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

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Abstract

A 2005 change in the eligibility of split–rated bonds for inclusion in the Lehman Brothers bond indices provides a 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 two percent on average and exhibit abnormal order flows over several months following the Lehman rule announcement. In addition, Ford and GM 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 informal 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

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 valuation fundamentals.[1] Empirically, however, it is difficult to disentangle capital shocks from contemporaneous informational shocks to asset fundamentals. This paper uses a change in the eligibility rules for inclusion of 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 price deviations from fundamentals that can be attributed to market segmentation in the absence of confounding concurrent changes in fundamental asset valuations.

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] In particular, both official regulation and informal internal investment policies at banks, insurance companies, pension funds and mutual funds typically restrict ownership of bonds with low credit ratings. Hence, a systematic change in how credit ratings are interpreted and used can affect portfolio decisions for many institutional investors, which in turn can affect bond prices.

The Lehman (now Barclays Capital) corporate investment-grade index is an important benchmark for institutional investors. Consequently, Lehman's definition of what precisely constitutes

[1]Duffie (2010), Duffie and Strulovici (2009), and Gromb and Vayanos (2007) show how market segmentation and capital immobility can affect asset prices and how the ownership distribution of assets feeds back into prices.

[2]Duffie, Garleanu, and Pedersen (2007) show in a search-based model that illiquidity discounts 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 NSRO by the SEC in 2003, and A.M. Best, a rating agency specializing in insurance companies, was recognized as an NSRO in 2005.

"investment grade" is potentially influential with portfolio managers and investment committees and how they view the credit worthiness of bonds where there is some ambiguity. This is particularly true for bonds with split ratings where official regulations give investors some discretion for whether to treat split–rated bonds as investment grade or junk. 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 by 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, 59 bonds—with a total market value of $33.4 billion comprising 2.1% of the IG index and, respectively, 5.0% of the HY index—had index rating which could be expected to increase from high yield to investment grade based on their credit ratings on the announcement date.[4]

In this paper, we investigate whether the Lehman rule change altered institutional investors' perceptions of split–rated bonds, thereby leading to changes in their ownership structure and pricing. Importantly for this study, the Lehman rule change was arguably unaccompanied by new information about valuation fundamentals for these bonds since their Moody's, S&P, and Fitch ratings were already public and did not change with the Lehman announcement. Our analysis of the upgraded bonds finds evidence consistent with market segmentation effects:

- The upgraded bonds exhibit significantly positive abnormal returns of 1.5% over a twenty-day window around the Lehman announcement. Abnormal returns peak at 3% five months later around the effective date (July 1, 2005), and then partially revert to about 2%.

- Bonds with high post-announcement turnover outperform bonds with low post-event turnover by 5% (consistent with a change in ownership structure), and long maturity bonds outperform

[4]On May 31, 2005 the market values of the IG and HY indices were $1,576 billion and $670 billion, respectively, according to data from Lehman Brothers Fixed Income Research. After merging FISD issue characteristics with TRACE transactions data, the market value for the IG (HY) index members in our sample is $1,340 ($277) billion.

short maturity bonds by 4% (consistent with ownership effects being greater for bonds which need to be held over long horizons).

- Daily turnover in the upgraded bonds more than doubled after the Lehman announcement.
- Purchases by insurance companies, which are particularly sensitive to bond ratings, increased, suggesting buying pressure from previously constrained investors.
- Bonds switching from the high-yield to the investment-grade index experience a significant increase in return correlations with proxies for investment-grade market indices.

One possible alternative explanation is that the Lehman announcement prompted a revision in the general reputation of Fitch ratings and, thus, that the bond returns were due to changes in the market's perception of the upgraded bond's underlying credit risk. However, we find evidence against this informational hypothesis. First, the stock prices of companies with upgraded bonds did not react to the Lehman announcement.[5] In addition, the price impact in the bond market seems to be disproportionately concentrated in bonds close to the HG-HY boundary. A second possible alternative explanation is index inclusion effects. Inclusion of the upgraded bonds in the IG index may simply have forced passive indexers to buy the bonds. However, there were a small number of bonds whose index ratings were upgraded, but which were not included in the IG index because of they failed to meet other unrelated index criteria. We find that these *orphaned bonds* had similar returns to the upgraded bonds which were added to the index.

Another set of bonds we consider 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, the GM and Ford bonds' index ratings were BBB- due to a BBB- rating by S&P (together with higher ratings by Moody's). In early 2005, a downgrade to junk status by S&P was widely expected, which would, in turn, force these bonds out of the IG index. Consequently, the GM and Ford bonds were under considerable selling pressure as investors reduced their holdings in anticipation of forced

[5] Goh and Ederington (1993) show that rating announcements motivated by issuer's improved financial prospects should have a positive impact in stock prices.

sales in the near future. Given the enormous size of the outstanding GM and Ford debt,[6] capital immobility effects would be pronounced as it would be difficult for high-yield investors to absorb these bonds in a short interval. Under the new Lehman rule, GM and Ford bonds would continue to have a BBB index rating or better after any S&P downgrade given their more optimistic ratings from Moody's and Fitch. Following the announcement of the new rule, selling pressure in these bonds abated, presumably because the likelihood of their being forced out of the IG index is lower under the new rule. As a result, GM and Ford bonds had positive abnormal returns following the Lehman announcement. Insurance company holdings data show that this is because the intensity of front-running of the anticipated forced sales decreased. These results for the GM and Ford bonds reinforce our evidence for rating–based market segmentation.

Our paper contributes to a large prior literature that investigates capital shocks and market segmentation empirically.[7] A few recent papers are particularly closely related to our study. Kisgen and Strahan (2009) exploit the SEC's certification of Dominion Bond Rating Service as Nationally Recognized Statistical Rating Organization to learn about the certification role of rating agencies. Bongaerts, Cremers, and Goetzmann (2010) examine the certification role of ratings by means of regression analysis over the period 2002 to 2007. Ambrose, Cai, and Helwege (2009) and Ellul, Jotikasthira, and Lundblad (2010) study the price effects of fire sales by insurance companies of downgraded bonds. 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 following the Lehman announcement have a pricing impact.

The remainder of the paper is organized as follows: In Section 2, we describe how rating-based regulations lead to market segmentation and develop the hypotheses for our analysis. In Section 3,

[6] Based on their 2004 annual reports, as of Dec 31, 2004 the total debt outstanding for GM was $300 billion and for Ford was $173 billion. Ford also has additional indirect debt obligations because of off-balance sheet borrowing arrangements. For each company, approximately 90% of the debt is issued by the financial services segment and the balance by the automotive segment.

[7] 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 effects in eurobonds associated with announcements of watchlistings and rating changes by S&P and Moody's. 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 with focus on the link to corporate capital budgeting decision.

we describe our data and our empirical approach. We document our empirical findings in Sections 4 and 5. Finally, Section 6 concludes.

2 Background and Hypotheses

The use of credit ratings in both official regulations and informal industry practices can cause segmentation of the bond market into high-yield and investment-grade investor clienteles. Consequently, changes in Lehman's index rating methodology have the potential to alter the ownership structure of affected bonds.

2.1 Rating-based segmentation

Credit ratings are widely used to facilitate 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 of the 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).[8] These regulations typically implicitly or explicitly 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 assets for net-capital requirements. Savings and loan associations (S&L) have been prohibited since 1989 from investing in high-yield bonds. The NAIC imposed a 20% cap on how much junk bonds insurers may hold as a percentage of their assets in 1991, and investment-grade bond mutual funds can hold up to only 5% of assets in junk bonds and must sell any security if it falls below a B rating (see Cantor and Packer (1994) and Kisgen (2007)).

Within the scope defined by official regulation, institutional portfolio managers and investment committees have some degree of discretion in terms of whether they treat split–rated bonds as

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

investment grade and below-investment grade.[9] These decisions are presumably influenced by prevailing industry norms and best practices. Rating-based industry practices are, therefore, another feature which can engender segmentation in the US corporate bond market, with only a subset of buyers allowed—and *willing*—to hold risky bonds in unrestricted amounts. We argue that the Lehman rule change influenced informal industry norms for split–rated bonds and, thereby, affected decisions about portfolio holdings of split–rated bonds by portfolio managers and investment committees.

2.2 Lehman's index rating rule change

The Lehman Brothers bond indices have been in existence since January 1, 1973. With a history of over 30 years, they are widely used benchmarks in the fixed-income market.[10] The specific indices of interest for this study are the US Corporate Investment-grade 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.[11]

A bond's eligibility for inclusion in the Lehman IG or HY indices is based in part on its *index rating* which, in turn, depends solely on ratings issued by the major credit agencies. Index ratings do not provide any additional credit risk 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 events surrounding the 2005 rule change.

Insert Table 1 about here

[9]For example, Basel II and NAIC rules are based on the middle rating if a bond has three ratings which is generally a more liberal rule than the pre-2005 Lehman rule.

[10]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.

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

Lehman Brothers has redefined its index rating methodology only three times over the index's 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 one-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 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 rating (or if not rated by one of these agencies, the index rating was the other agency). We refer to the 2003 procedure as the *old rule* and the corresponding index ratings as the *old index ratings*.

Our analysis focuses on the most recent index rule change.[12] On January 24, 2005 Lehman Brothers announced that, effective July 1, 2005, bond 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 the bond is rated by only one agency, the bond's index rating is simply this rating.) We refer to the rule effective July 1 onwards as the *new rule* and the corresponding index ratings as *new index ratings*. Depending on a bond's Fitch rating, 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 the ratings assigned to it by any of the major rating agencies and, presumably, no change in the bond's fundamentals.

The 2005 Lehman index rating redefinition provides a natural experiment to examine the effects of market segmentation and ratings on bond prices in the absence of concurrent information about bond creditworthiness.[13] In particular, although bond credit ratings themselves did not change, we posit that the Lehman announcement influenced how institutional investors *use* these credit ratings in their portfolio decisions. This is in contrast to changes in bond credit ratings which potentially trigger portfolio holding changes but which also potentially convey new information about bond

[12] We have limited data on transaction prices and little information about the implementation and institutional details for the earlier index rule changes.

[13] As natural experiments are hard to come by, we face the usual caveat that the number of observations is small.

credit risk. If the corporate bond market is segmented because of rating-based regulations and industry practices, then bonds upgraded from high yield to investment grade should experience additional demand from investors constrained to investment-grade securities. The converse should hold for bonds downgraded to junk. Given downward-sloping demand curves, bond prices should rise (fall) when a bond experiences positive (negative) demand shocks. The resultant price pressure may, in turn, consist of a transitory component (which eventually is reversed once investors' portfolio reallocations are finalized) and a permanent component (securities 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 including Fitch in its index rating computation. It had not had such a conference call for several years. The context in which this announcement was made was one of market stress about potential GM and Ford downgrades. A news story released in the Wall Street Journal, Wednesday February 2, 2005, page C1—and revealingly titled "GM Bond Worries Fade With Some Magic From Lehman"—provides the following 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 (IG) and high-yield (HY) indices over time (normalized by the index level at the start of our control window, 50 trading days prior to January 24, 2005). The vertical dotted lines indicate major events (as described in Table 1) relating to the three TRACE phases, the Lehman index rule change, and the subsequent 2005 GM and Ford downgrades. Clearly the performance of IG and HY debt diverged over this time period. Our market segmentation tests involve testing 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, changes around the time of the announcement.

Insert Figure 1 about here

3 Data and methodology

We use an event study analysis to investigate the effect of the Lehman redefinition on different segments of the bond market. This section describes the main data sources. Our sample period begins in 2004, before the January 24, 2005 Lehman announcement, and continues after the July 1 rule effective date through to the end of 2005. We also describe how we implement our event study.

3.1 Corporate bond characteristics

We obtain bond characteristics (e.g., coupon, maturity) from the 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 announcement date, January 24, 2005. 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 maturity of the bond 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 bonds with registration rights, and (v) the bond trades at least once over the three months preceding the announcement date. The last criterion ensures that the 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 sample consists of $8,175$ bonds, out 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 in our sample. The average par value outstanding as of the announcement date is approximately $250 million. Naturally, index members have larger issues sizes, around 10 times more on average, than bonds not in any Lehman index. Along other dimensions, IG index members (Panel B) have features comparable to HY index members (Panel C) and index non-members (Panel D). Overall, the average maturity is 9.4 years, and the average seasoning of bonds in the sample is 3.8 years. The coupon rate ranges from zero coupon bonds to high-yield bonds with a coupon of 14.25%.

Insert Table 2 about here

In Table 3, Panel A summarizes bond index ratings, calculated according to the old and, respectively, the new index rating rules. The vast majority of bonds in our sample, 98%, are rated by Moody's and S&P. By contrast, only 74% of the sample is rated by Fitch. The issues most likely to experience a change of ownership (because constrained investors are likely to buy) are bonds that experience 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 rating of BB and 5 bonds with an old rating of B for a total of 48 bonds. Panel B documents that Fitch assigns a bond rating that is better than the lower of Moody's and S&P's in 70% of cases, on 4,229 out of 6,017 bonds. The remaining statistics reveal that the difference in assigned letters is pervasive across rating categories and industries.[14] Lastly, Table 3 shows that a very small number of bonds have lower index ratings under the new rule.[15]

[14] It is not crucial for our findings whether ratings differences across agencies are due to different rating scales or different measurement objectives.

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

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 information on all TRACE-eligible corporate bonds.[16] The TRACE system was instituted by the National Association of Securities Dealers (NASD) to meet demands from investors for greater transparency in the corporate bond market. 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. As a result, TRACE coverage drops off significantly as we go back further (see also Table 1). Around 4,700 bonds traded on any given day after February (or, 20% of all issues with trades reported for 2005 in TRACE) and, respectively, 4,100 bonds between October and February, while this number drops to 1,600 before October 1, 2004.

To be in our sample, a bond must have transaction prices which were publicly disseminated before the Lehman announcement (see rule (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.

Our study also uses the National Association of Insurance Commissioners (NAIC) database which includes all corporate bond trades involving insurance companies. While more limited in

[16]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 the TRACE data.

scope, the NAIC date has two advantages over TRACE. First, the NAIC identifies who is trading. Second, it provides actual (not truncated) transaction size data and a buy-sell indicator. We use this information to compute measures for bond turnover and for buying and selling pressure from constrained institutional investors.

Data on equity prices for the companies in our sample is 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 return (MKT), size (SMB), and B/M (HML)—from Kenneth French's website.

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. As a result, estimating bond returns can be challenging because price movements are not observable without trading activity. Since there is no standard method for computing returns for infrequently traded securities, we verify our results are robust to different approaches.[17]

We 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. To ensure that infrequent trading does not bias our results, we use two methods to handle non-trading days. Both approaches compute cumulative returns as the percentage difference between a bond's post-event daily midpoint price and the pre-event base price. *Method 1* imputes the

[17] In our study, the infrequent trading is alleviated because the event we study tends to increase trading activity and, thereby, eases the measurement problem. The infrequent nature of trading is also less concerning when computing returns over monthly than over daily horizons.

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 when a bond does not trade on a given day. The difference between the two approaches is the imputed timing of when returns are assumed to be realized. Importantly, neither approach requires trading on consecutive days, but they do give the same return when a bond does trade each day.[18]

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 downgrade of GM and Ford was presumably depressing the HY index. Thus, when the Lehman announcement gave GM and Ford a reprieve, this presumably relieved some of the price pressure on the HY index bonds. As a result, bonds staying in the HY index should have appreciated. Our long-short matched sample design controls for this effect.

Our matched sample methodology matches each bond in the treatment sample to a set of control bonds that are identical to the treatment bond along all dimensions deemed relevant except their Fitch rating status. 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).[19] Regarding their Fitch rating status, our control group consists, throughout the paper, of bonds that are either not rated by Fitch (from Table 2, this is the most numerous type of control bonds) or that have a Fitch rating below Moody's and S&P. The reason is that the new rule relies

[18] 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.

[19] We have also matched based on industry, coupon, issue size (or amount outstanding) and liquidity. The industry-matching is based on a broad sector definition: utility, financial, and industrial. Issue size bins are constructed by separating the universe of bonds into three bins based on par value (<\$150 MM, \$150–250 MM, ≥\$250 MM). We then require the control bonds to be in the same size bin. Liquidity is measured by the frequency of non-trading days. Fewer matches result from additional criteria. This, in turn, increases the impact on long-short portfolio returns of idiosyncratic price movements in some of the control bonds and lowers the overall quality of the match—as can be inferred from erratic abnormal performance over the pre-event control window. As a consequence, we only report results when matching on rating and maturity.

on the middle rating. Bonds with equal rating from Fitch, Moody's, S&P therefore potentially benefit from the rule change.

The sample of control bonds are used to form sets of long-short portfolios. That is, we compute hypothetical returns for portfolios that are long the treatment bonds and short a set of control bonds. For each treatment bond there are a number of 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 simulated sample of long-short portfolio returns can also be used to form the empirical distribution of abnormal announcement 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 implemented as described in Appendix A.

4 Does Rating-Based Market Segmentation Matter?

In this section we investigate bond returns, trading, and the portfolio behavior of investors around the Lehman rule change. Our analysis focuses on bonds that are likely to experience a change in ownership because of the redefinition of the index rating. The first set are bonds whose index rating switches directly from high yield to investment grade as a result of the redefinition. To the extent that the Lehman definition (or at least its timing) was a response to the GM and Ford crisis, these upgraded bonds can be viewed as "bystanders" who got swept up in the Lehman redefinition which can be viewed as being exogenous as far as these bonds are concerned. The second set are high-yield bonds which a favorable Fitch rating relative to their Moody's and S&P ratings. This group of bonds potentially benefit from the redefinition through a higher probability of inclusion in the IG index in the future. The third set are the GM and Ford. Under the old index rating rule, these bonds were widely expected to be forced out of the IG segment in the near future, but under the new index rating rule they received a reprieve. These bonds experienced substantial selling by institutional investors prior to the Lehman announcement. The segmentation hypothesis predicts that the first two sets of bonds should have experienced an increase in buying pressure, while for the third set the announcement should have alleviated selling pressure.

Our analysis focuses on event windows defined relative to three important dates. The first is day -10 before the Lehman announcement. We use this as the start for the announcement window because this was the time of the S&P watchlisting of GM which, in part, prompted the Lehman index rating redefinition. The second important day is the Lehman announcement on day 0. The third is the redefinition effective date on day +114.

4.1 Abnormal announcement returns on bonds upgraded to IG

Does rating-based market segmentation matter and does it have an impact on asset prices? The bonds most likely to have a change in ownership because of the Lehman redefinition are bonds whose index rating is upgraded from high yield to investment grade. There are 48 such bonds for which we have complete data.[20] Most of these bonds qualify for IG index inclusion, but some do not. 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. As a result, out of the 48 upgraded bonds, 30 become eligible for IG index inclusion, 8 drop out of the HY index but do not enter the IG index, and 10 remain out of any index because their issue size is less than $150 MM.

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

[20]At the time of the announcement, the financial press reported that 59 bonds were directly affected by the rule change. The difference between this number and our sample stems from lack of TRACE transactions data for some of the bonds. Even though starting with TRACE Phase III traders became obliged by the regulator to disseminate all transactions in liquid bonds, there are no transactions reported during our pre-event control window period for some of the affected bond issues. As a result, we are not able to compute announcement returns for these bonds.

the matched sample procedure described in the previous section. We show in a later section that other bonds with favorable Fitch ratings which were not added to the IG index also react in a similar fashion.

Insert Figure 2 and Table 4 about here

As a test of whether the control sample has similar risk characteristics as the treatment sample, we measure abnormal portfolio returns over a pre-event control window $[-50, -10]$ (transaction price availability in TRACE is limited before $t = -50$) 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 10 (25) basis points with p-value of 0.4 (0.3) under *Method 1* (*Method 2*). These control window 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.

In Table 4, $t = 0$ refers to the announcement date (January 24, 2005) and $t = 114$ to the effective date for the rule change (July 1, 2005; also indicated by 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. As can be seen, the bonds that can most reasonably be expected to enter the IG index experience an economically significant positive abnormal return of 1.5% over the twenty day window surrounding the announcement day. Abnormal returns are significantly positive at the 1 percent statistical level. The CARs peak around day 10 after the announcement before a short-term reversal occurs. The upgraded bonds then further outperform until abnormal returns peak at 3% around the effective date. Figure 2 shows that the return peak is around the time of the GM/Ford downgrades, which presumably affected the spread between all IG and HY bonds. Therefore, not all of that peak may be due to the ex ante impact of the upgrade. At the end of 2005 (after 245 trading days), the CARs are around 2%, still about 2/3 of the peak price impact. Thus, it appears that the valuation impact of the Lehman announcement consists of a transitory component which eventually is reversed and a permanent component. The long-run abnormal return is a point estimate of the permanent component. The power of our test for a permanent component falls over time, however, because the standard errors grow over time as the cumulative variation in returns increases, making detecting a given permanent effect harder. These patterns are robust to the imputation method used to compute returns (*Method 1* or *Method 2*). In the remainder, we limit attention to results obtained using the more conservative *Method 1*.[21]

We expect bonds to react more strongly to the Lehman announcement the more sensitive their valuation is to their ownership structure. To check this, we split the sample into short- and long-maturity bonds. Panel (a) in Figure 3 plots the announcement returns split by maturity into short (1-5 years) and long (5 years or longer). Out of the 30 upgraded bonds, 11 (19) have short (long) maturities. We find that longer maturities react more. Over longer horizons, the last two sets of columns in Table 4 report cumulative abnormal returns based on the matched sample procedure. The abnormal return difference for long maturity bonds amounts to up to 4%.

Insert Figure 3 about here

4.2 Reputation vs. ratings-based segmentation

An alternative to rating-based segmentation is the possibility that the Lehman announcement prompted a revision in the perceived quality of Fitch ratings. In this case, we would expect bonds in all rating categories to have positive abnormal returns if they have a favorable Fitch

[21]Our analysis of long-term price effects does not control for the fact that some of the upgraded bonds may subsequently experience downgrades and drop back into the HY index or that still other bonds may experience upgrades. Out of the 30 in our sample, 29 bonds stay in the treatment sample at the effective date and only one drops out because of a downgrade before the effective date. In turn, three bonds with investment-grade status at the announcement get downgraded by S&P during the implementation period and reenter the IG index at the effective date because of the rule change. In addition, four high-yield bonds are newly issued during the implementation period and enter the IG index on the effective date because of the rule change. An additional 10 bonds are eligible throughout and enter the IG index on the effective date, but we have no TRACE data before the announcement. These bonds are excluded from the original treatment sample (see also Footnote 20). As a result, the number of eligible bonds in our sample increases to 46 at the effective date. Our analysis is restricted to just the initial 30 bonds on the announcement date.

rating (i.e., better than the S&P and Moody's rating). This is in contrast to market segmentation which implies that the price effects should be confined to bonds with a higher probability of receiving investment-grade status and an expanded investor clientele. Hence, segmentation price effects should be concentrated around the IG-HY boundary. We exploit this difference to test the reputation hypothesis against ratings-induced segmentation.

Table 5 reports value-weighted average cumulative raw returns, CR, over the announcement event period [-10,+10], split by the old Lehman rating and the respective Fitch rating status. Here, we compute value-weighted returns for all bonds with given combination of old rating and Fitch status, but we do not match on additional criteria such as maturity. We report p-values for the one-sided alternative $H_a : CR_{[-10,+10]} \geq 0$ in brackets. The column titled *Difference fav. - not fav.* reports the return difference between bonds rated favorably by Fitch and bonds not rated favorably (i.e., rated lower than Moody's and S&P or not rated by Fitch). All groups of bonds have positive returns over the announcement period. High-yield bonds rated favorably by Fitch outperform high-yield bonds without favorable Fitch rating by 0.81% (p-value 0.002) and, consistent with market segmentation, also outperform investment-grade bonds by 0.76% (p-value 0.003). When we split the sample by the individual index ratings under the old system (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. In particular, BB+ bonds with favorable Fitch rating outperform BB+ bonds without favorable Fitch rating by 1.3% with a p-value of 0.01 (the difference test). In contrast, IG bonds rated favorably by Fitch do not economically outperform IG bonds without favorable Fitch rating. The column *Diff-in-diff* in Panel A reports a difference-in-difference test for returns on bonds rated favorably versus bonds not rated favorably by Fitch for the HY and IG segments; while Panel B reports the corresponding test for BB+ versus BBB- bonds. We find that HY bonds (BB+ bonds) with favorable Fitch rating outperform the corresponding long-short IG (BBB-) portfolio by 0.76% (0.98%) with a p-value of 0.004 (0.04).

Insert Table 5 about here

Table 6 presents CARs over longer horizons for bonds rated favorably by Fitch split by their index ratings under the old rule. Abnormal returns are again computed relative to the control group 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. From the sample of bonds rated favorably by Fitch, we exclude the 30 bonds expected to switch to the IG index, since we already know from Table 4 that they react positively to the announcement. We find that only the subsets of bonds that are predicted to be most affected by market segmentation—high-yield bonds—have significant positive abnormal returns. The announcement CARs are largest for the HY bonds closest to the IG-HY boundary. In contrast, the CARs for the IG bond portfolios with favorable Fitch rating are lower than for the HY portfolios and are mostly statistically insignificant. Interestingly, almost all of the CARs for bonds favorably rated by Fitch are positive on the redefinition effective date with the returns peaking close to the HY-IG boundary. Since the redefinition was previously announced, this return pattern seems more consistent with ownership effects rather than credit news. Thus, the return evidence supports market segmentation over the alternative reputation hypothesis.

Insert Table 6 about here

4.3 Order flow imbalances of institutional investors

Are the abnormal announcement returns for upgraded bonds due to demand pressure from constrained institutional investors? In order to answer this question, we examine whether trading in the upgraded bonds is consistent with a demand shock. We then directly examine trading by insurance companies as important class of constrained investors.

4.3.1 Bond trading activity

We first examine whether abnormal turnover in the affected bonds follows the Lehman announcement. We construct trading measures from the TRACE transactions data and from the NAIC data on holdings by insurance companies. 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 4 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 announcement date, a post-announcement window starting two weeks before the announcement date and going to the effective date, and then a six-month post-effective window starting from the effective date to year-end. Consistent with the demand shock hypothesis, the turnover for the upgraded bonds exhibits a significant transitory increase. Between the announcement and effective dates, the turnover for the bonds expected to switch to the IG index doubles, from .26% to .54% per day and then, after the effective date, reverts somewhat to its former level before the rule change. The control bonds do not exhibit this pattern.[22]

Insert Figure 4 and Table 7 about here

If there is an economic link between trading and prices, abnormal returns should covary positively with the 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 post-event window [+1,+30] and compute abnormal returns separately on the bonds upgraded to the investment-grade index. Figure 3, Panel (b), summarizes the results. Consistent with the demand pressure hypothesis, the highest turnover sample (plotted as the solid line) has the highest abnormal returns, peaking at over +4%.

Are the increased turnover and abnormal returns due to demand from constrained institutional investors? To answer this, we establish a link between the time-series of institutional order flow imbalances and bond returns. The TRACE data set, unfortunately, provides neither a buy-sell

[22]We also looked at the dollar trading volume. Trading volume exhibits spikes similar to turnover. We have also checked the Financial Times archives and the internet for major news stories. We could not identify materially relevant events on bonds in the treatment group. From the sample of controls, 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.

indicator for which party initiates the trade nor any information on the identity of the traders. Hence, we cannot directly observe net buying by constrained investors. We can, however, impute the trade direction. Following a trade classification procedure similar to Lee and Ready (1991), we compare the transaction price on each trade with the previous day's closing price. If the trade price is higher, we classify the trade as a buy, and otherwise as a sell. The buy/sell indicators are then used to compute daily order flow imbalances. The size of each transaction is used as indicator for the type of investor, since large trades over $1 MM in par value are predominantly institutional.

Table 8 examines the relation between daily returns and order flow imbalances for the HY-to-IG upgraded bonds. The dependent variable are the daily portfolio returns. We look at both the post-announcement window (-10,+114] (Panel A) and the post-effective window (+114,+245] (Panel B). We show estimation results using both pooled OLS regression and also average coefficients from time-series regressions for individual bonds. Trading volume is used as a control variable in the regressions, though results are very similar in the univariate case. The positive significant coefficients on all order flow variables suggest that order flow imbalances from institutional investors cause bond prices to move upwards in order to accommodate the increased demand. The reported R^2s indicate that order flow imbalances explain up to 41% of the announcement returns.

Insert Table 8 about here

4.3.2 Bond portfolios of insurance companies

Bond trading data for insurance companies allows us to investigate directly whether the increased turnover is due, in part, to increased buying by constrained investors after the Lehman announcement. Insurance companies are a prominent example of a constrained investor class.[23] According to Federal Reserve data for 2004-5, insurance companies own 25 percent of corporate bonds outstanding. Insurance companies, together with high-yield mutual funds, hedge funds, and some pension funds, do actively trade in HY bonds (see Wells Fargo (2009)). They often purchase and sell HY

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

bonds for their own investment needs or to fund the separate accounts of variable insurance and annuity products. Given their significant holdings and the regulations they face, insurance companies are a natural candidate for being rating-sensitive investors.

Figure 5 summarizes trading by insurance companies around the Lehman announcement. Depicted is the cumulative change in the aggregate holdings of the 30 bonds expected to enter the IG index due to the rule change. As a control, the dashed line plots the corresponding change in inventory per bond for all HY bonds that stay in the HY index. To make the change in holdings comparable across the two samples, we normalize the cumulative change by the number of bonds in each sample—arriving at an equal-weighted average change in holdings. We see that insurance companies accumulate holdings in the bonds expected to enter the IG index over the post-announcement period and sell the control bonds over the same period.

Insert Figure 5 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 January 24 to December 31, and Panel B over the post-effective time period from July 1 to December 31. The first (second) set of columns measure insurance company transactions in dollar terms (in percent of issue size). On average insurance companies bought \$27.5 million in each bond entering the IG index (\$6.2 million after the announcement plus an extra \$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 to institutional front-runners. In contrast, insurance companies shun bonds with no favorable Fitch rating, irrespective of their index rating. As a result, the abnormal change of bonds entering the IG index in insurance company portfolios relative to the control sample of bonds which stayed HY amounts to \$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 p-values, the increase is statistically larger than the change in holdings of control bonds for all of the control samples. These results are consistent with rating-sensitive investors buying bonds that have mechanically become investment grade.

Insert Table 9 about here

4.4 Change in correlation structure of bonds switching the index

In segmented markets, financial securities are priced using different investors' marginal rates of substitution so long as they held (or are expected to be held) by different investor clienteles. This implies that an asset's price dynamics may change when the security switches trading from one segment to another. In particular, segment-specific shocks should affect bonds differently depending on whether they are considered investment grade or high yield. As a result, we expect a change in the correlation structure of the returns of the bonds switching segments. The correlation with the new segment's index should increase as this segment's marginal investor now prices the bond, and the correlation with the market index of the bond's previous segment should tend to decline.[24]

We test these predictions in Table 10. Given representative indices for the IG and HY segments, we check whether the return correlations of switching bonds (the "treatment sample") change around the time of the switch. We do this by comparing factor loadings in a multi-factor model of returns over three time periods: a six-month pre-announcement window ending two weeks before the announcement date, a post-announcement window from two weeks before the announcement date through the effective date, and a post-effective window going from the effective date to year-end. Specifically, we regress daily returns of the value-weighted portfolio of bonds switching to the IG index on two bond market indices, one representative index for the IG segment (new market) and one for the HY segment (old market). To diminish confounding effects of endogenous correlation between the index and index constituents, we choose the indices with largest distance to the IG-HY boundary, the AAA index and, respectively, the B index.

Insert Table 10 about here

[24]See Vijh (1994), Barberis, Shleifer, and Wurgler (2005), and Hendershott and Seasholes (2009) for evidence from equity markets on the change in return correlations associated with stock index additions and deletions.

Again consistent with market segmentation, Table 10 shows that for the 30 bonds switching to the IG index the factor loadings on the new index rise and they drop on the old index. The null hypothesis that the factor loading on the investment-grade index remained the same around the switch is rejected with a p-value of 0.002. Bonds that do not switch exhibit no comparable pattern. The difference-in-difference test is significant with a p-value of 0.005.[25] However, the corresponding results for the B index are weaker and are not statistically significant.

4.5 Long-run impact on bond liquidity

To what extent did the increase in trading over the implementation period increase liquidity? 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 $Roll = 2\sqrt{-cov(\Delta P_t, \Delta P_{t-1})}$ 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 Amhihud (2002) measure.

Table 11 gives estimates of liquidity in the pre-announcement, the post-announcement, and the post-effective windows. The estimates for the HY-to-IG bonds show that the increased turnover is associated with improved liquidity. Roll's measure is significantly reduced during the post-announcement period, while it reverts after the effective date. These patterns are less pronounced in the control sample. However, a formal difference-in-difference test indicates that the differences in liquidity for the two sets of bonds are not statistically significantly different. Since liquidity does not seem to have change, this can be interpreted as evidence against an alternative hypothesis that the positive abnormal returns on the upgraded bonds were caused by improvement in priced liquidity.

Insert Table 11 about here

******* Note: Need to update table to include Amihud results ********

[25] For robustness, we have also compared univariate correlation coefficients between different value-weighted bond portfolios and the returns on different bond indices. The results are similar to the multivariate case.

4.6 GM and Ford bonds

Bonds issued by GM and Ford, together with their financial arms GMAC and FMCC, constitute a significant portion of the Lehman investment-grade index—each representing about 2 percent of the total index.[26] Their ratings are BBB- under the old rating rule, just one notch from high yield. Given their enormous size, a GM or Ford downgrade to high-yield segment would have generated significant price impacts spilling over to other HY bonds, since the increased supply would tax the capacity of high-yield investors to purchase these bonds (Acharya, Schaefer, and Zhang, 2008). On January 14, S&P announced that it would review GM ratings within the next six months. Market participants therefore expected that S&P would downgrade GM to high yield later that year, triggering fire sales from constrained investors in anticipation of the downgrade.[27] However, under Lehman's new index rating rule, these bonds would remain in the investment-grade index even if S&P downgraded them so long as Moody's and Fitch maintained their investment-grade ratings for these bonds.[28] As a result, the selling pressure should abate and prices recover as a result on Lehman's announcement. Our results could therefore be confounded by the GM/Ford fire sales if prices recover only slowly once demand pressure disappears. To rule out this explanation, we first check whether trading activity in bonds issued by GM and Ford is consistent with the anecdotal evidence in the financial press and that Lehman's announcement indeed diminished selling pressure. We then show that prices recovered rapidly—reaching pre-fire sale levels within just a few days.

Panel (a) in Figure 6 plots the bond turnover around the announcement date for three portfolios distinguished by Moody's ratings. The turnover is computed using the TRACE transactions data.

[26]General Motors Acceptance Corporation (GMAC) is the financing arm of General Motors and Ford Motor Credit Corporation (FMCC) is the financing arm of Ford Motors. Although the motorcar manufacturing subsidiary and the financing subsidiary of each firm issues its own bonds, the subsidiaries are owned by a single parent firm.

[27]If the likelihood of a downgrade in the near future is high, ratings-constrained investors tend to sell off their holdings in anticipation of the actual downgrade (Da and Gao, 2008).

[28]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 procedure, 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 procedure, 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.

Consistent with BBB bonds having the greatest decrease in selling pressure, we find that the turnover of these bonds experiences the largest decrease around the announcement date.

Insert Figure 6 about here

In Panel (b) of Figure 6 we plot the cumulative returns of the GM and Ford bonds. The bonds are, again, split based on their Moody's ratings. Several trends are apparent from the graphs. First, bond prices exhibit a downward trend approaching the announcement date. This pattern is consistent with constrained investors selling their bonds in anticipation of a downgrade and bond prices being depressed because the demand curve for these bonds is downward sloping. On the announcement date, the trend reverses and cumulative returns exhibit an upward trend. With a reduced likelihood of these bonds being downgraded to high yield, constrained investors reduced their sales of these bonds, which in turn reduced the excess supply of these bonds in the market, and prices recover immediately.

The impact of the announcement differs systematically across the three portfolios with different Moody's rating. Bonds with the lowest Moody's rating (BBB) experience the largest decrease in price prior to the announcement and also the largest recovery on the announcement date. These bonds presumably had the greatest likelihood of being downgraded under the old index ratings rule because a one notch downgrade by S&P or a two notch downgrade by Moody's would have required these bonds to leave the IG index. Therefore, constrained investors were most actively selling these bonds prior to the announcement. Correspondingly, after the announcement, the drop in selling pressure is the most pronounced for these bonds—which in turn results in the largest jump in price.

As a robustness test, we also perform a cross-sectional regression of cumulative returns for the sample of GM and Ford bonds to verify that the differences in returns across portfolios with different Moody's rating categories are not due to bond characteristics that systematically vary across these portfolios. Appendix C describes the methodology and summarizes the control variables we use. The estimation results, reported in Table 12, confirm that the differences in cumulative returns are due to differences in downgrade likelihood and are consistent with the trends observed in Figure 6.

Over the [-1,+10] event window, the cumulative returns for the Moody's BBB (BBB+) portfolio exceeds that of the A- portfolio by 1.6% (0.8%). These numbers are very close to the raw returns on the announcement date.

Insert Table 12 about here

5 Robustness and Implications

Our maintained hypothesis is that the positive abnormal returns on upgraded bonds are because of investment constraints on institutional investors. We now perform additional tests to examine whether alternate hypotheses are supported by the data. We explore the impact of the announcement on equity prices. Last, we examine the impact of index rating rules on the demand for multiple ratings.

5.1 Fundamental news? The announcement effect on stock prices

We now examine how the stock prices of bond issuers in different ratings-based portfolios reacted to the change in index rating procedure. In particular, we check whether there are abnormal stock returns across the different underlying bond portfolios to rule out bond prices rising simply because the asset value of the issuing companies were revised. In addition, we want to rule out that Lehman's announcement has a certification effect on equity values for firms whose bonds have a favorable Fitch rating. For this purpose, we perform a cross-sectional regression of cumulative abnormal returns for the issuers' stock corresponding to the bonds in our sample.

In the estimations reported in Table 13, we regress equity CARs on a set of indicator variables that correspond to the different bond portfolios of interest. Since companies issue multiple bonds, our stock sample consists of 561 stocks, far less than 8,175 bonds in our sample. 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 measure expected stock returns as follows:

$$E(R_{i,t}) = \beta_i MKT_t + s_i SMB_t + h_i HML_t,$$

where R_i is firm i's excess stock return, MKT is the market excess return, SMB is the size factor, and HML is the book-to-market factor. We apply the standard procedure outlined in Appendix B to compute (cumulative) abnormal returns.

Insert Table 13 about here

Table 13 reports estimates from a cross-sectional regression explaining cumulative abnormal stock returns with issuer characteristics. The indicator variables included in the regression are the firm's weighted-average bond rating up to the notch and interaction terms with the rating status assigned by Fitch. The estimates reveal that the Lehman announcement had no significant price effect in the stock market. An information-based explanation for the Lehman announcement is, therefore, unlikely since one would expect a positive effect of reduced default risk on equity value. However, none of the abnormal stock returns are significant and we also do not find significant correlation with abnormal bond returns. Taken together, these results suggest that the bond returns are not driven by changes in underlying asset values.

5.2 The impact of index rating rules on the demand for multiple ratings

To the extent that Lehman was an industry leader in how credit ratings are interpreted by institutional investors, its decision to use Fitch ratings should have had a significant positive impact on Fitch's business. As a result, the demand for Fitch ratings should have increased after the announcement.[29] To the extent that it does, this is an indication of the importance of market segmentation for the ratings business.[30]

Table 14 compares the market share penetration of each rating agency before and, respectively, after the Lehman rule change. Specifically, we report the fraction of new corporate bond issues

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

[30] 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.

rated by each of the three rating agencies. We choose a pre-event period covering two years prior to the Lehman announcement and a post-event period of two years after the announcement.[31] We the FISD ratings history data to construct two measures of market penetration.[32] The first 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 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.[33] Panel A reports results 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 last two columns in the table report p-values for hypothesis tests that check the alternative that the rated portion of issues has declined ($H_a : Post \leq Pre$) or, respectively, increased ($H_a : Post \geq Pre$).

Insert Table 14 about here

Market penetration of Moody's and S&P appears to be flat or, depending on the measure, even to have declined slightly over time—with around 80-90% of issuers soliciting a rating from each agency. By contrast, there seems to be a structural break in the market penetration of Fitch following the index rule change announcement in January 2005. Fitch's market penetration increased significantly from below 50% in 2003-4 to over 50% in 2005-6 and has become around 15 (10) percentage points closer to that of Moody's (S&P). This suggests that Lehman's decision to include Fitch ratings in computing its index ratings had with a marked impact on Fitch's business, though, from this evidence alone it is impossible to 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 determinant of whether a bond is purchased by a constrained investor.

[31] 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).

[32] 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.

[33] 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.

6 Conclusion

The Lehman Brother index rating redefinition announced in January 2005 is a natural experiment to test whether bonds trade in segmented markets with different inelastic demand curves, and whether bond 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 frictionless market paradigm. Split–rated bonds whose index rating was upgraded to investment grade exhibit significantly positive short- and long-run abnormal returns, significantly increased turnover, large institutional demand, and a shift in the correlation structure of their returns towards stronger comovement with their new new segment. In addition, GM and Ford bonds, which were widely expected to be downgraded to high yield, exhibit positive abnormal returns and reduced net selling pressure consistent with an increased likelihood of staying in the investment-grade market segment. This suggest that market frictions may also be important in explaining other bond price/credit spread 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.

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.

Bessembinder, H., Kahle, K. M., Maxwell, W., and D. Xu (2009). "Measuring abnormal bond performance" *Review of Financial Studies*, forthcoming.

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" Yale ICF Working Paper No. 08-27.

Cantor, R., and F. Packer (1994). "The credit rating industry" *FRBNY Quarterly Review*, Summer-Fall.

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.

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

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

Duffie, D., and B. Strulovici (2009). "Endogenous capital mobility and price dynamics" 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.

Ellul, A., C. Jotikasthira, and C. Lundblad (2010). "Regulatory Pressure and Fire Sales in the Corporate Bond Market" Working paper.

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.

Gromb, D., and D. Vayanos (2007). "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.

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

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 (2009). "Do Regulations Based on Credit Ratings Affect a Firm's Cost of Capital?" NBER Working Papers 14890, National Bureau of Economic Research.

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.

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.

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.

A Bootstrap Procedure

The bootstrap procedure to compute empirical p-values is implemented as follows:

- We form a matched sample for our portfolio of treatment bonds (containing as many control bonds as there are in the treatment sample) by randomly picking one control for each treatment bond. We then calculate the cumulative abnormal return (CAR) for this long-short portfolio on each event day, as described above. Denote the CAR in round i at date t by $CAR_{t,i}$.
- We repeat the matched sample formation procedure, using another random sample 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, $CAR_t = \frac{1}{I}\sum_{i=1}^{I} CAR_{t,i}$.
- Last, we construct the empirical distribution, F_{CAR}, for the CAR on each event day and use F_{CAR} to compute empirical p-values and to test whether the abnormal returns are statistically significant, as follows. Since, by assumption, the matching portfolios should have similar risk, we expect $E(CAR_t) = 0$. We can therefore form the empirical p-value for the hypothesis $H_0 : CAR_t \leq 0$ by computing $p = 1 - F_{CAR}(CAR_t)$.

This procedure allows us to compute (cumulative) abnormal announcement returns and to test whether they significantly differ from zero. The confidence bounds for the abnormal returns can be determined similarly. The confidence interval is given by the empirical values $[\underline{CAR}, \overline{CAR}]$ for which $F_{CAR}(\underline{CAR}) = .05$ and $F_{CAR}(\overline{CAR}) = .95$.

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 to predict the firm's stock returns. This is accomplished by regressing $R_{i,t}$ 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 announcement). The coefficient estimates from this regression are used to predict 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 [-20, +20] days, and aggregate ARs at portfolio level. Then compute CARs as follows:

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

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

C Robustness Tests

As a robustness test, we perform a cross-sectional regression of cumulative returns for the sample of GM and Ford bonds to verify that the differences in returns across portfolios with different Moody's rating categories are not due to bond characteristics that systematically vary across these portfolios. The cross-sectional approach allows us to simultaneously estimate the abnormal returns on multiple sub-samples of interest. We regress cumulative returns against a set of variables that have been used in the literature to explain bond returns. In order to measure the abnormal returns of K sub-samples, we use as explanatory variables a set of indicator variables $I_k, k = 1, \ldots, K$, that take on a value of one if the bond is in sub-sample k, and zero otherwise. The coefficient β_k on I_k yields an estimate for the CAR on sub-sample k. That is, we estimate a model of the form:

$$CR_i = \alpha + \sum_k \beta_k I_k + \gamma' X_i + \varepsilon_i,$$

where CR_i is the cumulative return for bond i, X_i is a set of control variables, and $I_k, k = 1, \ldots, K$ are the indicator variables used to identify the bonds in sample k.

To address measurement issues due to the infrequent nature of trading, we compute returns by averaging transaction prices over consecutive days. We determine the pre-event (post-event) price as the volume-weighted average of the 'clean' prices over a window of a fixed number of days (here we pick four days) surrounding the pre-event (post-event) date. In detail, we use the volume-weighted average price over $[t_0, t_0 + 3]$ as the pre-event price and the volume-weighted price over $[t_1 - 3, t_1]$ as the post-event price, if the CR is computed over the time $[t_0, t_1]$, with $t_0 < -3$ and $t_1 \geq 3$. Cumulative returns are then computed as the percentage difference between post-event and pre-event bond prices: $CR_{[t_0,t_1]} = \ln(\overline{P}_{t_1-3,t_1}) - \ln(\overline{P}_{t_0,t_0+3})$. Finally, the cumulative returns are winsorized at the 1% and 99% sample values to mitigate any adverse effects of outliers and potential data entry errors in TRACE.

The control variables we use are the following:

- Maturity: maturity of bond i in years;
- Age: age of bond i, measured in years since offering date;
- Coupon: measured in percent;
- Amount outstanding: 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.
- Dummies for ratings under the old rule: AA, A, $BBB/BBB+$, $BBB-$, $BB+$, $BB/BB-$, B, C/D and bonds unrated by Moody's and S&P;
- Dummy for being rated by Fitch with a same or more favorable rating than Moody's and S&P;
- Dummies for interaction term between a rating under the old rule and being rated by Fitch with a same or favorable rating (Fitch bonus).

Table 1: Timeline of Events.

Date	Event	Description
January 1, 1973	Lehman bond index inception	Lehman Brothers bond indices become in existence. The initial index rating rule was the average of the bond's rating assigned by Moody's and S&P. The index rule rarely changes during its 30+ year history.
August 1988	Lehman index rule change 1	The Lehman index rule changes so that the index rating for a bond is its Moody's rating. If the bond is not rated by Moody's, its index rating is its S&P rating.
July 1, 2002	TRACE Phase I	The 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 decides to use the lower of the ratings assigned by Moody's and S&P in an effort to reduce the dependence on one rating agency and 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 it will change the way in which it determines membership in its family of corporate bond indices. Fitch is for the first time included in the formula used to compute the index rating. The new rule will assign an index rating equal to the middle of Moody's, S&P, and Fitch. If the bond is rated by only two agencies, the index rating will remain to be the lower of the two. The index rating rule change would 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 to negative from stable.
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 announcement date.

	Mean	S.D.	Min	Max
Panel A: Full sample – 8,175 bonds				
Amount outstanding ($ MM)	233.80	388.94	0.00	5500.00
Maturity (years)	9.43	9.27	1.10	93.37
Coupon (%)	6.01	1.83	0.00	14.25
Age (years)	3.82	3.83	0.22	67.70
Panel B: IG index members – 2,232 bonds				
Amount outstanding ($ MM)	600.80	537.14	250.00	5500.00
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
Panel C: HY index members – 659 bonds				
Amount outstanding ($ MM)	419.90	304.96	150.00	2750.00
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
Panel D: Index non-members – 5,284 bonds				
Amount outstanding ($ MM)	55.57	87.35	0.00	3250.00
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
Panel E: Bonds upgraded to IG – 30 bonds				
Amount outstanding ($ MM)	592.07	329.48	250.00	1500.00
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

Table 3: Index ratings and rating comparison across agencies.

This table summarizes the index ratings of all bonds in our sample as of the announcement date based on the old and new index rating rules (Panel A). The old rating is the more conservative of the Moody's and S&P rating and the new rating is the middle of the Moody's, S&P and Fitch rating. See the text for additional details. 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 Rating							
Old 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 bond 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 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 announcement returns for bonds upgraded to investment grade.

This table reports cumulative abnormal returns for the sample of bonds whose index rating changes from high yield to investment grade because of the index rating rule change. 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. 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 the hypothesis $H_0 : CAR_{[-50,-10]} = 0$ allows to test whether the matched sample controls for all risk characteristics deemed relevant. 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. The sample consists of the bonds eligible for IG index inclusion.

Time	HY-to-IG (*Method 1*)		HY-to-IG (*Method 2*)		HY-to-IG (Short mat.)		HY-to-IG (Long mat.)	
	CAR	Emp. p	CAR	Emp. p	CAR	Emp. p	CAR	Emp. p
Control window:	0.31	[0.16]	0.36	[0.12]	0.69	[0.03]	0.26	[0.26]
Event window:								
-5	0.57	[0.00]	0.76	[0.00]	-0.37	[0.81]	0.97	[0.00]
0	1.39	[0.00]	1.32	[0.00]	0.14	[0.36]	1.94	[0.00]
10	1.52	[0.00]	1.33	[0.00]	-0.40	[0.83]	2.46	[0.00]
20	0.71	[0.02]	0.93	[0.01]	-0.52	[0.92]	1.39	[0.00]
30	0.90	[0.03]	0.90	[0.03]	-0.67	[0.98]	1.75	[0.00]
50	1.37	[0.00]	1.25	[0.00]	0.54	[0.12]	1.67	[0.00]
80	2.10	[0.01]	2.41	[0.00]	0.50	[0.27]	2.79	[0.01]
114†	2.80	[0.00]	2.55	[0.00]	0.17	[0.43]	4.12	[0.00]
150	2.98	[0.00]	2.55	[0.00]	0.49	[0.31]	4.22	[0.00]
200	1.60	[0.02]	2.03	[0.01]	-0.04	[0.53]	2.37	[0.01]
245	2.45	[0.00]	2.20	[0.00]	0.41	[0.33]	3.47	[0.00]

Table 5: Reputation vs. ratings-induced segmentation: Short-run announcement returns.

The table reports cumulative returns, CR, over the 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. Cumulative returns are calculated using *Method 1* described in Section 3.3. 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]		

TABLE 6: REPUTATION VS. RATINGS-INDUCED SEGMENTATION: LONG-RUN ABNORMAL ANNOUNCEMENT RETURNS.

The table reports cumulative abnormal returns for the sample of 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. 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 the hypothesis $H_0 : CAR_{[-50,-10]} = 0$ allows to test whether the matched sample controls for all relevant 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 are excluded from the sample. The 30 bonds eligible for IG index inclusion (reported in Table 4) are also excluded from the sample.

	Investment-grade bonds						High-yield bonds					
	AAA - A		BBB+ - BBB		BBB-		BB+		BB - BB-		B	
Time	CAR	Emp. p	CAR	Emp. p	CAR	Emp. p	CAR	Emp. p	CAR	Emp. p	CAR	Emp. p
Control window:	0.22	[0.00]	-0.09	[0.81]	-0.05	[0.61]	0.67	[0.06]	0.17	[0.30]	-0.88	[0.97]
Event window:												
-5	-0.07	[1.00]	-0.11	[0.91]	0.05	[0.35]	0.73	[0.00]	0.36	[0.09]	0.13	[0.23]
0	-0.03	[0.78]	0.07	[0.21]	0.02	[0.43]	1.11	[0.00]	0.23	[0.16]	-0.31	[0.93]
10	-0.20	[1.00]	0.15	[0.13]	0.32	[0.01]	1.41	[0.00]	0.35	[0.12]	0.10	[0.41]
20	-0.27	[1.00]	0.04	[0.37]	-0.19	[0.92]	1.96	[0.00]	-0.03	[0.51]	0.67	[0.06]
30	-0.21	[1.00]	0.05	[0.34]	-0.23	[0.89]	1.65	[0.00]	0.36	[0.11]	0.56	[0.11]
50	-0.07	[0.97]	0.31	[0.02]	-0.54	[1.00]	1.34	[0.00]	0.69	[0.01]	0.29	[0.29]
80	0.00	[0.52]	0.72	[0.00]	0.50	[0.04]	2.05	[0.03]	2.44	[0.00]	1.30	[0.08]
114†	-0.36	[1.00]	0.43	[0.00]	0.50	[0.04]	1.76	[0.01]	1.77	[0.00]	2.67	[0.01]
150	-0.34	[1.00]	0.41	[0.01]	0.36	[0.12]	1.86	[0.01]	1.14	[0.00]	2.59	[0.01]
200	-0.60	[1.00]	-0.19	[0.83]	-0.06	[0.54]	2.86	[0.03]	1.95	[0.00]	1.85	[0.04]
245	-0.60	[1.00]	0.38	[0.03]	-0.05	[0.53]	2.84	[0.02]	0.55	[0.19]	2.23	[0.03]

Table 7: Long-run impact on bond trading activity.

The table reports statistics on daily turnover over different event windows. Daily turnover is computed for each bond over three time periods: 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.

	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 (%*100)	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 (%*100)	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 examines the relation between the daily returns and order flow imbalances in the portfolio of bonds upgraded to investment grade. The dependent variable is the daily portfolio 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 (July 1, 2005) and ending at year-end (December 31, 2005). We show estimation results using both pooled OLS and time-series regressions (reported is the average slope coefficient from time-series OLS on each bond). To compute order flow imbalances, we first compare the transaction price of each trade with the previous day's closing price. If the trade price is higher, we classify the trade as a buy, otherwise as a sell. The buy/sell indicators are then used to compute order flow imbalances. All variables are expressed in terms of logarithms. Standard errors are shown in parenthesis. *, **, *** indicate significance at the 10%, 5%, and 1% level, respectively.

	Pooled	TS	Pooled	TS	Pooled	TS
Panel A: Post-announcement window (-10, +114], 2,133 observations						
Order imbalance	3.83***	4.32***				
	(0.12)	(0.53)				
Order flow imbalance (no. trades)			34.87***	48.19***		
			(1.32)	(8.31)		
Order flow imbalance (no. trades $\geq$ \$1 MM)					36.00***	43.63***
					(1.51)	(6.93)
Volume	2.97***	1.60	3.88***	2.82	4.26***	3.54*
	(0.99)	(1.66)	(1.00)	(1.73)	(1.10)	(1.75)
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***				
	(0.12)	(0.38)				
Order flow imbalance (no. trades)			35.71***	43.20***		
			(1.35)	(4.18)		
Order flow imbalance (no. trades $\geq$ \$1 MM)					34.60***	41.38***
					(1.76)	(4.79)
Volume	2.85***	3.29**	3.17***	3.81***	3.77***	4.99***
	(0.81)	(1.19)	(0.82)	(1.30)	(0.90)	(1.37)
R^2	0.26	0.38	0.24	0.36	0.11	0.18

Table 9: Insurance company trading in bond 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 contains all bonds switching from the HY index to the 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 (July 1, 2005) 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 column of each panel reports the aggregate change in insurance company holdings by rating category, and the second reports p-values for the hypothesis that purchases of switching bonds (treatment sample) are not larger than those of bonds in the corresponding control sample. The p-values are two-sided for the difference tests and one-sided for the difference-in-difference 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: Change in return correlations for bonds switching from HY to IG index.

The table reports the factor loadings (β) from a regression of daily returns on value-weighted bond portfolios comprised of high-yield bonds affected differently by Lehman's rule change and the returns on different bond indices. The regression are performed over three time periods: 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.

	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							
β_{AAA}	0.51	0.76	0.74	0.25	0.22	0.31	0.27
	[0.00]	[0.00]	[0.00]	[0.00]	[0.01]	[0.01]	[0.01]
β_B	0.32	0.39	0.22	0.07	-0.10	-0.07	-0.03
	[0.03]	[0.00]	[0.01]	[0.64]	[0.54]	[0.71]	[0.88]
Observations	110	115	122				
R^2	0.52	0.69	0.72				
F-stat	58.82	126.71	154.02				
Panel B: HY bonds not rated favorably by Fitch (control sample)							
β_{AAA}	0.09	0.03	0.04	-0.06	-0.05	–	–
	[0.14]	[0.50]	[0.29]	[0.36]	[0.44]	–	–
β_B	0.76	0.90	0.70	0.14	-0.07	–	–
	[0.00]	[0.00]	[0.00]	[0.36]	[0.70]	–	–
Observations	110	115	122				
R^2	0.20	0.78	0.46				
F-stat	13.64	201.65	49.90				

Table 11: Long-run impact on liquidity.

The table reports statistics on liquidity over different event windows. Liquidity is captured by Roll's measure and computed for each bond over three time periods: 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). Following Goyenko *et al.* (2009), we compute Roll's (1984) measure of the effective spread as

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

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. The treatment sample are the bonds mechanically upgraded from HY to IG. The control sample comprises high-yield bonds with unfavorable or no Fitch rating. p-values are reported in brackets. Bonds issued by GM and Ford are excluded from the sample.

	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]
	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]	–	–

Table 12: 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. Standard errors are shown in parenthesis. *, **, *** indicate significance at the 10%, 5%, and 1% level, respectively.

	[-1,+10]	[-1,+20]
Moody's BBB	164.39**	138.28**
	(72.94)	(54.63)
Moody's BBB+	82.66**	102.71***
	(40.36)	(28.03)
Maturity	10.57*	5.34
	(5.71)	(3.79)
Age	4.67	5.62
	(8.28)	(8.34)
Coupon	29.37	3.97
	(28.54)	(20.87)
Amount outstanding \$50-150 MM	22.40	49.13
	(30.98)	(31.97)
Amount outstanding \$150-250 MM	−106.91*	−174.96**
	(61.11)	(77.70)
Amount outstanding \$250-1,000 MM	−22.78	−12.21
	(75.98)	(51.80)
Amount outstanding ≥\$1,000 MM	142.84***	117.71***
	(27.05)	(28.12)
Observations	868	916
R^2	0.49	0.30

Table 13: Abnormal stock returns around announcement.

The table reports estimation results on the cross-sectional variation in CARs around the announcement date on stocks that are matched to bonds in the sample. The set of regressors includes dummy variables indicating the old Lehman rating category and the old Lehman rating interacted with an indicator for a favorable Fitch rating. Standard errors are shown in parenthesis. *, **, *** indicate significance at the 10%, 5%, and 1% level, respectively.

	[-10,+10]	[-10,+30]
AA & Fitch favorable	1.39	1.46
	(1.35)	(1.84)
A & Fitch favorable	−0.02	−1.37**
	(0.51)	(0.66)
BBB+ - BBB & Fitch favorable	0.28	−1.21
	(0.64)	(0.84)
BBB- & Fitch favorable	0.68	−1.16
	(0.70)	(1.07)
BB+ & Fitch favorable	0.67	1.91
	(2.18)	(2.80)
BB - BB- & Fitch favorable	0.06	0.08
	(1.18)	(1.66)
B & Fitch favorable	−0.40	−1.40
	(1.14)	(1.48)
C - D & Fitch favorable	2.02	0.11
	(2.23)	(1.97)
No old rating & Fitch favorable	−0.51	−2.85***
	(0.94)	(0.95)
Controls	included	included
Observations	561	561
R^2	0.02	0.04

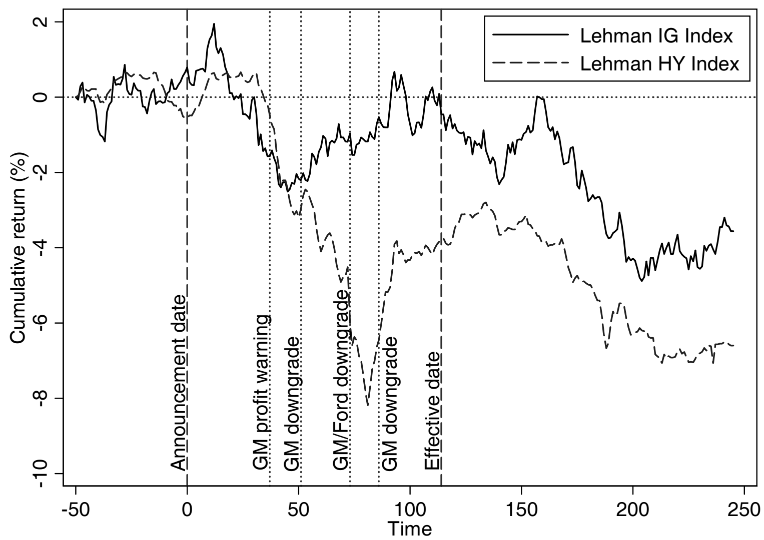
Table 14: MARKET PENETRATION BY RATING AGENCIES BEFORE AND AFTER THE RATING RULE CHANGE.

The table reports what fraction of new corporate bond issues is rated by each rating agency. The pre-event period covers the two years prior to the announcement, and the post-event period spans the two years succeeding the announcement of the rating rule change. 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 last two columns report p-values for hypothesis tests that check the alternative that the rated portion of issues has declined ($H_a : Post \leq Pre$) or, respectively, increased ($H_a : Post \geq Pre$).

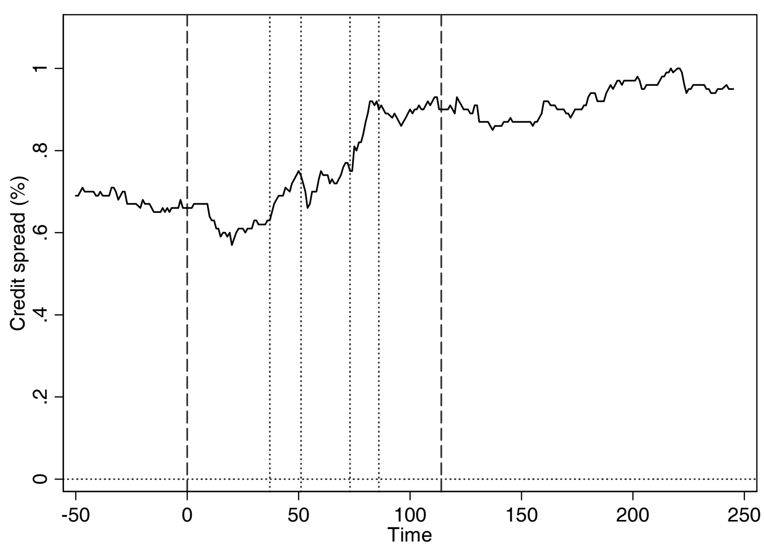
	Pre-event	Post-event	Post - Pre	p-value for H_a : Post $\leq$ Pre	p-value for H_a : Post $\geq$ Pre
Panel A: Par value of new issues rated (%)					
Fitch	0.45	0.56	0.11	[1.00]	[0.00]
Moody's	0.84	0.80	-0.04	[0.02]	[0.98]
S&P	0.86	0.87	0.01	[0.74]	[0.26]
Panel B: Number of new issues rated (%)					
Fitch	0.45	0.52	0.07	[1.00]	[0.00]
Moody's	0.86	0.78	-0.08	[0.00]	[1.00]
S&P	0.90	0.87	-0.03	[0.01]	[0.99]

Figure 1: Index performance, credit spreads, and timeline of events.

Panel A plots the cumulative return over time for the Lehman index for investment-grade (IG) and high-yield (HY) bonds (normalized relative to the index level on November 15, 2004 ($t = -50$)) along with major events in the corporate bond market. The solid line plots the IG index and the dashed line plots the HY index. The vertical dotted lines refer to important events 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). Panel B plots the credit spread over the same time period, computed as the yield spread between AAA and BBB rated long-maturity bonds.



(a) Index performance.



(b) Credit spread.

Figure 2: Announcement returns in bonds upgraded to investment grade.

The figure plots value-weighted cumulative abnormal returns on bonds mechanically upgraded from high yield to investment grade. 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. 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).

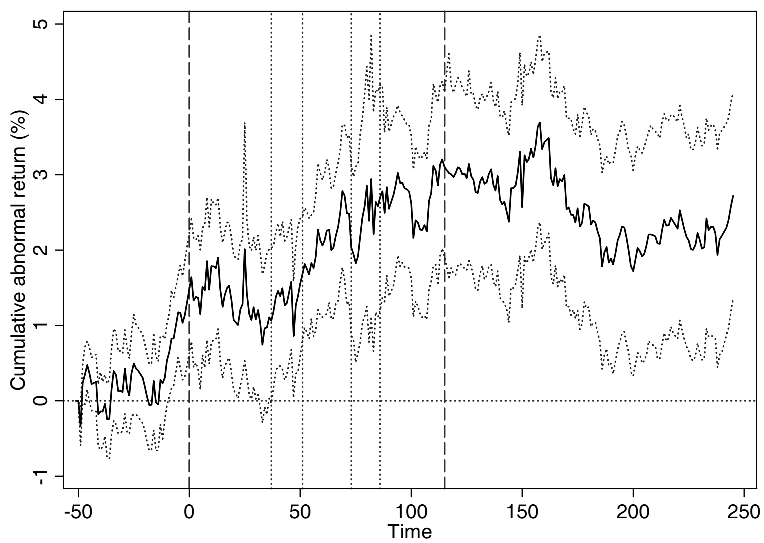
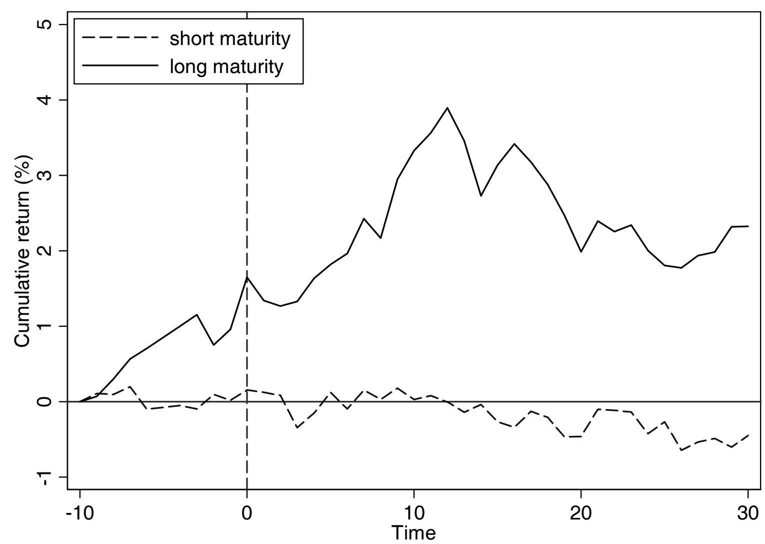
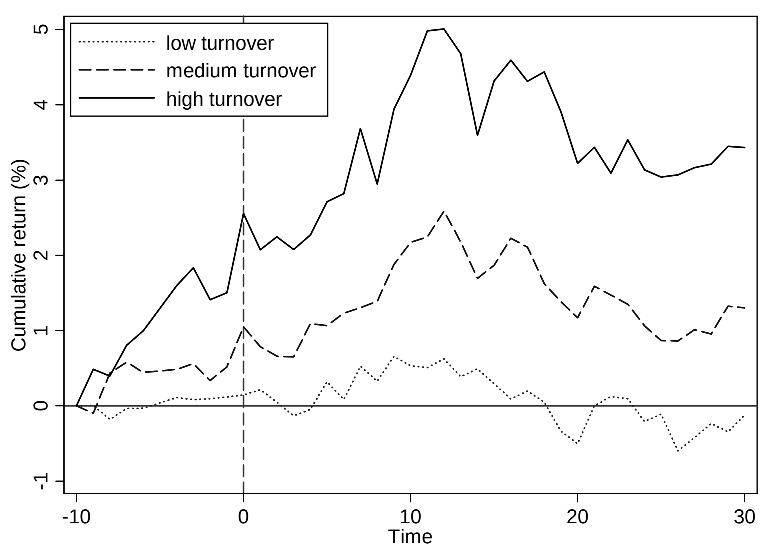


Figure 3: Announcement returns in bonds upgraded to investment grade—split by maturity and turnover.

The figure plots the cumulative returns on buy-and-hold bond portfolios comprising bonds mechanically upgraded from high yield to investment grade. In Panel (a), the 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 bonds are classified into three sub-samples based on their turnover over the post-event window [+1,+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) Announcement returns on bonds mechanically upgraded to IG- –split by maturity.



(b) Announcement returns on bonds mechanically upgraded to IG- –split by turnover.

Figure 4: Post-announcement turnover in bonds upgraded to investment grade.

The figure reports the daily turnover in bonds mechanically upgraded from high yield to investment grade (solid line) around the announcement date. Turnover is calculated as the dollar volume of all transactions reported in TRACE and normalized by the par value of the amount outstanding. The control sample (dotted 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).

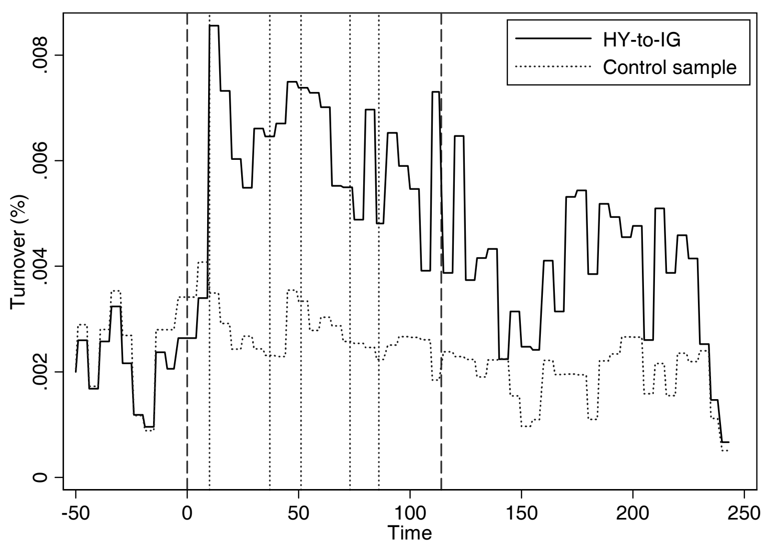


Figure 5: Insurance company trading in bonds switching from HY to IG index.

The figure plots the equal-weighted cumulative change in the aggregate holdings (in units of $ MM) by insurance companies of bonds expected to enter the IG index due to the rule change, as determined by their old index rating on the announcement date. We normalize the cumulative change by the number of bonds in each sample (yielding an equal-weighted change in holdings) in order to make the changes comparable across treatment and control sample. The dashed line plots, as control sample, the corresponding change in inventory per bond for the matched sample of bonds that do not switch to the IG index. On the horizontal axis, 0 marks the announcement date (January 24, 2005) and 114 the effective date (July 1, 2005).

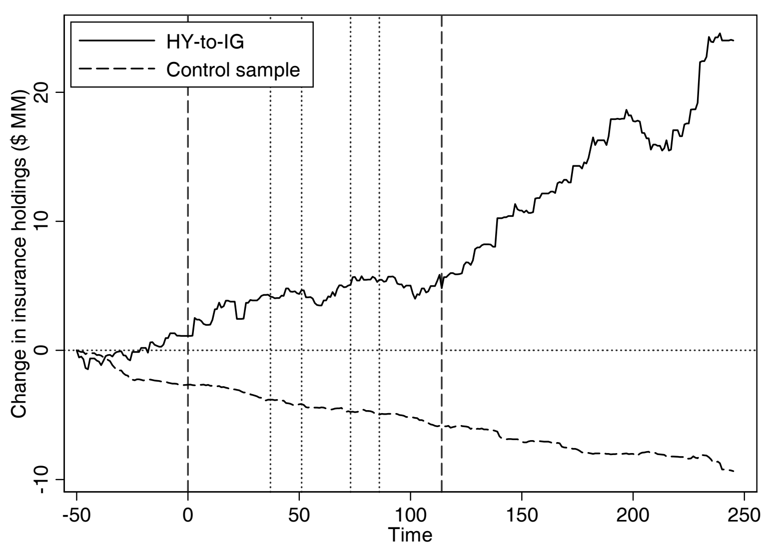
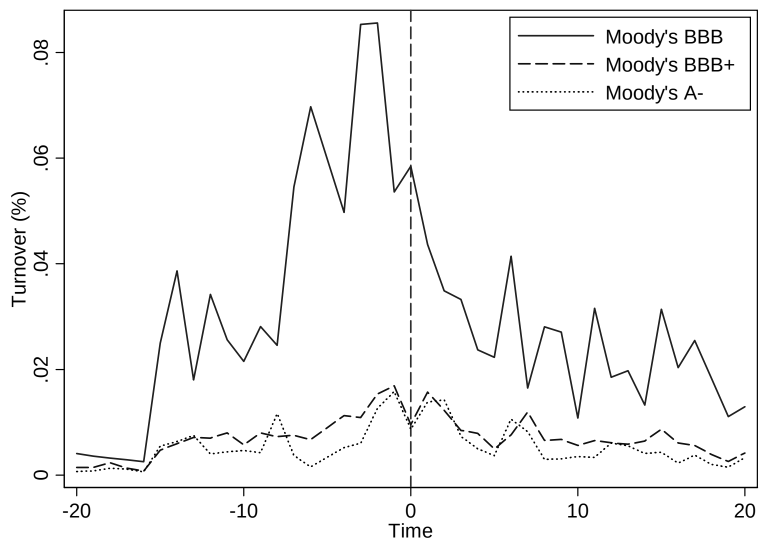
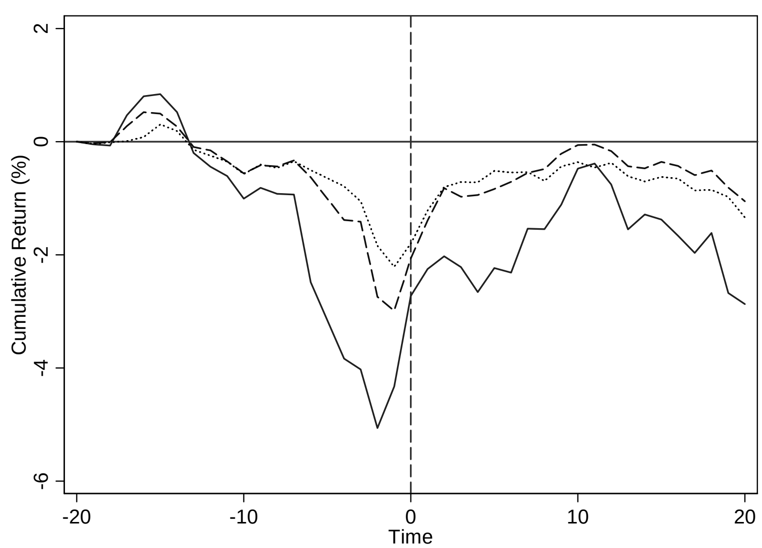


Figure 6: Upgraded GM and Ford bonds around Lehman announcement date.

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.