importantly, the third coefficient, the interaction between the first two, is positive and significant. This implies that, even though in general lower-rated bonds traded less in the initial months of the crisis, still among those held by investors with exposure to securitized bonds, higher exposure and lower bond rating were directly related to more trades. This is consistent with Hypothesis (4b). That is, when faced with large uncertainty about recurring future liquidity shocks (as measured by exposure to securitized bonds), investors chose to sell lower-rated corporate bonds and hold on to higher-rated corporate bonds, as a hedge against future forced liquidations.

This provides the final missing link between securitized bond holdings, investor sales and corporate bond yields. It shows that the corporate bonds that experience increases in yields due to high exposure of their holders to securitized bonds are also the ones that display spikes in trading volumes and increases in representations of mutual fund trades among overall trades during the same initial months of the crisis. Overall, these results suggest that funds significantly increase their price pressure on low quality bonds during the crisis and that this impact is negatively related to the length of their investment horizon.

6.3 Are Insurance Companies Strategic Liquidity Providers in the Time of Crisis?

In this subsection we examine whether insurance companies acted as strategic liquidity providers to offset the sales of corporate bonds by short-horizon mutual funds at the onset of the crisis.[24] Our analysis consists of comparisons of investor behavior in pre-crisis and crisis periods, such as correlation of their trades with mutual funds' and price impact of their trades and mutual funds' trades on bond yield spreads.

First, we examine the extent to which mutual funds' net trades of individual corporate bonds are (positively or negatively) correlated with insurance companies' net trades of the same bonds. The model we estimate and report in Table IX is as follows:

$$MF\_Netbuy_{it} = \alpha + \beta_1 INS\_Netbuy_{it} \times (1 - Crisis_t) + \beta_2 INS\_Netbuy_{it} \times Crisis_t + \gamma' x_{it-1} + \varepsilon_{it} \quad (9),$$

where MF_Netbuy_{it} and INS_Netbuy_{it} are mutual funds' and insurance companies' net purchases of corporate bond i at t, respectively. Column (1) reports the results for all the mutual funds, while columns (2)-(4) and (5)-(7) report the results for short-horizon funds and non-short-horizon funds, respectively. Positive and significant coefficients for β_1 and β_2 imply that insurance companies' trades and mutual funds' trades are positively correlated both in the pre-crisis and crisis periods. The large F-stat values for H_0: $\beta_1 = \beta_2$ show that the positive correlation between the trades became stronger, not weaker, during the crisis months.

Second, we examine the price impact of mutual funds' sales in excess of insurance companies' purchases (if any) on the yield spreads before and during the crisis periods. We estimate the following model and report the results in Table X:

$$\Delta YS_{it} = \alpha + \beta_1 Absorb_{it} \times (1 - Crisis_t) + \beta_2 Absorb_{it} \times Crisis_t + \gamma' x_{it-1} + \varepsilon_{it} \quad (10),$$

where $Absorb_{it}$ is defined as the mutual funds' net sales of bond i in excess of purchases by insurance companies at t. The idea is that, if insurance companies are collectively matching mutual funds' sales with their purchases, this may lessen the price impact of mutual funds' liquidity-motivated trades on the bonds' yield changes.

We separately measure the impact of this measure on bond i's yield spreads during the pre-crisis and crisis periods. The coefficient β_1 is insignificant whereas β_1 is positive and significant; the F-test for their equality is rejected at 5 to 10% significance. This suggests that net sales of

[24] We acknowledge that our analysis is limited by the fact that we do not observe holdings by other classes of investors, such as hedge funds, banks, governments, and foreign investors. Clearly, it is important to understand who besides insurance companies acted as liquidity providers in various asset class markets during this time of the crisis. For example, He, Khang, and Krishnamurthy (2010) argue that banks were liquidity providers in the securitized bond market.

bonds by short-horizon funds are either insignificant or are matched sufficiently by insurance companies' purchases in the pre-crisis periods, and thus have no price impact on the corporate bonds, whereas in the crisis periods, their sales in excess of insurance companies' purchases had negative price impact (positive impact on yields) on the bonds. This evidence does not support the view that insurance companies were significant liquidity providers during the crisis.

Finally, we break down the institutional trades into mutual fund trades and insurance company trades, and examine if there was a structural break in the relationship between the trades and the bond yields at the onset of the crisis. The results are reported in Table XI. This analysis provides several interesting findings. First, we document in columns (1) and (2) that institutional investors overall are larger net sellers of corporate bonds in the crisis period than in the pre-crisis period. This change in behavior is related to mutual funds' increased net sales volumes. In contrast, insurance companies' net trades remain constant as percentage of their total holdings. In column (3), we show that the relation between the institutional investors' (i.e., mutual funds and insurance companies) net trades and bond yield spread changes was positive in the pre-crisis periods, whereas it turns negative, i.e., net sales are associated with yield increases in the crisis periods. In column (4), we break down the institutional investors' net trades into mutual funds' and insurance companies' trades, and show that this structural break in the relation between trades and yield changes is driven by mutual funds rather than insurance companies.

Our interpretation of the results is as follows: Mutual funds were strategic liquidity providers for corporate bonds they held during the pre-crisis period, buying in an environment where yield for the bond was going up (buy when price was low). As the crisis hit, mutual funds became liquidity demanders, effectively selling when the price was low. In contrast, insurance companies never act strategically. We think that this is perhaps because their flows are steady and they do not have much room to act strategically. Also, their capital regulation might have curtailed their economic incentives to hold (especially) low-rated corporate bonds.

Overall, these findings suggest that insurance companies did not act as strategic liquidity providers at the onset of the crisis nor did they offset the net sales of low-rated corporate bonds by mutual funds.

Conclusion

We study a transmission mechanism that explains the contagion of the crisis from the securitized bond market to the corporate bond market. We posit that, ceteris paribus, corporate bonds held by investors with high exposure to securitized bonds and liquidity needs experience greater selling

pressure and price declines (yield increases) at the onset of the crisis. We further test predictions of the theory of dynamic asset liquidation: Investors with large enough future liquidity shocks hold on to the most liquid assets, and instead sell assets that have relatively high (temporary) price impact of trading. We investigate a series of hypotheses based on this dynamic liquidation model as well as a more naïve Scholes conjecture, which predicts that investors face with liquidation needs choose to liquidate the most liquid assets first.

The results confirm our predictions about the transmission mechanism and the dynamic determinants of investors' portfolio decisions. First, we show that prior to the onset of the crisis mutual fund investors were eager participants in the securitized bond market, especially in the top-rating category. This was 'rational' in the pre-crisis world when these securitized bonds were considered to be safe, liquid and informationally insensitive, relative to corporate bonds with higher idiosyncratic risk and needs for more intensive credit research.

When securitized bonds abruptly became illiquid and their resale values plunged, the institutional investors with significant exposure to securitized bonds and liquidity needs – i.e., mutual funds with short investment horizon and insurance firms with regulatory capital constraints – faced a complicated portfolio rebalancing problem. The mutual funds did not sell the now impaired and hard-to-value securitized bonds, and instead reduced holdings of corporate bonds, while the insurance companies sold neither class of assets (except those with a below-threshold level of risk-based capital, which reduced holdings of securitized bonds). The investors' portfolio decisions induced a transmission of shocks from the securitization market to the corporate bond market via corporate bondholders' exposure to securitized bonds. The higher the fraction of securitized bonds held in the portfolio, the more the investor sells corporate bonds and especially low quality corporate bonds. Our findings show a direct channel of transmission of the crisis from securitized bonds to the corporate bond market. They show that institutional investors have played a significant role in spreading the crisis from the securitized bond market to the seemingly unrelated corporate bond market. The incentives and contract features significantly affect the behavior of institutional investors, as indicated by the impact of investment horizon as well as institutional differences between mutual funds and insurance companies on their behavior.

References

Adrian, T., and H. Shin, 2008. Financial Intermediary Leverage and Value-at-Risk. Federal Reserve Bank of New York Staff Reports. Staff Report No. 338.

Almgren, R., and N. Chriss, 1999. Value Under Liquidation. *Risk* 12, 61-63.

Almgren, R., 2000, Optimal Execution or portfolio transactions. *Journal of Risk* 3, 5-39.

Amihud, Yakov, 2002, Illiquidity and Stock Returns: Cross-section and Time-series Effects, *Journal of Financial Markets* 5, 31-56.

Bernardo A.E., and I. Welch, 2004, Liquidity and Financial Market Runs, *Quarterly Journal of Economics*, 135-157

Bertsimas, D., and A. Lo, 1998, Optimal Control of Execution Costs. *Journal of Financial Markets* 1, 1-50.

Blundell-Wignall, A., Structured Products: Implications for Financial Markets, OECD, 2007.

Boyd, S., and L. Vandenberge, 2004. *Convex Optimization*. Cambridge University Press. Cambridge, UK.

Brown, D., B. Carlin, and M. Lobo, 2009, On the Scholes Liquidation Problem, Working Paper.

Brunnermeier, M., 2009, Deciphering the Liquidity and Credit Crunch 2007-2008. *Journal of Economic Perspectives* 23, 77-100.

Brunnermeier, M., and S. Nagel, 2004, Hedge Funds and the Technology Bubble, Journal of Finance 59, 2013-2040.

Caballero, R., E. Farhi, and P. Gourinchas, 2008, An Equilibrium Model of 'Model Imbalances' and Low Interest Rates, *American Economic Review* 98, 358-393.

Carhart, M., R. Kaniel, D. Musto, and A. Reed, 2002, Leaning for the Tape: Evidence of Gaming Behavior in Equity Mutual Funds. *Journal of Finance* 57, 661-693.

Carlin, B.I., M.S. Lobo, and S. Viswanathan, 2007, Episodic Liquidity Crises: Cooperative and Predatory Trading. *Journal of Finance* 62, 2235-2274.

Chen, Y., W. Ferson, and H. Peters, 2008, Measuring the Timing Ability of Fixed Income Mutual Funds, Working paper, University of Southern California.

Chen, Q., I. Goldstein, and W. Jiang, 2007, Payoff Complementarities and Financial Fragility: Evidence from Mutual Fund Outflows, Unpublished Working Paper, University of Pennsylvania.

Chen, X., J. Harford, and K. Li, 2007, Monitoring: Which Institutions Matter? *Journal of Financial Economics* 86, 279-305.

Cheng, M., and A. Madhavan, 1997, In Search of Liquidity: Block Trades in the Upstairs and Downstairs Markets. *Review of Financial Studies* 10, 175-203.

Chu, S., A. Lehnert, and W. Passmore, 2009, Strategic Trading in Multiple Assets and the Effects on Market Volatility. Forthcoming, *International Journal of Central Banking*.

Colin-Dufresne, P., R. Goldstein, and J. S. Martin, 2001. The Determinants of Credit Spread Changes. Journal of Finance 56, 2177—2207.

Coval, J.D., and E. Stafford, 2007, Asset Fire Sales (and Purchases) in Equity Markets, *Journal of Financial Economics* 86, 479-512.

DeMarzo, P., and B. Urosevic, 2009, Optimal Trading by a Large Shareholder. Forthcoming in *Journal of Political Economy*.

Diamond, D., and P. Dybvig, 1983, Bank Runs, Deposit Insurance, and Liquidity, *Journal of Political Economy* 91, 401–419.

Duffie, D., and A. Ziegler, 2003, Liquidity Risk. *Financial Analysts Journal*, 42-51.

Edelen, R., 1999, Investor Flows and the Performance of Open-Ended Mutual Funds, *Journal of Financial Economics* 53, 439-466.

Gaspar J.-M., M. Massa, and P. Matos, 2006, Favouritism in Mutual Fund Families? Evidence on Strategic Cross-Fund Subsidization, *Journal of Finance* 61, 73-104.

Getter, D., M. Jickling, M. Labonte, and E. Murphy, 2007, Financial Crisis? The Liquidity Crunch of August 2007, CRS Report for Congress.

Gennotte, G., and A. Kyle, 1991, Intertemporal Insider Trading with a Smooth Order Flow, Working Paper, Haas School of Business Administration, UC Berkeley.

Gorton, G., 2008, The Panic of 2007, Working Paper.

Gorton, G., 2009, Slapped in the Face by the Invisible Hand: Banking and the Panic of 2007, Working Paper.

Gorton, G., and A. Metrick, 2009, Securitized Banking and Run on Repo, Working Paper.

Gutierrez, R., W. Maxwell, and D. Xu, 2010, On Economies of Scale and Persistence in Corporate-Bond Mutual Funds, Working paper, University of Oregon.

He, Z., I. Khang, and A. Krishnamurthy, 2010, Balance Sheet Adjustments during the 2008 Crisis, Working paper.

Herring, R., and T. Schuermann, 2003, Capital Regulation for Position Risk in Banks, Securities Firms and Insurance Companies, Working Paper.

Holmstrom, B., 2008, "Discussion of 'The Panic of 2007,' by Gary Gorton," in *Maintaining Stability in a Changing Financial System*, Proceedings of the 2008 Jackson Hole Conference, Federal Reserve Bank of Kansas City, 2008.

Holthausen, R., R. Leftwich, and D. Mayers, 1990, Large Block Transactions, the Speed of Response, and Temporary and Permanent Stock-Price Effects. *Journal of Financial Economics* 26, 71-95.

Huang J.C., K.D. Wei, and H. Yan, 2007, Volatility of Performance and Mutual Fund Flows, Working Paper, University of Texas at Austin.

Huberman, G., and W. Stanzl, 2005, Optimal Liquidity Trading. *Review of Finance* 9, 165-200.

Keys, B.J., T.K. Mukherjee, A. Seru, and V. Vig. 2008. Did Securitization Lead to Lax Screening? Evidence from Subprime Loans, Working Paper.

Knez, P., R. Litterman, and J. Scheinkman, 1994. Explorations Into Factors Explaining Money Market Returns. *Journal of Finance* 49, 1861-1882.

Litterman, R. and J. Scheinkman, 1991. Common Factors Affecting Bond Returns. *Journal of Fixed Income,* 54-61.

Lobo M. S., M. Fazel and S. Boyd, 2007, Portfolio optimization with linear and fixed transaction costs. *Annals of Operations Research* 152, 341-365.

Massa, M., A. Yasuda, and L. Zhang, 2009, Supply Uncertainty of the Bond Investor Base and the Leverage of the Firm, Working Paper.

Mian, A. and A. Sufi, 2008, The Consequences of Mortgage Credit Expansion: Evidence from the U.S. Mortgage Default Crisis, Working Paper.

Mian, A. and A. Sufi, 2009, House Prices, Home Equity-based Borrowing, and the U.S. Household Leverage Crisis, Working Paper.

Morris, S., and H.S. Shin, 1998, Unique Equilibrium in a Model of Self-fulfilling Currency Attacks, *American Economic Review* 88, 587-597.

Nini, G., 2009. How Non-banks Increased the Supply of Bank Loans: Evidence from Institutional Term Loans, Working Paper.

Petersen, M., 2009, Estimating Standard Errors in Finance Panel Data Sets: Comparing Approaches, *Review of Financial Studies* 22, 435-480.

Shleifer, A. and R. Vishny, 1997, The limits to arbitrage, *Journal of Finance* 52, 35-55.

Schleifer, A. and R. Vishny, 2009, Unstable Banking, Working Paper.

Scholes, M., 2000, Crisis and Risk Management. *American Economic Review* 90, 17-21.

Vayanos, D., 1998, Transaction Costs and Asset Prices. *Review of Financial Studies* 11, 1-58.

Appendix: Variable Definitions

I. Mutual Fund Characteristics

$H, \Delta H, \Delta C$ Holdings of corporate bonds and securitized bonds in the mutual fund's portfolio, and changes thereof around the crisis. H is defined as the percentage of corporate bonds (respectively securitized bonds) in the mutual fund's portfolio, in excess of the average percentage holdings of corporate bonds (respectively securitized bonds) among the funds in the same sector as the fund. We define sectors based on the maturity and rating of the securities held in the funds' portfolios by crossing three maturity terciles and three rating terciles, obtaining nine sectors. ΔH is the change in H between June 2007 and December 2007. C is the percentage of investment grade (resp. sub-investment grade) corporate bonds in the mutual fund's portfolio, defined analogously. ΔC is the change in C between June 2007 and December 2007.

Turnover ratio Turnover ratio of the mutual fund's portfolio, defined as the minimum (of aggregated sales or aggregated purchases of securities) divided by the average 12-month total net assets of the fund.

Flow-performance sensitivity Sensitivity of the investment flow into the mutual fund to the fund's past performance. Define the net flow into the mutual fund in a given month as:

$$Flow_t = \frac{TNA_t - (1 + R_t) \times TNA_{t-1}}{TNA_{t-1}}$$

where TNA is the fund's total net asset value, and R is the fund's return. Every month, the fund's alpha is estimated, as the intercept from an eight-factor model for the fund's return, specified as:

$$R_t = \alpha + \beta_1 (R_{mt} - R_{ft}) + \beta_2 HML_t + \beta_3 SMB_t + \beta_4 UMD_t + \beta_5 (R_{bt} - R_{ft}) + \beta_6 TS_t + \beta_7 CS_t + \beta_8 RS_t + \varepsilon_t,$$

where R is the portfolio return, R_m is the return on the market portfolio, R_f is the risk-free return, HML, SMB, UMD are the returns on the book-to-market, size, and momentum factors, R_b is the return on the bond market portfolio (Dow Jones bond index), and TS, CS, and RS are the returns on the term spread, curvature spread, and risk spread factors. The model is estimated on a rolling window of length equal to 36 months. Next. the alphas are sorted into percentiles, and the fund's performance is equal to the percentile rank, i.e. a performance equal to 0.99 indicates that the fund has an alpha above 99% of all funds in the data set in a given month. Finally, the following regression is estimated, over a rolling window of length equal to 12 months:

$$Flows_s = a_t + b_t \alpha_s + \varepsilon_s, \quad s = t - 12, \ldots t$$

The fund's flow-performance sensitivity in month t is the estimate $\hat{b}_t$.

Flow volatility Standard deviation of the mutual fund's monthly flows (defined above), computed over a rolling window of length 12 months.

Log(Family size) Natural logarithm of the total net assets under management of the fund's mutual fund family, expressed in thousands of dollars.

Affiliated to commercial bank Indicator variable equal to one if the mutual fund belongs to a fund family that is affiliated to a commercial bank (following Massa and Rehman (2008)).

Past flow Investment flow into the mutual fund (defined above) over the previous quarter.

Fund return Quarterly return of the mutual fund.

Family equity holdings Equity holdings by the fund's fund family as a fraction of total holdings.

Mgmt fee Management fees of the mutual fund, as a fraction of its average net assets, obtained from the CRSP Survivor-Bias-Free Mutual Fund Database.

Expense Ratio Fund's expense ratio in the most recent fiscal year, defined as the total investment that the shareholders pay for the fund's operating expenses (including12b1 fees).

Actual 12b1 Ratio of total assets of the fund attributed to marketing and distribution costs, as reported in the Annual Report Statement of Operations.

Average maturity of the holdings Natural logarithm of the average maturity of the fixed income holdings of the mutual fund, expressed in quarters.

No equity (N/Y) Indicator variable equal to one if the fund does not hold any equity, zero otherwise.

Fund's equity holdings return Quarterly return on the equity holdings of the mutual fund.

II. Bond characteristics

logSale (Jul-Oct 2007/Jul-Dec 2007) Natural logarithm of the net sales (in $K) of the bond by institutional investors over the periods July to October 2007 or July to December 2007.

ΔYS (Jul-Oct 2007/Jul-Dec 2007) Change in the bond's yield spread (defined as the spread between the bond's yield and the yield of a government bond of comparable maturity) over the periods July to October 2007 or July to December 2007.

ΔTr (Jul-Oct 2007/Jul-Dec 2007) Net sales of the bond by mutual funds as a fraction of the bond's total trading volume, over the specified periods (July-Oct 2007/July-Dec 2007).

Holders' Exposure Holdings of securitized bonds as a fraction of the portfolio of the average mutual fund holding the bond. For each bond, we compute the fraction of securitized bonds in the portfolio of each mutual fund that holds the bond. We then weight average across mutual funds, with weights proportional to the par amount held by each fund.

Insurance Holders' Exposure Average holdings of securitized bonds as a fraction of the portfolio of the average insurance company holding the bond.

No rating (Y/N) Indicator variable equal to one if the bond does not have a rating, zero otherwise.

InvRating An inverse measure of the quality of the bond's rating, as defined in the text.

Bond face value Natural logarithm of the total amount outstanding of the bond at the issuance date, expressed in thousands of dollars.

Covenants (Y/N) Indicator variable equal to one if there are covenants attached to the bond, and zero otherwise. Data on covenants are obtained from the Mergent Fixed Income database.

CovIndex Billet *et al.* (2007) index of covenant protection ranging from zero (no covenant protection) to one (complete covenant protection).

Log(Months to maturity) Natural logarithm of the bond's time to maturity, expressed in months.

Amihud Amihud's (2002) illiquidity proxy, as defined in the text.

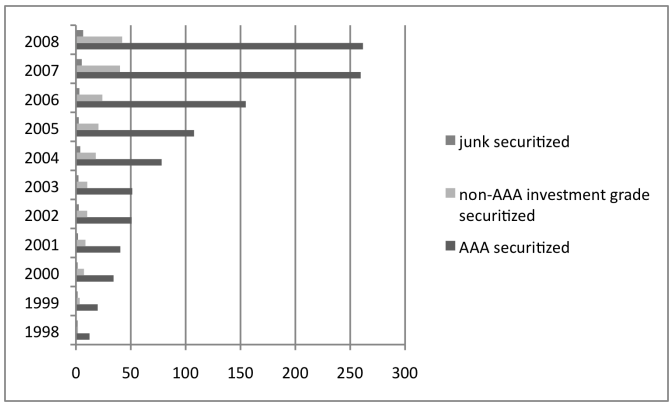
InvTrades The natural logarithm of the inverse of the number of trades on the bond, as reported from FINRA's TRACE data set.

Table I Summary Statistics

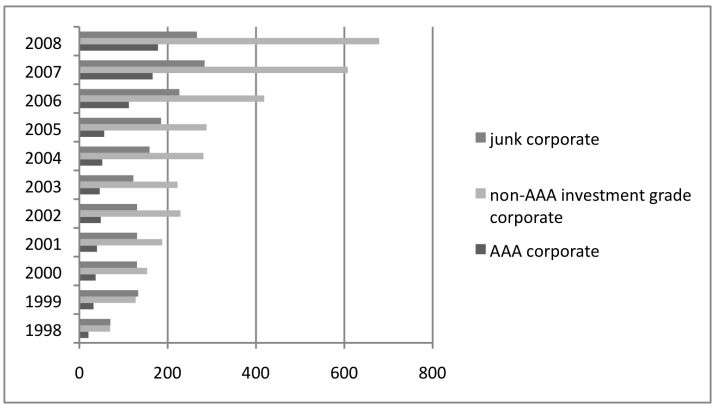
The table reports the summary statistics. Panels A and B report the securitized bond and corporate bond holdings by mutual funds (Panel A) and insurance companies (Panel B). Panel C reports AAA-rated bond holdings by % of the total portfolio. Panels D reports the breakdown of securitized bond holdings by collateral type (residential mortgage-backed securities (RMBS), commercial mortgage-backed securities (CMBS), other asset-backed securities (ABS), and government agency-backed securities (Agency). Panel E reports the summary statistics for the main variables used in the analysis.

A. Corporate bond and securitized assets holdings of mutual funds

A-1: Securitized Bonds ($bn)

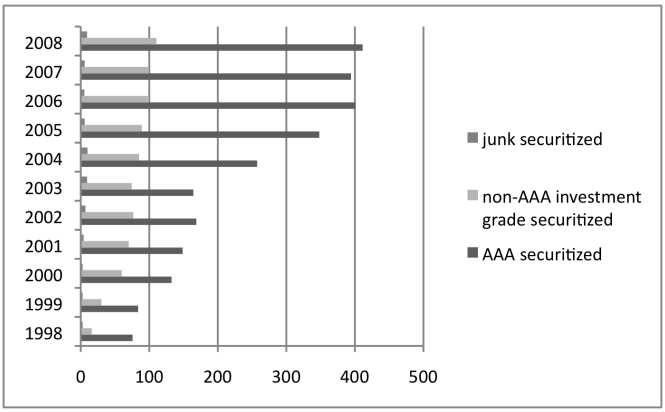


A-2: Corporate Bonds ($bn)

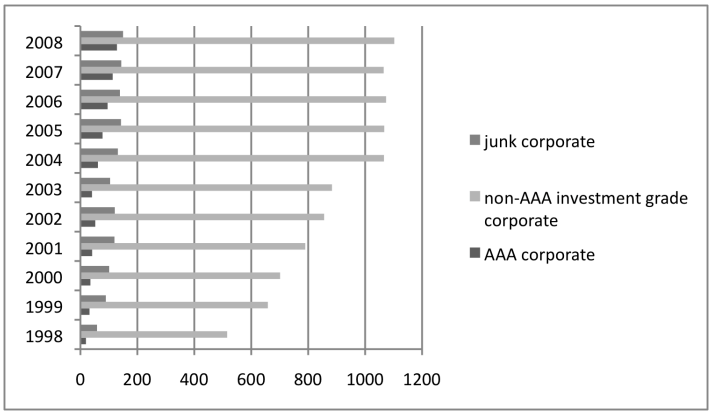


B. Corporate bond and securitized assets holdings of insurance companies

B-1: Securitized Bonds ($bn)

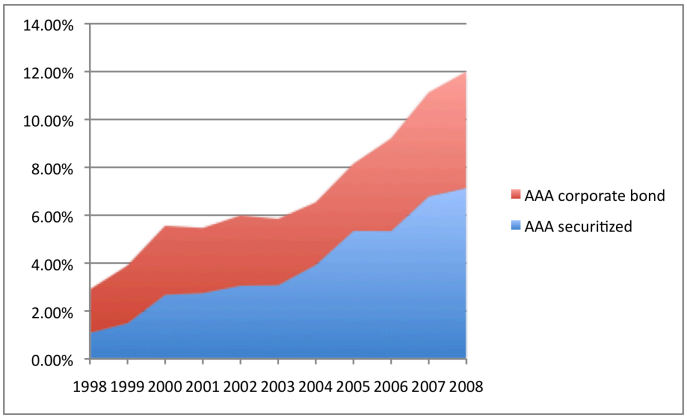


B-2: Corporate Bonds ($bn)

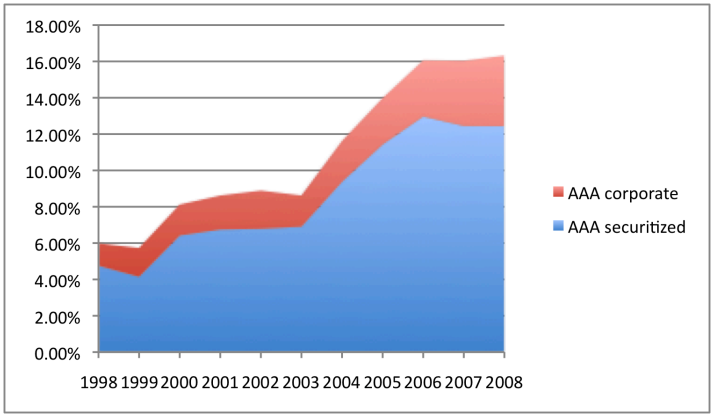


C: AAA-rated bonds as % of total

C-1: Mutual fund portfolio

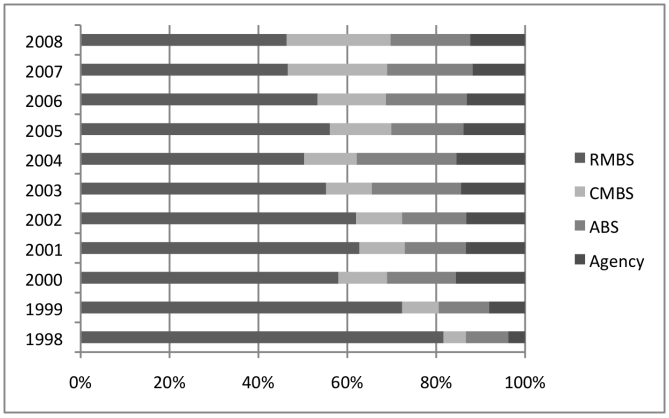


C-2: Insurance company portfolio

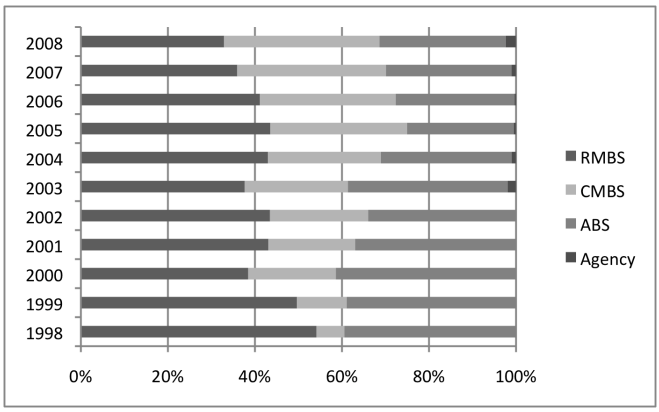


D. Securitized bond holdings, by underlying asset type and ratings

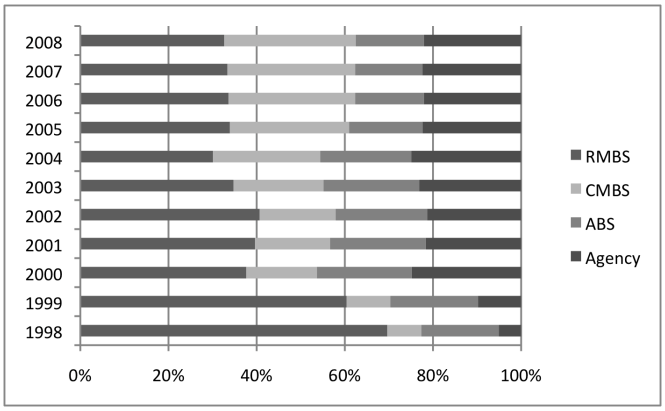
D-1: Mutual fund portfolio – all ratings



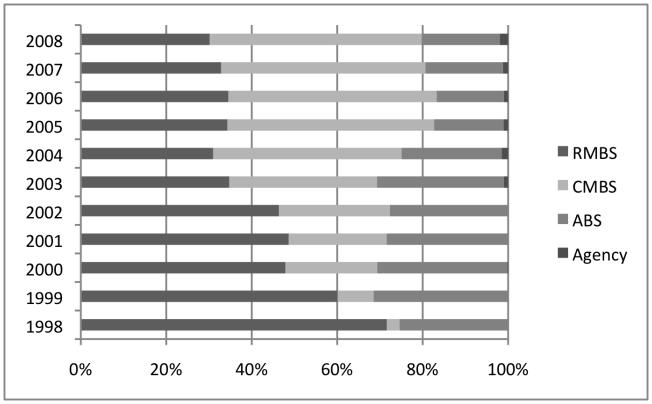
D-2: Mutual fund portfolio – AAA-rated only



D-3: Insurance company portfolio – all ratings



D-4: Insurance company portfolio – AAA-rated only



E. Variables Used in the Analysis

	Mean	Median	St. Dev.	Min	Max	N. Obs
	(1)	(2)	(3)	(4)	(5)	(6)
E-1: Variables used in Tables II, IV, and V						
Excess holdings of corporate bonds	0.0346	0.0000	0.2809	-0.8644	0.9861	16252
Excess holdings of securitized assets	0.0154	0.0000	0.2216	-0.6464	0.8956	16252
Turnover ratio	0.0135	0.0088	0.0137	0.0000	0.0980	16252
Flow-performance sensitivity	0.1572	0.0643	0.2277	0.0024	1.9973	16088
Flow volatility	0.0549	0.0303	0.0658	0.0031	0.3987	15400
Log(Family Size)	3.0722	3.0809	1.8474	0.0000	7.2332	16252
Affiliated to commercial bank	0.2877	0.0000	0.4527	0.0000	1.0000	16252
Past flow	0.0202	-0.0009	0.1187	-0.2176	1.9452	16252
Fund return	0.0136	0.0114	0.0432	-0.3982	0.7702	16252
Family equity holdings	0.1582	0.0000	0.2720	0.0000	0.9837	16252
Mgmt fee	0.4956	0.5030	0.2465	0.0000	2.2210	16252
Exp. ratio	0.0105	0.0093	0.0066	0.0000	0.1877	16252
Actual 12b1	0.0025	0.0000	0.0036	0.0000	0.0103	16252
Average maturity of holdings	42.004	36.797	20.769	0.0007	196.00	16252
No equity [1 = NO]	0.8166	1.0000	0.3869	0.0000	1.0000	16252
Fund's equity holdings return	0.0114	0.0000	0.1050	-0.8961	2.0006	16252
E-2: Variables used in Tables III, VI, VII, and VIII						
logSale (Jul-Oct 2007)	3.3864	0.0000	4.3138	0.0000	13.541	8148
logSale (Jul-Dec 2007)	4.2004	0.0000	4.7330	0.0000	13.893	8148
ΔYS (Jul-Oct 2007)	0.8151	0.5376	1.2439	0.0495	13.191	7346
ΔYS (Jul-Dec 2007)	1.9650	1.2949	2.0580	0.3239	19.965	7346
ΔTr (Jul-Oct 2007)	0.0029	0.0000	0.0237	-0.0096	0.0564	8666
ΔTr (Jul-Dec 2007)	0.0035	0.0000	0.0084	0.0000	0.0499	8728
Holders' Exposure (to Securitized Bonds)	0.0944	0.0000	0.1472	0.0000	0.9050	9598
High-Turnover holders	0.3113	0.0000	0.4631	0.0000	1.0000	8728
High-Flow sensitivity holders	0.3348	0.0000	0.4719	0.0000	1.0000	8728
High-Flow volatility holders	0.3291	0.0000	0.4699	0.0000	1.0000	8728
InvRating	-2.6509	-3.0445	1.0272	-3.3322	0.0000	9598
Yield spread in 2007Q2	1.3392	1.1010	1.4089	0.3530	9.4245	9598
No Rating (Y/N)	0.1267	0.0000	0.3327	0.0000	1.0000	9598
Bond face value	11.275	12.067	2.0613	7.0553	15.425	9598
Covenants (Y/N)	0.4974	0.0000	0.5000	0.0000	1.0000	9598
CovIndex	0.1673	0.0000	0.2004	0.0000	0.6667	9598
log(Months to maturity)	4.1110	4.2627	1.1467	0.0000	6.9903	9598
Insurance Holders' Exposure	0.2182	0.2761	0.1751	0.0000	0.9716	9598
Bond is not held by mutual funds (Y/N)	0.4359	0.0000	0.4959	0.0000	1.0000	9598
Amihud	0.4466	0.4095	0.2848	0.0433	1.5162	9598
InvTrades	-0.9774	-0.8544	0.5011	-4.0012	-0.2231	9598

Table II The Effects of Fund Types on the Propensity to Hold Securitized Bonds

The table reports the estimates of a model:

$$H_{it} = \alpha + \beta Horizon_{it} + \gamma' x_{it} + \varepsilon_{it}, \qquad (1)$$

where each observation represents the portfolio composition of a given mutual fund in a given quarter. The dependent variable *H* is the excess percentage ownership of the fund's portfolio represented by securitized Bonds (Panel A) or corporate bonds (Panel B). *Horizon* is the mutual fund's horizon, proxied for by *Turnover ratio*, *Flow-performance sensitivity*, or *Flow volatility*. *x* is a set of standard control variables. In both panels, in columns (1)-(5) the model is estimated using the Fama-MacBeth procedure. The standard errors are Newey-West, with lag length parameter equal to 4. In columns (6)-(10), the model is estimated as a pooled OLS with quarter fixed effects, and standard errors clustered around each fund. The sample includes all the mutual funds belonging to the merged Lipper eMAXX-CDA/Spectrum data set, over the period 1998Q1-2007Q2. The symbols *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels.

A. Holdings of Securitized Bonds

	Fama-MacBeth			**Pooled OLS**		
	(1)	(2)	(3)	(4)	(5)	(6)
Turnover ratio	1.3535***			1.2427***		
	4.84			*3.40*		
Flow-performance sensitivity		0.0512***			0.0446***	
		3.10			*3.44*	
Flow volatility			0.1841***			0.1442**
			4.78			*2.57*
Log(Family Size)	-0.0015	0.0000	-0.0002	-0.0018	-0.0006	-0.0006
	-0.74	*0.01*	*-0.09*	*-0.56*	*-0.18*	*-0.17*
Affiliated to commercial bank	0.0198**	0.0202***	0.0181**	0.0205	0.0207	0.0202
	2.57	*2.75*	*2.69*	*1.58*	*1.60*	*1.53*
Past flow	0.0001	-0.0366*	-0.1230**	-0.0002***	-0.0002***	-0.0016
	0.01	*-1.94*	*-2.15*	*-3.53*	*-3.36*	*-0.66*
Fund return	-0.3157	-0.3112	-0.2957	-0.1361***	-0.1408***	-0.1334***
	-1.66	*-1.59*	*-1.55*	*-3.18*	*-3.25*	*-3.01*
Family equity holdings	-0.0185**	-0.0199**	-0.0189*	-0.0226	-0.0245*	-0.0255*
	-2.12	*-2.25*	*-1.93*	*-1.64*	*-1.76*	*-1.8*
Mgmt fee	-0.0330***	-0.0355***	-0.0367***	-0.0441**	-0.0462**	-0.0450**
	-4.37	*-4.40*	*-4.84*	*-2.26*	*-2.38*	*-2.25*
Exp. ratio	-1.8571	-1.2989	-1.6070	-2.4794***	-2.1743***	-2.2712***
	-1.62	*-1.21*	*-1.45*	*-3.39*	*-3.19*	*-3.21*
Actual 12b1	-2.7116	-3.2677	-3.0727	-1.5528	-1.9233	-2.0592
	-1.29	*-1.67*	*-1.58*	*-0.99*	*-1.26*	*-1.31*
Average maturity of holdings	0.0005	0.0006	0.0007	0.0010***	0.0011***	0.0012***
	1.25	*1.42*	*1.57*	*3.38*	*3.94*	*3.91*
No equity	0.1173***	0.1213***	0.1234***	0.1252***	0.1308***	0.1340***
	21.35	*20.87*	*25.32*	*10.62*	*11.17*	*11.12*
Fund's equity holdings return	0.0062	-0.0006	0.0003	-0.0261**	-0.0258**	-0.0244**
	0.20	*-0.02*	*0.01*	*-2.37*	*-2.27*	*-2.10*
Quarter fixed effects	No	No	No	Yes	Yes	Yes
Standard error	Newey-West	Newey-West	Newey-West	Clustered by fund	Clustered by fund	Clustered by fund
N. Obs.	16252	16088	15400	16252	16088	15400
(Average) R^2	0.14	0.14	0.13	0.11	0.11	0.11

Table II The Effects of Fund Types on the Propensity to Hold Securitized Bonds (cont'd)

B. Holdings of Corporate Bonds

	Fama-MacBeth			Pooled OLS		
	(1)	(2)	(3)	(4)	(5)	(6)
Turnover ratio	-1.8692***			-1.9044***		
	-5.41			*-4.12*		
Flow-performance sensitivity		-0.0468***			-0.0355**	
		-2.77			*-2.09*	
Flow volatility			-0.1113**			-0.0399
			-2.04			*-0.52*
Log(Family Size)	-0.0001	-0.0020	-0.0012	0.0010	-0.0008	-0.0002
	-0.02	*-0.78*	*-0.46*	*0.24*	*-0.20*	*-0.05*
Affiliated to commercial bank	-0.0290***	-0.0303***	-0.0309***	-0.0274	-0.0283*	-0.0305*
	-3.11	*-3.24*	*-3.22*	*-1.64*	*-1.70*	*-1.80*
Past flow	0.0214	0.0669*	0.1425	0.0003***	0.0003***	0.0022
	1.63	*1.92*	*1.64*	*5.10*	*4.80*	*0.99*
Fund return	0.3316	0.3103	0.2993	0.1771***	0.1844***	0.1798***
	1.04	*0.95*	*0.92*	*2.67*	*2.76*	*2.60*
Family equity holdings	-0.0381***	-0.0376***	-0.0359**	-0.0345	-0.0319	-0.0286
	-3.37	*-3.47*	*-2.61*	*-1.44*	*-1.33*	*-1.18*
Mgmt fee	0.0219*	0.0277**	0.0182*	0.0557*	0.0597**	0.0535*
	1.85	*2.65*	*1.78*	*1.94*	*2.12*	*1.83*
Exp. ratio	6.8974***	6.0309***	7.0888***	5.1192***	4.6388***	4.8543***
	4.62	*4.56*	*5.30*	*3.06*	*2.97*	*2.81*
Actual 12b1	-0.9586	-0.0320	-1.3660	0.8405	1.4623	1.1335
	-0.47	*-0.02*	*-0.84*	*0.31*	*0.56*	*0.41*
Average maturity of holdings	-0.0010*	-0.0012**	-0.0012**	-0.0018***	-0.0020***	-0.0020***
	-1.92	*-2.04*	*-2.09*	*-4.48*	*-5.03*	*-4.99*
No equity	0.0993***	0.0906***	0.0932***	0.0575***	0.0469**	0.0465**
	3.33	*3.22*	*3.20*	*2.76*	*2.25*	*2.19*
Fund's equity holdings return	-0.0221	-0.0164	-0.0051	0.0391*	0.0388*	0.0408*
	-0.33	*-0.24*	*-0.07*	*1.93*	*1.88*	*1.95*
Quarter fixed effects	No	No	No	Yes	Yes	Yes
Standard error	Newey-West	Newey-West	Newey-West	Clustered by fund	Clustered by fund	Clustered by fund
N. Obs.	16252	16088	15400	16252	16088	15400
(Average) R^2	0.09	0.09	0.09	0.06	0.05	0.05

Table III Sales of Corporate Bonds by Institutional Investors Around the Crisis

The table reports the estimates of a model:

$$\log Sale_i = \alpha + \beta Quality + \delta \log Hold_i + \gamma' x_i + \varepsilon_i, \quad (2)$$

where each observation corresponds to a corporate bond with data in the FINRA TRACE data set. The dependente variable is *logSale*, the log-net sales (in thousands of dollars) of the bond by institutional investors between July 2007 and December 2007. *logHold* denotes the log-dollar holding of the bond by institutional investors as of June 2007, and *x* is a vector of standard bond characteristics, including issuer and offering year fixed effects. *Quality* denotes one of three proxies for the quality of the bond: *InvRating* (the natural logarithm of the inverse of 1 + the numerical value of the bond's S&P rating, which ranges from 0 (no rating) to 24 (AAA rating or higher)), the bond's *Amihud* illiquidity ratio, and *InvTrades* (the natural logarithm of the inverse of the average number of daily trades of the bond over the period January-June 2007). In all specifications, the standard errors are clustered around bond issuers. The sample includes all bonds in the FINRA TRACE data set with available data on bond characteristics from the Mergent FISD data set. The symbols *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels.

	(1)	(2)	(3)	(4)
InvRating	1.0496**			1.0712**
	2.14			*2.25*
Amihud		-0.9552***		-0.7488***
		-4.54		*-3.56*
InvTrades			-0.4114***	-0.2938***
			-5.26	*-3.72*
No Rating (Y/N)	-3.1242**	0.0897	0.0967	-3.2439**
	-2.01	*0.95*	*1.02*	*-2.15*
Bond is not held by institutional investors (Y/N)	4.8895***	4.6887***	4.7389***	4.6379***
	25.10	*24.01*	*25.04*	*24.34*
logHold (2007Q2)	1.0148***	0.9738***	0.9840***	0.9647***
	33.00	*31.90*	*32.83*	*31.98*
Bond face value	0.1919***	0.1640***	0.1756***	0.1492***
	5.99	*4.76*	*5.27*	*4.29*
Covenants (Y/N)	1.1209***	1.0253***	1.0170***	1.0459***
	4.61	*4.33*	*4.37*	*4.36*
CovIndex	-0.1055	0.0722	0.0346	-0.1165
	-0.25	*0.20*	*0.09*	*-0.27*
log(Months to maturity)	-0.3952***	-0.3226***	-0.3886***	-0.3348***
	-9.23	*-8.39*	*-9.58*	*-8.78*
Issuer fixed effects	Yes	Yes	Yes	Yes
Offering year fixed effects	Yes	Yes	Yes	Yes
Standard error cluster	Issuer	Issuer	Issuer	Issuer
N. Obs.	8148	8148	8148	8148
R^2	0.91	0.88	0.91	0.91

Table IV Changes in Mutual Fund Holdings of Securitized Bonds and Corporate Bonds Between 2007Q2 and 2007Q4

The table reports the estimates of a model:

$$\Delta H_i = \alpha + \beta Horizon_i + \gamma' x_i + \varepsilon_i, \qquad (3)$$

The dependent variable ΔH is the change, between 2007Q2 and 2007Q4, in the fraction of the fund's portfolio represented by securitized Bonds (columns (1)-(3)) or corporate bonds (columns (4)-(6)), in excess of the average for the fund's class (based on the average rating and maturity of the securities in the fund's portfolio), both defined in the Appendix. *Horizon* is the mutual fund's horizon, proxied for by *Turnover ratio*, *Flow-performance sensitivity*, or *Flow volatility*. *x* is a set of standard mutual fund characteristics. Both *Horizon* and *x* are expressed in their values as of June 2007. The t-statistics are based on White heteroskedasticity-robust standard errors. The sample includes all the mutual funds belonging to the merged Lipper eMAXX-CDA/Spectrum data set, over the period 2007Q1-2007Q4. The symbols *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels.

	Holdings of Securitized Bonds			**Holdings of Corporate Bonds**		
	(1)	(2)	(3)	(4)	(5)	(6)
Turnover ratio	0.7613*			-0.6441		
	1.96			*-1.32*		
Flow-performance sensitivity		0.0184*			-0.0465***	
		1.70			*-3.56*	
Flow volatility			0.0193***			-0.0262***
			10.05			*-8.79*
Securitized holdings – 2007Q2	-0.0426**	-0.1354***	-0.1360***			
	-2.47	*-5.94*	*-5.42*			
Corp. bond holdings – 2007Q2				-0.0339*	-0.1093***	-0.1073***
				-1.76	*-4.65*	*-4.15*
Affiliated to commercial bank	0.0151	0.0335***	0.0324***	-0.0135	-0.0344***	-0.0328**
	1.63	*3.08*	*2.78*	*-1.15*	*-2.72*	*-2.45*
log(Family size)	0.0066***	-0.0006	0.003	-0.0036	0.0049*	0.0017
	3.16	*-0.28*	*1.24*	*-1.27*	*1.76*	*0.55*
Past flow	0.0348***	0.0088	-0.0239***	-0.0376***	0.0003	0.0446***
	13.35	*0.09*	*-4.88*	*-13.47*	*0.00*	*5.23*
Fund return	-0.2889	-0.2278	-0.4472*	0.2498	-0.1047	0.2724
	-1.37	*-1.01*	*-1.78*	*0.88*	*-0.41*	*0.87*
Family equity holdings	0.0026	0.0538***	0.0450***	0.0144	-0.0553***	-0.0363**
	0.21	*4.08*	*3.11*	*0.99*	*-3.30*	*-2.11*
Mgmt fee	0.0008	-0.0005	-0.0001	-0.0043***	-0.0029**	-0.0035***
	1.14	*-0.41*	*-0.12*	*-4.01*	*-2.27*	*-2.94*
Exp. ratio	-0.5660	-2.3714**	-2.3063*	1.7435	3.6949***	3.7557**
	-0.54	*-2.25*	*-1.87*	*1.20*	*2.74*	*2.44*
Actual 12b1	0.0002**	0.0002*	0.0003**	-0.0003**	-0.0002*	-0.0003*
	2.21	*1.83*	*2.15*	*-1.98*	*-1.68*	*-1.92*
Average maturity of holdings	0.0000	0.0011***	0.0010***	0.0001	-0.0012***	-0.0010***
	0.11	*4.11*	*3.56*	*0.21*	*-3.70*	*-3.08*
No equity	-0.0099	-0.0019	0.0011	0.0170	0.0209	0.0241
	-0.82	*-0.13*	*0.07*	*1.16*	*1.21*	*1.34*
Fund's equity holdings return	-0.0209	-0.0900	-0.0848	0.0195	-0.0007	-0.0038
	-0.21	*-0.85*	*-0.75*	*0.15*	*-0.01*	*-0.03*
Standard error	White	White	White	White	White	White
N. Obs.	513	560	578	513	560	578
R^2	0.09	0.13	0.11	0.05	0.11	0.08

Table V Changes in Mutual Fund Holdings of Corporate Bonds Between 2007Q2 and 2007Q4, By Rating Category

The table reports the estimates of a model:

$$\Delta C_i = \alpha + \beta Horizon_i + \gamma' x_i + \varepsilon_i$$

In the odd-numbered columns, the dependent variable *ΔC* is the fund's excess sales of investment grade bonds, as a fraction of the value of the fund's portfolio as of June 2007. In the even-numbered columns, the dependent variable is the fund's sales of sub-investment grade bonds. *Horizon* is the mutual fund's horizon, proxied for by *Turnover ratio*, *Flow-performance sensitivity*, or *Flow volatility*. *x* is a set of standard control variables. Both *Horizon* and *x* are expressed in their values as of June 2007. *F*-stat *p*-values for statistical significance of the two *Horizon* coefficients (for high and low-rated bonds) are provided in the row labelled *F*-stat (*p*-value). The sample includes all the mutual funds belonging to the merged Lipper eMAXX-CDA/Spectrum data set, over the period 2007Q2-2007Q4. The symbols *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels.

Rating	**High**	**Low**	**High**	**Low**	**High**	**Low**
	(1)	(2)	(3)	(4)	(5)	(6)
Turnover ratio	-0.8464***	-1.0635***				
	-3.84	*-3.47*				
Flow-performance sensitivity			-0.0115	-0.0447**		
			-0.96	*-2.09*		
Flow volatility					-0.0764	-0.2495***
					-1.64	*-3.19*
Affiliated to commercial bank	-0.0038	-0.0370***	-0.0019	-0.0408***	-0.0014	-0.0378***
	-0.62	*-2.88*	*-0.27*	*-3.26*	*-0.19*	*-2.98*
log(Family size)	-0.0002	-0.0048*	0.0005	-0.0028	0.0008	-0.0021
	-0.13	*-1.80*	*0.32*	*-1.07*	*0.57*	*-0.79*
Securitized holdings in 2007Q2	-0.0236**	-0.1922***	-0.0348***	-0.1862***	-0.0352***	-0.1906***
	-2.42	*-9.89*	*-3.17*	*-9.77*	*-3.21*	*-10.14*
Past flow	0.0086***	-0.0002	0.0678	-0.0008	0.2415**	0.4938**
	3.82	*-0.06*	*1.22*	*-0.01*	*1.99*	*2.5*
Fund return	0.1249	0.0860	0.0891	0.0888	0.0586	0.0847
	1.24	*0.45*	*0.91*	*0.39*	*0.63*	*0.4*
Family equity holdings	-0.0018	-0.0287	0.0114	-0.0330	0.0101	-0.0364
	-0.19	*-1.19*	*1.07*	*-1.37*	*0.99*	*-1.55*
Mgmt fee	0.0046***	-0.0013	0.0044***	-0.0013	0.0044***	-0.0012
	7.91	*-1.35*	*4.31*	*-1.29*	*4.30*	*-1.21*
Exp. ratio	-1.2765	-1.3879	-0.1546	0.0223	0.1155	0.4578
	-1.34	*-1.01*	*-0.16*	*0.01*	*0.12*	*0.30*
Actual 12b1	0.0000	-0.0002	0.0000	-0.0002	0.0000	-0.0002
	-0.28	*-1.16*	*-0.04*	*-1.24*	*-0.12*	*-1.23*
No equity	-0.0145**	-0.0037	-0.0180**	-0.0009	-0.0180**	0.0029
	-1.98	*-0.21*	*-2.40*	*-0.05*	*-2.48*	*0.17*
Fund's equity holdings return	-0.0775*	0.0713	-0.1203**	0.0859	-0.1010*	0.1135
	-1.68	*0.5*	*-2.24*	*0.57*	*-1.94*	*0.74*
***F*-stat (*p*-value)**	0.44 (0.5095)		3.03* (0.0816)		4.15** (0.0416)	
Standard error	White	White	White	White	White	White
N. Obs.	510	511	556	558	570	569
R^2	0.25	0.07	0.24	0.05	0.24	0.05

Table VI Changes in Corporate Bonds' Yield Spreads Around the Crisis

Panel A of this table reports the estimates of a model:

$$\Delta YS_i = \alpha + \beta\, HoldersExposure_i + \gamma\, InvRating_i + \delta\left(HoldersExposure_i \times InvRating_i\right) + \varphi' x_i + \varepsilon_i, \quad (4)$$

where each observation corresponds to a corporate bond with data in the FINRA TRACE data set. The dependent variable ΔYS is the change in the bond's yield spread around the crisis. The yield spread is the difference between the bond's yield on the secondary market, as reported by TRACE, and the yield on a Treasury bond of comparable maturity. Data on Treasury bond yields are retrieved from the Federal Reserve Statistical Release. In columns (1)-(4) ΔYS is defined as the change in the bond's yield spread over the period from the last week of June through to the last week of October 2007, while in columns (5)-(8) it is the change in the bond's yield spread over the period from the last week of June through to the last week of December 2007. The explanatory variables are: *HoldersExposure* (the average fraction of securitized bonds in the portfolio of the mutual funds that hold the bond), *InvRating* (the natural logarithm of the inverse of 1 + the numerical value of the bond's S&P rating, which ranges from 0 (no rating) to 24 (AAA rating or higher)), the interaction term between these two variables, and a standard set of bond characteristics *x*, including issuer and offering year fixed effects.

Panel B of this table reports the estimates of a model:

$$\Delta YS_i = \alpha + \beta\, ShortExposedHolders_i + \gamma\, InvRating + \delta\left(ShortExposedHolders_i \times InvRating_i\right) + \varphi' x_i + \varepsilon_i \quad (5)$$

where each observation corresponds to a corporate bond with data in the FINRA TRACE data set. The dependent variable ΔYS is defined as in Panel A. In columns (1)-(3) ΔYS is defined as the change in the bond's yield spread over the period from the last week of June through to the last week of October 2007, while in columns (4)-(6) it is the change in the bond's yield spread over the period from the last week of June through to the last week of December 2007. *ShortExposedHolders* is an indicator equal to 1 if the bond's short-horizon mutual fund holder's exposure to securitized bonds is above the sample median. We use three proxies for mutual fund horizon: turnover ratio, flow-performance sensitivity, and flow volatility. We obtain one indicator *ShortExposedHolders* for each proxy: *High-Turnover holders*, *High-Flow sensitivity holders*, and *High-Volatility holders*. *InvRating* is defined as in Panel A. We further include the interaction term between these two variables, along with a standard set of bond characteristics *x* (the same set of variables as in Panel A), including issuer and offering year fixed effects. For brevity, only the key coefficients are shown for this panel.

In both panels and in all specifications, the standard errors are clustered around bond issuers. The sample includes all bonds in the FINRA TRACE data set with available data on bond characteristics from the Mergent FISD data set. The symbols *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels.

Panel A: The Baseline Model

	Change in Yield Spread – Jul-Oct 2007				**Change in Yield Spread – Jul-Dec 2007**			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Holders' Exposure (to Securitized Bonds)	0.9870**	0.8919**	0.8518*	0.4201	0.7543*	0.6909	0.5702	0.7071
	2.56	*1.98*	*1.8*	*0.9*	*1.96*	*1.54*	*1.19*	*1.38*
InvRating	0.9579***	0.9684***	0.9160**	0.8653**	1.7354***	1.7291***	1.6813***	1.6718***
	2.59	*2.61*	*2.43*	*2.28*	*2.84*	*2.84*	*2.69*	*2.67*
Holders' Exposure X InvRating	0.3631***	0.3325**	0.3599**	0.3244**	0.2867**	0.2639*	0.3071**	0.2691*
	3.14	*2.35*	*2.54*	*2.34*	*2.47*	*1.83*	*2.13*	*1.87*
Yield spread in 2007Q2	-0.3245***	-0.3248***	-0.3275***	-0.3294***	-0.2610**	-0.2610**	-0.2628**	-0.2623**
	-3.40	*-3.41*	*-3.49*	*-3.53*	*-2.47*	*-2.47*	*-2.54*	*-2.50*
No Rating (Y/N)	-3.2082***	-3.2539***	-3.0845***	-2.9110**	-5.7222***	-5.7155***	-5.5638***	-5.5285***
	-2.74	*-2.78*	*-2.60*	*-2.42*	*-2.94*	*-2.95*	*-2.80*	*-2.79*
Bond is not held by mutual funds (Y/N)	0.0963	0.1046	0.0815	0.0739	-0.0607	-0.0621	-0.0746	-0.0791
	1.32	*1.41*	*1.00*	*1.01*	*-0.55*	*-0.55*	*-0.72*	*-0.71*
Bond face value	-0.0064	-0.009	0.0018	0.0126	-0.0462**	-0.0453**	-0.0369	-0.0344

	-0.46	*-0.65*	*0.11*	*0.80*	*-2.01*	*-2.04*	*-1.30*	*-1.46*
Covenants (Y/N)	0.0352	0.0296	0.034	0.0374	-0.0771	-0.0825	-0.0794	-0.0741
	0.38	*0.32*	*0.36*	*0.40*	*-0.76*	*-0.83*	*-0.79*	*-0.74*
CovIndex	-0.1177	-0.1006	-0.0761	-0.0618	0.0973	0.1216	0.1497	0.1462
	-0.45	*-0.37*	*-0.28*	*-0.23*	*0.34*	*0.44*	*0.54*	*0.53*
log(Months to maturity)	-0.0837**	-0.0832**	-0.0948***	-0.0836**	-0.2231***	-0.2234***	-0.2323***	-0.2243***
	-2.44	*-2.42*	*-2.61*	*-2.34*	*-3.20*	*-3.23*	*-3.06*	*-3.21*
Insurance Holders' Exposure		0.0375	0.03	0.0257		0.0356	0.0267	0.031
		0.29	*0.23*	*0.20*		*0.26*	*0.20*	*0.23*
Insurance Holders' Exposure X InvRating		0.1909	0.1919	0.1828		0.0699	0.0637	0.0700
		0.44	*0.44*	*0.42*		*0.17*	*0.16*	*0.17*
Amihud			0.1692				0.1011	
			0.86				*0.44*	
Holders' Exposure X Amihud			0.3619				0.7293	
			0.71				*1.56*	
InvTrades				-0.2150***			-0.0882	
				-2.83			*-1.06*	
Holders' Exposure X InvTrades				0.3861*			-0.0186	
				1.81			*-0.08*	
Issuer fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Offering year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Standard error cluster	Issuer	Issuer	Issuer	Issuer	Issuer	Issuer	Issuer	Issuer
N. Obs.	7257	7257	7257	7257	7233	7233	7233	7233
R^2	0.69	0.69	0.69	0.69	0.79	0.79	0.79	0.79

Panel B: Short-horizon Investors with Exposure to Securitized Bonds

	Change in Yield Spread – Jul-Oct 2007			Change in Yield Spread – Jul-Dec 2007		
	(1)	(2)	(3)	(4)	(5)	(6)
High-Turnover holders	0.3551			0.7577**		
	1.41			*2.46*		
High-Flow Sensitivity holders		0.3705*			0.5282**	
		1.74			*1.99*	
High-Flow volatility holders			0.3340			0.4825*
			1.49			*1.76*
InvRating	0.7831**	0.7869**	0.7798**	1.8432***	1.7650***	1.7624***
	2.05	*2.09*	*2.04*	*3.49*	*3.36*	*3.35*
High-Turnover holders X InvRating	0.1171			0.2161**		
	1.42			*2.23*		
High-Flow sensitivity holders X InvRating		0.1325*			0.1471*	
		1.86			*1.77*	
High-Flow volatility holders X InvRating			0.1385*			0.1489*
			1.90			*1.79*
Insurance Holders' Exposure	-0.0188	-0.0757	-0.089	-0.7963	-0.4688	-0.4772
	-0.03	*-0.15*	*-0.18*	*-1.34*	*-0.85*	*-0.87*
Insurance Holders' Exposure X InvRating	-0.0348	-0.0552	-0.061	-0.2637	-0.1509	-0.1547
	-0.2	*-0.35*	*-0.39*	*-1.32*	*-0.82*	*-0.86*
Issuer fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Other Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Offering year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Standard error cluster	Issuer	Issuer	Issuer	Issuer	Issuer	Issuer
N. Obs.	7335	7335	7335	7312	7312	7312
R^2	0.65	0.65	0.65	0.78	0.78	0.78

Table VII Corporate Bond Trading Pressure by Mutual Funds Around the Crisis

Panel A of this table reports the estimates of a model:

$$\Delta Tr_i = \alpha + \beta\, HoldersExposure_i + \gamma\, InvRating_i + \delta\left(HoldersExposure_i \times InvRating_i\right) + \varphi' x_i + \varepsilon_i, \quad (6)$$

where each observation corresponds to a corporate bond with data in the FINRA TRACE data set. The dependent variable ΔTr_i is the selling pressure of mutual funds on the bond, defined as the total net sales by mutual funds divided by the total trading volume on the bond, over the crisis period. In columns (1)-(4) ΔTr_i is defined over the period from July through to October 2007, while in columns (5)-(8) it is defined over the period from July through to the December 2007. The explanatory variables are: *HoldersExposure* (the average fraction of securitized bonds in the portfolio of the mutual funds that hold the bond), *InvRating* (the natural logarithm of the inverse of 1 + the numerical value of the bond's S&P rating, which ranges from 0 (no rating) to 24 (AAA rating or higher)), the interaction term between these two variables, and a standard set of bond characteristics *x*, including issuer and offering year fixed effects.

Panel B of this table reports the estimates of a model:

$$\Delta Tr_i = \alpha + \beta\, ShortExposedHolders_i + \gamma\, InvRating + \delta\left(ShortExposedHolders_i \times InvRating_i\right) + \varphi' x_i + \varepsilon_i \quad (7)$$

where each observation corresponds to a corporate bond with data in the FINRA TRACE data set. The dependent variable ΔTr is defined as in Panel A. In columns (1)-(3) ΔTr is defined over the period from the last week of June through to the last week of October 2007, while in columns (4)-(6) it is over the period from the last week of June through to the last week of December 2007. The explanatory variables are defined as follows. *ShortExposedHolders* is an indicator equal to 1 if the bond is held by short-horizon mutual funds with exposure to securitized bonds above the median. We use three proxies for mutual fund horizon: turnover ratio, flow-performance sensitivity, and flow volatility. We obtain one indicator *ShortExposedHolders* for each proxy: *High-Turnover holders*, *High-Flow sensitivity holders*, and *High-Volatility holders*. *InvRating* is defined as in Panel A. We further include the interaction term between these two variables, along with a standard set of bond characteristics *x* (the same set of variables as in Panel A), including issuer and offering year fixed effects. For brevity, only the key coefficients are shown.

In both panels and in all specifications, the standard errors are clustered around bond issuers. The sample includes all bonds in the FINRA TRACE data set with available data on bond characteristics from the Mergent FISD data set. The symbols *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels.

Panel A: Baseline model

	Trading Pressure of Mutual Funds – Jul-Oct 2007				**Trading Pressure of Mutual Funds – Jul-Dec 2007**			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Holders' Exposure (to Securitized Bonds)	0.0104***	0.0093**	0.0123***	0.0112**	0.0031	0.0041	0.0051	0.0056
	2.75	*2.41*	*3.09*	*2.40*	*1.00*	*1.20*	*1.56*	*1.48*
InvRating	0.0010	0.0010	0.0012	0.0012	0.0010	0.0010	0.0013	0.0009
	0.38	*0.40*	*0.47*	*0.47*	*0.54*	*0.56*	*0.69*	*0.50*
Holders' Exposure X InvRating	0.0038***	0.0034***	0.0033***	0.0038***	0.0024**	0.0027**	0.0019*	0.0025**
	3.10	*2.75*	*2.66*	*3.11*	*2.38*	*2.45*	*1.84*	*2.51*
2007Q2 log-volume	0.0001*	0.0001	0.0001	0.0000	0.0001**	0.0001**	0.0001**	0.0001*
	1.75	*1.64*	*1.60*	*0.45*	*2.14*	*2.08*	*2.37*	*1.89*
No Rating (Y/N)	-0.0031	-0.0034	-0.0039	-0.0039	-0.0035	-0.0035	-0.0043	-0.0032
	-0.38	*-0.41*	*-0.47*	*-0.48*	*-0.58*	*-0.59*	*-0.73*	*-0.55*
Bond is not held by mutual funds (Y/N)	-0.0039***	-0.0039***	-0.0039***	-0.0039***	-0.0056***	-0.0056***	-0.0056***	-0.0057***
	-7.10	*-6.95*	*-6.99*	*-6.94*	*-12.12*	*-12.19*	*-11.90*	*-11.96*

Bond face value	0.0000	0.0000	-0.0001	-0.0001	0.0001**	0.0001**	0.0001	0.0002**
	-0.29	*-0.57*	*-0.94*	*-0.72*	*2.42*	*2.21*	*1.63*	*2.35*
Covenants (Y/N)	-0.0012	-0.0013	-0.0012	-0.0012	0.0008	0.0009	0.0008	0.0009
	-1.04	*-1.09*	*-1.09*	*-1.09*	*0.82*	*0.89*	*0.77*	*0.89*
CovIndex	0.0057*	0.0060*	0.0054*	0.0056*	0.0015	0.0011	0.0011	0.0016
	1.81	*1.84*	*1.70*	*1.77*	*0.56*	*0.44*	*0.44*	*0.60*
log(Months to maturity)	-0.0001	-0.0001	-0.0001	-0.0001	-0.0005***	-0.0005***	-0.0004***	-0.0005***
	-1.47	*-1.46*	*-0.61*	*-1.43*	*-4.97*	*-4.99*	*-4.00*	*-4.96*
Insurance Holders' Exposure		0.0020			-0.0009	-0.0009		
		0.98			*-0.49*	*-0.49*		
Insurance Holders' Exposure X InvRating		0.0004			-0.0005	-0.0005		
		0.62			*-0.72*	*-0.72*		
Amihud			-0.0091**				-0.0006*	
			-2.21				*-1.85*	
Holders' Exposure X Amihud			-0.0006*				-0.0094**	
			-1.69				*-2.49*	
InvTrades				0.0006				0.0000
				1.20				*0.11*
Holders' Exposure X InvTrades				-0.0006				-0.0021
				-0.25				*-1.40*
Issuer fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Offering year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Standard error cluster	Issuer	Issuer	Issuer	Issuer	Issuer	Issuer	Issuer	Issuer
N. Obs.	8666	8666	8666	8666	8728	8728	8728	8728
R^2	0.58	0.58	0.58	0.58	0.68	0.68	0.68	0.68

Panel B: Short-horizon Investors with Exposure to Securitized Bonds

	Mutual fund selling pressure – Jul-Oct 2007			Mutual fund selling pressure – Jul-Dec 2007		
	(1)	(2)	(3)	(4)	(5)	(6)
High-Turnover holders	0.0038***			0.0049***		
	2.86			*4.02*		
High-Flow Sensitivity holders		0.0043***			0.0049***	
		3.23			*4.25*	
High-Flow volatility holders			0.0038***			0.0044***
			2.82			*2.98*
InvRating	0.0020	0.0019	0.0019	0.0020	0.0018	0.0018
	0.77	*0.74*	*0.73*	*1.08*	*0.98*	*1.01*
High-Turnover holders X InvRating	0.0010**			0.0007*		
	2.14			*1.84*		
High-Flow sensitivity holders X InvRating		0.0010**			0.0009**	
		2.54			*2.39*	
High-Flow volatility holders X InvRating			0.0008*			0.0007
			1.86			*1.52*
Insurance Holders' Exposure	0.0017	0.0015	0.0023	-0.0015	-0.0019	-0.0011
	0.83	*0.75*	*1.09*	*-0.78*	*-0.99*	*-0.50*
Insurance Holders' Exposure X InvRating	0.0003	0.0003	0.0006	-0.0006	-0.0007	-0.0005
	0.52	*0.41*	*0.81*	*-0.82*	*-1.07*	*-0.58*
Issuer fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Other Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Offering year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Standard error cluster	Issuer	Issuer	Issuer	Issuer	Issuer	Issuer
N. Obs.	8666	8666	8666	8728	8728	8728
R^2	0.58	0.58	0.58	0.69	0.68	0.68

Table VIII Corporate Bond Trading Volume Around the Crisis

The table reports the estimates of a model:

$$\log Vol_i = \alpha + \beta\, HoldersExposure_i + \gamma\, InvRating_i + \delta\left(HoldersExposure_i \times InvRating_i\right) + \varphi' x_i + \varepsilon_i \quad (8)$$

where each observation corresponds to a corporate bond with data in the FINRA TRACE data set. The dependent variable *logVol* is the natural logarithm of the bond's average daily trading volume (expressed in number of trades) over the crisis period. In columns (1)-(4) *logVol* is defined over the period from July through to October 2007, while in columns (5)-(8) it is defined over the period from July through to the December 2007. The explanatory variables are: *HoldersExposure* (the average fraction of securitized Bonds in the portfolio of the mutual funds that hold the bond), *InvRating* (the natural logarithm of the inverse of 1 + the numerical value of the bond's S&P rating, which ranges from 0 (no rating) to 24 (AAA rating or higher)), the interaction term between these two variables, and a standard set of bond characteristics *x*, including issuer and offering year fixed effects. In all specifications, the standard errors are clustered around bond issuers. The sample includes all bonds in the FINRA TRACE data set with available data on bond characteristics from the Mergent FISD data set. The symbols *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels.

	Trading Volume – Jul-Oct 2007				**Trading Volume – Jul-Dec s2007**			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Holders' Exposure (to Securitized Bonds)	0.8778***	0.9275***	1.3250***	0.5752	0.6254***	0.6348**	1.0685***	-0.0996
	2.73	*2.63*	*3.49*	*1.34*	*2.96*	*2.49*	*3.75*	*-0.33*
InvRating	-1.5356***	-1.5018***	-1.4736***	-1.4969***	-0.6168***	-0.5842***	-0.5456***	-0.5862***
	-4.38	*-4.37*	*-4.35*	*-4.36*	*-2.96*	*-2.88*	*-2.78*	*-2.92*
Holders' Exposure X InvRating	0.2382**	0.2686**	0.1395	0.2664**	0.1564**	0.1718*	0.0253	0.1594*
	2.28	*2.21*	*1.11*	*2.21*	*2.18*	*1.89*	*0.30*	*1.76*
2007Q2 log-volume	0.4286***	0.4152***	0.4076***	0.4176***	0.5093***	0.4963***	0.4588***	0.5088***
	10.44	*10.50*	*11.02*	*11.08*	*18.22*	*18.03*	*17.28*	*19.98*
No Rating (Y/N)	4.8706***	4.7862***	4.7075***	4.7739***	2.0144***	1.9284***	1.8119***	1.9423***
	4.46	*4.46*	*4.44*	*4.45*	*3.11*	*3.05*	*2.95*	*3.10*
Bond is not held by mutual funds (Y/N)	-0.6231***	-0.5944***	-0.6176***	-0.5910***	-0.4955***	-0.4686***	-0.4976***	-0.4627***
	-6.10	*-5.89*	*-6.03*	*-5.83*	*-6.63*	*-6.37*	*-6.65*	*-6.37*
Bond face value	0.2756***	0.2649***	0.2636***	0.2653***	0.1389***	0.1289***	0.1260***	0.1317***
	7.62	*7.37*	*7.25*	*7.07*	*8.74*	*8.28*	*8.12*	*8.07*
Covenants (Y/N)	0.0862	0.1031	0.1084	0.0931	0.1788*	0.1914**	0.1942**	0.1773*
	0.64	*0.78*	*0.83*	*0.70*	*1.90*	*2.08*	*2.18*	*1.94*
CovIndex	0.6117**	0.5301*	0.4661	0.5293*	0.4216**	0.3590*	0.2972	0.3563*
	2.07	*1.81*	*1.60*	*1.81*	*2.27*	*1.94*	*1.64*	*1.93*
log(Months to maturity)	-0.0981***	-0.0958***	-0.0928***	-0.0954***	-0.1056***	-0.1035***	-0.0869***	-0.1028***
	-4.57	*-4.42*	*-3.88*	*-4.44*	*-8.47*	*-8.32*	*-5.97*	*-8.47*
Insurance Holders' Exposure		0.3089	0.3357	0.3042		0.3452*	0.3919**	0.3325*
		0.97	*1.07*	*0.95*		*1.77*	*2.09*	*1.65*
Insurance Holders' Exposure X InvRating		-0.0785	-0.0612	-0.0796		-0.0552	-0.0302	-0.0589
		-0.69	*-0.54*	*-0.70*		*-0.88*	*-0.50*	*-0.93*
Amihud			0.0632				-0.1411	

			0.33				*-1.50*	
Holders' Exposure X Amihud			-2.2277**				-2.4864***	
			-2.46				*-4.18*	
InvTrades				-0.0400				-0.1293**
				-0.50				*-2.50*
Holders' Exposure X InvTrades				0.3435				0.6824***
				1.41				*4.17*
Issuer fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Offering year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Standard error cluster	Issuer	Issuer	Issuer	Issuer	Issuer	Issuer	Issuer	Issuer
N. Obs.	9598	9598	9598	9598	9573	9573	9573	9573
R^2	0.80	0.80	0.80	0.80	0.88	0.88	0.88	0.88

Table IX Relationship between mutual funds' and insurance companies' trades

The table reports the estimates of a model:

$$MF\_Netbuy_{it} = \alpha + \beta_1 INS\_Netbuy_{it} \times (1 - Crisis_t) + \beta_2 INS\_Netbuy_{it} \times Crisis_t + \gamma' x_{it-1} + \varepsilon_{it} \quad (9)$$

where each observation is a given corporate bond, in a given quarter. The dependent variable *MF_Netbuy* is the net purchases of the bond by all mutual funds (column (1)), or by mutual funds that have a large exposure to securitized bonds and a short horizon, i.e. the high-Turnover (column (2)), high-Flow sensitivity (column (3)), and high-Flow volatility (column (4)) funds, defined as in table X above, or by non-exposed mutual funds that have a long horizon (columns (5)-(7)), i.e. by all funds minus the highly exposed, short-horizon funds. *MF_Netbuy* is equal to net purchases of the bond by these categories of funds, divided by the total institutional holdings of the bond (holdings of mutual funds plus holdings of insurance companies) as of the previous quarter. *INS_Netbuy* is the net purchases of the bond by insurance companies, again divided by the total institutional holdings of the bond. *Crisis* is an indicator variable equal to one for dates between 2007Q3 and 2008Q1. *x* is a vector of standard bond characteristics used throughout the paper, including bond issuer and quarter fixed effects. The last row of the table reports the *F* test statistic for H_0: $\beta_1 = \beta_2$. The sample includes all bonds in the FINRA TRACE data set with available data on bond characteristics from the Mergent FISD data set and bond holdings in the Lipper EMAXX data set, for the period 1998Q1-2008Q1. The symbols *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels.

	All funds	**Short-horizon mutual funds**			**All other mutual funds**		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
INS_Netbuy X (1-Crisis)	0.1046***	0.0018***	0.0011***	0.0018***	0.1001***	0.1015***	0.0974***
	13.52	*6.64*	*5.51*	*5.81*	*12.94*	*13.06*	*12.73*
INS_Netbuy X Crisis	0.2793***	0.0070***	0.0050***	0.0092***	0.2218***	0.2225***	0.2324***
	11.59	*6.97*	*6.43*	*6.94*	*9.60*	*9.55*	*10.28*
InvRating	-0.0270***	0.0002	0.0002*	0.0002	-0.0267***	-0.0255***	-0.0270***
	-4.27	*0.98*	*1.68*	*0.64*	*-4.25*	*-4.09*	*-4.40*
Log-volume	-0.0026***	-0.0001***	-0.0001***	-0.0001***	-0.0025***	-0.0025***	-0.0025***
	-7.88	*-9.34*	*-10.49*	*-8.85*	*-7.74*	*-7.78*	*-8.02*
No Rating (Y/N)	0.0439**	-0.0008*	-0.0008**	-0.0010	0.0454**	0.0418**	0.0472***
	2.41	*-1.67*	*-2.36*	*-1.56*	*2.50*	*2.32*	*2.67*
Bond not held by mut. funds (Y/N)	0.0083	0.0000	0.0000	0.0002**	0.0111**	0.0111**	0.0103**
	1.63	*0.26*	*-0.05*	*2.23*	*2.32*	*2.32*	*2.16*
Bond face value	0.0033***	-0.0001***	-0.0001***	-0.0001***	0.0031***	0.0030**	0.0028**
	2.79	*-3.30*	*-4.29*	*-4.09*	*2.63*	*2.51*	*2.36*
Covenants (Y/N)	-0.0143	0.0013***	0.0032**	0.0015**	-0.0188	-0.0259	-0.0194
	-0.73	*3.04*	*2.23*	*2.22*	*-1.19*	*-1.36*	*-1.04*
CovIndex	0.0031	-0.0015***	-0.0010***	-0.0017***	0.0074	0.0070	0.0072
	0.36	*-5.40*	*-4.49*	*-4.61*	*0.85*	*0.81*	*0.83*
log(Months to maturity)	0.0019***	0.0002***	0.0001***	0.0002***	0.0015***	0.0016***	0.0015***
	4.16	*10.06*	*8.22*	*6.62*	*3.51*	*3.64*	*3.39*
Issuer and quarter fixed effects	Y	Y	Y	Y	Y	Y	Y
Standard error cluster	Bond	Bond	Bond	Bond	Bond	Bond	Bond
N. Obs.	68561	68588	68568	68555	67387	67373	67377
R^2	0.286	0.124	0.115	0.126	0.289	0.291	0.288
F-stat for H_0: $\beta_1 = \beta_2$	20.87***	29.58***	23.67***	25.61***	32.06***	24.40***	25.03***

Table X Price impact of mutual funds' trades relative to insurance companies' trades

The table reports the estimates of a model:

$$\Delta YS_{it} = \alpha + \beta_1 Absorb_{it} \times (1 - Crisis_t) + \beta_2 Absorb_{it} \times Crisis_t + \gamma' x_{it-1} + \varepsilon_{it} \quad (10)$$

where each observation is a corporate bond-quarter pair. The dependent variable ΔYS is the quarterly change in the bond's yield spread. $Absorb_{it}$ is defined as the sales of the bond *i* by short horizon, high-exposure mutual funds net of the purchases of the bond *i* by insurance companies. In column (1), it is defined using Turnover as the investment horizon measure; in column (2), it is defined using flow volatility as the horizon measure; in column (3), it is defined using flow sensitivity to performance as the horizon measure; in columns (4)-(6), it is analogously defined, except using overall sales by mutual funds rather than net sales. All the *Absorb* proxies are divided by the total institutional holdings of the bond as of the previous quarter. *Crisis* is an indicator variable equal to one for dates between 2007Q3 and 2008Q1. *x* is a vector of standard bond characteristics used throughout the paper, including bond issuer and quarter fixed effects. For brevity, only the key coefficients are shown. The last row of the table reports the *F*-test statistic for H_0: $\beta_1 = \beta_2$..The sample includes all bonds in the FINRA TRACE data set with available data on bond characteristics from the Mergent FISD data set and bond holdings in the Lipper EMAXX data set, for the period 1998Q1-2008Q1. The symbols *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels.

	(1)	(2)	(3)	(4)	(5)	(6)
Absorb I-High Turnover X (1 - Crisis)	0.0394					
	0.36					
Absorb I-High Turnover X Crisis	0.5031*					
	1.94					
Absorb I-High Flow volatility X (1 - Crisis)		0.0167				
		0.15				
Absorb I-High Flow volatility X Crisis		0.5627**				
		2.13				
Absorb I-High Flow sensitivity X (1 - Crisis)			0.0128			
			0.12			
Absorb I-High Flow sensitivity X Crisis			0.5484**			
			2.11			
Absorb II-High Turnover X (1 - Crisis)				0.0158		
				0.15		
Absorb II-High Turnover X Crisis				0.6582***		
				2.80		
Absorb II-High Flow volatility X (1 - Crisis)					0.0292	
					0.27	
Absorb II-High Flow volatility X Crisis					0.5803**	
					2.35	
Absorb II-High Flow sensitivity X (1 - Crisis)						0.0581
						0.55
Absorb II-High Flow sensitivity X Crisis						0.5789**
						2.36
Issuer and quarter fixed effects	Y	Y	Y	Y	Y	Y
N. Obs.	66916	66910	66918	66902	66896	66898
R^2	0.232	0.231	0.232	0.232	0.232	0.232
***F*-test stat for** H_0: $\beta_1 = \beta_2$.	2.68*	3.64*	3.59*	6.13**	4.15**	4.74**

Table XI Structural break in institutional trades and the correlation of the yield spread to institutional trades
In columns (1)-(2), the table reports the estimates of a model:

$$Netbuy_{it} = \beta_1 \, Crisis_{it} + \beta_2 \left(1 - Crisis_{it}\right) + \varepsilon_{it}$$

where *Netbuy* is either *INST_Netbuy* (column (1)) or *MF_Netbuy* (column (2)). *INST_Netbuy* is the aggregate net purchases of a given bond by all institutional investors (insurance companies plus mutual funds), divided by the prior-quarter total holdings of insurance companies plus mutual funds. *MF_Netbuy* is the net purchases of a given bond by all mutual funds, divided by the prior-quarter total holdings of insurance companies plus mutual funds. *Crisis* is an indicator variable equal to one for dates between 2007Q3 and 2008Q1. The last row in these columns reports the F test statistic for the null hypothesis that $\beta_1 = \beta_2$.

In column (3), the table reports the estimates of a model:

$$\Delta YS_{it} = \alpha + \beta_1 \, INST\_Netbuy_{it} \times \left(1 - Crisis_t\right) + \beta_2 \, INST\_Netbuy_{it} \times Crisis_t + \gamma' x_{it} + \varepsilon_{it}$$

where *INST_Netbuy* and *Crisis* are defined as above, and *x* is a of standard bond characteristics used throughout the paper, including bond issuer and quarter fixed effects.

In column (4), the table reports the estimates of a model:

$$\begin{aligned} \Delta YS_{it} = {} & \alpha + \beta_1 \, INS\_Netbuy_{it} \times \left(1 - Crisis_t\right) + \beta_2 \, INS\_Netbuy_{it} \times Crisis_t + \\ & + \beta_3 \, MF\_Netbuy_{it} \times \left(1 - Crisis_t\right) + \beta_4 \, MF\_Netbuy_{it} \times Crisis_t + \gamma' x_{it} + \varepsilon_{it} \end{aligned}$$

where *MF_Netbuy* and *Crisis* are defined as above, *INS_Netbuy* is defined as the aggregate net purchases of the bond by insurance companies, divided by the prior-quarter total holdings of insurance companies plus mutual funds, and *x* is a of standard bond characteristics used throughout the paper, including bond issuer and quarter fixed effects.

In all columns, the sample includes all bonds in the FINRA TRACE data set with available data on bond characteristics from the Mergent FISD data set and bond holdings in the Lipper EMAXX data set, for the period 1998Q1-2008Q1. The symbols *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels.

Table XI Structural break in institutional trades and the sensitivity of the yield spread to institutional trades – cont'd

Dependent Variable	**INST_Netbuy**	**MF_Netbuy**	ΔYS	ΔYS
	(1)	(2)	(3)	(4)
Crisis	-0.0685***	-0.0436***		
	-72.00	*-53.83*		
1 - Crisis	-0.0517***	-0.0233***		
	-112.21	*-66.95*		
INST_Netbuy X (1-Crisis)			0.2700*	
			1.93	
INST_Netbuy X Crisis			-1.9886***	
			-9.38	
INS_Netbuy X (1-Crisis)				-0.1677
				-1.41
INS_Netbuy X Crisis				-0.1395
				-0.47
MF_Netbuy X (1-Crisis)				0.7301***
				4.33
MF_Netbuy X Crisis				-3.2083***
				-12.27
InvRating			0.6694***	0.2283*
			2.71	*1.70*
Log-volume			-0.0064	-0.0014
			1.46	*-0.37*
No Rating (Y/N)			-2.0342***	-0.7611**
			-2.84	*-2.00*
Bond not held by mut. funds (Y/N)			0.0139	0.0023
			0.13	*0.02*
Bond face value			-0.0276***	-0.0150**
			-3.40	*-2.39*
Covenants (Y/N)			-0.2074**	-0.1663*
			-1.99	*-1.69*
CovIndex			0.0311	0.0535
			0.34	*0.71*
log(Months to maturity)			-0.0429***	-0.0320***
			-7.59	*-6.86*
Issuer and quarter fixed effects	N	N	Y	Y
Standard error cluster at	Bond	Bond	Bond	Bond
N. Obs.	64021	63757	64021	63395
R^2	0.318	0.188	0.201	0.250
***F* test (*p*-value)**	311.44 (0.0000)	706.56 (0.0000)		

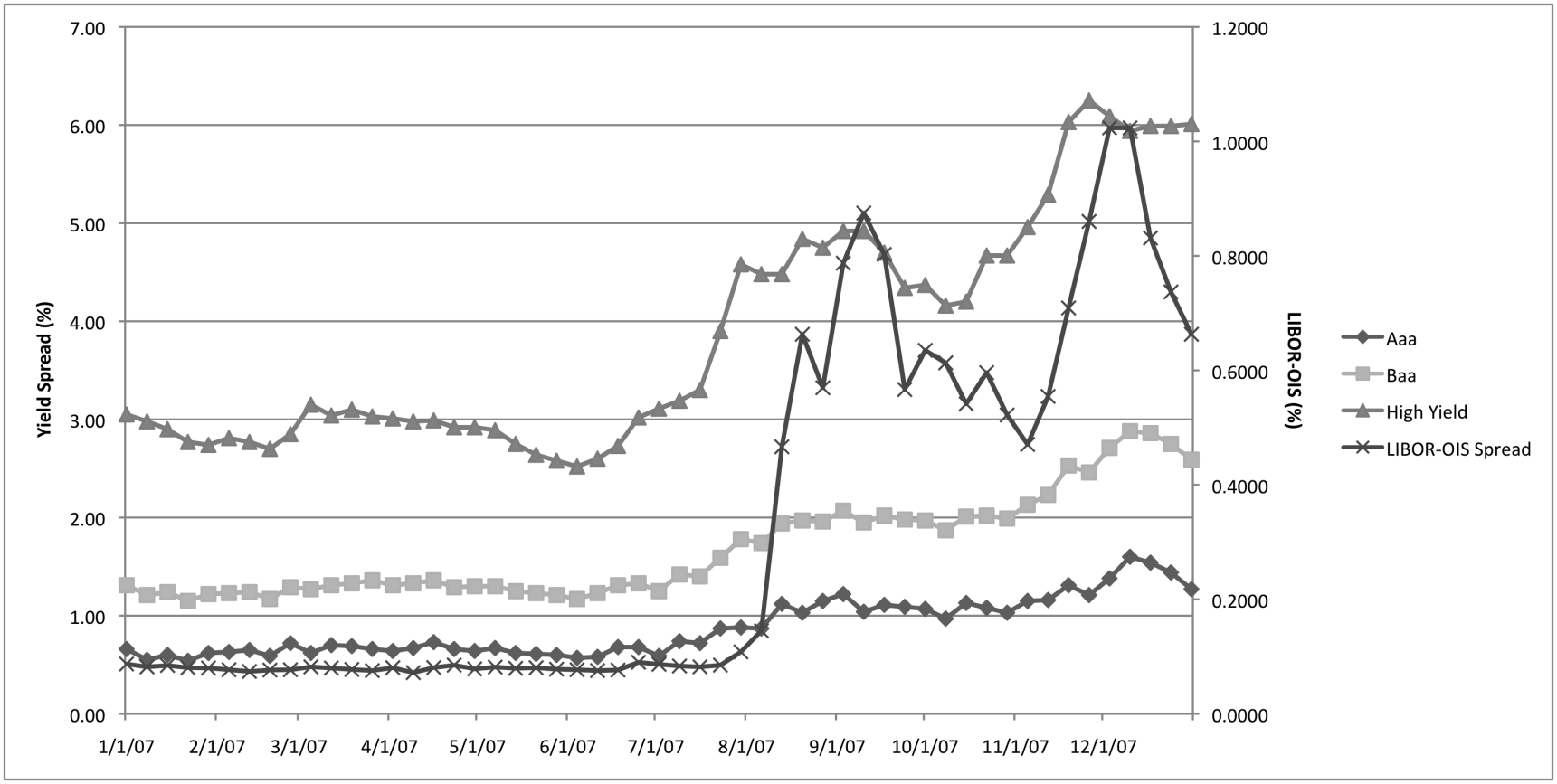


Figure 1 Corporate Bond Yield Spreads and LIBOR-OIS spread
The graph plots weekly average yield spreads on corporate bonds 2007, for Aaa, Baa, and High Yield corporate bonds, as well as the spread between the LIBOR rate and the Overnight Index swap rate (LIBOR-OIS Spread, secondary axis). The yield spread is defined as the difference between a bond's yield on the secondary market and the yield on a Treasury bond of comparable maturity. Data on Treasury yields are retrieved from the Federal Reserve Statistical Release.

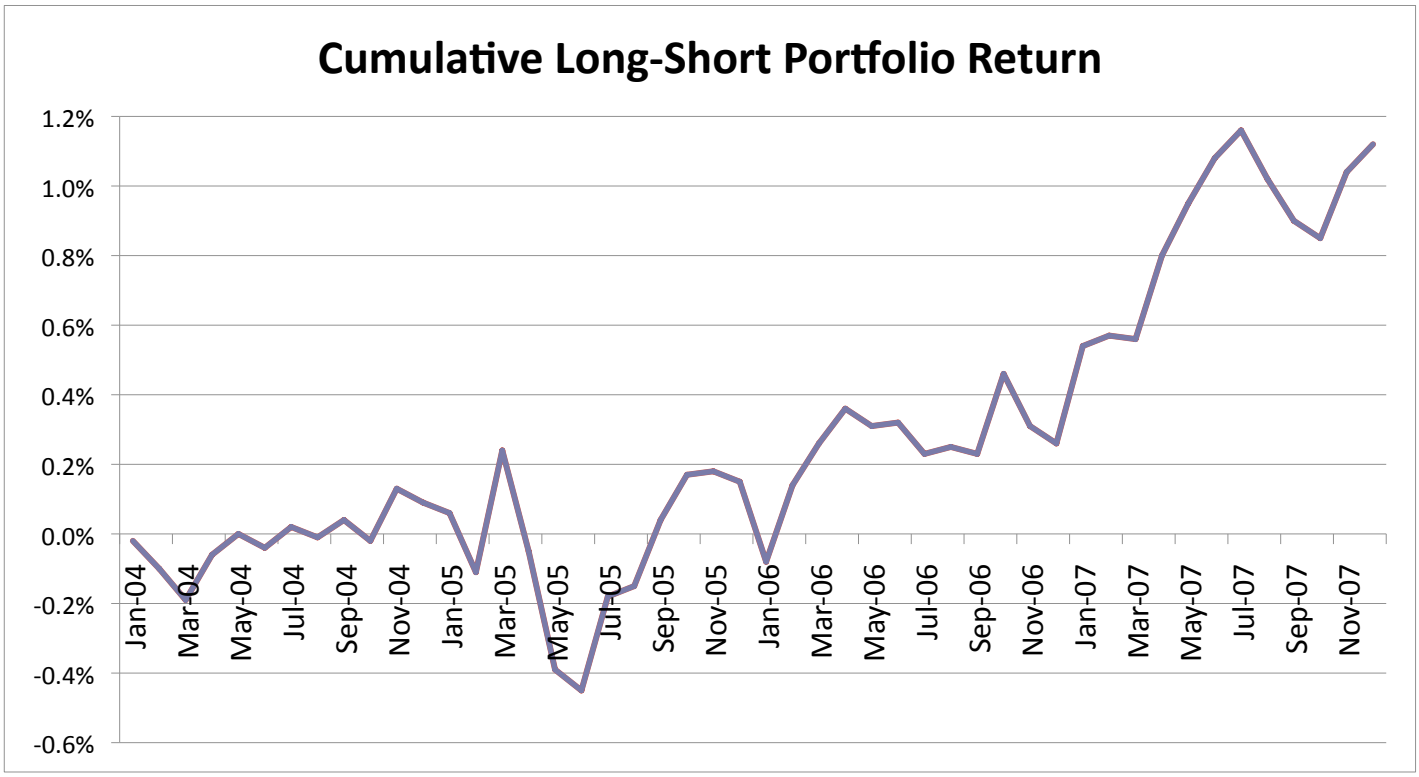


Figure 2 Alpha of a Long-short Portfolio of Low-rated Corporate Bonds with and without Exposure

The figure plots the cumulative monthly return on a portfolio that is *short* on the below-investment grade bonds whose mutual fund holders have high exposure to securitized bonds, and *long* on a set of issuer- and duration-matched bonds without the exposure, over the period 2004-2007.

We define "high exposure" as those corporate bonds whose average mutual fund holder's exposure to securitized bonds is in the top 30% in either of the previous two quarters. We place these bonds in the short portfolio if and only if it has a matching bond satisfying the following criteria: (i) the matching bond is issued by the same issuer firm; and (ii) the time to maturity of the matching bond is between 50% and 150% of the time to maturity of the shorted bond. We place these matching bonds in the long portfolio. The long-short portfolio's monthly return is then the long portfolio's monthly return (rebalanced to be equal-weighted each month) minus the short portfolio's monthly return (similarly rebalanced). Returns on individual corporate bonds are constructed from the secondary market prices, as reported by TRACE. In each period, bond returns are also winsorized at 1%.