Why Ratings Matter: Evidence from the Lehman Brothers Index Rating Redefinition

Zhihua Chen Aziz A. Lookman Norman Schürhoff Duane J. Seppi *

March 5, 2011

*Chen is with the School of Finance at Shanghai University of Finance and Economics; Lookman is with Moody's Research Labs; Schürhoff is with the Faculty of Business and Economics at University of Lausanne, Swiss Finance Institute, and CEPR; and Seppi is with the Tepper School of Business at Carnegie Mellon University. We thank Darrell Duffie for extensive discussions and for sharing his notes on Lehman's index construction. We also thank Andrew Ellul, Florian Heider, Jean Helwege, Olfa Maalaoui, and seminar and conference participants at McGill University, the University of Lausanne, the 2009 EFA, the 2010 NBER Summer Meeting on Credit Rating Agencies, the 6th MTS Conference on Financial Markets, and the 6th Swiss Doctoral Workshop for helpful feedback. Chen and Schürhoff gratefully acknowledge research support from the Swiss Finance Institute and from NCCR FINRISK of the Swiss National Science Foundation.

Abstract

A 2005 change in the eligibility of split-rated bonds in the Lehman Brothers bond indices provides a quasi-natural experiment to examine the role of credit ratings in the corporate bond market. Our results show that rating-induced market segmentation has a direct effect on bond pricing. Bonds that were mechanically upgraded from high yield to investment grade for purposes of index eligibility have positive abnormal returns of roughly 1.6 percent on average and exhibit abnormal order flows over several months following the Lehman rule announcement. Bonds upgraded to investment grade but not eligible for index inclusion exhibit abnormal returns of similar magnitude. In addition, GM and Ford bonds, which had been on watch for downgrade to high yield but which benefited from the Lehman rule change, experienced reduced selling and a rapid price recovery. The fact that official regulations were unaffected by the Lehman announcement suggests market segmentation due to rating-based investor norms and practices in addition to segmentation due to rating-based regulation.

JEL Classification: G12, G14

Key words: Corporate bond market, rating agencies, rating-based regulation, market segmentation, liquidity, index addition, institutional investors, industry practices

1 Introduction

Market segmentation, capital immobility, and illiquidity are important departures from the paradigm of a frictionless market. In the presence of such frictions, asset prices can be affected by supply and demand shocks to capital as well as by changes in valuation fundamentals.[1] Empirically, however, there is an identification problem in disentangling capital shocks from contemporaneous shocks to fundamentals. This paper uses a change in the eligibility rules for split-rated bonds in the Lehman Brothers investment-grade bond index to investigate how bond ratings affect bond ownership, pricing, and trading. This setting allows us to measure pricing effects due to market segmentation in the absence of confounding concurrent changes to cash flow fundamentals.

The US corporate bond market is a natural setting in which to investigate market segmentation. First, it is an opaque decentralized over-the-counter (OTC) market where traders incur search costs in locating counterparties. Because of the relatively small number of potential counterparties, we expect shocks to the ownership structure of bonds to lead to order flow imbalances and price changes that are larger and more persistent than capital shocks in the more liquid equity markets that have been the focus of much of the previous research on capital immobility.[2] Second, bond ratings by Nationally Recognized Statistical Rating Organizations (NRSROs) play a central role in this largely institutional market.[3] Official regulation and informal policies and procedures at banks, insurance companies, pension funds and mutual funds both restrict ownership of bonds rated below-investment grade. Split-rated bonds—where rating agencies disagree on the credit worthiness of a bond—are of particular interest since their investment-grade status depends both on their ratings and on the rule used to aggregate divergent ratings. Hence, a systematic change in the rule used to determine which ratings correspond to investment grade can affect portfolio decisions for many institutional investors, which in turn can affect split-rated bond prices.

[1]Duffie (2010), Duffie and Strulovici (2011), and Gromb and Vayanos (2009) show how market segmentation and capital immobility can affect the ownership distribution of assets and how this feeds back into asset prices.

[2]Duffie, Garleanu, and Pedersen (2007) show that illiquidity discounts in a search market are higher when counterparties are harder to find and when sellers have less bargaining power.

[3]As of early 2005, Moody's and S&P rated over 90% of corporate bonds issued, and Fitch rated about 70% of these bonds. Dominion Bond Rating Service, a Canadian credit agency, was recognized as an NRSRO by the SEC in 2003, and A.M. Best, a rating agency specializing in insurance companies, was recognized as an NRSRO in 2005.

The Lehman (now Barclays Capital) corporate investment-grade index is an important benchmark for institutional investors. Consequently, Lehman's definition of what precisely constitutes "investment grade" could be influential with portfolio managers and investment committees. On January 24, 2005 Lehman announced a change in its methodology for computing the index rating of split-rated bonds. Index ratings are used to determine a bond's eligibility for inclusion in the Lehman investment-grade bond index. Effective July 1, 2005, the index rating for a split-rated bond would be the middle rating of the credit ratings issued by Moody's, S&P, and Fitch. Previously, Fitch ratings were ignored under the old rule which set a bond's index rating to be the more conservative of its ratings from Moody's and S&P. Empirically, ratings by Fitch were higher than its competitors' for 70% of all bonds it rated. Consequently, the Lehman rule change mechanically improved the index rating of several hundred bonds by an entire letter or by one or two notches within the same letter rating. Of these, there are a total of 48 bonds which i) had index ratings that would prospectively increase from high yield (HY) to investment grade (IG) based on their credit ratings on the announcement date for which ii) the necessary data for our analysis is available.[4] For a bond with an IG index rating to be included in the actual IG index, it must also satisfy a minimum par size condition. The majority of the 48 bonds satisfied the size requirement, but some did not. Our analysis focuses on a subset of 30 bond issues (which we call *upgraded bonds*) that could be expected to switch immediately from the HY index into the IG index on the effective date. However, we also examine the 18 other bonds (which we call *orphan bonds*) that received an investment-grade index rating under Lehman's new rule but which did not enter the IG index.

In this paper, we investigate whether the Lehman rule change altered institutional investors' perceptions of split-rated bonds, thereby leading to changes in these bonds' ownership structure and pricing. We call this the *market segmentation hypothesis*. In this context, two facts are important. First, Lehman's old index rating rule (which depended on the lower of Moody's and S&P ratings) was more conservative than prevailing official regulations (which focused on middle ratings). Thus,

[4]According to the financial press at the time of the announcement, the total number of bonds expected to switch index ratings was 59 (with a total market value of $33.4 billion comprising 2.1% of the IG index and 5.0% of the HY index). The difference between 59 bonds and our sample of 48 stems from a lack of TRACE transactions data. Even though traders became obliged with TRACE Phase III to disseminate all transactions in liquid bonds, there are no transactions reported during our pre-event control window for 11 of the 59 affected bond. As a result, we are not able to compute announcement returns for these bonds.

there was some "slack" within which investors taking a similarly conservative stance could follow Lehman's lead vis-a-vis their treatment of split-rated bonds and still meet the minimum standard set by official regulations. Second, the Lehman rule change was arguably unaccompanied by new information about valuation fundamentals since the Moody's, S&P, and Fitch ratings themselves were already public and did not change with the Lehman announcement. Rather, it is the *use* of these ratings by Lehman, and possibly other investors, that changed. Our analysis of the 30 bonds upgraded to the IG index finds evidence consistent with market segmentation effects:

- The upgraded bonds exhibit significantly positive abnormal returns of 1.6% over a twenty-day window around the Lehman announcement. Abnormal returns peak at 3% five months later around the effective date, and then partially revert to about 2.5% by year-end.
- These abnormal returns include a statistically significant permanent increase around the Lehman announcement and a permanent component that is contingent on the subsequent differential performance of the IG and HY indices after the announcement.
- Bonds with high post-announcement turnover outperform bonds with low turnover by 5% (consistent with changes in ownership structure), and long-maturity bonds outperform short-maturity bonds by 4% (consistent with ownership effects being greater for bonds which need to be held over long horizons).
- Average daily turnover in the upgraded bonds more than doubled for several months after the Lehman announcement. In addition, purchases by insurance companies increased which is consistent with buying pressure from rating-sensitive investors.

One possible alternative explanation is that the Lehman announcement prompted a revision in the general reputation of Fitch ratings, which caused a general revision in the market's perception of the credit risk of bonds with high Fitch ratings and raised their prices (Kliger and Sarig, 2000; Boot, Milbourn, and Schmeits, 2006). However, we find evidence against this informational hypothesis. First, the stock prices of companies with bonds with favorable Fitch ratings did not react to the Lehman announcement.[5] In addition, the price impact in the bond market seems to be disproportionately concentrated in bonds just below the IG-HY boundary where market segmentation effects should be strongest. A second alternative explanation is index inclusion effects.[6] Inclusion of the upgraded bonds in the IG index may have simply forced passive indexers to buy the bonds. However, we find that the 18 orphan bonds left out of the IG index (despite their new investment-grade index rating) had similar returns to the upgraded bonds which were added to the index. A third alternative explanation is changes in priced liquidity risk. However, we find that the improved liquidity associated with increased turnover in the upgraded bonds dissipates over time.

Another set of bonds we investigate are bonds issued by General Motors and Ford. These bonds are central to the back–story behind the Lehman rule change. Under the old Lehman rule, GM and Ford bonds had index ratings of BBB– (due to a BBB– rating by S&P together with higher ratings by Moody's). In early 2005, S&P was widely expected to downgrade these bonds which, under the old Lehman rule, would lower their index rating to junk and, thereby, force them out of the IG index. Consequently, GM and Ford bonds were under considerable selling pressure as investors reduced their holdings in anticipation of forced sales in the near future. Given the enormous size of the outstanding GM and Ford debt,[7] capital immobility effects would be severe as it would be difficult for high-yield investors to absorb these bonds in a short interval. The new Lehman rule gave the GM and Ford bonds a reprieve. So long as their higher ratings from Moody's and Fitch held, GM and Ford would maintain a BBB index rating or better despite any S&P downgrade. Following the Lehman announcement, selling pressure in the GM and Ford bonds abated and these bonds experienced positive abnormal returns. The results for the GM and Ford bonds reinforce our evidence for rating-based market segmentation.

Our paper contributes to a large literature on the economic role of rating agencies and the

[5] Holtausen and Leftwich (1986), Hand, Holthausen and Leftwich (1992) and Goh and Ederington (1993) show that bond rating changes have an impact in stock prices.

[6] Vijh (1994), Barberis, Shleifer, and Wurgler (2005), and Hendershott and Seasholes (2009) provide evidence from equity markets on the effects associated with stock index additions and deletions.

[7] Based on their 2004 annual reports, the total debt outstanding as of Dec 31, 2004 was $300 billion for GM and $173 billion for Ford. Ford also has additional indirect debt obligations because of off-balance sheet borrowing arrangements. Approximately 90% of this debt was issued by their financial services subsidiaries.

effects of capital shocks and market segmentation.[8] A few recent papers are closely related to our study. Kisgen and Strahan (2010) exploit the SEC's designation of Dominion Bond Rating Service as a NRSRO to learn about the certification role of rating agencies. Bongaerts, Cremers, and Goetzmann (2010) find time series evidence of segmentation in that multiple credit ratings play a tie–breaking role in bond pricing but only around the IG–HY boundary. Ambrose, Cai, and Helwege (2009) and Ellul, Jotikasthira, and Lundblad (2010) come to differing conclusions about the price effects of fire sales of downgraded bonds by insurance companies. In contrast, our study holds bond ratings and their putative information content fixed and investigates whether changes in the interpretation and use of bond ratings have a pricing impact. Recent SEC regulations have reduced the reliance on ratings by NRSROs and introduced softer criteria for determining capital requirements. As a consequence, industry conventions and procedures are likely to be even more important in the future.

The remainder of the paper is organized as follows: Section 2 describes how rating-based regulations and institutional conventions can lead to market segmentation and develops the basic hypotheses for our analysis. Section 3 describes the data and our empirical approach. Sections 4 and 5 present our empirical findings. Finally, Section 6 concludes.

2 Background and Hypotheses

The use of credit ratings in official regulation and informal industry practices can segment the bond market into high-yield and investment-grade investor clienteles. Moreover, changes in Lehman's index rating methodology have the potential to influence how the industry uses bond ratings and, thereby, alter the ownership structure of affected bonds. In the following, we discuss the institutional setting and provide background information on the Lehman rule change.

[8] Coval and Stafford (2007) examine asset fire sales in equity markets, Mitchell and Pulvino (2007) examine large capital redemptions of convertible bond hedge funds, and Newman and Rierson (2004) analyze the impact of large issues by European Telecom firms. Steiner and Heinke (2001) examine price pressure in eurobonds associated with announcements of watchlistings and rating changes by S&P and Moody's. Holthausen and Leftwich (1986) and Hand, Holthausen, and Leftwich (1992) examine the effects of bond rating agency announcements on bond and stock prices. Kisgen (2007) studies the market for credit ratings and the link to corporate capital budgeting. Becker and Milbourn (2010) show that the quality of S&P and Moody's ratings gradually deteriorated after the entry of Fitch.

2.1 Rating-based segmentation

Credit ratings are widely used in regulatory oversight of financial institutions. The Securities and Exchange Commission (SEC), the Bank for International Settlements (BIS), and the National Association of Insurance Commissioners (NAIC) all use credit ratings to measure the credit risk exposure of institutions under their purview. The number of rating-based regulations has grown steadily. By 2002, there were at least 8 federal statutes, 47 federal regulations, and over 100 state laws and regulations that use credit ratings from Nationally Recognized Statistical Rating Organizations (NRSROs).[9] These regulations typically restrict institutional holdings of bonds with low credit ratings. For example, SEC Rule 15c3-1 requires broker-dealers to take a larger discount ("haircut") on below-investment grade corporate bonds when calculating their net-capital. Savings and loan associations (S&L) have been prohibited since 1989 from investing in high-yield bonds. The NAIC has a 20% cap on how much junk bonds insurers may hold as a percentage of their assets. Investment-grade bond mutual funds can hold up to only 5% of assets in junk bonds and must sell any security falling below a B rating (see Cantor and Packer, 1994; and Kisgen, 2007).

For split-rated bonds—where rating agencies disagree on a bond's creditworthiness—some amount of judgement is called for in determining whether a bond is investment grade. Official regulations set minimum standards, but nothing prevents portfolio managers and investment committees from being more conservative.[10] Rating-based industry practices are, therefore, another channel, on top of official regulation, through which segmentation can arise the US corporate bond market, with only a subset of buyers allowed—and *willing*—to hold large positions in risky bonds. In this regard, institutions are presumably influenced by prevailing industry norms and best practices. Many investment management mandates, for instance, reference Lehman index ratings. Hence, we argue that Lehman, as an industry leader, had the potential to influence informal industry norms and, thereby, affect institutional decisions about portfolio holdings of split-rated bonds.

[9] US Senate (2002) provides an excellent summary of rating-based regulations.

[10] Lehman's pre-2005 rule, which was presumably indicative of practices by other institutional investors at the time, was stricter than official regulations which focused on middle (or higher) ratings by more than two agencies. For instance, according to SEC Rules 15c3-1 and 206(3)-3T, a bond must be rated in one of the four highest categories by at least *two* NRSROs to be investment grade. SEC Rules 3a1-1 and 3a-7 require a rating in one of the four highest categories by at least *one* NRSRO for a bond to be investment grade. Under NAIC regulations, a bond rated by three NRSROs is assigned the rating falling second lowest (see NAIC, 2009).

2.2 Lehman's index rating rule change

The Lehman Brothers (now Barclays Capital) bond indices have been in existence since January 1, 1973.[11] With their long history, they are widely used benchmarks in the fixed-income market. The specific indices of interest for this study are the investment-grade US Corporate index (IG) and the US Corporate High-yield index (HY). The IG index is composed of investment-grade, US dollar-denominated, fixed-rate, taxable securities that also meet certain size, maturity, and other criteria. The HY index is composed of below-investment grade corporate bonds that meet characteristic criteria that are generally looser than those for the IG index.[12]

A bond's eligibility for inclusion in the Lehman IG or HY indices is based in part on its *index rating* which Lehman computes simply by aggregating ratings issued by the major credit agencies. Index ratings do not provide any additional credit information beyond the Moody's, S&P, and Fitch bond ratings. Table 1 provides a short history of Lehman index rating rules along with a timeline of other potentially pertinent market events surrounding the 2005 redefinition.

Insert Table 1 about here

Lehman Brothers has redefined its index rating methodology only three times over its history. Under the original Lehman rule, a bond's index rating was the average of its Moody's and S&P ratings. A bond with a split rating of investment grade by one agency and high yield by the other contributed half of its weight to both the investment-grade and the high-yield indices (conditional on meeting the respective indices' bond characteristics criteria). In August 1988, the index rule was changed so that a bond's index rating was just its Moody's rating (or, if not rated by Moody's, its S&P rating). In October 2003, the rule was again changed so that a bond's index rating was the more conservative of its Moody's and S&P ratings (or, if not rated by both agencies, its rating

[11] On September 22, 2008 Barclays Capital acquired Lehman Brothers' North American investment banking and capital markets businesses. Barclays has continued the family of indices and associated index calculation, publication, and analytical infrastructure.

[12] Additional details on the Lehman bond indices is available at `https://ecommerce.barcap.com/indices/`.

from the single agency). We refer to the 2003 procedure as the *old rule* and the corresponding index ratings as the *old index ratings*.

In this paper, we investigate the most recent rule change.[13] On January 24, 2005 Lehman Brothers announced that, effective July 1, 2005, index ratings would also depend on Fitch credit ratings. In particular, a bond's index rating would be the middle rating assigned by Moody's, S&P, and Fitch. (For bonds rated by only two agencies, the index rating is the more conservative of the two ratings. If rated by only one agency, a bond's index rating is simply this single rating.) We refer to the 2005 rule as the *new rule* and the corresponding index ratings as *new index ratings*. Depending on their Fitch ratings, the new rule could cause bonds to transition mechanically from a high-yield to an investment-grade index rating, even though there was no change in credit ratings by any of the major rating agencies and, presumably, no change in valuation fundamentals.

The 2005 Lehman index rating redefinition provides a quasi-natural experiment to examine the effects of market segmentation and ratings in the absence of concurrent information about bond creditworthiness.[14] Although bond credit ratings themselves did not change, we argue that the Lehman announcement influenced how institutional investors *use* credit ratings in their portfolio decisions. If true, this allows us to circumvent the identification problem that bond rating changes themselves potentially convey new credit information as well as trigger changes in investor portfolio holdings. Whether the Lehman announcement caused investor norms to change or was itself a response to changing investor norms is not crucial for our purposes. In either case, if the bond market is segmented because of rating-based regulations and industry practices, then bonds upgraded from high yield to investment grade should experience additional investor demand. Given downward-sloping demand curves, the prices of these bonds should rise. This price pressure may,

[13]We have little data on transaction prices for the earlier Lehman index rule changes or for earlier redefinitions by other index providers. In particular, Merrill Lynch announced on October 14, 2004 changes in the selection criteria for the Merrill Lynch global bond indices. Effective December 31, 2004, Merrill Lynch switched its index rating rule from the average of Moody's and S&P to the average of Moody's, S&P, and Fitch. According to Business Wire ("Merrill Lynch Announces Changes to Global Bond Index Rules," October 14, 2004), the new methodology resulted in adjusted ratings on roughly 12% of all Merrill Lynch index constituents, the vast majority of which moving up by one rating grade. A total of 17 bonds fell below investment grade and none moved from below investment grade to investment grade. The Lehman corporate indices are generally considered to be more widely followed than the Merrill Lynch corporate indices.

[14]As natural experiences are rare, the usual caveat applies about the number of observations being small.

in turn, consist of a transitory component (which is eventually reversed once investors' portfolio reallocations are completed) and a permanent component (since bonds in different market segments are priced using different investors' marginal rates of substitution).

The Lehman redefinition was largely a surprise since redefinitions are typically implemented only after consultation with three advisory councils, comprised of major fixed-income investment firms, that only meet once a year. On Monday, January 24, Lehman unexpectedly scheduled a conference call with its advisory councils to discuss the rule change. It had not had such a conference call for several years. The context in which this announcement occurred was one of market stress about potential GM and Ford downgrades. An article (Eisinger, 2005) in the *Wall Street Journal*—revealingly titled "GM Bond Worries Fade With Some Magic From Lehman"—provides an explanation for the redefinition, its motivation, and timing:

> "Lehman long had contemplated including Fitch, and it was on the agenda for a meeting later this year. So why the rush? Word had filtered into the media that Lehman was considering adding Fitch. 'We wanted to remove any attention to our indices, as quickly as we could' said a person familiar with the matter. And this person says Lehman had taken note of the market's GM jitters. Along with Moody's, Fitch rates GM bonds higher than S&P, two notches above junk. Even if S&P downgrades GM, as long as the other two stand pat, the auto maker would remain in Lehman's investment-grade indexes under the new system."

Figure 1 plots the Lehman investment-grade and high-yield indices over time. We normalize them relative to the index level at the start of our control window, 50 trading days prior to the Lehman announcement. The vertical dotted lines indicate major events (as described in Table 1) relating to the three TRACE phases, the Lehman index rating redefinition, and the subsequent 2005 GM and Ford downgrades. Clearly the performance of IG and HY debt diverged over this time period. Our analysis tests whether the pricing and trading of split-rated bonds which were classified as below-investment grade under the old Lehman index rating rule but which were reclassified as investment grade under the new rule, changed around the time of the Lehman announcement.

Insert Figure 1 about here

3 Data and methodology

We use an event study analysis to investigate the impact of the Lehman redefinition on different segments of the bond market. This section describes the main data sources. We also describe how we implement our event study.

3.1 Corporate bond characteristics

We obtain bond characteristics (e.g., coupon, maturity) from Mergent's Fixed Investment Securities Database (FISD), which contains comprehensive characteristic information on all bonds that are assigned CUSIPs or are likely to receive one. The FISD data also includes a complete ratings history from Moody's, S&P, and Fitch for all corporate bond issues.

To construct our sample, we start with all outstanding bonds as of the Lehman announcement date. Next, we filter out redeemed bonds and bonds with special features. Specifically, we require that (i) the amount outstanding is positive at the announcement date, (ii) the remaining maturity is at least one year, (iii) the bond is not convertible or floating-rate, (iv) the bond is not a private placement bond, unless it is an SEC Rule 144A bond with registration rights, and (v) the bond is added to TRACE at least three months before the announcement date. This last criterion ensures that bonds in our sample have transaction prices before the announcement date (see Table 1 and the next section for a description of the different phases of transaction price reporting and dissemination). Our final universe consists of 8,175 bonds, of which 2,232 are IG index members, 659 are HY index members, and 5,284 are not member of any Lehman index.

Table 2 presents summary statistics of the bond characteristics for various samples used in our study. The average par value outstanding as of the announcement date is approximately $250 million. Index members have much larger issue sizes than bonds not in any Lehman index (around 10 times on average). Trading frequency also varies systematically between index and non-index members.[15] Along other dimensions, IG index members (Panel A) have features comparable to HY index members (Panel B) and index non-members (Panel C). Overall, the average maturity is 9.4 years, and the average seasoning of bonds in the sample is 3.8 years. Coupon rates range from zero to 14.25%.

Insert Table 2 about here

Table 3 Panel A summarizes bond index ratings calculated according to the old and new rules. The vast majority of bonds in our sample, 99.5%, are rated by Moody's and S&P. By contrast, only 74% of the sample is rated by Fitch. The bonds most likely to experience a change of ownership (i.e., because of buying by rating-sensitive investors) are bonds that had a prospective upgrade in their index rating from high yield to investment grade as of the announcement date. This group consists of 43 bonds with an old index rating of BB and 5 bonds with an old index rating of B for a total of 48 bonds.[16] Panel B shows that Fitch assigned ratings that are higher than the lower of Moody's and S&P's to 4,229 (or 70%) of the 6,017 bonds they rated. This difference in assigned ratings is pervasive across rating categories and industries.[17] Table 3 also shows that a very small number of bonds have lower index ratings under the new rule.[18]

Insert Table 3 about here

3.2 Prices and transactions

Our main source for bond transactions data is the Trade Reporting And Compliance Engine (TRACE) which provides tick-by-tick data on transaction price, quantity, and supplementary in-

[15]Figure IA.1 in the Internet Appendix compares the distributions of days between trades over the period $(-50, +245]$ for the sample of 30 bonds upgraded to IG and the control sample. The two distributions look similar.

[16]The three bonds upgraded from BB– to AAA had previously experienced a material change in creditworthiness, leading to a downgrade from AAA to BB– by Moody's, while S&P and Fitch kept their rating at AAA.

[17]It is not crucial for our analysis whether ratings differences across agencies are due to different rating scales or different measurement objectives. Our interest is in the impact of ratings beyond their informational content.

[18]If a bond is rated by only one of Moody's and S&P, then a low Fitch rating can reduce its index rating.

formation on all TRACE-eligible corporate bonds.[19] The TRACE system was instituted by the National Association of Securities Dealers (NASD) to meet demands from investors for greater transparency. Beginning on July 1, 2002, the NASD required all over-the-counter corporate bond transactions in TRACE-eligible securities to be reported to the TRACE system. Public dissemination of TRACE data was implemented in three phases (see Table 1 for details). Transactions data on all corporate bonds considered to be reasonably liquid became available with the first stage of TRACE Phase III, which started on October 1, 2004. The remaining less liquid issues were then added as part of the second stage of TRACE Phase III on February 7, 2005. Around 4,700 bonds traded per day after February (or 20% of all issues with trades reported in TRACE in 2005) and 4,100 bonds per day between October and February. However, TRACE coverage dramatically falls off to roughly 1,600 bonds per day before October 1, 2004.

To be in our sample, a bond must have transaction prices which were publicly disseminated before the Lehman announcement (see condition (v) in the previous section). The data were filtered to eliminate potentially erroneous entries. For instance, transactions flagged as canceled or corrected are deleted to ensure that our results are based on actual transactions. We also winsorize the price data at the 0.1% and 99.9% levels to mitigate the impact of outliers on our analysis.

The National Association of Insurance Commissioners (NAIC) database includes all corporate bond trades involving insurance companies. While more limited in scope, the NAIC data have two advantages over TRACE. First, the NAIC identifies who is trading. Second, it provides actual (non-truncated) transaction sizes and buy-sell indicators. We use this information to compute measures for bond turnover and order flow imbalances.

Equity prices for the companies in our sample are from the Center for Research in Security Prices (CRSP). We use daily end-of-day prices adjusted for splits and dividends. We obtain the three Fama-French factors—market excess returns (MKT), the size factor (SMB), and book-to-market factor (HML)—from Kenneth French's website.

[19]TRACE has two main limitations. First, transaction volume is truncated at $5 MM for investment-grade bonds and at $1 MM for high-yield bonds during our sample period. Second, the publicly disseminated version of TRACE does not provide a buy-sell indicator, which limits its ease-of-use for calculating transaction costs. See Bessembinder *et al.* (2009), Edwards *et al.* (2007) and Goldstein *et al.* (2007) for additional details on TRACE.

3.3 Methodology

We face two methodological challenges in doing an event study around the Lehman announcement. The first is missing data due to infrequent bond trading. The second is determining an appropriate control for computing abnormal returns.

3.3.1 Measuring cumulative returns in illiquid markets

Corporate bonds trade infrequently, with the typical bond trading only once every other day. Table 2 gives trading frequencies for various bond samples in this study. As a result, estimating bond returns is challenging because price movements are not observable without trading. Since there is no standard method for computing returns given infrequent trading, we use two simple imputation methods and verify our results are robust to both approaches.[20] Both approaches compute cumulative returns as the percentage difference between a bond's midpoint price and a pre-event reference price. *Method 1* imputes the last observed daily midpoint price when a bond does not trade on a given day. *Method 2* instead imputes the next observed daily midpoint price for missing prices. The difference between the two approaches is the imputed timing of when missing returns are assumed to be realized. Neither approach requires trading on consecutive days, but they do give the same return when a bond does trade each day.[21] We then form cumulative returns on portfolios by taking the weighted average across all bonds in the portfolio. Following Bessembinder *et al.* (2009), we use value-weighting instead of equal-weighting.

3.3.2 Matched-sample approach for measuring abnormal returns

We measure abnormal returns using a matched sample methodology, as in Barber and Lyon (1997). The formation of a suitable control sample is of particular importance. The looming potential

[20]Infrequent trading is alleviated somewhat in our study because the event we study tended to increase trading (e.g., see Panel D in Table 2 and Section 4.2.1 below for the upgraded bonds). Infrequent trading is also less problematic when computing returns over longer than daily horizons.

[21]We have also conducted cross-sectional studies in which we instead measure the prices used to compute returns by averaging over all transactions across several consecutive days. The results are similar.

downgrade of GM and Ford was presumably depressing the HY index. Thus, when the Lehman announcement gave GM and Ford a reprieve, this should have relieved some of the price pressure on the HY index bonds and caused HY bonds to appreciate. Our long-short matched sample design controls for this effect and for other observable bond characteristics.

Our matched sample methodology matches each bond in the treatment sample to a set of control bonds that are similar along all dimensions deemed relevant except their Fitch rating. Specifically, we pair bonds based on their credit risk by matching on the index rating category up to the notch under Lehman's old split-rating rule (i.e., BB+, BB, BB–, B+, etc.). In addition, we match on being in the same maturity bin: short (1-5 years) or long (5 years or longer). The number of matches ranges between one and 19 for each upgraded bond with 11 matches on average. In robustness checks, we also match on index beta, liquidity, par size outstanding, coupon, and industry. Fewer matches result when more match criteria are imposed, which increases the impact of idiosyncratic price movements in the set of matched control bonds.[22] Therefore, our baseline analysis matches just on old index ratings and maturity. Regarding their Fitch ratings, the control bonds are either not rated by Fitch (the most numerous type of control bonds from Table 3) or have a Fitch rating below Moody's and S&P. In particular, we exclude from the control group bonds with better or equal Fitch rating compared to Moody's and S&P. The reason for excluding the "equal rating" bonds (even though their index ratings are unchanged under the new rule) is that the redefinition not only has an impact on bonds immediately upgraded to IG, but also a probabilistic impact on bonds not immediately upgraded. Bonds with Fitch ratings equal to their lower S&P or Moody's ratings are more likely to switch to IG in the future under the new rule and therefore also benefit from the rule change.[23]

The sample of control bonds are used to form sets of long-short portfolios. That is, we compute returns for portfolios that are long the treatment bonds and short a set of control bonds. For each

[22] We checked the *Financial Times* archives and the internet for major news stories. We could not identify materially relevant events on bonds affected by the redefinition. From the sample of control bonds, we have eliminated bonds issued by AT&T, since AT&T announced a merger with SBC Communications in January 2005 (see `http://www.corp.att.com/news/2005/01/31-1`). AT&T bonds had, at the time, a BB+ rating by all three agencies.

[23] The new rule expands the set of ratings changes which can cause a below-IG bond to be upgraded to IG. With one (or both) of its S&P and Moody's ratings below-IG and a Fitch rating also below-IG, a bond can be upgraded to an IG index rating if any one (two) of its two (three) below-IG ratings is raised to IG. In contrast, under the old rule, only upgrades specifically by the bond's one (two) below-IG big-two ratings can lead to an IG index rating.

treatment bond there are multiple possible control bond matches. In each round, one potential match for each treatment bond is used as the control and then a bootstrap draws different matches from the set of potential matches. Each long-short portfolio provides a set of cumulative abnormal returns (CARs) for each day during the event window. The average of these returns across the 1,000 bootstrap rounds yields the point estimates for the CAR that we report in the paper.

The bootstrapped sample of long-short portfolio returns are also used to form the empirical distribution of abnormal returns in order to compute significance levels. Bootstrapping the standard errors mitigates statistical issues related to the small sample size. Barber and Lyon (1997), Lyon, Barber and Tsai (1999), and Chhaochharia and Grinstein (2006) show that the bootstrap approach can improve the accuracy of hypothesis tests, thereby avoiding misleading inferences. The bootstrap procedure to compute empirical p-values is described in more detail in Appendix A.

4 Does Rating-Based Market Segmentation Matter?

In this section and the next we investigate bond returns, trading, and the portfolio behavior of investors around the Lehman index rating redefinition. Our analysis focuses on bonds that are likely to experience changes in ownership because of the Lehman redefinition. One such category of bonds are bonds whose index rating changed immediately from high yield to investment grade as a result of the redefinition. To the extent that the Lehman redefinition (or at least its timing) was a response to the GM and Ford crisis, these upgraded bonds can be viewed as "bystanders" swept up in the Lehman redefinition. As such, the redefinition was arguably an exogenous shock for these bonds.

A second category of interest are bonds whose index ratings did not change immediately, but where the probability of future index rating changes changed. Current prices would then reflect the market's updated probability beliefs about future rating-sensitive demand. One obvious example where a probabilistic impact was likely are the GM and Ford bonds. Under the old index rating rule, these bonds were widely expected to be forced out of the IG segment in the near future, and consequently experienced a substantial sell-off prior to the Lehman announcement. Market segmentation predicts that the Lehman announcement, and the resulting reduced probability of future index rating downgrades, should have alleviated this sell-off and raised prices. A second example where a probabilistic impact is likely are all high-yield bonds with a favorable Fitch rating relative to their Moody's and S&P ratings. These bonds also potentially benefited from the redefinition through an increased probability of future index rating upgrades.

Our analysis focuses largely on event windows defined relative to five important dates. We measure these horizons in terms of the number of trading days before or after the Lehman announcement on January 24, 2005 (day $t = 0$). Our control window begins in 2004 on day $t = -50$ before the Lehman announcement because transaction price availability before TRACE Phase III is limited. We use day $t = -10$, two weeks before the Lehman announcement, as the start for the announcement window to have a clean pre-event base price because S&P watchlisted GM the same week which, in part, prompted the Lehman redefinition. The effective date for the redefinition is day $t = +114$ (July 1, 2005). Our sample period then continues after the effective date through the end of 2005 (day $t = +245$).

4.1 Abnormal returns on bonds upgraded to IG

The bonds most likely to have a change in ownership because of the Lehman redefinition are bonds whose index rating was immediately upgraded from high yield to investment grade. There are 48 such bonds for which the necessary price data is available. Once minimum par requirements for index inclusion are taken into account, 30 of the 48 bonds were eligible to enter the IG index, 8 dropped out of the HY index but did not enter the IG index, and 10 were never in either index.[24] Because of data concerns about infrequent trading, we focus in this section on the 30 upgraded bonds eligible to enter the IG index. Table 2 shows that the average proportions of days with transactions for the 30 upgraded bonds is 70% higher than for the 18 orphan bonds. Later in Section 5 we confirm that the orphan bonds had similar returns.

[24] Lehman's IG index rules require bonds to have a par outstanding of at least $250 MM, while the HY index rules require only $150 MM of par outstanding.

Figure 2 and Table 4 report cumulative abnormal returns around the Lehman announcement for the 30 HY bonds that became eligible for inclusion in the IG index. CARs are computed using the matched sample procedure described in the previous section. The announcement day is day $t = 0$, and the effective date for the rule change is day $t = +114$ (also indicated by the † marker). The abnormal returns are cumulated starting at date $t = -10$, over horizons measured in trading days. Empirical p-values are one-sided for the null hypothesis $H_0 : CAR_t \leq 0$ and calculated using the bootstrap procedure described in Appendix A.

Insert Figure 2 and Table 4 about here

As a quick test of whether the control sample has similar risk characteristics as the treatment sample of upgraded bonds, we measure abnormal portfolio returns over a $(-50, -10]$ pre-event control window and test the hypothesis that the expected control window abnormal returns are zero. The first row in Table 4 shows that the CARs over the pre-event control window are 30 (42) basis points with a p-value of 0.16 (0.11) under *Method 1* (*Method 2*). These returns are insignificant, in both economic and statistical terms, and are robust to the method used to compute cumulative returns, suggesting that the control bonds adjust adequately for the bonds' risk characteristics.

Bonds that were prospectively expected to enter the IG index had an economically significant average abnormal return of 1.6% over the twenty day window surrounding the announcement day.[25] This is statistically significant at the 1 percent level. Information about the rule change apparently leaked into prices days before Lehman's announcement, consistent with press coverage of the event (see Eisinger, 2005). Some of the positive post-announcement drift may reflect delayed

[25]To avoid any look-back bias, our analysis of long-term price effects does not control for the fact that some upgraded bonds may subsequently experience downgrades and drop back into the HY index. Empirically, out of the 30 bonds in our sample, 29 maintained their new investment-grade index rating through the effective date but one dropped to high yield because of a downgrade before the effective date. We also exclude bonds that were unaffected by the rule change as of the announcement date but subsequently experienced index rating upgrades. In particular, three bonds with investment-grade status at the announcement were downgraded by S&P during the implementation period, but then reentered the IG index at the effective date because of the rule change. In addition, four high-yield bonds were newly issued during the implementation period and entered the IG index on the effective date because of the rule change. As already noted, our sample excludes 10 bonds which were eligible throughout and entered the IG index on the effective date but for which pre-announcement TRACE data to compute announcement returns was unavailable.

price adjustments due to slow-moving capital in search markets. The CARs peak around day +10 after the announcement after which a short-term reversal occurs. The upgraded bonds then further outperformed until they peaked around the effective date at 3%. At the end of 2005 (after 245 trading days), the CARs are around 2%, still about 2/3 of the peak price impact. A priori, the magnitudes of these returns seem plausible for market segmentation effects due to informal industry policies and procedures. (Presumably, the price impact of market segmentation due to official regulation is larger.) These patterns are robust to the imputation method used to compute returns (*Method 1* or *Method 2*). Hence, we just use the more conservative *Method 1* in the rest of our analysis.

Controlling for bond maturity in the matched sample methodology is important. Intuitively, ownership effects should be more pronounced in bonds that need to be held for a long time. The last two sets of columns in Table 4 report CARs for maturity-based subsamples of 11 bonds with short-maturities (1-5 years) and 19 bonds with long-maturities (5 years or longer). The difference in abnormal returns for long- versus short-maturity bonds is 2.58% on day +10 and almost 3% by the end of the year. Panel (a) in Figure 3 shows these returns over the immediate announcement window.

Insert Figure 3 about here

Table 5 has additional robustness checks to ensure the control sample has similar risk characteristics as the upgraded bond sample.[26] We report several different CARs where we match the control bonds on index rating, maturity, and also on various other additional characteristics. These include index beta, liquidity, outstanding par size, coupon, and industry. Details of the bins used to construct matches are in the table header. The results are similar to Table 4, suggesting any

[26]We also estimated multivariate cross-sectional regressions to verify that the abnormal returns on upgraded HY bonds are not due to bond characteristics being systematically different vis-a-vis the control bonds. Internet Appendix C describes the methodology and our control variables. To alleviate concerns about confounding firm-specific news arriving around the announcement, we cluster standard errors at the issuer level. The results, reported in Internet Appendix Table IA.1, confirm that the abnormal returns on the upgraded bonds are not due to differences in observable bond characteristics.

selection bias in the control sample is negligible when matching on just index rating and maturity.

Insert Table 5 about here

Having reassured ourselves on the robustness of our methodology, we now interpret the abnormal return evidence. Bond returns around the Lehman announcement and effective dates reflect a number of components which we want to estimate. First, there is the previously mentioned pre-announcement information leakage and post-announcement slow-moving capital price adjustments. Second, returns may include permanent and transitory responses to the Lehman redefinition. Third, events after the Lehman announcement may have price impacts which interact with the Lehman redefinition. For example, the CARs in Figure 2 peak around the time of the GM/Ford downgrades, which presumably affected spreads between all IG and HY bonds. We conjecture that the Lehman redefinition caused the upgraded bonds to react differently to subsequent events (like the GM and Ford downgrades) than they would have under the old index rating rule. We call this a *contingent price impact* of the redefinition. In particular, we argue that the upgraded bonds, as newly minted investment-grade bonds, traded at a premium over otherwise similar high-yield bonds and that the magnitude of this premium changed over time with the relative performance of the IG and HY indices.

To assess the magnitudes of the various permanent, transitory, and contingent components in returns, we decompose cumulative abnormal returns as follows:

$$
\begin{aligned}
CAR_t &= PC_t + TC_t, \\
PC_t &= PC_{t-1} + \alpha \frac{\mathbf{1}_{t_0 < t \le t_1}}{t_1 - t_0} + \beta_0 \, IMH_t \, \mathbf{1}_{t > t_1} + \ldots + \beta_K \, IMH_{t-K} \, \mathbf{1}_{t > t_1 + K} + \eta_t, \\
TC_t &= \delta_1 TC_{t-1} + \ldots + \delta_L TC_{t-L} + \epsilon_t,
\end{aligned}
\tag{1}
$$

where the permanent component PC_t is an unobserved unit root process, the transitory component TC_t is an unobserved mean-reverting process with a zero long-run mean, IMH_t is the daily excess return of a portfolio that is long the IG index and short the HY index, and $\mathbf{1}$ is an indicator that equals one during the time period indicated by the subscript, and is zero otherwise.

The permanent and transitory shocks η_t and ϵ_t are independent Gaussian random variables with variances σ_η^2 and, respectively, σ_ϵ^2. We allow for pre-announcement leakage and post-announcement slow-moving capital drift via the coefficient α, which lets the initial permanent impact of the redefinition accrete linearly over the announcement window $(-10, +10]$. The coefficients $\beta_0, \ldots, \beta_K$ allow the permanent component of the redefinition's impact to change over time in a way that is contingent on the subsequent differential returns on the IG and HY indices. Ideally, we would like to test whether post-announcement βs changed relative to pre-announcement βs. However, with limited data availability before the announcement (due to the timing of TRACE Phase III) and little variation in pre-announcement returns, this is not practical. Thus, we just test whether the post-announcement return differential IMH_t affects the relative pricing of the upgraded bonds.

Table 6 reports Kalman Filter estimates of the decomposition in (1). Each column corresponds to a different specification (with varying lag lengths L and K). The Akaike information criterion (AIC) and the Bayesian information criterion (BIC) both indicate that specification (D), with $K = 1$ and $L = 2$, provides the best fit. The estimated $\widehat{\alpha}$ implies an initial permanent price reaction of 1.45% (p-value $< .001$). The $\widehat{\beta}$ estimates are consistent with a statistically significant future contingent impact of the Lehman redefinition.

We further decompose the estimated permanent component from the Kalman Filter into a contingent component that depends on realized *IHM* differential returns, $\widehat{PC}_t^C = \sum_{s=t_1+1}^{t} (\widehat{\beta}_0\, IMH_s\, \mathbf{1}_{s>t_1} + \ldots + \widehat{\beta}_K\, IMH_{s-K}\, \mathbf{1}_{s>t_1+K})$, and an unconditional residual, $\widehat{PC}_t^U = \widehat{PC}_t - \widehat{PC}_t^C$, reflecting future events unrelated to differential *IMH* performance. Figure 4 plots this decomposition. As can be seen from $\widehat{PC}_t^C$, abnormal returns on the upgraded bond are sensitive to the *IMH* differential return, consistent with the notion that the upgraded bonds trade at a time-varying premium relative to their former HY peers.

Insert Figure 4 and Table 6 about here

4.2 Impact on order flows and liquidity

Are the abnormal announcement returns for the upgraded bonds due to a demand shock from ratings-sensitive institutional investors? In order to answer this question, we examine turnover and order flow imbalances around the Lehman announcement. We also directly examine trading by insurance companies as a specific example of ratings-sensitive investors.

4.2.1 Bond trading activity

Our first measure of trading activity is relative turnover, defined as TRACE trading volume divided by the total par value of the outstanding bond issue (from FISD). Figure 5 plots average daily turnover around the announcement date for the 30 upgraded bonds and for the matched sample of control bonds from Section 4.1. Table 7 reports statistics for average daily turnover over three time periods: a six-month pre-announcement window ending two weeks before the Lehman announcement date, a post-announcement window starting two weeks before the announcement date and going to the effective date,[27] and then a six-month post-effective window from the effective date to year-end. Consistent with the demand shock hypothesis, turnover for the upgraded bonds exhibits a significant transitory increase. Between the announcement and effective dates, turnover for the 30 upgraded bonds doubles, from 0.26% to 0.54% per day and then, after the effective date, reverts somewhat to its former level before the rule change. However, control bonds do not exhibit this same pattern. We test this formally with a Diff-in-Diff test and reject the null that changes in turnover in the upgraded and control bonds are the same.

Insert Figure 5 and Table 7 about here

If there is an economic link between trading and prices, abnormal returns should covary positively with abnormal demand in the cross-section of affected bonds. To check this, we split the sample based on ex-post turnover (low, medium, high) over the immediate post-event window

[27] We start our post-announcement window before the announcement to capture any information leakage. Results are unchanged when we start the window after the announcement.

(0,+30]. Figure 3, Panel (b), summarizes the results. Consistent with the demand pressure hypothesis, the upgraded bonds with the highest turnover (plotted as the solid line) have the highest abnormal returns, peaking at around 5%.

Next, we estimate the relation between order flow imbalances and bond returns. TRACE, unfortunately, provides neither a buy-sell indicator for which party initiates trades nor any information on the identity of the traders. Hence, we cannot directly observe trading by particular types of investors. We can, however, impute the trade direction and investor type. Following a trade classification procedure similar to Lee and Ready (1991), we compare each transaction price with the closing price on the most recent prior trading day (i.e., we do not use imputed prices). If the transaction price is higher, we classify the transaction as a buy, and otherwise as a sell. The buy/sell indicators are then used to compute daily order flow imbalances. We use transaction size is an indicator for investor type, since large trades over $1 MM in par value are predominantly institutional.

Table 8 describes the relation between daily returns and order flow imbalances for the 30 upgraded bonds. We show results using both pooled OLS regression and average coefficients from time-series regressions for individual bonds. The dependent variable is the daily return, and various order flow imbalance measures are the explanatory variable of interest.[28] Trading volume is included as a control variable, although the results are very similar in the univariate case. We look at both the post-announcement window (-10,+114] (Panel A) and the post-effective window (+114,+245] (Panel B). The coefficients on all order flow variables are positive and significant. Hence, positive order flow imbalances in the upgraded bonds is causing prices to appreciate. The reported R^2s indicate that order flow imbalances explain up to 41% of the returns.

Insert Table 8 about here

[28] We express all explanatory variables in logarithms in order to reduce fat tails. That is, *Order Imbalance* equals $ln(1 + \text{OI})$, if the raw order imbalance measure OI is positive, and $-ln(1 + |\text{OI}|)$ otherwise.

4.2.2 Bond portfolios of insurance companies

Bond trading data for insurance companies from NAIC allows us to investigate directly whether the increased turnover is due, in part, to increased buying by rating-sensitive investors after the Lehman announcement. Given their sizeable holdings and the regulations they face, insurance companies are a prominent example of ratings-sensitive investors.[29] According to Federal Reserve data for 2004-5, insurance companies own 25 percent of corporate bonds outstanding.[30] Insurance companies, together with high-yield mutual funds, hedge funds, and some pension funds, actively trade high-yield bonds (see Wells Fargo, 2009) for their own portfolio needs or to fund the separate accounts of variable insurance and annuity products.

Figure 6 summarizes trading by insurance companies around the Lehman announcement by showing the (equal weighted) average cumulative change per bond in the aggregate insurance company dollar holdings of the 30 upgraded bonds. The dashed line plots the corresponding inventory change for the matched sample of HY control bonds. Insurance companies clearly increased their holdings in the upgraded bonds over the post-announcement period and sold the HY control bonds.

Insert Figure 6 about here

Table 9 summarizes changes in insurance company holdings by rating category and tests statistically whether the portfolio shifts are abnormal. Panel A reports the changes in the inventory of insurance companies over the post-announcement time period from day -10 to day +114, and Panel B over the post-effective time period from day +114 to day +245. The first (second) set of columns measure insurance company transactions in dollar terms (in percent of issue size which controls for differences in bond size). On average, insurance companies bought $27.5 million of each bond entering the IG index ($6.2 million after the announcement plus a further $21.3 million after the effective date), or 5.7% of the issue size on average. Most of these purchases occurred after the effective date, suggesting that some of the bond turnover before the effective date is due

[29]NAIC imposes heavy reserve requirements on insurance company holdings of junk-rated bonds. In addition, in 1991 NAIC placed a 20 percent cap on the amount of junk bonds insurers may hold as a fraction of their assets.

[30]See Federal Reserve, Table L.212 Z.1 of the flow of funds accounts.

to front-runners. In contrast, insurance companies shunned bonds with no favorable Fitch rating, irrespective of their index rating. For example, the abnormal change of the holdings of upgraded bonds in insurance company portfolios is \$39.8 million per issue (\$11.5 plus \$28.3 million), or 9.6% of the issue size on average when compared to BB+ rated control bonds. As indicated by the Diff-in-Diff p-values, the increase in holdings of the upgraded bonds is statistically larger than for all of the different control bonds. These results are consistent with rating-sensitive investors buying bonds that have mechanically become investment grade.

Insert Table 9 about here

4.2.3 Long-run impact on bond liquidity

To what extent did the increase in trading over the implementation period increase liquidity, and was this improvement persistent? To answer this question, we use two measures of liquidity. Roll's (1984) measure estimates the effective spread based on the serial covariance between price changes. Following Goyenko *et al.* (2009), we compute the Roll measure as

$$Roll = 2\sqrt{-cov(\Delta P_t, \Delta P_{t-1})}, \tag{2}$$

if $cov(\Delta P_t, \Delta P_{t-1}) < 0$, and zero otherwise. We compute the Roll measure for each bond separately and report the cross-sectional average, dropping bonds for which we have insufficient data to compute the Roll measure. As a robustness check, we also use the Amihud (2002) measure of price sensitivity to trading volume,[31]

$$Amihud = \frac{|\Delta P_t / P_{t-1}|}{Volume_t}. \tag{3}$$

Table 10 gives estimates of liquidity in the pre-announcement, the post-announcement, and the post-effective windows for the 30 upgraded bonds. The estimates show that the increased turnover

[31]The Roll and Amihud measures are both constructed only using actual daily prices. Since imputed prices are not used, the calendar time between prices can be more than one day if there is non-trading.

is associated with a transitory increase in liquidity. Roll's measure is reduced during the post-announcement period, but then reverts after the effective date. These patterns are less pronounced in the control sample. However, a formal difference-in-difference test indicates that the changes in liquidity for the two sets of bonds are not statistically significantly different. The same is true for Amihud's measure of liquidity. Since liquidity does not seem to have changed permanently, this is evidence against an alternative hypothesis that the positive abnormal returns on the upgraded bonds were caused by improvement in priced liquidity.

Insert Table 10 about here

5 Other Predictions and Alternative Explanations

In this section, we test whether the Lehman redefinition had an impact on bonds whose investment grade status did not initially change under the new Lehman rule, but where the probability of remaining/becoming investment grade in the future is likely to have changed. Two groups of bonds where a probabilistic impact on market segmentation may be significant are GM and Ford bonds and also HY bonds close to the IG-HY boundary. In addition, we test two competing alternative hypotheses relating to the reputation of Fitch ratings and to index inclusion effects. Lastly, we measure the impact of index rating rules on the demand for multiple ratings.

5.1 GM and Ford bonds

Bonds issued by GM and Ford, including their General Motors Acceptance Corporation (GMAC) and Ford Motor Credit Corporation (FMCC) financial arms, constitute a significant portion of the Lehman investment-grade index—each representing about 2 percent of the total index. On January 14, S&P announced that it would review GM ratings within the next six months, at which time market participants widely anticipated that S&P would downgrade GM. Since both firms had index ratings of BBB– under the old rating rule, a downgrade would force GM out of the IG index; thereby, triggering fire sales from rating-sensitive investors (see Da and Gao (2008)). Given their enormous size, a GM or Ford downgrade to high-yield would have generated significant price spill-overs to other HY bonds, since the increased supply would tax the capacity of the high-yield market to absorb these bonds (Acharya, Schaefer, and Zhang, 2008). However, under Lehman's new index rating rule, GM and Ford would remain in the IG index, even if S&P downgraded them, so long as Moody's and Fitch maintained their investment-grade ratings.[32] As a result, market segmentation implies that the selling pressure should have abated and prices recovered after the Lehman announcement.

Figure 7 shows trading and prices for GM and Ford around the Lehman announcement. Panel (a) plots bond turnover for three portfolios distinguished by Moody's ratings. Consistent with BBB bonds having the greatest decrease in selling pressure, we find that turnover for these bonds fell the most around the announcement date.

Insert Figure 7 about here

Panel (b) of Figure 7 plots the cumulative returns of the GM and Ford bonds. The bonds are, again, split based on their Moody's ratings. Several patterns are apparent. First, bond prices exhibit a downward trend approaching the announcement date. This is consistent with investors selling their bonds in anticipation of a downgrade and bond prices being depressed because the demand curve for these bonds is downward sloping. After the announcement date, the trend reverses and returns exhibit an upward trend. With a reduced likelihood of these bonds being downgraded to high yield, ratings-sensitive investors curtailed their sales of these bonds, which in turn reduced the excess supply of these bonds in the market, and prices recover quickly.

The two panels clearly show that the announcement effects differed systematically across bonds with different Moody's rating. Bonds with the lowest Moody's rating (BBB) experience the largest

[32] As of the announcement date, Standard and Poor's had assigned its lowest possible investment-grade rating of BBB– to all bonds issued by GM, GMAC, Ford and FMCC. In contrast, Moody's had a more favorable and diverse view on the credit risk of these bonds, assigning 300 bonds an A- rating, 671 bonds a BBB+ rating, and 13 bonds a BBB rating. None of the bonds were rated BBB–. Accordingly, based on the old index rating rule, these bonds had an index rating of BBB–, and a one notch downgrade by S&P would have required these bonds to be removed from the IG index. Fitch rated the GM/GMAC bonds BBB, and the Ford/FMCC bonds BBB+. Accordingly, under the new index rating rule, the GM/GMAC bonds would have an index rating of BBB, and the Ford/FMCC bonds would have an index rating of BBB or BBB+, depending on the Moody's rating.

decrease in price prior to the Lehman announcement and the largest recovery afterward. These bonds presumably had the greatest likelihood of being downgraded under the old index ratings rule. Therefore, the anticipatory sell-off was greatest for these bonds prior to the Lehman announcement. Correspondingly, after the announcement, the reduction in selling pressure is the most pronounced for these bonds—which in turn resulted in the largest jump in price.[33]

5.2 Reputation or rating-based segmentation?

In this section, we investigate the impact of the Lehman redefinition on all bonds which had higher Fitch ratings than their S&P and Moody's ratings. We consider two competing hypotheses. The first is the probabilistic version of the market segmentation hypothesis which suggests that HY bonds close to the IG-HY boundary should appreciate (even if they are not immediately upgraded to investment grade) since they have an increased probability of reaching investment-grade status (and having an expanded investor clientele) in the future under the new rule. An alternative hypothesis—which we call the *Fitch reputation* hypothesis—is that the Lehman announcement prompted a revision in the perceived quality of Fitch ratings. Bonds with favorable Fitch ratings should have positive abnormal returns in all rating categories due to the improved perception of the quality of their high Fitch ratings. We exploit this predicted differential impact across ratings to test the two hypotheses.

Table 11 presents CARs over different horizons for bonds rated favorably by Fitch split by their index ratings under the old rule. (This analysis excludes the 30 upgraded bonds expected to switch to the IG index, since we already know from Table 4 that they reacted positively to the Lehman redefinition.) Abnormal returns are again computed relative to the control sample of all bonds matched on index rating and maturity that are either not rated by Fitch or have a Fitch rating below Moody's and S&P. We find that only the BB+ bonds close to the IG-HY boundary have

[33] As a formal statistical test, we estimated a cross-sectional regression of cumulative returns for the GM and Ford bonds to verify that the differences in returns across portfolios with different Moody's rating categories are not due to other characteristics that systematically vary across these bonds. The precise methodology and control variables are detailed in our Internet Appendix. The estimation results, reported in Table IA.2 in the Internet Appendix, are consistent with the trends observed in Figure 7.

significant positive abnormal returns as of the Lehman announcement date. None of the other bonds have economically and/or statistically significant announcement returns. Thus, the return evidence supports market segmentation over the alternative reputation hypothesis. Interestingly, almost all of the bonds favorably rated by Fitch have positive CARs on the redefinition effective date with the returns being largest for the HY bonds. Since the redefinition was previously announced, this return pattern seems more consistent with ownership effects rather than a delayed response Fitch-reputation news.[34]

Insert Table 11 about here

5.3 Fundamental news and stock prices?

As a second test of the Fitch reputation hypothesis, we examine how the stock prices of bond issuers in different ratings-based portfolios reacted to the change in index rating procedure. In particular, an enhanced Fitch reputation should affect the stock prices of companies with higher Fitch ratings than their S&P and Moody's ratings.[35]

Table 12 reports results from a cross-sectional regression using equity CARs. The cross-section consists of the 561 companies which issued the 8,175 bonds in our sample. Many of these companies issued more than one bond. For firms whose bonds have different ratings, we compute the firm's aggregate rating as the average rating of its bond issues. We use the Fama-French three-factor model to compute equity abnormal returns (see Appendix B for the specifics). The explanatory variables in the regression are indicator variables for a firm's weighted-average bond old index rating (up to the notch) interacted with a "favorable Fitch rating" dummy variable and, as controls for

[34] In the Internet Appendix, Table IA.3 reports cumulative raw returns, CR, over the short-run announcement window (-10,+10], split by the old Lehman rating and the respective Fitch rating status. Consistent with Table 11, high-yield bonds rated favorably by Fitch outperform high-yield bonds without favorable Fitch ratings. When we split the sample by the individual index ratings under the old rule (Panel B), high-yield bonds rated favorably by Fitch outperform their controls for all ratings, and the abnormal performance is largest for HY bonds closest to the IG-HY boundary.

[35] If a more credible high Fitch rating raises the market's estimate of a firm's asset value, this should be good news for stock prices. If instead the lower credit risk implied by a favorable Fitch rating is due to lower firm asset volatility, then this would be bad news for equity which is a call option on firm assets and, therefore, long asset volatility.

credit risk, the index rating indicators without the Fitch rating interaction and dummies for the company's industry segment.

Insert Table 12 about here

The results in Table 12 provide no evidence that the Lehman announcement had a significant price effect in the stock market. An information-based explanation for the Lehman announcement is, therefore, unlikely since one would expect reduced default risk at companies with bonds highly rated by Fitch to have an impact on equity values. However, the coefficients for Fitch-reputation effects are almost all not statistically significant.

5.4 Indexation-based or rating-based segmentation?

A large literature studies the effects of passive indexation by equity investors when stocks are added or dropped from a major stock market index.[36] While indexation is one way in which investors use index ratings (and, thus, credit ratings), we explore here whether our price effects are driven solely by bond indexers. We do this by comparing the impact of the Lehman announcement on the 30 upgraded bonds expected to move to the IG index with its impact the 18 orphan bonds whose index ratings were raised to investment grade but which did not enter the IG index due to the $250 million par size restriction. If the price effects in Section 4.1 are due solely to indexation, then the orphan bond prices should not react significantly to the Lehman announcement. Indeed, since the redefinition caused 8 orphan bonds to exit the HY index, their announcement returns might even be negative.

Table 13 gives the results from our orphan bond analysis. Panel A reports CARs using our matched sample methodology when we match on old index rating, maturity, and issue size. The announcement returns on the orphaned bonds are significantly positive (Panel A) and exhibit a similar trajectory as the bonds entering the IG index. Abnormal returns on the orphan bonds peak

[36]See, e.g., Vijh (1994), Barberis, Shleifer, and Wurgler (2005), Hendershott and Seasholes (2009), Shleifer (1986), Harris and Gurel (1986), Dhillon and Johnson (1991), Kaul, Mehrotra, and Morck (2000), Wurgler and Zhuravskaya (2002), Denis *et al.* (2003), Chen, Noronha, and Singhal (2004), Mitchell, Pulvino, and Stafford (2004), Greenwood (2005), Barberis, Shleifer, and Wurgler (2005), and Hendershott and Seasholes (2009).

at 5.1% around the effective date. To directly test whether the orphan bonds reacted differently to the Lehman redefinition, Panel B reports CARs for a portfolio that is long the upgraded bonds eligible for IG index inclusion and short the orphan bonds. If index inclusion has an impact over and above the value of an investment-grade label, this portfolio should have a positive return. On the announcement day itself, the 30 upgraded bonds outperformed the orphan bonds, but by day +10, once we have allowed for slow-moving capital price lags, the returns on the upgraded and orphan bonds are not statistically different. Thereafter for the rest of the year, upgraded bonds entering the IG index do not appear to significantly outperform the orphan bonds. The results suggest it is IG status that matters for bond prices, not necessarily IG index membership. Hence, passive indexation does not seem to be the sole cause for price effects we document. Rather, if these price effects are due to segmentation, the market is being segmented due to industry policies and procedures other than simple indexation and index-based benchmarking.

Insert Table 13 about here

5.5 Impact on the demand for multiple ratings

To the extent that Lehman was an industry leader for institutional investors, its decision to use Fitch ratings should have increased the demand for Fitch ratings.[37] To the extent that it does, this is an indication of the importance of market segmentation for the ratings business.[38]

Table 14 compares the market share penetration of each rating agency before and after the Lehman rule change. Specifically, we report the fraction of new corporate bond issues rated by each of the big three rating agencies. We compare a pre-event period covering two years before the Lehman announcement and a post-event period of two years after the announcement.[39] We use the

[37]The stock price of Fimalac S.A., the company that owns Fitch Rating, modestly outperformed that of Moody's by 5 percent over the year following the Lehman announcement.

[38]Bolton, Freixas, and Shapiro (2009) and Opp, Opp, and Harris (2010) analyze how rating agency incentives are altered when ratings are used for regulatory purposes. Skreta and Veldkamp (2009) and Sangiorgi, Sokobin, and Spatt (2009) study the motives for rating shopping and the incentives for rating inflation. Chen (2011) explores why issuers purchase ratings from multiple rating agencies.

[39]Results for one-year windows are somewhat smaller, with Fitch's penetration rising by 9% (6%) if measured in terms of par value rated (number of issues rated).

FISD ratings history data to construct two measures of market share.[40] The first (in Panel A) is the dollar par value rated by a particular agency divided by the total par value of all new issues in that month. The second measure (in Panel B) is the number of issues rated by a particular agency in a given month divided by the total number of issues in that month. Since we are interested in the demand for the ratings services by bond issuers, we exclude unsolicited ratings by filtering out any ratings issued more than thirty days after the offering date.[41] The last column in the table reports p-values for a test of the null hypothesis that the respective market shares declined ($H_0 : Post \leq Pre$).

Insert Table 14 about here

Market penetration of Moody's and S&P appears to be flat or even to have declined slightly over time—with around 80-90% of issuers soliciting a rating from each agency. In contrast, there seems to be a structural break in Fitch's market penetration following the Lehman announcement. Fitch's market share increased significantly from below 50% in 2003-4 to over 50% in 2005-6, moving roughly 15 (10) percentage points closer to Moody's (S&P). This suggests that Lehman's decision to include Fitch ratings in index ratings gave a significant boost to Fitch's business, though, from this evidence alone, it is impossible to formally establish a causal relation. These findings are, nonetheless, consistent with Lehman being an important arbiter of split ratings and its index rating being an important factor in the bond market.

6 Conclusion

The Lehman Brothers index rating redefinition in 2005 is a quasi-natural experiment which we use to test whether bonds trade in segmented markets with different inelastic demand curves, and whether credit ratings affect bond prices beyond whatever information they provide about credit risk. Our results are largely consistent with market segmentation and are evidence against the

[40]Even though additional agencies were recognized as NRSROs during this time period, the rating industry has long been dominated by Moody's and Standard & Poor's, and so we restrict attention to these two competitors.

[41]According to FISD data between 2000 and 2006, 95% of all rated bond issues are assigned their initial rating by Moody's and S&P within the first thirty days of issuance.

frictionless market paradigm. Split-rated bonds whose index ratings were upgraded to investment grade exhibit significantly positive short- and long-run abnormal returns, significantly increased turnover, and positive institutional demand. Bonds upgraded to investment grade but not eligible for index inclusion exhibit abnormal returns of similar magnitude. In addition, GM and Ford bonds, which had been widely expected to be downgraded to high yield, exhibit positive abnormal returns and reduced net selling pressure after the Lehman announcement, consistent with an increased likelihood of staying in the investment-grade market segment. Our findings suggest, more generally, that market frictions may help in explaining other bond pricing puzzles (e.g., see Collin-Dufresne, Goldstein, and Martin (2001)). Since the Lehman redefinition did not change official rating-based regulations, our results suggest a new channel through which ratings induce market segmentation via informal industry practices and norms. Recent regulations have reduced the reliance on ratings issued by NRSROs and introduced softer criteria for determining capital requirements. As a consequence, industry conventions and informal rules are likely to become even more important in the future.

References

Acharya, V., Schaefer, S. M., and Y. Zhang (2007). "Liquidity Risk and Correlation Risk: A Clinical Study of the General Motors and Ford Downgrade of May 2005" CEPR Discussion Papers 6619.

Ambrose, B., K. Cai, and J. Helwege (2009). "Fallen Angels and Price Pressure" Working paper.

Barber, B. M., and J. D. Lyon (1997). "Detecting Long-run Abnormal Stock Returns: The Empirical Power and Specification of Test Statistics" *Journal of Financial Economics* 43, 341-372.

Barberis, N., A. Shleifer, and J. Wurgler (2005). "Comovement" *Journal of Financial Economics* 75, 283-317.

Becker, B., and T. T. Milbourn (2010). "How Did Increased Competition Affect Credit Ratings?" *Journal of Financial Economics*, forthcoming.

Bessembinder, H., Kahle, K. M., Maxwell, W., and D. Xu (2009). "Measuring Abnormal Bond Performance" *Review of Financial Studies* 22, 4219-4258.

Bolton, P., X. Freixas, and J. Shapiro (2009). "The Credit Ratings Game" Working Paper 14712, National Bureau of Economic Research.

Bongaerts, D., Cremers, K. J. M., and W. Goetzmann (2010). "Tiebreaker: Certification and Multiple Credit Ratings" *Journal of Finance*, forthcoming.

Boot, A., Milbourn, T. T.,and A. Schmeits (2006). "Credit Ratings as Coordination Mechanisms" *Review of Financial Studies* 19, 81-118.

Cantor, R., and F. Packer (1994). "The Credit Rating Industry" *FRBNY Quarterly Review*, Summer-Fall.

Chen, Z. (2011). "Why Do Firms Buy Multiple Ratings?" Working paper, Shanghai University of Finance and Economics.

Chen, H., Noronha, G., and V. Singhal (2004). "The Price Response to S&P 500 Index Additions and Deletion: Evidence of Asymmetry and a New Explanation" *Journal of Finance* 59, 1901-1929.

Chhaochharia, V., and Y. Grinstein (2007). "Corporate Governance and Firm Value: the Impact of the 2002 Governance Rules" *Journal of Finance* 62, 1789-1825.

Collin-Dufresne, P., R. S. Goldstein and S. J. Martin (2001). "The Determinants of Credit Spread Changes," *Journal of Finance* 56, 2177-2207.

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

Da, Z., and P. Gao (2008). "Clientele Change, Persistent Liquidity Shock, and Bond Return Reversal after Rating Downgrades" Working paper, Notre Dame University.

Denis, D.K., McConnell, J.J., A. Ovtchinnikov, and Y. Yu (2003). "S&P 500 Index Additions and Earnings Expectations" *Journal of Finance* 58, 1821-1840.

Dhillon. U., and H. Johnson (1991). "Changes in the Standard and Poor's 500 List" *Journal of Business* 64, 75-85.

Duffie, D. (2010). "Asset Price Dynamics with Slow-Moving Capital" *Journal of Finance* 65, 1238-1268.

Duffie, D., Garleanu, N., and L. H. Pedersen (2007). "Valuation in Over-the-Counter Markets" *Review of Financial Studies* 20, 1865-1900.

Duffie, D., and B. Strulovici (2011). "Capital Mobility and Asset Pricing" Working paper, Stanford University.

Edwards, A., Harris, L., and M. Piwowar (2007). "Corporate Bond Market Transaction Costs and Transparency" *Journal of Finance* 62, 1421-1451.

Eisinger, J., (2005). "Long & Short: GM Bond Worries Fade with Some Magic from Lehman" *Wall Street Journal*, Feb 2, 2005, page C.1.

Ellul, A., C. Jotikasthira, and C. Lundblad (2010). "Regulatory Pressure and Fire Sales in the Corporate Bond Market" *Journal of Financial Economics*, forthcoming.

Goh, J. and Ederington, L., 1993. "Is a Bond Rating Downgrade Bad News, Good News, or No News for Stockholders?" Journal of Finance 48, 2001-2008.

Goldstein, M. A., Hotchkiss, E. S., and E. R. Sirri (2007). "Transparency and Liquidity: a Controlled Experiment on Corporate Bonds" *Review of Financial Studies* 20, 235-273.

Goyenko, R., Holden, C. W. and C. A. Trzcinka (2009). "Do Liquidity Measures Measure Liquidity?" *Journal of Financial Economics* 92, 153-181.

Greenwood, R. (2005). "The Price Response to S&P 500 Index Additions and Deletion: Evidence of Asymmetry and a New Explanation" *Journal of Finance* 59, 1901-1929.

Gromb, D., and D. Vayanos (2009). "Financially Constrained Arbitrage and Cross-market Contagion" Working paper, London School of Economics.

Hand, J., R. Holthausen, and R. Leftwich (1992). "The Effect of Bond Rating Agency Announcements on Bond and Stock Prices" *Journal of Finance* 47, 733-752.

Harris, L., and E. Gurel (1986). "Price and Volume Effects Associated with Changes in the S&P 500: New Evidence of Price Pressure" *Journal of Finance* 41, 815-830.

Hendershott, T., and M. S. Seasholes (2009). "Market Predictability and Non-Informational Trading" Working paper, University of California at Berkeley.

Holthausen, R. W., and R. W. Leftwich (1986). "The Effect of Bond Rating Changes on Common Stock Prices" *Journal of Financial Economics* 17, 57-89.

Kaul, A., Mehrotra, V., and R. Morck (2000). "Demand Curves for Stocks Do Slope Down: New Evidence From an Index Weights Adjustment" *Journal of Finance* 55, 893-912.

Kisgen, D. J. (2007). “The Influence of Credit Ratings on Corporate Capital Structure Decision” *Journal of Applied Corporate Finance* 19, 65-73.

Kisgen, D. J., and P. E. Strahan (2010). “Do Regulations Based on Credit Ratings Affect a Firm’s Cost of Capital?” *Review of Financial Studies* 23, 4324-4347.

Kliger, D., and O. Sarig (2000). “The Information Value of Bond Ratings” *Journal of Finance* 55, 2879-2902.

Lee, C. M. C., and M. J. Ready (1991). “Inferring Trade Direction from Intraday Data” *Journal of Finance* 46, 733-746.

Lyon, J. D., Barber, B. M., and C. L. Tsai (1999). “Improved Methodology for Tests of Long-run Abnormal Returns” *Journal of Finance* 54, 165-201.

Mitchell, M., Pedersen, L. H., and T. Pulvino (2007). “Slow Moving Capital” *American Economic Review* 97, 215-220.

Mitchell, M., Pulvino, T., and E. Stafford (2004). “Price Pressure Around Mergers” *Journal of Finance* 59, 31-63.

National Association of Insurance Commissioner, (2009). “NAIC Use of NRSRO Ratings in Regulation ” Staff Report dated March 10, 2009.

Newman, Y., and M. Rierson (2004). “Illiquidity Spillovers: Theory and Evidence from European Telecom Bond Issuance” Working paper, Stanford University.

Opp, C. C., Opp, M. M., and M. Harris (2010). “Rating Agencies in the Face of Regulation: Rating Inflation and Regulatory Arbitrage” Working paper, University of California at Berkeley.

Sangiorgi, F., J. Sokobin, and C. Spatt (2009). “Credit-Rating Shopping, Selection and the Equilibrium Structure of Ratings” Working paper, Carnegie Mellon University.

Shleifer, A. (1986). “Do Demand Curves for Stocks Slope Down?” *Journal of Finance* 41, 579-590.

Skreta, V., and L. Veldkamp (2009). “Ratings Shopping and Asset Complexity: A Theory of Ratings Inflation” *Journal of Monetary Economics* 56, 678-695.

Steiner, M., and V. Heinke (2001). “Event Study Concerning International Bond Price Effects of Credit Rating Actions” *International Journal of Finance and Economics* 6, 139-157.

United States Senate (2002). “Financial Oversight of Enron: The SEC and Private-sector Watchdogs” Technical report, Senate Committee on Governmental Affairs.

Vijh, A. M. (1994). “S&P 500 Trading Strategies and Stock Betas ” *Review of Financial Studies* 7, 215-251.

Wells Fargo (2009). “A Guide to Investing in High-yield Bonds” Technical report, Wells Fargo Advisors.

Wurgler, J., and E. Zhuravskaya (2002). “Does Arbitrage Flatten Demand Curves for Stocks?” *Journal of Business* 75, 583-608.

Appendix A. Bootstrap Procedure

Our bootstrap procedure for computing empirical p-values is implemented as follows:

- Form a matched sample for our portfolio of treatment bonds by randomly picking one control for each treatment bond. Calculate the cumulative abnormal return (CAR) for this long-short portfolio on each event day. Denote the CAR in round i at date t by $CAR_{t,i}$.
- Repeat the matched sample formation procedure, using another random draw of control bonds and calculate the corresponding CAR for the long-short portfolio. We draw a total of $1,000$ times to form an empirical distribution for the CAR at each event day. We then take the average CAR over the $I = 1,000$ simulations as the representative CAR value for the treatment bonds. That is, $CAR_t = \frac{1}{I}\sum_{i=1}^{I} CAR_{t,i}$.
- Construct the empirical distribution, F_{CAR}, for the CAR on each event day and use F_{CAR} to compute empirical p-values to test whether the abnormal returns are statistically significant relative to the null hypothesis $H_0 : CAR_t \leq 0$ by computing $p = 1 - F_{CAR}(CAR_t)$. Confidence bounds can be determined similarly as the values $[\underline{CAR}, \overline{CAR}]$ for which $F_{CAR}(\underline{CAR}) = .05$ and $F_{CAR}(\overline{CAR}) = .95$.

Appendix B. Abnormal Stock Return Computation

Step 1 Compute the return for firm i at date t: $R_{i,t} = \ln(P_{i,t+1}) - \ln(P_{i,t})$, where $P_{i,t}$ is the stock price of firm i at date t. If either price is missing, $R_{i,t}$ is set to missing.

Step 2 Use the Fama-French factors to develop a model for expected stock returns. Regress $R_{i,t}$ for each firm on the Fama-French factors over the six-month period from June 1, 2004 to December 24, 2004 (one month prior to the Lehman announcement). The coefficient estimates from this regression are used to model the stock's normal returns.

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_i MKT_t + s_i SMB_t + h_i HML_t + \epsilon_t.$$

Step 3 Compute ARs for firm i over the event window and aggregate ARs at portfolio level. Then compute CARs as follows:

$$\begin{aligned} AR_{i,t} &= (R_{i,t} - R_{f,t}) - \widehat{\alpha}_i - \widehat{\beta}_i MKT_t - \widehat{s}_i SMB_t - \widehat{h}_i HML_t, \\ AR_t &= \frac{1}{n}\sum_{i=1}^{n} AR_{it}, \\ CAR_\tau &= \sum_{t=-20}^{\tau} AR_t, \end{aligned}$$

where n is the number of firms in the portfolio and $\tau = -20, -19, ..., 0, ..., 19, 20$.

TABLE 1: TIMELINE OF EVENTS

Date	Event	Description
January 1, 1973	Lehman bond index inception	Lehman Brothers bond indices are established. The initial rule defines a bond's index rating as the average of its credit ratings from Moody's and S&P.
August 1988	Lehman index rule change 1	Lehman changes a bond's index rating to be its Moody's rating or, if not rated by Moody's, its S&P rating.
July 1, 2002	TRACE Phase I	NASD requires all over-the-counter bond transactions to be reported through the TRACE system. The rule affects investment-grade bonds having an original issue size of $1 billion or more (a total of 500 bond issues) as well as 50 high-yield bonds which were carried over from NASD's Fixed Income Pricing System (FIPS). Initially, NASD members were required to report transactions within 75 minutes of the trade's occurrence.
March 3, 2003	TRACE Phase II	The TRACE system includes all bonds with an original issue size of at least $100 million and an index rating of A or better. An additional 120 BBB rated bonds with issue sizes less than $1 billion are added as part of Phase II in April 2003. The number of disseminated bonds increases to approximately 4,200 bonds. In addition, the NASD shortens the time required to report a trade's occurrence to 45 minutes.
October 2003	Lehman index rule change 2	Lehman makes another change and defines a bond's index rating as the lower of its ratings from Moody's and S&P in an effort to reduce the dependence on one rating agency and to align its methodology with industry practice.
October 1, 2004	TRACE Phase III, Stage One	All "liquid" bond issues (i.e., TRACE-eligible securities transactions that were subject to immediate dissemination under the Phase III rule amendments) become subject to dissemination. As a result, the number of bonds in the TRACE universe jumps to 17,000 bonds. In addition, the required reporting time is reduced to 30 minutes.
January 14, 2005	GM rating review	S&P affirms the rating and outlook on General Motors (GM), but announces it will review them within the next six months.
January 24, 2005	Lehman index rule change 3	Lehman Brothers announces that Fitch ratings will be incorporated in computing index ratings. Under this new rule, a bond's index rating is to be the middle of its Moody's, S&P, and Fitch ratings. If rated by only two agencies, a bond's index rating will continue to be the lower of the two. The change is to go into effect on July 1, 2005.

Table 1 continued

Date	Event	Description
February 7, 2005	TRACE Phase III, Stage Two	All TRACE-eligible bond issues become subject to dissemination. NASD begins full dissemination of transaction and price data on the entire universe of corporate bonds, a total of approximately 29,000 issues. The required reporting time is scheduled to reach the final goal of 15 minutes by July 1, 2005.
March 16, 2005	GM profit warning	GM issues a profit warning. Fitch downgrades GM and GMAC by one notch to BBB– with negative outlook. S&P changes its GM and GMAC outlook from stable to negative.
April 5, 2005	GM downgrade	Moody's downgrades GM and GMAC by one notch to BBB– and BBB, respectively, with negative outlook.
April 20, 2005	GM announces $1.1 bn loss	GM posts record $1.1 bn loss. Rating agencies signal they could drop GM's bonds one notch to junk status, and they put rival Ford on notice.
May 5, 2005	GM & Ford downgrade	S&P downgrades GM and GMAC to BB with a negative outlook, and it downgrades Ford and FMCC to BB+ with negative outlook.
May 24, 2005	GM downgrade	Fitch downgrades GM and GMAC to BB+ with negative outlook.
July 1, 2005	Lehman index rule change	The index rating rule change announced by Lehman on January 24, 2005 goes into effect.

Table 2: Summary of bond characteristics

This table summarizes the characteristics of the bonds in our sample as of the Lehman announcement date.

	Mean	S.D.	Min	Max
Panel A: IG index members – 2,232 bonds				
Amount outstanding ($ MM)	600.80	537.14	250.00	5,500.00
Maturity (years)	10.13	11.07	1.10	93.37
Coupon (%)	6.13	1.56	0.00	10.63
Age (years)	4.11	3.16	0.24	23.20
% of days with trades over [-10,+10]	58.63	32.32	5.56	100.00
Panel B: HY index members – 659 bonds				
Amount outstanding ($ MM)	419.90	304.96	150.00	2,750.00
Maturity (years)	8.34	7.75	1.14	91.75
Coupon (%)	8.29	1.69	0.00	14.25
Age (years)	3.62	2.83	0.30	15.49
% of days with trades over [-10,+10]	71.76	23.22	5.56	100.00
Panel C: Index non-members – 5,284 bonds				
Amount outstanding ($ MM)	55.57	87.35	0.00	3,250.00
Maturity (years)	9.26	8.56	1.10	93.04
Coupon (%)	5.67	1.74	0.00	13.50
Age (years)	3.72	4.17	0.22	67.70
% of days with trades over [-10,+10]	29.63	23.13	5.56	100.00
Panel D: Bonds upgraded to IG index – 30 bonds				
Amount outstanding ($ MM)	592.07	329.48	250.00	1,500.00
Maturity (years)	12.02	10.26	1.39	29.70
Coupon (%)	6.71	0.82	4.63	8.28
Age (years)	3.71	2.11	0.34	8.13
% of days with trades over [-10,+10]	71.65	24.64	11.11	100.00
Panel E: Orphan bonds – 18 bonds				
Amount outstanding ($ MM)	119.77	73.11	10.00	200.00
Maturity (years)	16.61	20.22	2.72	91.75
Coupon (%)	7.57	1.29	5.00	10.13
Age (years)	6.55	4.01	1.15	12.52
% of days with trades over [-10,+10]	42.01	36.57	5.56	100.00
Panel F: HY bonds not rated favorably by Fitch (control sample) – 254 bonds				
Amount outstanding ($ MM)	366.34	249.23	1.00	1,418.00
Maturity (years)	9.63	9.83	1.14	91.75
Coupon (%)	7.64	1.22	3.63	11.00
Age (years)	4.14	3.30	0.30	15.49
% of days with trades over [-10,+10]	65.05	24.75	5.56	100.00

Table 3: Index ratings and rating comparison across agencies

This table summarizes the index ratings of all bonds in our sample as of the Lehman announcement date based on the old and new index rating rules (Panel A). The old index rating is the more conservative of the Moody's and S&P rating, and the new index rating is the middle of the Moody's, S&P and Fitch rating. A total of 39 bonds do not have an index rating under the old system as they are unrated by both Moody's and S&P. Panel B compares bond ratings issued by Fitch to the lower of the ratings by Moody's and S&P.

Panel A: Anticipated index rating transitions

	New index rating							
Old index rating	AAA	AA	A	BBB	BB	B	C or D	Total
AAA	593	0	6	0	0	0	0	599
AA	4	457	4	0	0	0	0	465
A	1	316	3,094	1	0	0	0	3,412
BBB	2	0	150	2,759	0	0	0	2,911
BB	3	0	0	40	238	0	0	281
B	0	0	0	5	29	255	1	290
C - D	0	0	0	0	0	19	159	178
Total	603	773	3,254	2,805	267	274	160	8,136

Panel B: Comparison of Fitch ratings with Moody's and S&P

	All	rated by Fitch	Fitch rates better	Fitch rates worse
All bonds	8,175	6,017	4,229	219
By old index rating:				
AAA	599	100	0	19
AA	465	308	193	18
A	3,412	2,736	2,015	42
BBB^+	475	367	151	11
BBB	898	696	373	64
BBB^-	1,538	1,408	1,235	20
BB^+	94	72	43	5
BB	82	65	50	4
BB^-	105	71	49	12
B	290	113	69	14
C - D	178	72	51	1
Missing	39	9	0	0
By industry:				
Industrial	2,899	1,935	1,058	94
Financial	4,642	3,556	2,865	104
Utility	634	526	306	21

Table 4: Abnormal returns for bonds upgraded to investment grade

This table reports cumulative abnormal returns for the sample of 30 upgraded bonds expected to move to the Lehman investment-grade index because of the Lehman index rating redefinition. Abnormal returns are calculated using the matched-sample approach described in Section 3.3. The control group consists of all bonds, matched on index rating and maturity, that are either not rated by Fitch or have a Fitch rating below Moody's and S&P. Specifically, we pair bonds based on their old Lehman index rating up to the notch. In addition, we match on being in the same maturity bin: short (1-5 years) or long (5 years or longer). Empirical p-values are one-sided for the null hypothesis $H_0 : CAR_t \leq 0$ and calculated using the bootstrap procedure described in Section 3.3. The control window abnormal returns are cumulated over the pre-announcement period $(-50, -10]$ and are used as a test of whether the matched sample controls for the relevant risk characteristics. The marker † indicates the effective date for the Lehman rule change (July 1, 2005), and $t = 0$ refers to the announcement date (Jan. 24, 2005). The event window abnormal returns are cumulated starting at date $t = -10$, and the horizons in the first column are in terms of trading days.

	HY-to-IG (*Method 1*)		HY-to-IG (*Method 2*)		HY-to-IG (Short mat.)		HY-to-IG (Long mat.)	
Time	CAR	p	CAR	p	CAR	p	CAR	p
Control window:	0.30	[0.16]	0.42	[0.11]	0.57	[0.04]	0.27	[0.25]
Event window:								
-5	0.56	[0.00]	0.35	[0.05]	-0.20	[0.70]	0.91	[0.00]
0	1.37	[0.00]	1.44	[0.00]	0.21	[0.28]	1.91	[0.00]
10	1.58	[0.00]	1.67	[0.00]	-0.15	[0.65]	2.43	[0.00]
20	0.86	[0.01]	0.95	[0.01]	-0.76	[0.97]	1.70	[0.00]
30	0.81	[0.03]	0.84	[0.04]	-0.52	[0.91]	1.49	[0.00]
50	1.26	[0.00]	1.06	[0.02]	0.60	[0.12]	1.49	[0.01]
80	2.66	[0.00]	2.66	[0.00]	1.73	[0.05]	3.02	[0.01]
114†	2.96	[0.00]	3.04	[0.00]	0.45	[0.25]	4.21	[0.00]
150	2.35	[0.00]	2.53	[0.00]	0.37	[0.31]	3.27	[0.00]
200	1.50	[0.03]	0.98	[0.11]	0.34	[0.33]	2.02	[0.02]
245	2.49	[0.00]	1.95	[0.01]	0.61	[0.22]	3.40	[0.00]

Table 5: Abnormal returns for bonds upgraded to investment grade—robustness

This table reports cumulative abnormal returns for the 30 upgraded bonds expected to move to the Lehman IG index. Abnormal returns are calculated using the matched-sample approach described in Section 3.3. The control group consists of all matched bonds that are either not rated by Fitch or have a Fitch rating below Moody's and S&P. The control bonds are matched on index rating, maturity, and the additional characteristics listed in the column headers. Specifically, we pair bonds based on their old Lehman index rating up to the notch (i.e., BB+, BB, BB–, B+, etc.) and two maturity bins (short: 1-5 years or long: 5 years or longer). Index betas for the IG index are estimated using Dimson's method with one lead and lag and are then used to define terciles bins (less than 0.06, 0.06-0.569, and greater than 0.569). Liquidity is measured by the frequency of non-trading days and then tercile bins are defined (less than 12%, 12-39%, and more than 39%). Issue sizes are grouped into tercile bins based on par value (<\$150 MM, \$150–250 MM, ≥\$250 MM). The industry-matching is based on three broad sectors (utility, financial, and industrial). Empirical p-values are one-sided for the null hypothesis $H_0 : CAR_t \leq 0$ and calculated using the bootstrap procedure described in Section 3.3. The control window abnormal returns are cumulated over the pre-announcement period $(-50, -10]$ and are used as a test of whether the matched sample controls for the relevant risk characteristics. The marker † indicates the effective date for the Lehman rule change (July 1, 2005), and $t = 0$ refers to the announcement date (Jan. 24, 2005). The event window abnormal returns are cumulated starting at date $t = -10$, and the horizons in the first column are in terms of trading days.

	Index beta		Liquidity		Issue size		Coupon		Industry		All	
Time	CAR	p	CAR	p	CAR	p	CAR	p	CAR	p	CAR	p
Control window:	0.28	[0.19]	0.35	[0.14]	0.42	[0.08]	0.27	[0.17]	0.16	[0.28]	0.09	[0.40]
Event window:												
-5	0.55	[0.00]	0.43	[0.01]	0.55	[0.00]	0.63	[0.00]	0.54	[0.00]	0.38	[0.01]
0	1.07	[0.00]	1.27	[0.00]	1.42	[0.00]	1.52	[0.00]	1.43	[0.00]	1.60	[0.00]
10	1.10	[0.00]	1.24	[0.00]	1.52	[0.00]	1.38	[0.00]	1.51	[0.00]	1.12	[0.00]
20	0.55	[0.03]	0.67	[0.01]	0.88	[0.00]	0.73	[0.01]	0.81	[0.01]	0.81	[0.00]
30	0.48	[0.12]	0.61	[0.06]	0.80	[0.02]	0.81	[0.03]	0.75	[0.05]	0.65	[0.06]
50	1.11	[0.00]	1.28	[0.01]	1.40	[0.00]	1.21	[0.00]	1.25	[0.01]	1.34	[0.00]
80	2.40	[0.00]	2.83	[0.00]	2.83	[0.00]	2.07	[0.01]	2.73	[0.00]	2.80	[0.00]
114†	2.62	[0.00]	2.91	[0.00]	2.95	[0.00]	2.59	[0.00]	2.80	[0.00]	2.49	[0.00]
150	1.96	[0.00]	2.30	[0.00]	2.40	[0.00]	2.08	[0.00]	2.09	[0.00]	1.75	[0.01]
200	1.38	[0.03]	1.54	[0.02]	1.59	[0.01]	1.24	[0.04]	1.33	[0.03]	1.50	[0.03]
245	2.36	[0.00]	2.34	[0.00]	2.43	[0.00]	2.26	[0.00]	2.41	[0.00]	2.35	[0.00]

Table 6: Decomposition of abnormal bond returns

The table reports estimates of the following decomposition of abnormal returns into a permanent component PC_t and a transitory component TC_t for the 30 upgraded bonds expected to move to the Lehman IG index:

$$\begin{aligned} CAR_t &= PC_t + TC_t, \\ PC_t &= PC_{t-1} + \alpha \frac{\mathbf{1}_{t_0 < t \le t_1}}{t_1 - t_0} + \beta_0\, IMH_t\, \mathbf{1}_{t > t_1} + \ldots + \beta_K\, IMH_{t-K} \mathbf{1}_{t > t_1 + K} + \eta_t, \\ TC_t &= \delta_1 TC_{t-1} + \ldots + \delta_L TC_{t-L} + \epsilon_t, \end{aligned}$$

where CAR_t is the cumulative abnormal return on the upgraded bond portfolio the matched-sample approach described in Section 3.3, PC_t is a unit root process, TC_t is a mean-reverting process with zero long-run mean, IMH_t is the return on date t of a portfolio that is long the IG index and short the HY index, and $\mathbf{1}$ is an indicator that takes value one during the time period indicated by the subscript, and zero otherwise. We choose $t_0 = -10$ and $t_1 = 10$. The error terms (η_t, ϵ_t) are independent Gaussian random variables. We use the Kalman filter to estimate α, β, δ, and PC_t and TC_t for $t = 1, ..., T$. Specifications (A), (B), and (C) vary the transitory lag length L. Specifications (B), (D), and (E) vary the permanent lag length K.

	(A)	(B)	(C)	(D)	(E)
α	1.50	1.44	1.44	1.45	1.45
	[0.01]	[0.00]	[0.00]	[0.00]	[0.00]
β_0	0.19	0.19	0.19	0.16	0.16
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
β_1				0.07	0.07
				[0.10]	[0.11]
β_2					-0.01
					[0.82]
δ_1	0.01	0.57	0.57	0.57	0.57
	[0.99]	[0.00]	[0.00]	[0.00]	[0.00]
δ_2		0.18	0.18	0.20	0.21
		[0.02]	[0.02]	[0.01]	[0.01]
δ_3			-0.02		
			[0.75]		
σ_η^2	0.02	0.01	0.01	0.01	0.01
	[0.00]	[0.10]	[0.08]	[0.15]	[0.15]
σ_ϵ^2	0.01	0.03	0.03	0.03	0.03
	[0.08]	[0.00]	[0.00]	[0.00]	[0.00]
Log-likelihood	59.33	62.60	62.65	67.36	66.71
AIC	-108.67	-113.20	-111.30	-120.72	-117.41
BIC	-90.44	-91.33	-85.78	-95.22	-88.31
Observations	283	283	283	282	281

Table 7: Impact on bond trading activity

The table reports statistics on equally-weighted average daily turnover for the 30 upgraded bonds expected to move to the Lehman IG index. There are three different event windows: the six-month window ending two weeks before the announcement date (pre-announcement window), from two weeks before the announcement date to the effective date (post-announcement window), and the six month window starting from the effective date to year-end (post-effective window). The control sample comprises high-yield bonds with unfavorable or no Fitch rating. p-values are reported in brackets. The Diff-in-Diff p-values are for Wald tests based on seemingly unrelated regressions (SUR) where the errors are assumed to be serially independent but may have contemporaneous cross-equation correlations.

	Event window			Difference		Diff-in-Diff	
	Pre-announce	Post-announce	Post-effective	Post-ann. – Pre-ann.	Post-eff. – Pre-ann.	Post-ann. – Pre-ann.	Post-eff. – Pre-ann.
	Panel A: HY-to-IG bonds						
Turnover (%)	0.26	0.54	0.37	0.28	0.11	0.27	0.16
	[0.00]	[0.00]	[0.00]	[0.00]	[0.09]	[0.00]	[0.00]
	Panel B: HY bonds not rated favorably by Fitch (control sample)						
Turnover (%)	0.30	0.31	0.25	0.01	-0.05	–	–
	[0.00]	[0.00]	[0.00]	[0.62]	[0.04]		

Table 8: Bond returns and order flow imbalances

This table gives results from regressions of daily returns on order flow imbalances for the 30 upgraded bonds expected to move to the Lehman IG index. The dependent variable is the daily return. In Panel A the time period is the post-announcement window starting two weeks before the announcement date (January 24, 2005) and ending on the effective date (July 1, 2005). In Panel B the time period is the post-effective window starting from the effective date and ending at year-end (December 31, 2005). We show estimation results for both pooled OLS and average coefficients from time-series OLS on each individual bond. To compute order flow imbalances, we compare the transaction price of each trade with the closing price on the most recent prior day with trading. If the transaction price is higher, we classify the transaction as a buy, otherwise as a sell. The buy/sell indicators are then used to compute the trade direction and then applied to log volume to compute order flow imbalances. p-values are shown in brackets.

	Pooled	TS	Pooled	TS	Pooled	TS
Panel A: Post-announcement window (-10, +114] – 2,133 observations						
Order imbalance	3.83	4.32				
	[0.00]	[0.00]				
Order flow imbalance (no. trades)			34.87	48.19		
			[0.00]	[0.00]		
Order flow imbalance (no. trades $\geq$ \$1 MM)					36.00	43.63
					[0.00]	[0.00]
Volume	2.97	1.60	3.88	2.82	4.26	3.54
	[0.00]	[0.34]	[0.00]	[0.11]	[0.00]	[0.05]
R^2	0.29	0.41	0.24	0.39	0.14	0.25
Panel B: Post-effective window (+114, +245] – 2,243 observations						
Order imbalance	3.40	3.90				
	[0.00]	[0.00]				
Order flow imbalance (no. trades)			35.71	43.20		
			[0.00]	[0.00]		
Order flow imbalance (no. trades $\geq$ \$1 MM)					34.60	41.38
					[0.00]	[0.00]
Volume	2.85	3.29	3.17	3.81	3.77	4.99
	[0.00]	[0.01]	[0.00]	[0.00]	[0.00]	[0.00]
R^2	0.26	0.38	0.24	0.36	0.11	0.18

Table 9: Insurance company trading in bonds switching from HY to IG index

The table reports the equal-weighted average net purchases by insurance companies of different types of bonds over two time periods. The treatment sample is the 30 upgraded bonds expected to move to the Lehman IG index. In Panel A the time period is the post-announcement window starting two weeks before the announcement date (January 24, 2005) and ending on the effective date (July 1, 2005). In Panel B the time period is the post-effective window starting from the effective date and ending at year-end (December 31, 2005). Bond classifications in each panel are according to bond ratings as of the announcement date. The two sets of columns measure insurance company purchases in dollar terms or, respectively, as fraction of issue size. The first pair of column in each set reports the aggregate change in insurance company holdings by rating category, and the second pair reports a Diff-in-Diff test of the hypothesis that purchases of upgraded bonds (treatment sample) are not larger than those of bonds in the corresponding control sample. The p-values are for Wald tests based on seemingly unrelated regressions (SUR) where the errors are assumed to be serially independent but may have contemporaneous cross-equation correlations. The p-values are two-sided for the difference tests and one-sided for the Diff-in-Diff tests.

	Δ Inventory ($ MM)				Δ Inventory (% of issue)			
	Difference [p]		Diff-in-Diff [p]		Difference [p]		Diff-in-Diff [p]	
Panel A: Post-announcement window (-10, +114]								
HY-to-IG bonds	6.18	[0.21]	–	–	1.73	[0.29]	–	–
Control sample: Bonds not rated favorably by Fitch, split by index rating								
AAA - A	-1.38	[0.05]	7.56	[0.07]	-0.98	[0.01]	2.71	[0.02]
BBB+ - BBB	-5.52	[0.00]	11.70	[0.02]	-2.22	[0.00]	3.95	[0.00]
BBB–	-1.89	[0.38]	8.07	[0.07]	-0.45	[0.56]	2.18	[0.06]
BB+	-5.37	[0.08]	11.55	[0.03]	-1.45	[0.42]	3.17	[0.02]
BB - BB–	-4.42	[0.00]	10.60	[0.02]	-1.09	[0.33]	2.82	[0.02]
B	-1.99	[0.02]	8.17	[0.06]	-0.66	[0.33]	2.38	[0.03]
Panel B: Post-effective window (+114, +245]								
HY-to-IG bonds	21.29	[0.02]	–	–	3.96	[0.10]	–	–
Control sample: Bonds not rated favorably by Fitch, split by index rating								
AAA - A	-6.09	[0.00]	27.38	[0.00]	-2.25	[0.00]	6.21	[0.00]
BBB+ - BBB	-4.74	[0.00]	26.03	[0.01]	-1.96	[0.01]	5.91	[0.00]
BBB–	-7.94	[0.04]	29.23	[0.00]	-2.80	[0.02]	6.75	[0.00]
BB+	-7.00	[0.28]	28.29	[0.01]	-2.47	[0.36]	6.43	[0.01]
BB - BB–	-4.96	[0.08]	26.25	[0.01]	-1.65	[0.31]	5.60	[0.00]
B	-3.21	[0.01]	24.50	[0.01]	-1.06	[0.29]	5.01	[0.00]

Table 10: Impact on liquidity

The table reports statistics on liquidity over three different event windows: the six-month window ending two weeks before the announcement date (pre-announcement window), from two weeks before the announcement date to the effective date (post-announcement window), and the six-month window starting from the effective date to year-end (post-effective window). We compute Roll and Amihud liquidity measures for each bond separately and report the cross-sectional average. See the text for further details. The treatment sample are the 30 upgraded bonds expected to enter the Lehman IG index. The control sample comprises high-yield bonds with unfavorable or no Fitch rating. p-values are reported in brackets. The Diff-in-Diff p-values are for Wald tests based on seemingly unrelated regressions (SUR) where the errors are assumed to be serially independent but may have contemporaneous cross-equation correlations.

	Event window			Difference		Diff-in-Diff	
	Pre-announce	Post-announce	Post-effective	Post-ann. – Pre-ann.	Post-eff. – Pre-ann.	Post-ann. – Pre-ann.	Post-eff. – Pre-ann.
Panel A: HY-to-IG bonds							
Liquidity (*Roll*)	1.27	1.13	1.17	-0.14	-0.10	-0.08	-0.06
	[0.00]	[0.00]	[0.00]	[0.08]	[0.27]	[0.75]	[0.68]
Liquidity (*Amihud*)	0.17	0.20	0.17	0.03	0.00	0.03	-0.01
	[0.00]	[0.00]	[0.00]	[0.74]	[0.95]	[0.89]	[0.57]
Panel B: HY bonds not rated favorably by Fitch (control sample)							
Liquidity (*Roll*)	1.23	1.17	1.19	-0.06	-0.04	–	–
	[0.00]	[0.00]	[0.00]	[0.15]	[0.36]		
Liquidity (*Amihud*)	0.24	0.24	0.25	0.00	0.01	–	–
	[0.00]	[0.00]	[0.00]	[0.93]	[0.94]		

Table 11: Reputation vs. rating-induced segmentation

The table reports cumulative abnormal returns for all bonds rated favorably by Fitch, split by the index rating under the old rule. Abnormal returns are calculated using the matched-sample approach described in Section 3.3. The control group consists of all bonds, matched on index rating and maturity, that are either not rated by Fitch or have a Fitch rating below Moody's and S&P. Specifically, we pair bonds based on their credit risk by matching on the index rating category up to the notch under Lehman's old split-rating system (i.e., BB+, BB, BB–, B+, etc.). In addition, we match on being in the same maturity bin: short (1-5 years) or long (5 years or longer). Empirical p-values are one-sided for the null hypothesis $H_0 : CAR_t \leq 0$ and calculated using the bootstrap procedure described in Section 3.3. The control window abnormal returns are cumulated over the pre-announcement period $(-50, -10]$ and are used as a test of whether the matched sample controls for the relevant risk characteristics. The marker † indicates the effective date for the rule change, and $t = 0$ refers to the announcement date. The event window abnormal returns are cumulated starting at date $t = -10$, and the horizons in the first column are in terms of trading days. Bonds issued by GM and Ford and the 30 bonds eligible for IG index inclusion (reported in Table 4) are excluded from this analysis. The number of treated bonds in each column is reported in parenthesis.

	Investment-grade bonds						High-yield bonds					
	AAA - A (2,180)		BBB+ - BBB (515)		BBB– (247)		BB+ (18)		BB - BB– (90)		B (64)	
Time	CAR	p	CAR	p	CAR	p	CAR	p	CAR	p	CAR	p
Control window:	0.37	[0.00]	-0.13	[0.90]	-0.07	[0.67]	0.71	[0.05]	0.13	[0.32]	-0.89	[0.98]
Event window:												
-5	-0.27	[1.00]	-0.38	[1.00]	0.08	[0.16]	0.60	[0.00]	0.38	[0.04]	0.11	[0.25]
0	-0.32	[1.00]	-0.24	[1.00]	0.08	[0.23]	1.17	[0.00]	0.27	[0.09]	-0.31	[0.94]
10	-0.15	[1.00]	-0.36	[1.00]	0.35	[0.01]	1.40	[0.00]	0.27	[0.14]	0.24	[0.26]
20	-0.90	[1.00]	-0.27	[1.00]	-0.20	[0.90]	2.11	[0.00]	-0.07	[0.59]	0.83	[0.05]
30	-0.33	[1.00]	-0.37	[1.00]	-0.17	[0.80]	1.72	[0.00]	0.11	[0.31]	0.71	[0.06]
50	0.04	[0.12]	0.30	[0.02]	-0.61	[1.00]	1.21	[0.01]	0.35	[0.13]	-0.06	[0.56]
80	-0.54	[1.00]	0.75	[0.00]	0.57	[0.01]	1.60	[0.11]	2.40	[0.00]	1.19	[0.04]
114†	-0.85	[1.00]	0.41	[0.01]	0.50	[0.05]	1.84	[0.02]	1.60	[0.00]	2.34	[0.00]
150	-0.89	[1.00]	0.27	[0.06]	0.41	[0.10]	1.44	[0.06]	1.14	[0.00]	2.42	[0.00]
200	-1.15	[1.00]	-0.18	[0.83]	0.00	[0.48]	2.53	[0.04]	1.79	[0.00]	1.51	[0.05]
245	-1.08	[1.00]	0.52	[0.01]	-0.03	[0.52]	2.77	[0.02]	0.61	[0.14]	1.85	[0.03]

Table 12: Abnormal stock returns and the Lehman announcement

The table reports estimation results on the cross-sectional variation in equity CARs around the Lehman announcement date on stocks that are matched to bonds in our universe of 8,175 bonds. The regressors of interest are dummy variables indicating the old Lehman rating category interacted with an indicator for a favorable Fitch rating. In addition, the regression includes the old index rating dummy variables by themselves as controls for overall credit risk and dummies for the company's industry segment. p-values are shown in brackets.

	(-10,+10]		(-10,+30]	
	Coef.	p	Coef.	p
AA × Fitch favorable	1.51	[0.25]	1.73	[0.30]
A × Fitch favorable	0.32	[0.54]	-0.77	[0.25]
BBB+ - BBB × Fitch favorable	0.46	[0.46]	-0.81	[0.31]
BBB– × Fitch favorable	0.63	[0.36]	-1.12	[0.29]
BB+ × Fitch favorable	0.31	[0.89]	1.39	[0.64]
BB - BB– × Fitch favorable	0.01	[0.99]	0.08	[0.96]
B × Fitch favorable	-0.47	[0.68]	-1.41	[0.34]
C - D × Fitch favorable	2.04	[0.36]	0.06	[0.98]
No old index rating × Fitch favorable	-0.35	[0.74]	-3.30	[0.00]
AAA	0.26	[0.81]	-1.12	[0.31]
AA	0.20	[0.83]	-0.63	[0.67]
A	0.41	[0.47]	-0.24	[0.73]
BBB+ - BBB	0.31	[0.57]	-0.05	[0.95]
BBB–	0.01	[0.99]	0.15	[0.85]
BB+	0.76	[0.72]	-0.76	[0.77]
BB - BB–	0.33	[0.73]	-0.39	[0.76]
B	0.12	[0.87]	0.06	[0.95]
C - D	1.14	[0.25]	0.75	[0.61]
Financial	-1.49	[0.01]	-1.88	[0.01]
Industrial	-0.18	[0.71]	0.53	[0.40]
Observations	561		561	
$R2$	0.02		0.04	

Table 13: ABNORMAL RETURNS FOR ORPHAN BONDS

The table reports cumulative abnormal returns for 18 bonds which were upgraded to an IG index rating but which were not eligible for IG index inclusion. Abnormal returns are calculated using the matched-sample approach described in Section 3.3. Panel A reports value-weighted CARs using the matched sample methodology. The control group consists of all bonds, matched on index rating, maturity, and issue size category that are either not rated by Fitch or have a Fitch rating below Moody's and S&P. Specifically, we pair bonds based on their credit risk by matching on the index rating category up to the notch under Lehman's old split-rating system (i.e., BB+, BB, BB–, B+, etc.). In addition, we match on being in the same maturity bin: short (1-5 years) or long (5 years or longer). Matching on size is based on size terciles. Panel B reports cumulative returns for a portfolio that is long the 30 upgraded bonds expected to move to the Lehman IG index and short the orphan bonds. Empirical p-values are one-sided for the null hypothesis $H_0 : CAR_t \leq 0$ and calculated using the bootstrap procedure described in Section 3.3. The control window abnormal returns are cumulated over the pre-announcement period $(-50, -10]$ and are used as a test of whether the matched sample controls for the relevant risk characteristics. The marker † indicates the effective date for the rule change, and $t = 0$ refers to the announcement date. The event window abnormal returns are cumulated starting at date $t = -10$, and the horizons in the first column are in terms of trading days.

	HY index members (8)		Index non-members (10)		All orphaned bonds (18)	
Time	CAR	p	CAR	p	CAR	p
Panel A: Long orphan bonds, short matched sample						
Control window:	0.29	[0.31]	-0.98	[1.00]	-0.07	[0.59]
Event window:						
-5	1.18	[0.00]	0.06	[0.37]	0.75	[0.00]
0	0.66	[0.06]	-2.93	[1.00]	-0.51	[0.96]
10	1.86	[0.00]	2.11	[0.00]	1.88	[0.00]
20	1.28	[0.02]	-0.27	[0.60]	0.69	[0.07]
30	1.21	[0.01]	1.24	[0.03]	1.22	[0.00]
50	0.68	[0.24]	1.89	[0.00]	1.05	[0.06]
80	2.84	[0.00]	5.81	[0.00]	4.00	[0.00]
114†	4.22	[0.00]	6.34	[0.00]	5.15	[0.00]
150	3.83	[0.00]	6.17	[0.00]	4.85	[0.00]
200	3.13	[0.00]	2.19	[0.01]	3.02	[0.00]
245	3.83	[0.01]	1.45	[0.03]	3.46	[0.00]
Panel B: Long HY-to-IG index bonds, short orphan bonds						
Control window:	0.47	[0.00]	1.64	[0.01]	0.83	[0.01]
Event window:						
-5	-0.13	[0.66]	-0.07	[0.64]	-0.09	[0.61]
0	0.68	[0.00]	2.80	[0.01]	1.30	[0.01]
10	0.20	[0.30]	-0.52	[0.86]	0.00	[0.48]
20	-0.52	[0.83]	-0.86	[0.92]	-0.57	[0.82]
30	-0.96	[0.90]	-2.33	[1.00]	-1.31	[0.94]
50	-0.71	[0.97]	-1.45	[1.00]	-0.89	[0.98]
80	-0.90	[1.00]	0.07	[0.50]	-0.64	[0.91]
114†	-1.27	[0.92]	0.75	[0.12]	-0.62	[0.70]
150	-1.52	[0.95]	-0.07	[0.55]	-1.07	[0.84]
200	-1.72	[0.96]	2.56	[0.10]	-0.38	[0.61]
245	-1.32	[0.91]	4.81	[0.00]	0.60	[0.34]

Table 14: Rating agency market shares before and after the Lehman announcement

The table reports the fraction of new corporate bond issues is rated by each rating agency. The pre-event period covers the two years prior to the Lehman announcement, and the post-event period spans the two years following the announcement. We restrict attention to ratings assigned within the first thirty days after issuance, and the data is aggregated at monthly frequency. Panel A measures market penetration in terms of the dollar par value rated and Panel B counts the number of issues rated as a fraction of all new issues. The column reports p-values for for tests of the null hypothesis that market share declined ($H_0 : Post \leq Pre$).

	Pre-event	Post-event	Post - Pre	p-value for H_0 : Post $\leq$ Pre
Panel A: Par value of new issues rated (%/100)				
Fitch	0.45	0.56	0.11	[0.00]
Moody's	0.84	0.80	-0.04	[0.98]
S&P	0.86	0.87	0.01	[0.26]
Panel B: Number of new issues rated (%/100)				
Fitch	0.45	0.52	0.07	[0.00]
Moody's	0.86	0.78	-0.08	[1.00]
S&P	0.90	0.87	-0.03	[0.99]

Figure 1: Index performance and timeline of events

The figure plots the cumulative return over time for the Lehman indices for investment-grade (IG) and high-yield (HY) bonds normalized relative to the index level on November 15, 2004 ($t = -50$). The solid line plots the IG index and the dashed line plots the HY index. The vertical dotted lines refer to important events in the corporate bond market as described in Table 1. On the horizontal axis, 0 marks the announcement date (January 24, 2005) and 114 the effective date (July 1, 2005).

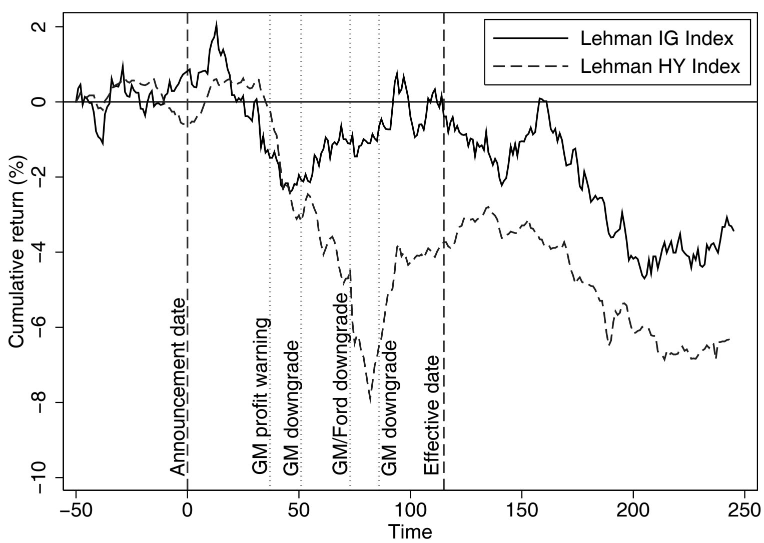


Figure 2: Announcement returns in bonds upgraded to investment grade

The figure plots value-weighted average cumulative abnormal returns for the 30 upgraded bonds expected to move to the Lehman investment-grade index because of the Lehman index rating redefinition. Abnormal returns are calculated using the matched-sample approach described in Section 3.3. The control group consists of all bonds, matched on index rating and maturity, that are either not rated by Fitch or have a Fitch rating below Moody's and S&P. Specifically, we pair bonds based on their credit risk by matching on the index rating category up to the notch under Lehman's old split-rating rule (i.e., BB+, BB, BB–, B+, etc.). In addition, we match on being in the same maturity bin: short (1-5 years) or long (5 years or longer). The dotted lines are the confidence interval at 95 percent significance level estimated using empirical p-values obtained using a bootstrap simulation procedure. On the horizontal axis, 0 marks the announcement date (January 24, 2005) and 114 the effective date (July 1, 2005).

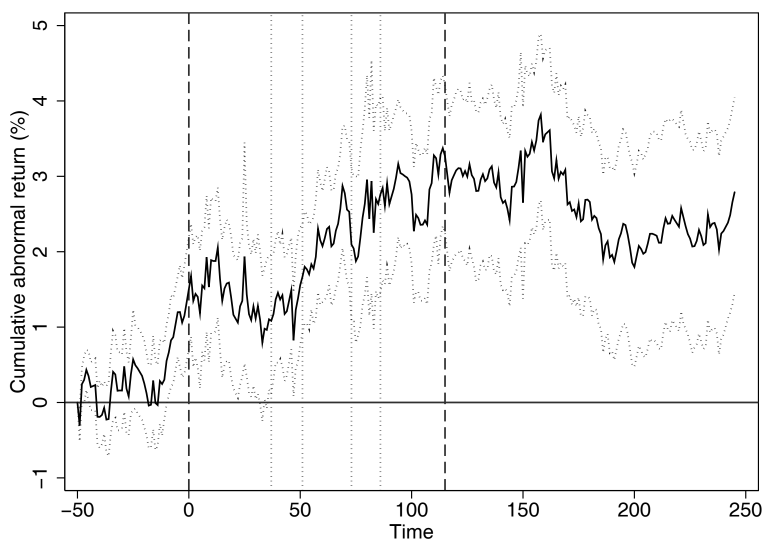
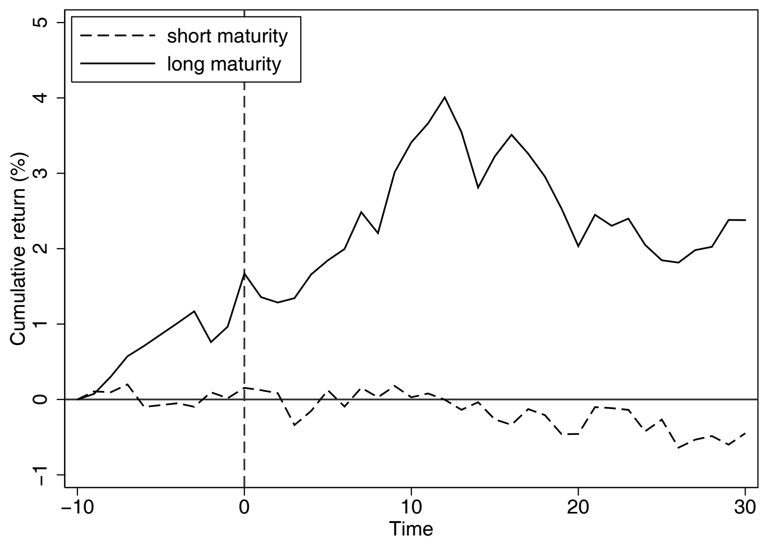
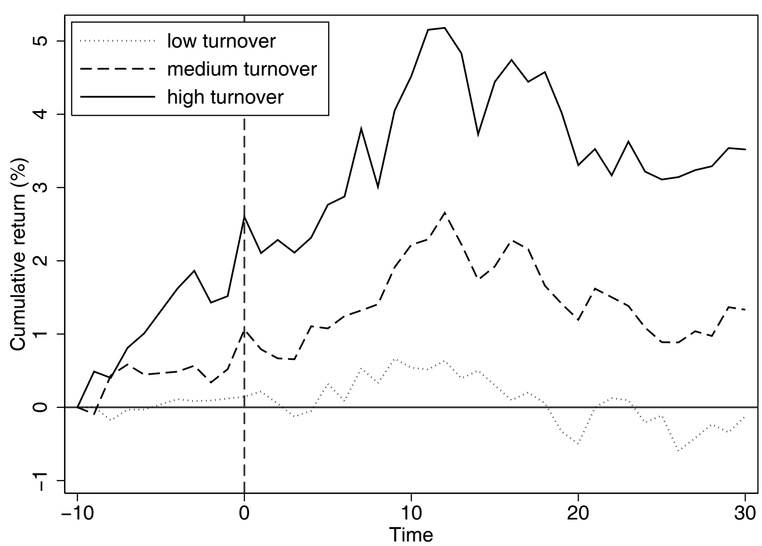


Figure 3: Announcement returns in bonds upgraded to investment grade—split by maturity and turnover

The figure plots the cumulative returns on buy-and-hold bond portfolios comprising the 30 upgraded bonds expected to move to the Lehman IG index. In Panel (a), the 30 upgraded bonds are classified into two sub-samples based on their maturity. The solid line refers to the sample with long maturity (5 years or longer), and the dashed line to the short maturity sample (1-5 years). In Panel (b), the 30 upgraded bonds are classified into three sub-samples based on their turnover over the post-event window (0,+30], with one third of bonds in each sub-sample. The solid line refers to the sample with high turnover (top tercile), the dashed line to the medium turnover sample (middle tercile), and the dotted line to the low turnover sample of bonds (bottom tercile). Date $t = 0$ refers to the announcement on January 24, 2005.



(a) Returns on bonds upgraded to IG—split by maturity



(b) Returns on bonds upgraded to IG—split by turnover

Figure 4: Return decomposition for bonds upgraded to investment grade

The figure plots value-weighted average cumulative abnormal returns on the 30 upgraded bonds expected to move to the Lehman IG index (dotted line) and their estimated permanent and transitory components. Abnormal returns are calculated using the matched-sample approach described in Section 3.3. CARs are decomposed into estimated permanent and transitory components, $\widehat{PC}_t$ and $\widehat{TC}_t$, based on the Kalman Filter estimation of specification (D) in Table 6. The estimated permanent component is then further decomposed into an uncontingent component, $\widehat{PC}_t^U = \widehat{PC}_t - \widehat{PC}_t^C$ and a contingent permanent component that is conditional on the differential return in the IG index relative to the HY index, $PC_t^C = \sum_{s=t_1+1}^{t}(\widehat{\beta}_0\, IMH_s\, \mathbf{1}_{s>t_1} + \ldots + \widehat{\beta}_K\, IMH_{s-K}\mathbf{1}_{s>t_1+K})$ where IMH_t is the return on date t of a portfolio that is long the IG index and short the HY index, and $\mathbf{1}$ is an indicator that takes value one during the time period indicated by the subscript, and zero otherwise where t_1 is event day +10. On the horizontal axis, 0 marks the announcement date (January 24, 2005) and 114 the effective date (July 1, 2005).

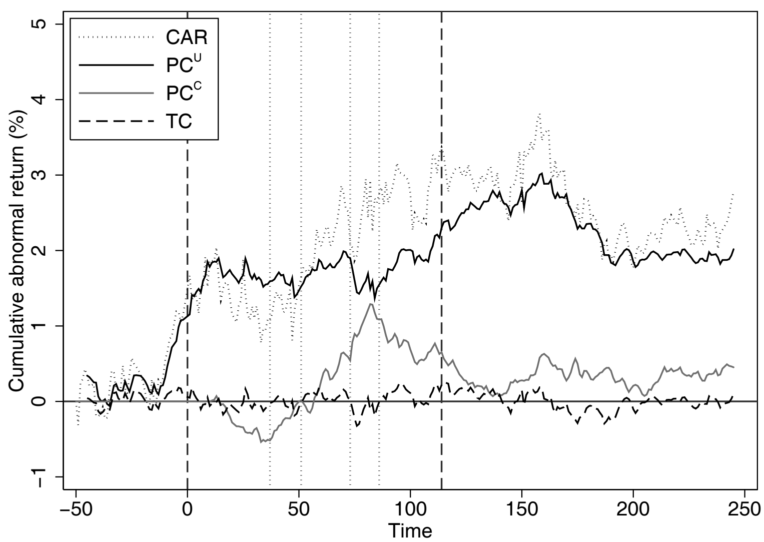


Figure 5: Post-announcement turnover in bonds upgraded to investment grade

The figure reports the equally-weighted average daily turnover for the 30 upgraded bonds expected to move to the Lehman IG index (solid line). Turnover is calculated as the dollar volume of all transactions reported in TRACE and normalized by the outstanding par value. The control sample (dashed line) comprises high-yield bonds with unfavorable or no Fitch rating. On the horizontal axis, 0 marks the announcement date (January 24, 2005) and 114 the effective date (July 1, 2005).

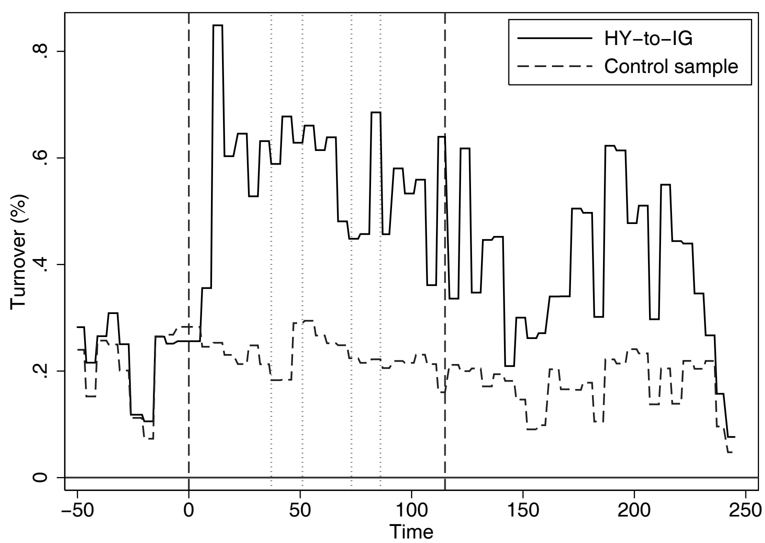


Figure 6: Insurance company trading in bonds switching from HY to IG index

The figure plots the equal-weighted average cumulative change in the aggregate insurance company holdings of the 30 upgraded bonds expected to move to the Lehman IG index (in units of $ MM per bond). The dashed line plots the corresponding average change in inventory for bonds in the control sample of matched bonds. On the horizontal axis, 0 marks the announcement date (January 24, 2005) and 114 the effective date (July 1, 2005).

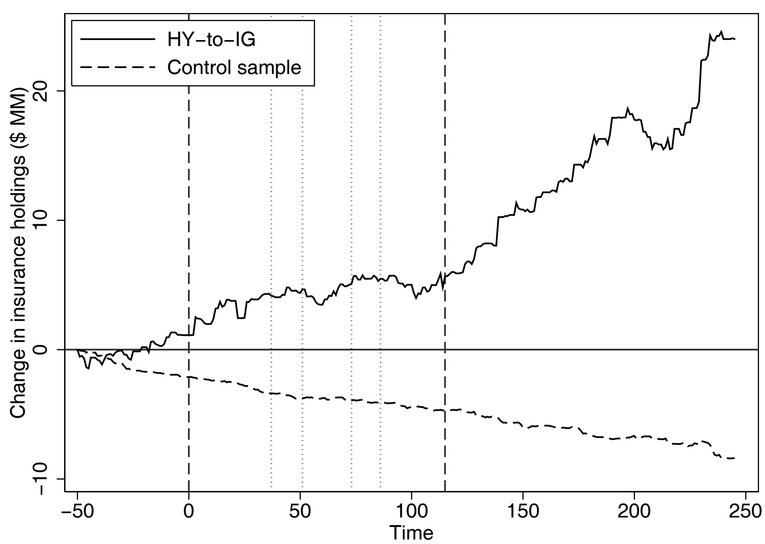
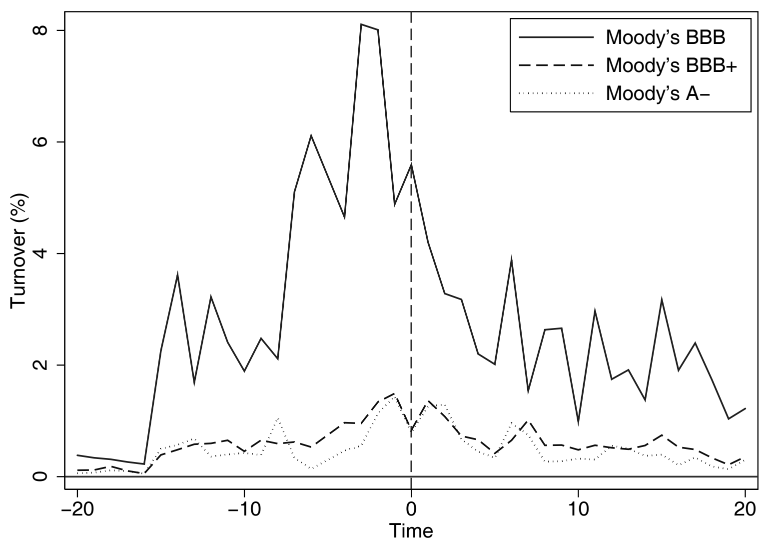
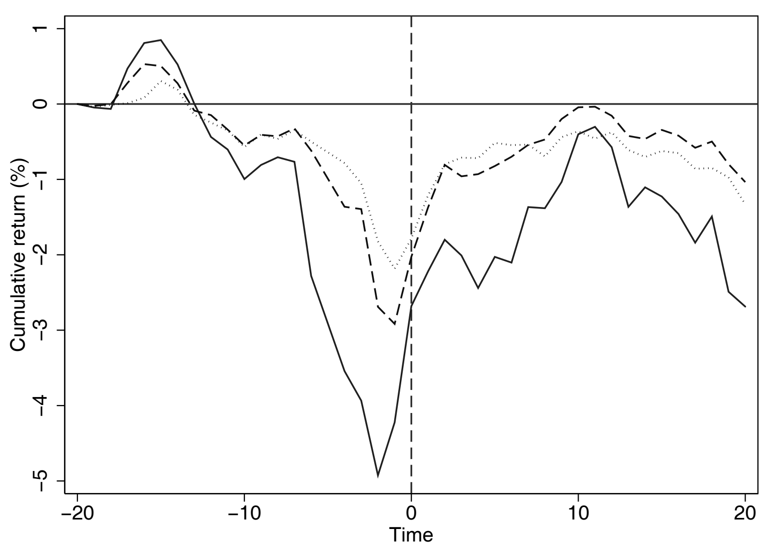


Figure 7: Upgraded GM and Ford bonds around Lehman announcement date

Panel (a) plots the average daily turnover in GM, GMAC, Ford, and FMCC bonds around the announcement date. Turnover is measured using TRACE transactions volume data and normalized by the par amount outstanding (obtained from FISD). Panel (b) plots the cumulative returns of bonds issued by GM, GMAC, Ford, and FMCC around the announcement date. All of these bonds have a BBB– rating issued from Standard and Poor's and a rating of BBB or BBB+ from Fitch. The sample consists of 984 bonds and is split according to the credit rating issued by Moody's into A– (farthest from HY), BBB+, and BBB (closest to HY). On the horizontal axis, 0 marks the announcement date (January 24, 2005).



(a) Turnover



(b) Announcement returns

Internet Appendix

Appendix C. Cross-sectional Regression and Control Variables

Cross-sectional regressions are used to verify that the differences in returns across the treated bonds and the control sample are not due to bond characteristics that vary systematically across these portfolios. The cross-sectional approach allows us to simultaneously estimate the abnormal returns on multiple sub-samples of interest. We run regressions of the following form:

$$CR_i = \alpha + \sum_k \beta_k I_{i,k} + \gamma' X_i + \varepsilon_i,$$

where the cumulative raw return CR_i for bond i is regressed on two types of explanatory variables. The first regressors are a set of indicator variables $I_{i,k}, k = 1, \ldots, K$ for a set of K subsamples, that take on a value of one if bond i is in sub-sample k, and zero otherwise. The coefficient β_k on $I_{i,k}$ yields an estimate for the mean CAR on sub-sample k. The second regressors are a set of control variables X_i that have been used in the literature to explain bond returns:

- Maturity: maturity of bond i in years;
- Age: age of bond i, measured in years since offering date;
- Coupon: measured in percent;
- Issue size: Dummies for the par amount of the bond outstanding, split into five ranges: $(0, 50)$, $[50, 150)$, $[150, 250)$, $[250, 1,000)$, $[1,000, \infty)$ in \$MM.
- Credit risk: dummies for the rating under the old rule: AAA, AA, A, $BBB/BBB+$, $BBB-$, $BB+$, $BB/BB-$, B, C - D and bonds unrated by Moody's and S&P, or a coarser definition (AAA - A, BBB, BB, B, etc.);
- Dummies for the industry group: Industrial, Financial, Utility.

To address measurement problems due to infrequent trading, we compute returns by averaging transaction prices over consecutive days. We use the volume-weighted average "clean" price over $[t_0 - L, t_0]$ as the pre-event price and the volume-weighted "clean" price over $[t_1, t_1 + L]$ as the post-event price when computing the cumulative return over the time period $[t_0, t_1]$. For most of the analysis, we choose $L = 3$. Cumulative returns are then computed as the percentage difference between post-event and pre-event bond prices: $CR_{[t_0,t_1]} = \ln(\overline{P}_{t_1,t_1+L}) - \ln(\overline{P}_{t_0-L,t_0})$.

Table IA.1: Cross-sectional determinants of announcement returns

The table reports determinants of cumulative returns, CR, over the short-run announcement window $(-10,+10]$ and long-run event window $(-10,+114]$. Cumulative returns are calculated as described in Appendix C. We run the following regression in the cross-section:

$$CR_i = \alpha + \beta I_{\text{HY-to-IG}} + \gamma' X_i + \varepsilon_i,$$

where CR_i is the cumulative return for bond i, I is an indicator variables used to identify the bonds in the treated sample, and X_i is a set of control variables. The sample consists of the 30 upgraded bonds expected to move to the Lehman IG index and also all bonds without favorable Fitch ratings. Standard errors are clustered at the issuer level. In brackets we report p-values for the null hypothesis $H_0 : CR = 0$.

	(-10,+10]		(-10,+114]	
	Coef.	p	Coef.	p
HY-to-IG	1.05	[0.04]	2.87	[0.01]
AAA - A	3.09	[0.24]	-0.39	[0.92]
BBB	3.20	[0.22]	-1.02	[0.80]
BB	2.48	[0.34]	-2.90	[0.48]
B	1.74	[0.50]	-2.70	[0.50]
No old rating	-0.27	[0.96]	-2.44	[0.71]
Maturity	0.15	[0.00]	0.18	[0.00]
Age	-0.01	[0.77]	0.03	[0.64]
Coupon	-0.03	[0.72]	-0.41	[0.00]
Amount outstanding \$50-150 MM	0.56	[0.08]	0.27	[0.60]
Amount outstanding \$150-250 MM	0.39	[0.24]	1.26	[0.12]
Amount outstanding \$250-1,000 MM	0.42	[0.09]	0.36	[0.43]
Amount outstanding \$1,000 MM	0.76	[0.00]	0.67	[0.14]
Financial	-0.12	[0.81]	-0.25	[0.71]
Industrial	0.50	[0.35]	-0.31	[0.65]
Observations	960		771	
R^2	0.28		0.22	

Table IA.2: Determinants of announcement returns on bonds issued by GM and Ford

The table reports estimates for the cross-sectional determinants of cumulative returns around the announcement date for bonds issued by GM and Ford. Estimation results are from a cross-sectional regression on cumulative returns over different horizons. p-values are shown in brackets.

	[-1,+10]		[-1,+20]	
	Coef.	p	Coef.	p
Moody's BBB	1.64	[0.02]	1.38	[0.01]
Moody's BBB+	0.83	[0.04]	1.03	[0.00]
Maturity	0.11	[0.06]	0.05	[0.16]
Age	0.05	[0.57]	0.06	[0.50]
Coupon	0.29	[0.30]	0.04	[0.85]
Amount outstanding $50-150 MM	0.22	[0.47]	0.49	[0.12]
Amount outstanding $150-250 MM	-1.07	[0.08]	-1.75	[0.02]
Amount outstanding $250-1,000 MM	-0.23	[0.76]	-0.12	[0.81]
Amount outstanding ≥$1,000 MM	1.43	[0.00]	1.18	[0.00]
Observations	868		916	
R^2	0.49		0.30	

Table IA.3: Reputation vs. rating-induced segmentation: Short-run announcement returns

The table reports cumulative returns, CR, over the short-run event window $(-10,+10]$ for value-weighted samples of bonds split by the old segment (Panel A) and old index rating (Panel B) and the respective Fitch rating status. The column *Difference fav. – not fav.* reports the return difference between bonds rated favorably by Fitch (that is, bonds with Fitch rating higher quality than Moody's and S&P) and bonds not rated favorably (that is, bonds with Fitch rating of lower quality than Moody's and S&P or not rated by Fitch). The column *Diff-in-diff* reports the difference between the HY and IG segment (Panel A) or between BB+ and BBB– (Panel B) in the return difference between bonds rated favorably versus not rated favorably by Fitch. In brackets we report p-values for the one-sided alternative $H_a : CR_{(-10,+10]} \geq 0$.

Panel A: Split by segment

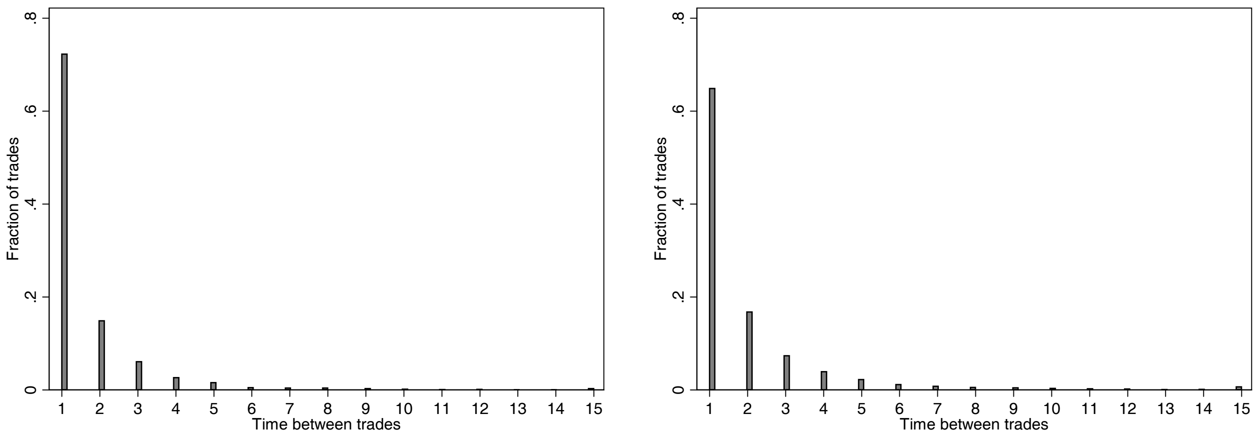
	Fitch favorable			Fitch not favorable			Difference		Diff-in-diff	
	Obs.	CR	p	Obs.	CR	p	fav. – not fav.		HY – IG	
IG	2,247	0.84	[0.00]	1,399	0.79	[0.00]	0.05	[0.30]		
HY	191	1.14	[0.00]	236	0.33	[0.03]	0.81	[0.00]	0.76	[0.00]

Panel B: Split by index rating

	Fitch favorable			Fitch not favorable			Difference		Diff-in-diff	
	Obs.	CR	p	Obs.	CR	p	fav. – not fav.		BB+ – BBB–	
IG by rating:										
AAA - AA-	128	0.34	[0.01]	533	0.69	[0.00]	-0.35	[0.94]		
A+ - A-	1,479	0.79	[0.00]	443	0.74	[0.00]	0.05	[0.36]		
BBB+	128	1.16	[0.00]	92	0.76	[0.00]	0.40	[0.10]		
BBB	292	1.04	[0.00]	209	1.14	[0.00]	-0.10	[0.65]		
BBB–	220	0.98	[0.00]	122	0.64	[0.00]	0.34	[0.04]		
HY by rating:										
BB+	41	2.07	[0.00]	26	0.75	[0.02]	1.32	[0.01]	0.98	[0.04]
BB	44	0.99	[0.00]	13	0.74	[0.04]	0.25	[0.31]		
BB–	44	0.73	[0.00]	42	0.70	[0.01]	0.03	[0.48]		
B+ - B–	62	0.85	[0.01]	155	0.12	[0.31]	0.73	[0.05]		

Figure IA.1: Trading frequency

This figure plots the frequency of trading over the time period $(-50, +245]$. Panel (a) is for the 30 upgraded bonds expected to move the the Lehman IG index, and panel (b) is for the control bonds.



(a) HY-to-IG (b) Control sample

Figure IA.2: Bond returns and order flow imbalances

This figure plots the actual (solid) and predicted (dashed) average cumulative abnormal returns for the 30 upgraded bonds expected to move to the Lehman IG index. The predictions are obtained from the regression of daily returns on order flow imbalances and volume in Table 8.