Why Ratings Matter: Evidence from Lehman's Index Rating Rule Change*

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Abstract

We examine institutional price pressure in corporate bond markets by exploiting an unanticipated mechanical change in how a Lehman's bond index is constructed. We show that bond market segmentation into investment-grade and high-yield sectors because of rating-based regulation has a first-order impact on security prices. Institutional investors with investment constraints increase their holdings of split-rated bonds that are now mechanically considered investment-grade instead of high-yield by Lehman, resulting in temporary order imbalances that creates positive price pressure. Bonds that are mechanically upgraded to investment-grade exhibit large capital flows and experience positive abnormal returns of +200 basis points over a two week horizon. Price reactions are transitory, however, and vanish after twenty to thirty days. Similarly, bonds that were expected to downgrade to high-yield but were mechanically upgraded also exhibit transitory positive abnormal returns and reduced net selling. Taken together, our results suggest that the demand curve for bonds is downward-sloping in the short run.

JEL Classification: G12, G14

Key words: Institutional price pressure; Rating-based regulation; Market segmentation; Liquidity; Index addition; Corporate bond; Institutional investors

I. Introduction

The recent turmoil in financial markets challenges the frictionless market paradigm which posits that supply and demand shocks to capital have negligible effects on security prices. Lack of liquidity, market segmentation, and capital immobility seem to have been of first-order importance for asset prices during recent months. Recent theoretical research, by Duffie and Strulovici (2008), Gromb and Vayanos (2007), amongst others, shows that market segmentation and capital immobility can have important effects on asset prices and that the ownership distribution of assets feeds back into prices. Rating agencies have been under particular scrutiny during recent months, partly because they directly affect the ownership distribution of assets through rating-based regulation. What economic role rating agencies play in price formation and the allocation of capital remains, however, largely an open question. Several scholars have empirically examined the importance of capital flows on asset prices.[1] However, the settings used in existing studies make it challenging to disentangle the effects of the liquidity shock from contemporaneous shocks to the asset's fundamentals. By taking advantage of a recent natural experiment in the US corporate bond market, we are able to examine how an unanticipated ratings rule change that affects the ownership structure of bonds affects the price and liquidity of bonds in different ways. Our setting allows us to directly measure price deviations from fundamentals that can be attributed to capital immobility in a setting that is not confounded by concurrent changes in fundamental value of the assets under consideration.[2]

The US corporate bond market provides an excellent setting to examine whether market segmentation has a first-order impact on asset prices. First, it is an opaque decentralized over-the-counter (OTC) market where traders incur search costs in locating counterparties.[3] Because of the relatively small number of potential counterparties available immediately after a supply or demand shock, order imbalances are likely to result in price reactions that are larger in magnitude and manifest

[1] For instance, 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.

[2] As natural experiments are hard to come by, we face the same caveat as in other settings exploiting unanticipated events that the number of independent observations is small.

[3] Compared to equity markets, the corporate bond market is illiquid. A typical bond trades only once every couple of months.

themselves for a longer duration as compared to those in liquid equity markets that have been the focus of much of the previous analysis on capital immobility.[4] Second, the investment-grade segment is overwhelmingly institutional, with banks, insurance companies, pension funds and mutual funds being the main participants. Investment policies formulated for these institutions typically restrict ownership to securities with low credit risk and rely extensively on credit ratings assigned by Nationally Recognized Statistical Rating Organizations (NRSROs) to determine the credit quality of a security.[5] Hence, a systematic change in how credit ratings are interpreted for implementing ratings-based investment policies will simultaneously affect the holding costs of certain securities for many institutional investors, which in turn can have marked impact on asset prices. We exploit a mechanical change in how these credit ratings are interpreted to examine how market segmentation affects asset prices, and the role of ratings in setting financial asset prices, over and above their role in providing information about an asset's fundamental value.

Investment-grade status and inclusion in investment-grade bond indices are major channels through which rating-based regulations affect bond markets. Lehman's corporate investment-grade index is an important benchmark for investment-grade investors, so Lehman's definition of what constitutes "investment-grade" is particularly important for market participants in general, and for institutional investors in particular as they need to rely on an authoritative institution to make a determination regarding whether a bond with a split-rating is considered investment-grade or not for the purposes of their investment policies. On January 24, 2005 Lehman announced it would change the methodology used for computing the index rating of split-rated bonds. This index rating is used to determine whether a bond is included in the Lehman's investment-grade bond index. Specifically, effective July 1, 2005, the index rating for a bond would be the middle rating from amongst the credit ratings issued by Moody's, S&P and Fitch. In contrast, the existing method for calculating the index rating was the lower (that is, more conservative) of the rating issued by Moody's and S&P. This change mechanically improved the index rating of several hundred bonds

[4] Duffie *et al.* (2007) show in a search-based model that illiquidity discounts are higher when counterparties are harder to find or when sellers have less bargaining power.

[5] The major NSROs are Moody's, S&P and Fitch. As of early 2005, Moody's and S&P rated 90+% of corporate bonds issued, and Fitch rated about 70% of these bonds. The other two NSROs are Dominion Bond Rating Service, a Canadian credit rating agency recognized as an NSRO by the SEC in 2003 and A.M. Best, a rating agency that in rating insurance companies, which was recognized as an NSRO in 2005.

either by an entire letter or by one or two notches within the same letter rating. Based on ratings issued by Moody's, S&P and Fitch as of the announcement date, 59 bonds with total market value of $33.4 billion would be added into the investment-grade index, while no bond would be deleted.

The redefinition of Lehman's index rating provides an excellent natural experiment to study the impact of capital immobility on asset prices. First, the redefinition announcement was largely viewed as a surprise by the financial markets. Lehman had redefined the index rating only thrice over the index's 30+ year history. A redefinition is typically done only after consultation with three advisory councils comprised of major fixed-income investment firms that only met once a year. According to the popular press, Lehman unexpectedly scheduled a conference call with its advisory councils on Monday, January 24 to discuss including Fitch in the index rating computation, and such a conference call had not occurred for the past several years.[6] Second, the redefinition announcement was not confounded by any contemporaneous events or the release of new information that would affect the fundamental values of the bonds. So, any change in bond prices or trading activity can reasonably be attributed to how the redefinition affected bond ownership. Third, since bond investors are segmented across investment-grade and high-yield sectors, a mechanical upgrade in a bond's index rating from high-yield to investment-grade because of this redefinition will result in an increase in demand for this bond whose effects we can then examine on the bond's price and liquidity to assess the significance of capital immobility on asset prices.

We perform our analysis using price and transaction volume data from the US corporate bond market reported in the Trade Reporting and Compliance Engine (TRACE) dataset augmented with bond transactions conducted by insurance companies reported in the National Association of Insurance Commissioners (NAIC) dataset. Our sample covers a large portion of the US corporate bond market during the sample period (more than 8,000 issues).

[6] An excerpt from a news article provides the following explanation for the rushed redefinition of the index rating procedure: " Lehman long had contemplatedincluding 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."

Our analysis of the short-run effects of market segmentation focuses on two sets of bonds most likely to experience a change in ownership because of redefinition of the index rating. The first set are bonds whose index rating is upgraded from high-yield to investment-grade. These bonds exhibit significantly positive abnormal returns of +76 basis points on the announcement day.[7] The price reaction is slow and transient. The abnormal return peaks over +150 bps two weeks after the announcement and then reverts to zero within 20 to 30 days. A substantial increase in bond turnover is associated with the abnormal price reaction, amounting to approximately two times the turnover prior to the event. Analysis of bond transactions by insurance companies suggests that the increased turnover is caused by increased buying by constrained investors such as insurance companies subsequent to the announcement.

The second set of bonds we focus on are bonds that, as of the announcement date, were expected to be forced out of the investment-grade in the near future under the old index rating rule but not under the new index rating rule. Specifically, we examine bonds issued by General Motors (GM) and Ford, including bonds issued by their financial services segments. As of the announcement date, these bonds had an index rating of BBB- under the old index rating rule, but a BBB or better index rating under the new rule. The old index rating was determined by S&P, which had a credit rating of BBB- for these bonds; Moody's and Fitch held more optimistic views about the prospects of these companies. Since S&P was expected to downgrade these bonds to high-yield in the near future, these bonds were under considerable selling pressure prior to the announcement as constrained investors were actively reducing their holdings of these bonds in anticipation of a forced sale in the near future. However, post-announcement, the selling pressure drops off considerably as the likelihood of these bonds being forced out of the investment-grade index is lower under the new index rating rule. We also the supply shock for these bonds to complement our results using the demand shock for the bonds that were upgraded to investment-grade under the new index rating rule. Additionally, GM and Ford in aggregate had approximately $500 billion in outstanding debt.[8] Given their enormous size, capital immobility effects would be more pronounced as it would

[7]We calculate abnormal returns using a matched-sample portfolio approach, by matching the treatment bonds with a set of control bonds on the basis of maturity, industry, issue size, and credit risk. Details of the matching procedure are provided later in the paper.

[8]Based on information collected from 2004 annual reports, as of Dec 31, 2004, the total debt outstanding for GM

be difficult for high-yield investors to purchase these many bonds from two firms in a short interval. Consistently, we find that GM and Ford bonds also exhibit positive abnormal returns. The data on insurance companies holdings shows that this is because the intensity of front-running of the anticipated forced sales decreased after the announcement.

Our short-run results are robust to a series of robustness tests to rule out the short-run bond price effects being because of a temporary shock to the underlying credit risk of the affected bonds.

Lehman's use of the Fitch ratings has also had a significant impact on Fitch's business. After the announcement the market share of new issues rated by Fitch has increased permanently from levels significantly below Moody's and S&P to about the same level.[9] This is consistent with Lehman being considered an important interpreter of credit ratings by fixed-income investors.

This paper contributes to the literature in two ways. While extensive research has studied liquidity in the stock market, little is known about liquidity and pricing in the bond market and other opaque over-the-counter (OTC) markets. But in order to understand which market structure is optimal for various types of assets, it is crucial to empirically study the actual workings of different market mechanisms. Our paper adds this by exploiting institutional price pressure induced by exogenous liquidity shocks in a typical OTC market. In particular, the Lehman rating rule change offers a unique laboratory to test how exogenous liquidity shocks affect the balance between demand and supply. Compared to the stock market, we document larger price effects and delayed recovery. Hence, our results do not support the frictionless economic paradigm. Rather, the findings suggest that market frictions are of first-order importance for financial asset prices and that the demand curve for financial assets is not perfectly elastic, at least in the short-run. This article also contributes to the literature on the economic importance of rating agencies and the impact of rating-based-regulations. Certain institutions are restricted from investing in low-grade bonds or are limited in the amount that they can invest, thereby inducing market segmentation. We

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.

[9] 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 (+50% versus +45%).

find that significant price and liquidity effects can be caused by market segmentation when certain groups of investors trade simultaneously.

The rest of the paper is organized as follows: In Section II., we describe how ratings-based regulations leads to market segmentation and develop the hypothesis for our analysis. In Section III., we provide a description of the data used for our empirical analysis. We report the results in Section IV.. Finally, Section VI. concludes.

II. Background & Hypotheses

This section describes how regulations that rely on credit ratings can result in segmentation of bond investors into high-yield and investment-grade investors and how the change in Lehman's methodology to compute the index rating serves as an exogenous event that drives a change in ownership of certain affected bonds across these market segments.

A. Bond Market Segmentation by Rating-based Regulations

In addition to being used by investors to estimate the credit risk of an investment, credit ratings are increasingly used to formulate investment guidelines for and to facilitate regulatory oversight of several financial institutions. Major regulators including the SEC, BIS, NAIC, amongst others use credit ratings to measure the credit risk of the institutions under their purview. The number of such rating-based regulations has been growing steadily. By 2002, there were already at least eight federal statutes and 47 federal regulations, along with over 100 state laws and regulations, that use credit ratings provided by Nationally Recognized Statistical Rating Organizations (NRSROs) (See US Senate (2002)). These regulations typically place implicit or explicit restrictions on several institutional investors from holding debt with a low credit ratings. We refer to investors whose ownership of high-yield bonds is restricted as *constrained investors*. For example, since 1975, the SEC's Rule 15c3-1 requires broker-dealers to take a larger discount on below-investment grade bonds a haircut when calculating their assets for the purposes of the net capital requirements than for investment grade corporate bonds, S&L institutions have been prohibited since 1989 from investing in high-yield bonds, the NAIC imposed a 20% cap on the amount of 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)).[10] Since the bond market is overwhelmingly institutional, rating-based regulations engenders market segmentation in the US corporate bond market, where only a subset of all potential buyers are allowed to purchase high-yield securities.

B. Lehman's Index Rating Rule Change

The Lehman Brothers bond indices have been in existence since January 1, 1973. With a history of 30+ years, they are widely used as benchmarks by participants in the fixed-income markets.[11] The indices of interest for this study are the US corporate investment-grade (IG) and high-yield (HY) index. The IG index is composed of investment-grade, US dollar-denominated, fixed-rate, taxable securities that also meet certain size, maturity and other criteria. Correspondingly, the US corporate high-yield (HY) index is composed of non-investment-grade corporate bonds that also need to meet certain size and other criteria. However, the bond characteristic restrictions are generally looser for inclusion into the HY as compared to the IG index.[12]

A bond is included in the IG or HY index, based on its *index rating*. Lehman uses an *index rule* to mechanically compute a bond's index rating based on the bond's credit ratings issued by the major ratings agencies. Hence, the index rating does not provide any additional information about the bond's credit risk over and above its credit rating.

The index rule has rarely changed since the inception of the bond indices. Under the original rule, the index rating for a bond was the average of its Moody's and S&P rating. A bond rated investment-grade by one agency and high-yield by the other contributed one-half of its weight to

[10] An excellent summary of ratings-based regulations is provided in US Senate (2002).

[11] On 22 September 2008, Barclays Capital completed its acquisition of Lehman Brothers' North American Investment Banking and Capital Markets businesses. As part of the transaction, Lehman Brothers indices have become part of Barclays Capital. Barclays has continued maintaining the family of Lehman Brothers indices and the associated index calculation, publication, and analytical infrastructure and tools.

[12] Additional details on the Lehman bond indices is available at http://www.lehman.com/fi/indices/.

each of the investment-grade and the high-yield indices (assuming it met the bond characteristics criteria for both indices). In August 1988 the index rule was changed so that the index rating for a bond was its Moody's rating. If the bond was not rated by Moody's, its index rating was its S&P rating. In October 2003, the rule was again changed so that the index rating for a bond was the more conservative of its Moody's and S&P rating. If the bond was not rated by one of these two agencies, the rating from the other agency was used as the bond's index rating. We refer to the procedure in the text as the *old rule* and the corresponding index ratings as the *old index ratings*.

Our analysis is centered around the most recent change in the index rule announced on January 24, 2005. In a departure from previous index rules, effective July 1, 2005, a bond's index rating would also depend on its Fitch rating. Under the new rule, 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 in the text as the *new rule* and the corresponding index ratings as *new index ratings*.

Depending on a bond's Fitch rating, the index rule change could cause a bond to transition from high-yield to investment-grade.[13]. The following example illustrates how the rule change affects a split-rated bond. Consider a bond with the following ratings: Fitch – BBB, Moody's – Baa3, S&P – BB+. Under the new rule, the bond's index rating is the middle rating of Baa3, and the bond would be considered investment-grade. In contrast, under the old rule, the index rating would be BB+, the more conservative of the S&P and Moody's rating, and the bond would be considered high-yield. Hence, because of a change in the index rule, this bond would have been upgraded from high-yield to investment-grade – even though there was no change in the bond's fundamentals or in the ratings assigned to it by any of the major rating agencies.

As discussed earlier, the market for US corporate bonds is segmented because of ratings-based regulations. With restricted capital flows between the high yield and investment grade segments,

[13]While a transition from investment-grade to high-yield is also theoretically possible, there are no such bonds in our sample. Depending on the bond's characteristics, the change in index rating may also affect whether a bond is a constituent of the IG or HY index. The bond may either transition between the IG and HY indices, or transition from the IG or HY index to not being part of any index, or vice-versa.

a security that changes from high-yield to investment-grade can potentially experience lots of buying interest from investors constrained to investment-grade securities. Conversely, securities that change from investment-grade to high-yield can experience lots of selling pressure from these constrained investors. We examine whether a change in ownership between the HY and IG segments of the bond market has a first-order effect on the bond market.

Since the bond market is segmented based on ownership restrictions on lower rated bonds, it is generally difficult to separate the effect of market segmentation from fundamental valuation effects. This is because ownership change would be triggered by a change in a bond's *credit rating*, which typically conveys new information about the credit risk of the affected bond. We posit that in addition to credit ratings, institutional investors also rely on a bond's *index rating* in making their investment decisions. The change in Lehman's index rule provides us with an excellent natural experiment to examine the effect of market segmentation on the bond markets as it resulted in a change in *index ratings* and therefore in ownership of several hundred securities *without* being accompanied by any new information about its creditworthiness. Hence, any price reaction for these affected securities can be reasonably attributed to market segmentation.

Our main hypothesis, which we refer to as the *price-pressure hypothesis* is that bond markets are segmented, with demand curves over the short-run being downward sloping. That is, when there is a demand shock for a bond, its price temporarily rises above its fundamental value. However, once the demand shock is satisfied, prices revert to their fundamental values. Understanding whether a demand shock can have a first-order price effect is important as classical asset pricing theories assume that demand curves for securities are horizontal in the short- and long-run.[14]

III. Data

In this section we describe the main data sources for our study and the sample construction. Our sample period is October 1, 2004 to September 30, 2005.

[14]Other studies that examine the price pressure hypothesis include Hand *et al.* (1992) and Steiner and Heinke (2001).

A. Corporate Bond Characteristics

We obtain bond characteristics from the Mergent's Fixed Investment Securities Database(FISD) which contains comprehensive bond characteristic and ratings information on all fixed income securities that are either assigned CUSIPs are likely to receive one in the near future. The FISD data set also contains a complete rating history from Moody's, S&P, and Fitch for individual corporate bonds.

We start with the entire sample of outstanding bonds as of the announcement date, January 24, 2005. Next, we filter out redeemed bonds or bonds with special features that might affect their pricing or liquidity. Specifically, we require that i) the amount outstanding is at least \$100,000, ii) the maturity of the bond is at least one year, iii)the bond is not a convertible or a floating-rate bond, iv) the bond is at least 3 months old to mitigate any price or trade effects associated with new issues, and v) the bond is not a private placement bond, unless it is an SEC Rule 144A bonds with registration rights. Our final sample consists of $8,175$ bonds.

Table 1 presents summary statistics of the bond characteristics in our sample. The amount outstanding as of the announcement date ranges from 0.1 million to 5.5 billion in par value, with the average being approximately 250 million. The average maturity is 9.42 years, and the average seasoning of the bonds in the sample is 3.82 years. The coupon rate ranges from zero coupon bonds to the high-yield bonds with a coupon of 14.25%. The average coupon is 6%.

Table 2 summarizes the bond index ratings, calculated according to the old and new index rating rules. The BBB and A bonds constitute the bulk of the sample, 36% and 42%, respectively. The vast majority of the bonds are rated either by Moody's (97.9%) or S&P (98.5%). However, only 73.6% of the sample is rated by Fitch. We focus on bonds likely to experience a change of ownership because constrained investors are more likely to buy bonds that experience an upgrade in their index rating. First, we examine the bonds upgraded from high-yield to investment-grade. This group consists 40 bonds with an old rating of BB and 5 bonds with an old rating of B, for a total of 45 bonds. Next, we examine bonds upgraded from BBB- to BBB or better, which means that the likelihood of downgrade to high-yield under the new rule is considerably lower. This group consists of 150 bonds with a new index rating of A, and several hundred bonds with a new index rating of BBB or BBB+.

As Table 2 shows, a small number of bonds are also downgraded according to the new index rating rule. However, no bonds transition from investment-grade to high-yield.

B. Bond Trades

The main data source for bond transactions used in our analysis is the Trade Reporting And Compliance Engine (TRACE) database. The data provides tick-by-tick data on transaction price, quantity, and supplementary information on the universe of TRACE-eligible corporate fixed income securities. The TRACE system was implemented by the National Association of Securities Dealers (NASD) to meet growing demand from bond investors to make the corporate bond market more transparent. 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. Initially, transactions data for approximately 500 securities was publicly disseminated, with data on additional securities being disseminated in later years. While TRACE provides high-quality data on a large proportion of the universe of bond transactions, it has two important limitations. First, transaction volume is truncated at \$5 MM for investment-grade bonds and at \$1 MM for high-yield bonds. Hence, all results in our paper that are based on TRACE transactions volume should be interpreted with some caution. Second, the publicly disseminated version of TRACE does not provide a buy-sell indicator, which limits its usefulness for calculating transaction costs.[15]

We perform a series of checks to the data to eliminate potentially erroneous data. Following Bessembinder *et al.* (2009), we remove all price "spikes" that consist of a 15% change in the price of the bond followed by a reversal of similar magnitude, since these "spikes" are likely caused by a data entry error rather than an actual change in traded price. We also delete all transactions flagged as canceled or corrected to ensure that our results are based on actual transactions and

[15]See Bessembinder *et al.* (2009), Edwards *et al.* (2007) and Goldstein *et al.* (2007) for additional details on the TRACE data.

delete transactions where the transaction price of the bond is $2 or below. Finally, we winsorize the price data at the 0.1% and 99.9% levels to mitigate the impact of outliers on our analysis.

As mentioned earlier, our sample period begins from October 1, 2004. This start date was chosen in part because TRACE coverage drops off significantly as we go further back from the announcement date. Three months before the announcement 7,740 out of the 8,175 bonds have TRACE data. However, six months before the announcement only 2,457 bonds are in the TRACE data set.

We also use corporate bond transaction data from the National Association of Insurance Commissioners (NAIC) data set. This data set covers transactions involving insurance companies. While this data set is limited in scope, it offers two advantages over the TRACE data. First, it provides actual and 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.

C. Equity Prices

We obtain data on equity prices for the companies in our sample from the Center for Research in Security Prices (CRSP) database. We use daily end-of-day prices adjusted for splits and dividend. We obtain the three Fama-French risk factors—market excess return (MKT), size (SMB), and B/M (HML) from Kenneth French's website.

IV. Does Regulation-Based Market Segmentation Matter?

Our analysis of the short-run price effects of market segmentation focuses on two sets of bonds most likely to experience a change in ownership because of redefinition of the index rating. The first set are bonds whose index rating is upgraded from high-yield to investment-grade. The second set of bonds we focus on are bonds that, as of the announcement date, were expected to be forced out of the investment-grade in the near future under the old index rating rule but not under the new index rating rule. These bonds were associated with substantial selling by institutional investors prior to the announcement. A specific example are bonds issued by General Motors (GM) and Ford, including bonds issued by their financial services segments. The first set of bonds experiences an increase in buying pressure, while for the second set the announcement alleviates selling pressure.

A. Short-term price pressure on bonds upgraded to IG from HY

Does market segmentation caused by ratings-based regulation matter and does it have a first-order impact on asset prices? In order to answer this question, we examine whether bonds upgraded from HY to IG status experience significant abnormal returns around the announcement date. In a second step, we try to identify the causes for these abnormal returns.

Upon Lehman's announcement of changes to its index construction, the class of bonds most likely to experience a change in ownership because of redefinition of the index construction are bonds whose index rating is upgraded from high-yield to investment-grade. Our sample consists of 45 such bonds.[16] Among these bonds, a large fraction qualifies for IG index inclusion, while a small subset does not. The reason is that Lehman's investment-grade index rules require bonds to have a par amount outstanding of at least \$250 MM, while Lehman's high-yield index rules require only \$150 MM of par amount outstanding. As a result, some bonds affected by the rule change got kicked out of the HY index and not added to the IG index. For now, we restrict our analysis to the 30 bonds in our sample that move from the HY to the IG index. We later check if the bonds dropped from the HY index react in a similar fashion.

Measuring cumulative returns in illiquid markets An obvious difficulty in computing bond returns and measuring abnormal returns arises from data limitations due to the fact that corporate bonds trade infrequently, with the 'average' bond across the universe of bonds trading once every few days. As a result, estimating bond returns is challenging even at a daily frequency because

[16] Out of the 45 bonds in our sample, 30 bonds become eligible for IG index inclusion, 8 bonds drop out of the HY index but do not enter the IG index, and 7 bonds remain out of any index because of small issue size. At the time of the announcement, the popular 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 transaction data for some of the bonds.

price movements are not observable without trading activity. Since there is no standard method for computing cumulative returns (CR) for infrequently traded securities, we use different approaches to measure bond returns and make sure the results are robust to the assumptions underlying these methods. For our study the infrequent trading may be not that crucial because the event we study tends to increase trading activity and so eases the measurement problem.

We have taken two main steps to ensure that the infrequent trading does not bias our results. First, we form cumulative returns on bond portfolios using two methods that differ in the way they handle non-trading days. Our first approach, which we term time-portfolio aggregation, first computes cumulative returns for each bond that trades on the given post-event date as the log-difference between post-event and pre-event bond prices and, second, averages the returns across all bonds in the portfolio. This approach does not rely on trading on two consecutive days. Our second approach, which we term portfolio-time aggregation, first computes daily portfolio returns as the value-weighted daily return on each bond and, second, cumulates returns across time. The latter approach has the advantage that it allows computing daily portfolio returns, but it requires trading on two consecutive days. Following Bessembinder *et al.* (2009), we compute portfolio returns by using value-weighting instead of equal-weighting. Second, in our cross-sectional studies we measure the prices used to compute returns by averaging over all transactions on several consecutive days. Details on the construction can be found in the corresponding sections below.

Figure 1, Panel (a) plots the value-weighted cumulative returns around the announcement date for the portfolio of bonds entering the IG index. The solid line depicts cumulative returns computed using the time-portfolio aggregation approach. The dashed line depicts cumulative returns computed using the portfolio-time aggregation approach. The bonds switching to the IG index exhibit significantly positive returns of around +76 basis points on the announcement day. More importantly, the price reaction is slow and transient. The cumulative return peaks at +150 to +200 bps two weeks after the announcement and then reverts to zero within 20 to 30 days. Next we validate that these returns are indeed abnormal.

Matched-sample approach to measuring abnormal returns We measure the abnormal returns based on the matched samples methodology (Barber and Lyon, 1997). In this methodology we match the treatment sample of bonds with a set of control bonds that remain in the high-yield index on the basis of maturity, industry, issue size (or, amount outstanding), and credit risk. Specifically, maturity-matching of the control bonds occurs based on being in the same maturity bin: short (1-5 years), medium (5-10 years) or long (10 years or longer). We match bonds by industry based on a broad sector definition: utility, financial and industrial. Next, we construct issue size bins by separating the universe of bonds into six equal-sized bins based on par value and require the control bonds to be in the same size bin. Last, we match bonds on credit risk based on the index rating category (BB+, BB, BB-, and B+) under the old split-rating procedure. That is, the index rating is the more conservative of the Moody's and S&P rating. The sample of control bonds are used to form sets of long-short pseudo-portfolios (i.e., hypothetical returns from portfolios that are long the treatment bonds and short the control bonds). Following Bessembinder *et al.* (2009), we again compute portfolio returns by using value-weighting instead of equal-weighting.

We compute p-values using a bootstrap procedure in order to mitigate the adverse effects of small sample sizes. Barber and Lyon (1997), 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. Our bootstrap procedure is implemented as follows:

- We form a matched sample for our portfolio of treatment bonds and calculate the abnormal return (AR) and cumulative abnormal return (CAR) for this long-short pseudo-portfolio on each event day. Denote the (C)AR in round i at date t by $(C)AR_{t,i}$.
- We repeat the matched sample formation procedure, using another random sample of control bonds and calculate the corresponding AR and CAR for the long-short pseudo-portfolio. We draw a total of $1,000$ times to form an empirical distribution for the AR and CAR at each event day.
- Last, we take the average AR/CAR over the $I = 1,000$ simulations as the representative AR/CAR value for the treatment bonds. That is, $(C)AR_t = \frac{1}{I}\sum_{i=1}^{I}(C)AR_{t,i}$. We then use the empirical distribution, $F_{(C)AR}$, for the AR and CAR on each event day to compute empirical p-values and to test whether the abnormal returns are statistically significant.

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 allows us to test whether the (cumulative) abnormal returns significantly differs 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 $F_{CAR}(\overline{CAR}) = .95$.

Table 3 reports the abnormal returns computed using the matched sample procedure for the bonds that experience an upgrade to IG index rating and become eligible for index inclusion. The sample consists of 30 bonds for which we have transactions data. As can be seen from the table, these bonds experience a significantly positive abnormal return of +76 bps on the announcement day and the corresponding cumulative abnormal return is +67 bps. Both returns are significantly positive at the 1 percent level. Cumulative abnormal returns peak at +151 bps on day 12 and then revert to zero by day 18. In Figure 1 we plot the trajectory of the cumulative abnormal returns. Confidence bounds are, again, computed using the bootstrap procedure. The dotted lines correspond to confidence intervals at 5 percent significant level. One can see that abnormal returns are briefly insignificant for days 3 before becoming significant until day 19.

The transitory abnormal increase in the prices of the affected bonds is consistent with the short-term price pressure hypothesis. When these bonds are considered eligible investments for constrained institutional investors, there is a sudden increase in demand for these bonds. As the supply curve for these securities is upward sloping because of search constraints, the price of these securities increases to clear the market. However, as the abnormal demand from the constrained investors is met, buying pressure in these securities decreases and prices of upgraded bonds revert to their normal levels.

B. Do order flow imbalances of institutional investors explain the abnormal returns?

Are the abnormal announcement returns really due to price pressure? In order to answer this question, we next examine whether trading activity in the upgraded bonds is consistent with a transitory demand shock.

In the following, we first examine whether abnormal turnover in the affected bonds results from the announcement. We construct different turnover measures directly from the TRACE transactions data and from the NAIC data on holdings by insurance companies. Our main measure of trading activity is turnover, which we define as TRACE trading volume divided by the total par value of the outstanding bond issue (obtained from FISD). Alternatively, we have looked at the number of transactions and the dollar trading volume. The results are similar and omitted.

Figure 2 plots the turnover around the announcement date for the upgraded bonds and for a matched sample. The matched sample consists of all control bonds identified in the matched-sample procedure discussed above. Consistent with the hypothesis of a transitory shock to the demand for the upgraded bonds, we find that turnover for the bonds experiences a significant transitory increase, with post-announcement turnover peaking at two to three times the turnover prior to the event, before reverting to the levels for the matched sample. The peak in turnover lines up in time with the peak in abnormal returns documented in Figure 1 and Table 3. Hence, a substantial increase in bond turnover is associated with the abnormal price reaction.

Strong support for the hypothesis that the link between trading activity and price reaction is causal would be if we find that the abnormal returns vary positively with the abnormal demand in the cross-section of affected bonds. To check this, we split the sample on ex-post turnover (low, medium, high) over the post-event window [+1,+30] and compute the abnormal announcement returns separately on the bonds upgraded to the investment-grade index. Figure 3 summarizes the results. The solid line refers to the sub-sample with high turnover, the dotted line refers to the medium turnover sub-sample, and the dashed line refers to the low turnover sub-sample. The figure reveals that the highest turnover sample has the highest abnormal returns, consistent with the hypothesis that the returns are caused by demand pressure.

Are the increased turnover and the abnormal returns indeed caused by demand from constrained institutional investors? There are several ways one can go about answering this question. The TRACE data set does not provide a buy-sell indicator nor does it provide information on the identity of the traders. Hence, we cannot directly observe net buying by constrained investors. However, the size of a transaction is typically a good indicator for the type of investor. Large trades over $1 MM in par value are predominantly institutional. An analysis of the bond transactions initiated by insurance companies may further reveal whether the increased turnover is caused by increased buying by constrained investors subsequent to the announcement. We use the NAIC data to determine net buying by an important and representative class of constrained institutional investors, insurance companies.[17]

Figure 4 summarizes the trading pattern of institutional investors around the announcement date. In panel (a) institutional trading activity is captured by the number of trades with a transaction volume greater or equal to $1 MM. In panel (b) institutional trading activity is captured directly by the trades of insurance companies. The dashed line refers to the total purchases by insurance companies (reported in the NAIC dataset) of bonds upgraded to investment-grade, and the solid line refers to total purchases net of sales. Date 0 refers to the announcement on January 24, 2005. The sample consists of the 30 bonds eligible for IG index inclusion. The trading pattern is broadly consistent with institutions buying and thereby pushing prices up.

Figure 5 shows monthly transactions by insurance companies in bonds whose index rating is upgraded to investment-grade for three months prior to three months after the announcement date. Consistent with constrained investors selling downgraded bonds, net sales are negative before the announcement date. After the announcement date, investors previously constrained from holdings these bonds become net buyers for two months following the announcement date. This is consistent with constrained investors slowly buying up bonds that have suddenly become investment grade.

Last, we link the time-series of order flow imbalances and bond returns. Table 4 examines the relation between the daily returns and order imbalances in the portfolio of bonds eligible for the investment-grade index. The dependent variables are the daily portfolio returns over the event windows [-1,+30). We show estimation results using both pooled OLS and time-series Fama-MacBeth methodology (reported is the average slope coefficient from time-series OLS on each

[17]According to Federal Reserve data, insurance companies own approximately 25 percent of corporate bonds (based on 2004 and 2005 holdings data). Given their significant holdings, purchases and sales of bonds by these companies is probably representative of the trades made by constrained investors.

bond). For the computation of order imbalances, we follow a similar trade classification procedure as Lee and Ready (1991). Specifically, 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 imbalances. All variables are expressed as logarithms. The positive significant coefficients on all order flow variables suggest that order imbalances from institutional investors cause bond prices to move upwards in order to accommodate the increased demand. The reported measures of fit reveal that order flow imbalances explain up to 47% of the announcement returns.

C. Does index membership or investment-grade status matter?

We can disentangle whether inclusion in the investment-grade index or investment-grade status by itself matters for investors' trading behavior and asset prices by simply comparing what effect the announcement has had on bonds added to the IG index and, respectively, bonds with an investment-grade rating but not added to the IG index because the remaining par amount outstanding is less than $250 MM. There is a total of 15 such bonds (8 of these bonds got dropped from the HY index as a consequence of the rating rule change).

Figure 6 plots the announcement returns and the turnover around the announcement date for the pool of bonds dropped from the HY segment. These bonds are upgraded to investment-grade status but not added to the IG index because of technical constraints on the par amount outstanding. Announcement returns are significantly positive and exhibit a similar trajectory as the bonds entering the IG index. Similarly, turnover also increased significantly on the days following the announcement. The results suggest it is IG status that matters for investors and the behavior of asset prices, not IG index membership itself.

D. How fast do prices recover when demand pressure vanishes?

Upgraded BBB- bonds are a natural candidate to see how prices behave once demand pressure abruptly disappears. We now turn to this group of bonds. Bonds with an index rating of BBB-under the old index rating procedure and a higher index rating under the new procedure should also be affected by market segmentation. These bonds are one notch away from being downgraded to high yield. Therefore, the likelihood of a downgrade in the near future is high and, as documented by Da and Gao (2008) amongst others, ratings-constrained investors will be actively selling off their holdings in anticipation of the actual downgrade. If the index ratings of these bonds improves under the new index rating procedure, such constrained investors will be less concerned about the bond being downgraded to below investment-grade, which in turn will reduce the selling pressure on these bonds and their price will rise.

Bonds issued by GM and Ford constitute a significant proportion of the BBB- rated bonds that are upgraded under the new index rating rule. We now examine these bonds in greater detail. GM/GMAC and Ford/FMCC are the second and third largest bond issuers, respectively, in the Lehman investment-grade index, each representing about 2 percent of the total index.[18] Given their enormous size, a downgrade to high-yield would have a very significant price impact if the bond markets are segmented as the size of these issues would tax the capacity of high-yield investors to purchase these bonds (e.g., Acharya, Schaefer, and Zhang, 2008). According to the financial press, many expected that Standard & Poor's may downgrade GM to high-yield later that year. However, under the new index rating procedure, these bonds would remain in the investment grade index even if S&P were to downgrade these bonds to high-yield grade so long as Moody's and Fitch kept maintained an investment-grade rating for these bonds.[19]

We first check whether trading activity in bonds issued by GM and Ford is consistent with the anecdotal evidence in the press and the claim that the announcement eliminated any selling pressure. Figure 7, Panel (a) plots the bond turnover around the announcement date for three

[18]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.

[19]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.

portfolios segregated by Moody's ratings. The turnover is computed using the TRACE transactions data. 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.

In Figure 7, Panel (b) we plot the cumulative returns of the GM and Ford bonds. The bonds are segregated 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 trend 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. Again, this trend is consistent with market segmentation. With the likelihood of these bonds being downgraded to high-yield having dropped, constrained investors now reduce the intensity of the sales of these bonds, which in turn reduces the excess supply of these bonds in the markets and their prices rise.

The impact of the announcement differs significantly across the three portfolios with different Moody's ratings and is consistent with market segmentation and price pressure. Bonds with the lowest Moody's rating (BBB) experienced the largest decrease in price prior to the announcement, and also the largest increase of +177 bps on the announcement date. These bonds have 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 require 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 decrease in selling pressure was the most pronounced for these bonds which in turn resulted in the largest increase in price. The returns for the BBB+ and A- rated bonds is +99 bps and +47 bps, respectively, and is consistent with there being a reduction in selling pressure for these bonds.

Cross-sectional regression approach to measuring abnormal returns 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. 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 previously used in the literature to explain bond returns. To measure the abnormal returns of sub-samples $1, 2, \ldots K$, 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 sub-sample k. The control variables we use are described in Appendix A.

In the cross-sectional studies we measure the prices used to compute returns by averaging over all transactions on several consecutive days. Specifically, we determine the pre-event (post-event) price as the volume-weighted average of the 'clean' prices over a window of four days surrounding the pre-event (post-event) date.[20] We have implemented several alternate schemes for estimating representative pre-event and post-event prices. Our main results are qualitatively unchanged across these different schemes. Cumulative returns are then computed as the log-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 averse effects of outliers and data entry errors.

Estimation results are shown in Table 5. The results confirm that the differences in cumulative returns are due to differences in downgrade likelihood and are consistent with the trends observed in Figure 7. For instance, over the [-5,+3] event window, the cumulative returns for the Moody's BBB portfolio exceeds that of the A- portfolio by 125 bps, and the cumulative returns on the BBB+ portfolio exceeds that of the A- portfolio by 32 bps. These numbers are remarkably close to

[20] In detail, if the CR is computed over the time $[t_0, t_1]$, with $t_0 < -3$ and $t_1 \geq 3$, 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.

the uncorrected returns for the one-day announcement returns of $177 - 47 = 130$ bps for the BBB minus A- portfolio and $99 - 47 = 52$ bps for the BBB+ minus A- portfolio.

E. Robustness Tests & Alternative Hypotheses

E.1 Effect of Index Rating Change Across All Rating Classes

Our hypothesis is that the transient abnormal returns documented is because investment constraints on institutional investors have a first-order impact on security prices. We now perform a series of tests to examine whether alternate hypotheses are supported by the data. We examine whether the effect of the index rating upgrade is limited to the two groups of bonds that we posit will be affected by the index rating change, namely, the GM/Ford bonds that have a BBB- rating and are upgraded, and the bonds upgraded from high-yield to investment grade. We regress the cumulative return for all bonds in our sample for which have sufficient trading data on a set of explanatory variables and a set of control variables that have been used in the literature to explain cross-sectional differences in bond returns. If Lehman's use of Fitch ratings somehow conveyed additional fundamental information to the markets, then, we would expect that bonds in all ratings categories that had a Fitch rating that was better than the S&P or Moody's rating would also experience a positive abnormal return. We use dummy indicator variables to identify such bonds in each ratings category of interest. If this alternate hypothesis is correct, we should find that these dummy variables are positive and significant for all ratings categories. The control variables we use are: bond maturity (in years), bond age (in years), coupon rate, dummies for old index rating classified into AAA, AA, A, BBB, BB, B, C-D, or unrated, dummies for amount outstanding in five different ranges: $(0M, 50M)$, $[50M, 150M)$, $[150M, 250M)$, $[250M, 1000M)$, $[1000M, \infty)$, a dummy for Fitch rating being worse than S&P or Moody's, dummy for a Fitch rating, dummy for leaving HY index while not entering the IG index, dummy for entering the IG index, dummies for industry group: industry, financial,utility. We also control for changes in the treasury rate using the log difference of the yield for a maturity-matched Treasury bond. In all the regression results presented, standard errors are shown in parentheses below the coefficient estimate, and *, **, *** indicates significance at the 10%, 5%, and 1% level, respectively.

The regression results for the entire sample is presented in Table 6, for cumulative returns over the the period [-5,+10] relative to the announcement date. As seen in the table, only the subsets of bonds that would be affected by market segmentation, namely, the bonds that move from high-yield to investment-grade, contained in the BB and B portfolio of bonds that are upgraded, as identified by the indicator variables *BB/BB- & Fitch better* and *B & Fitch better*, and the GM/Ford bonds, have a positive CAR. The unrated bonds rated by Fitch also have a positive CAR, however, since there are only 9 such bonds, the coefficient on *No old rating & Fitch rated* should be interpreted with some caution. In unreported analysis, we also performed similar regressions on different sub-samples based on: maturity, industry, liquidity, amount outstanding and being in either the HY or IG Lehman bond index. The results are qualitatively similar to those in Table 6.

E.2 Fundamental News? The Announcement Effect on Stock Prices

We now examine how stock prices for bonds in different ratings-based portfolios reacted to the change in index rating procedure by performing a cross-sectional regression of cumulative abnormal returns of the stocks corresponding to the bonds in our sample across indicator variables for the different bond portfolios. This regression serves two purposes. First, we want to check that there is no systematic variation in stock abnormal returns across the different bond portfolios to rule out bond prices rising simply because the asset value of the issuing companies also experienced a temporary increase. Second, this regression provides a further check against Lehman's use of the Fitch ratings having a certification effect on firms which have a better Fitch rating, which would would be counter to our maintained assumption that the index rating rule change did not convey any information.

We collect stock returns corresponding to the bonds used in the regression reported in Table 6. Since companies issue multiple bonds, our stock sample consists of only 561 stocks. We regress stock CAR on a set of indicator variables that correspond to the different bond portfolios of interest. For firms whose bonds have different ratings, we compute the firm's aggregate rating as the weighted average rating of its bonds, with weights equal to the bonds' amount outstanding. Our results are robust to alternate weighting schemes.

We use the Fama-French three-factor model to measure abnormal returns, namely,

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

where $R_{f,t}$ is risk-free rate, MKT is the market excess return, HML is the book-to-market factor, and SMB is the size factor. We apply the following procedure to compute abnormal returns (ARs) and cumulative abnormal returns (CARs):

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 $\tau = -20, -19, ..., 0, ..., 19, 20$.

Table 7 reports results from a cross-sectional regression explaining cumulative abnormal stock returns with issuer characteristics. The estimates reveal that the event has had no significant price effect in the stock market. This suggests that Fitch's inclusion has increased firm value for BBB- rated bonds. An information-based explanation for the price impact of the announcement is unlikely as one would expect a positive effect on equity value of reduced default risk. None of the abnormal returns for the upgraded bond portfolios are significant and the stock abnormal returns are not correlated with the bond abnormal returns. Taken together, these results also suggest that the bond returns are not driven by changes in underlying asset values.

V. The Impact of Index Rating Rules on the Demand for Multiple Ratings

We now investigate whether Lehman's decision has had any impact on Fitch's business. We posit that Lehman's use of Fitch ratings in computing index ratings provides Fitch with a valuable marketing tool. Bond issuers will be more inclined to solicit ratings from an agency if its ratings are used to construct a benchmark index. We investigate whether whether demand for Fitch ratings increased after the announcement. We use two measures to market share of solicited ratings by Fitch, along with that of Moody's and S&P. The first 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. A value of unity means that every issue was rated by that particular agency. The second measure is the value of issues, based on par value, rated by a particular agency divided by the total par value of all issues in that month. Again, a value of unity means that all bonds issued in a given month were rated by that particular agency. We used the ratings history in FISD to construct these market share measures. Since we are interested in the demand for the ratings services of the different ratings agencies, we exclude unsolicited ratings by filtering out any ratings issued more than one month after the offering date. The market share measures are plotted in Figure 8 for Moody's, S&P, and Fitch for the 2001 - 2007 period.[21] As seen in the figures, market share for Moody's and S&P has

[21] Even though additional agencies were recognized as NRSROs during this time period, the rating industry has long been dominated by Moody's, Standard & Poor's.

remained relatively constant over this time period, with 95+% of issuers soliciting a rating from each agency. However, there is a structural break in the market share for Fitch following the index rule change announcement in January 2005. Fitch's market share increased significantly over 2005 and was comparable to that of Moody's and S&P by early 2006. Lehman's decision to include Fitch's ratings in computing its index ratings has had a marked impact on Fitch's business. This finding is 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.

VI. Conclusion

The redefinition by Lehman was not companied by any fundamental change in issuer's risks, hence it provides a natural laboratory for testing whether bonds have almost perfectly elastic or horizontal demand curves, and whether a rating conveys information content beyond direct credit risk.

Many institutional investors, including insurance companies, mutual funds, pension funds and others, are restricted by mandate from holding bonds with high-yield ratings, thus resulting in clientele change when bonds rating status across pre-defined threshold. They tend to increase (decrease) holdings when bonds are upgraded or possibly upgraded from high-yield to investment-grade (downgraded or possibly downgraded from investment-grade to high-yield), which creates positive (negative) price pressure.

We find that bonds technically "upgraded" to investment-grade exhibit significantly positive abnormal returns. These bonds also experience large capital inflows and significantly rising turnover. In addition, GM and Ford bonds, which were expected to downgrade to high-yield at earlier time, exhibit positive abnormal returns and reduced net sales due to increased likelihood of staying in investment-grade.

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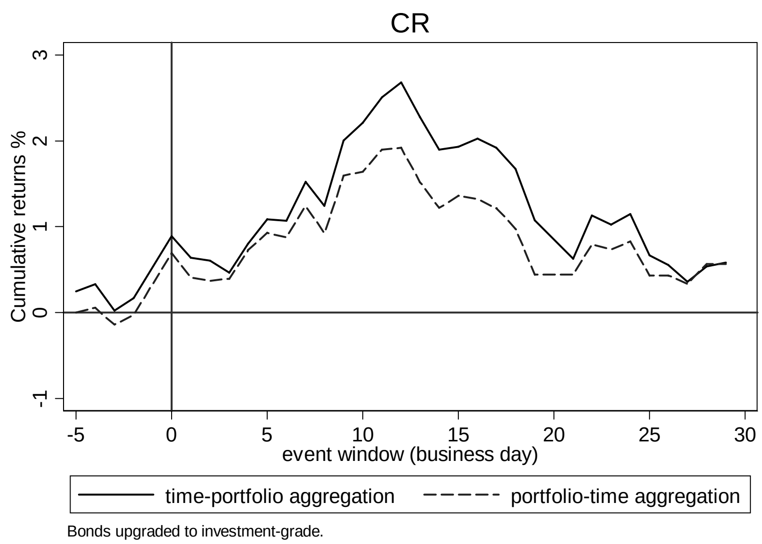
A Description of Explanatory Variables

The observed characteristics that we use as cross-sectional explanatory variables are the following:

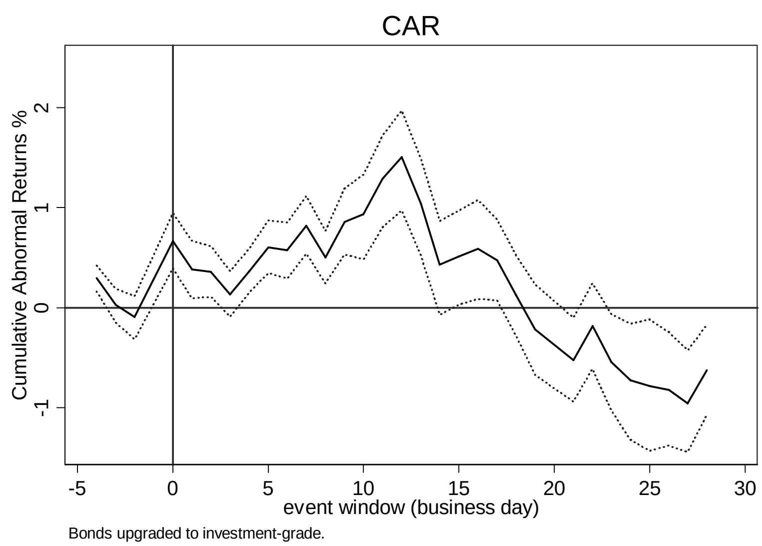
- Maturity: maturity of bond i in years;
- Age: age of bond i, measured in years since offering date;
- Coupon: measured in percent;
- Change in treasury rate: Change in interest rates during event period, defined by $\triangle R_f = R_{f,t_{\max}} - R_{f,t_{\min}}$, where R_f is the the risk-free rate chosen to match bond i's maturity.
- Amount outstanding: Dummies for the par amount of the bond outstanding. Split into five ranges: $(0M, 50M)$, $[50M, 150M)$, $[150M, 250M)$, $[250M, 1000M)$, $[1000M,)$.
- Dummies for Fitch better interact with old ratings AA, A, $BBB/BBB+$, $BBB-$, $BB+$, $BB/BB-$, B, C/D and bonds unrated by Moody's and S&P;
- Dummy for Fitch rating worse than Lehman's rating based on Moody's and S&P;
- Dummy for Fitch rated;
- Dummies for interaction term between bond being rated better by Fitch than Lehman's rating based on Moody's and S&P and the bonds old Lehman rating. The dummies include: AA Fitch better, A Fitch better, BBB/BBB+ Fitch better, BBB- Fitch better, BB+ Fitch better, BB/BB- Fitch better, B Fitch better, C/D Fitch better and No rating Fitch better;
- Dummy for entering the Lehman IG index under the new rating rule;
- Dummy for leaving the Lehman HY index, while not entering the IG index;
- Dummy for being in the Lehman IG index before the event;
- Dummy for being in the Lehman HY index before the event;
- Dummies for the industry group: Industrial, Financial, Utility.

Figure 1: Abnormal announcement returns on bonds upgraded to investment-grade.

Panel (a) plots value-weighted cumulative returns around the announcement date. The two lines differ in the way returns are computed when trading occurs infrequently. The solid line depicts cumulative returns computed using the portfolio-time aggregation approach. The dashed line depicts cumulative returns computed using the time-portfolio aggregation approach. Panel (b) plots cumulative abnormal returns. Abnormal returns are calculated using a matched sample approach that controls for sector, credit risk, bond maturity, and issue size. The dotted lines are the confidence interval at 95 percent significance level estimated using empirical p-values obtained using a bootstrap simulation procedure. The sample consists of the 30 bonds eligible for IG index inclusion.



(a) Cumulative returns.



(b) Cumulative abnormal returns.

Figure 2: Post-announcement turnover in bonds upgraded to investment-grade.

Figure 2 plots the daily turnover in bonds upgraded to investment-grade 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 matched sample controls for sector, credit risk, bond maturity, and issue size. Date 0 refers to the announcement on January 24, 2005. The sample consists of the 30 bonds eligible for IG index inclusion.

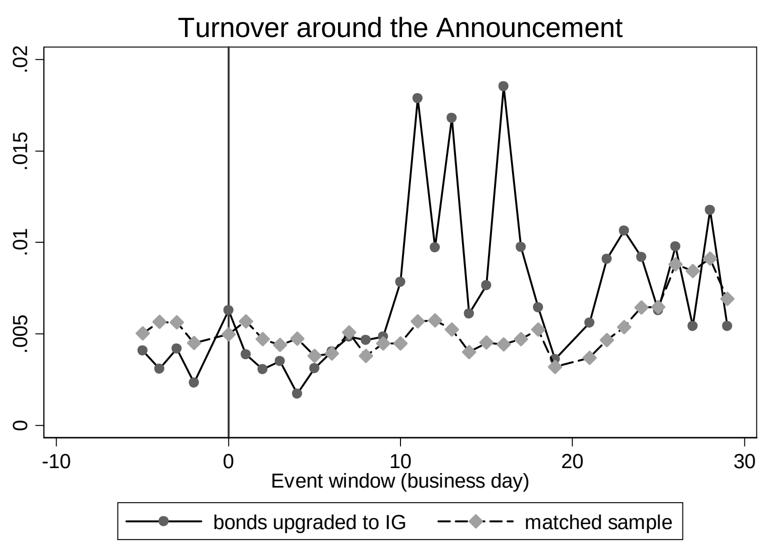


Figure 3: Abnormal announcement returns on bonds upgraded to investment-grade: Split by ex-post turnover.

Bonds upgraded to investment-grade are classified into three sub-samples based on ex-post turnover over the post-event window [+1,+30]. The solid line refers to the sub-sample with high turnover, the dotted line refers to the medium turnover sub-sample, and the dashed line refers to the low turnover sub-sample.

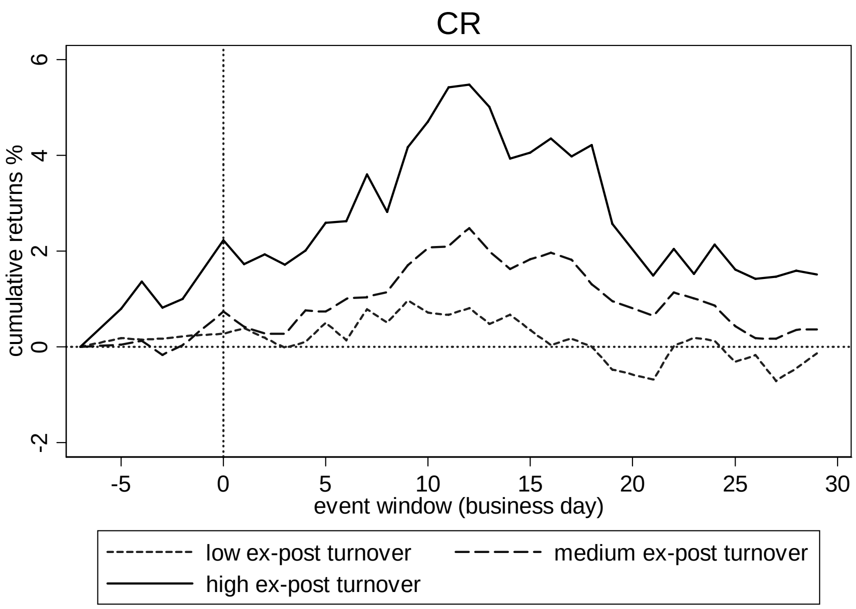
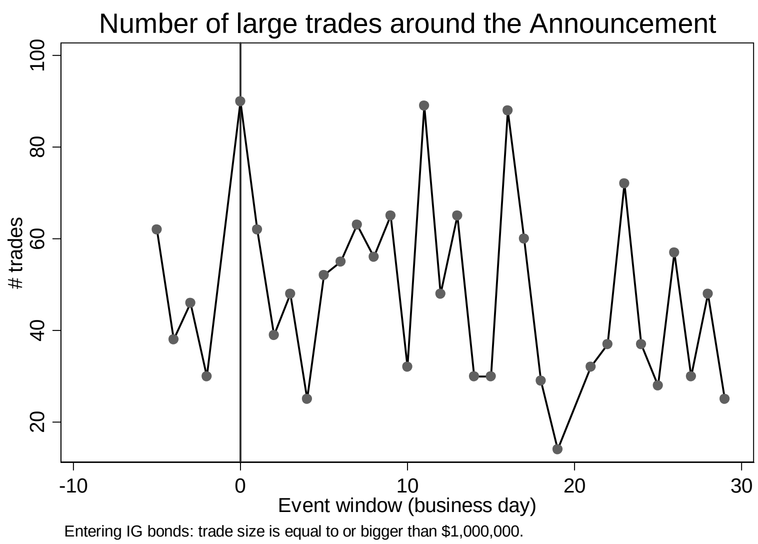
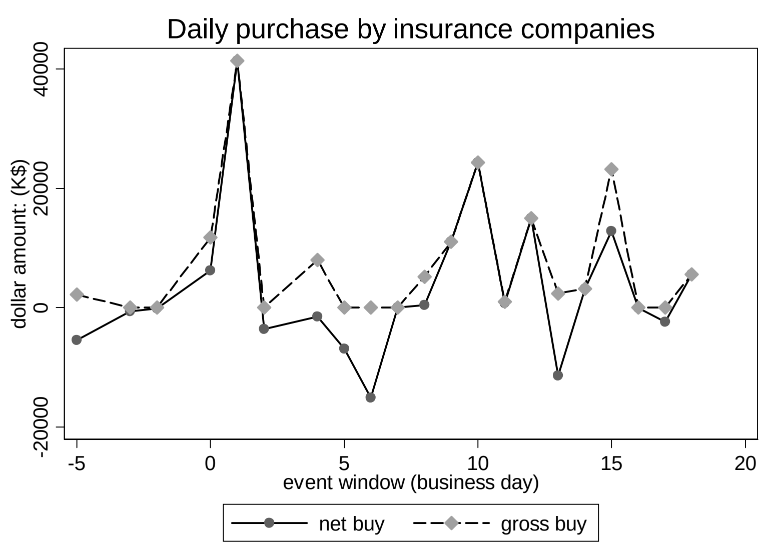


Figure 4: Post-announcement institutional trading activity in bonds upgraded to investment-grade.

Figure 4 documents the trading activity of institutional investors around the announcement date. In panel (a) institutional trading activity is captured by the number of trades with a transaction volume greater or equal to \$1 MM. In panel (b) institutional trading activity is captured directly by the trades of insurance companies. The dashed line refers to the total purchases by insurance companies (reported in the NAIC dataset) of bonds upgraded to investment-grade, and the solid line refers to total purchases net of sales. Date 0 refers to the announcement on January 24, 2005. The sample consists of the 30 bonds eligible for IG index inclusion.



(a) Institutional trading activity.



(b) Insurance company trading activity.

Figure 5: Insurance company trading in bonds upgraded to investment-grade – monthly data

Figure 5 plots the gross and net buying of the bonds upgraded to investment grade in the period around the announcement date. The transactions are aggregated into one-month intervals originating from the announcement date. Month -1 corresponds to time period December 24, 2004 to January 23, 2005 and month +1 corresponds to the time period January 24, 2005 to February 23, 2005. The other announcement-time months are constructed in an analogous manner.

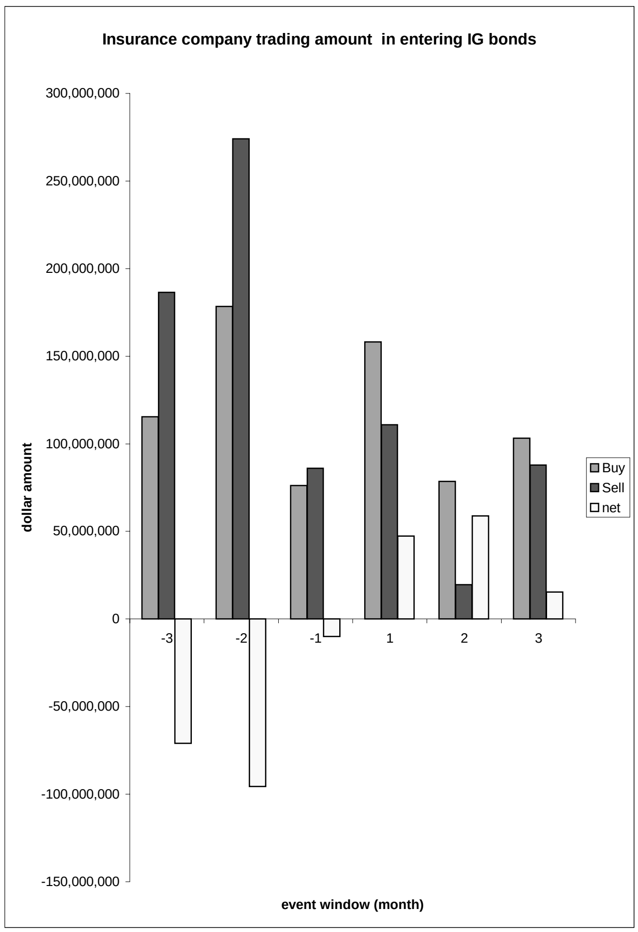
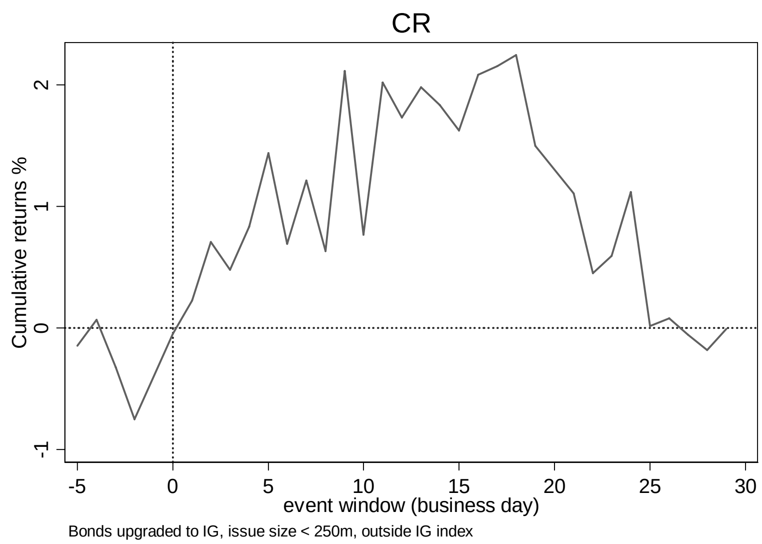
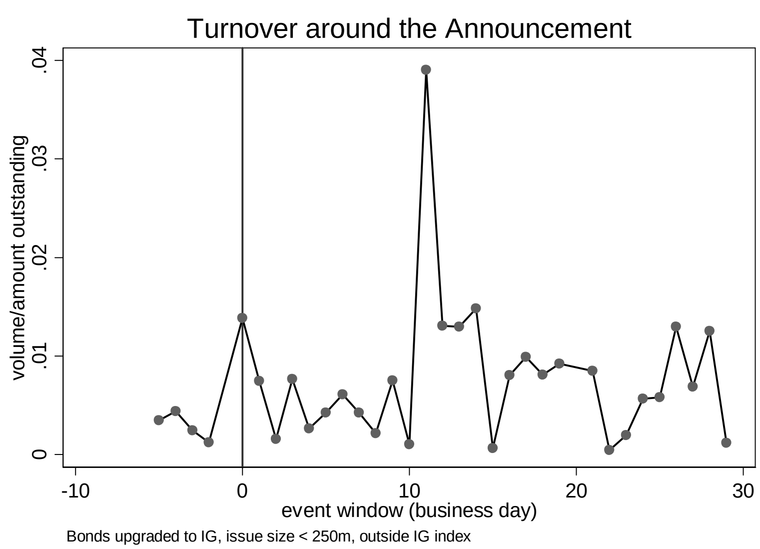


Figure 6: Announcement returns and turnover in bonds dropped from HY index.

Panel (a) plots value-weighted cumulative returns around the announcement date for bonds dropped from the HY index and not eligible for IG index inclusion. Panel (b) plots the daily turnover in these bonds 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. Date 0 refers to the announcement on January 24, 2005. The sample consists of 9 bonds dropped from the HY index but not eligible for IG index inclusion.



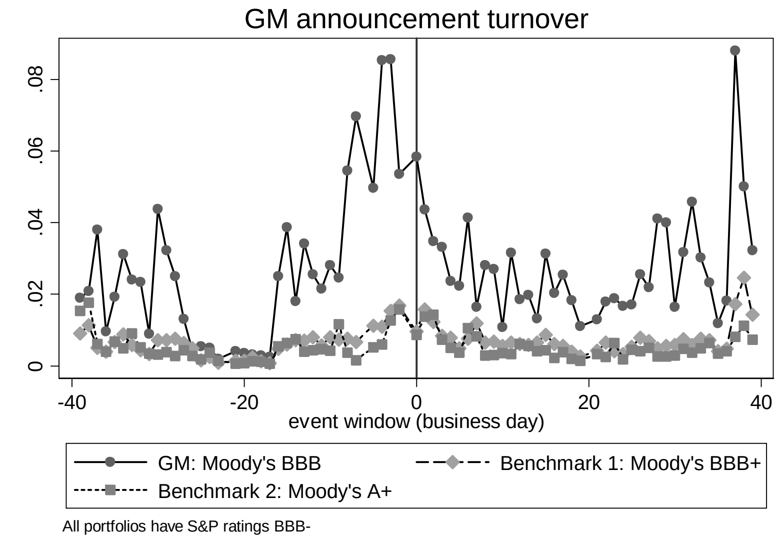
(a) Announcement returns.



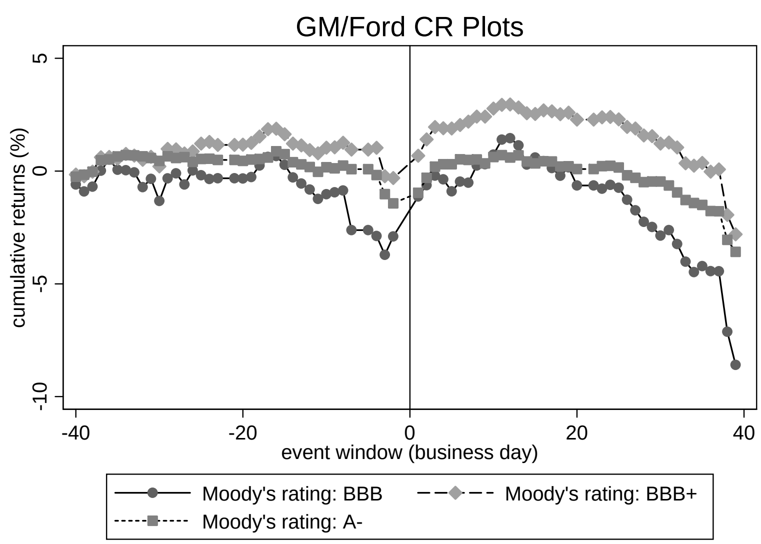
(b) Turnover.

Figure 7: Trading & price patterns in upgraded BBB- bonds around the announcement date.

Panel (a) plots the daily variation in trading volume in GM, GMAC, Ford, and FMCC bonds around the announcement date. Turnover is calculated using TRACE transactions volume data and is normalized by the par value of the amount outstanding (obtained from FISD). Panel (b) plots the cumulative returns of bonds issued by GM, GMAC, Ford, and FMCC around the announcement date. The bonds are segregated according to their Moody's credit rating. All bonds have a BBB- rating from Standard and Poor's and a rating of BBB or BBB+ from Fitch. The sample consists of 984 bonds.

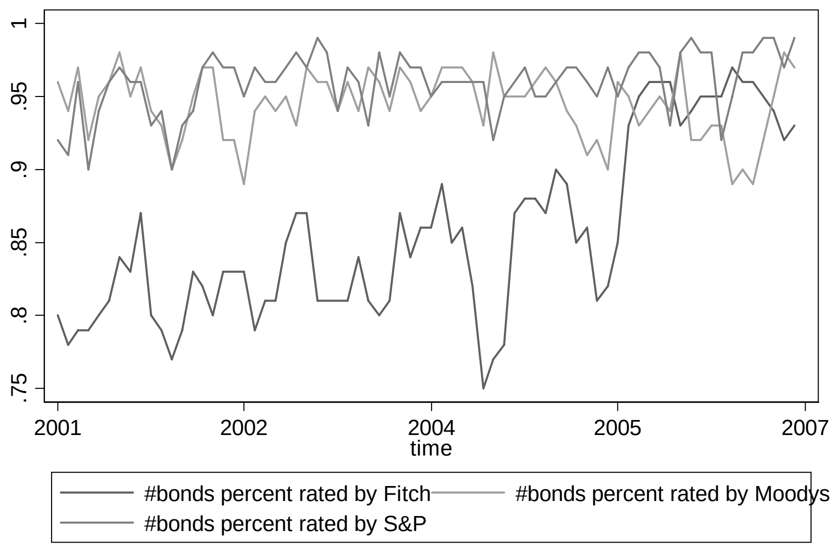


(a) Turnover.

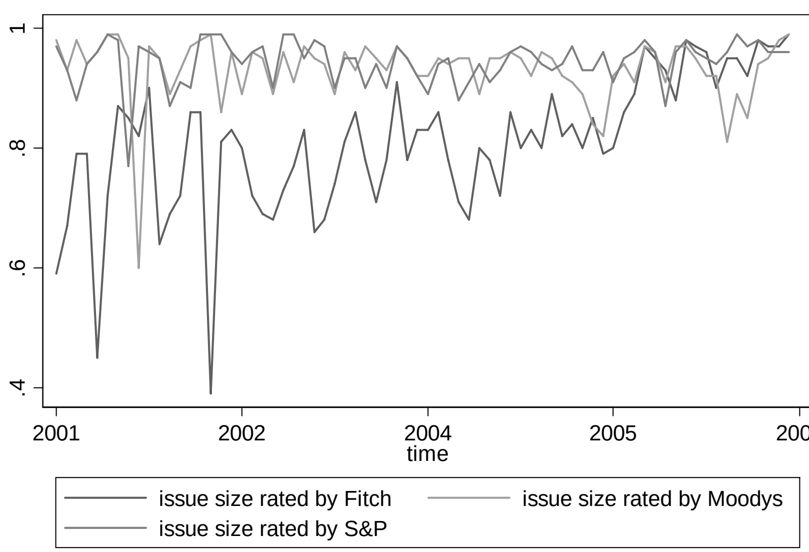


(b) Announcement returns.

Figure 8: Market share of each rating agency – 2001 to 2007



(a) Proportion of issued bonds rated by each agency



(b) Proportion of par value of issued bonds rated by each agency

Table 1: Summary of bond characteristics

Table 1 summarizes the characteristics of the bonds in our sample as of the announcement date.

	Obs	Mean	S.D.	Min	Max
Coupon (%)	8,175	6.01	1.83	0.00	14.25
Maturity (years)	8,175	9.43	9.27	1.10	93.37
Age (years)	8,175	3.82	3.83	0.22	67.70
Amount outstanding (million)	8,175	233.80	388.94	1.00	5,500.00

Table 2: Anticipated index rating transition as of the announcement date

2 summarizes the index ratings of all bonds in our sample as of the announcement date based on the old and new index rating rules. 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. Note that 39 bonds do not have an old index rating as they are unrated by Moody's and by S&P.

	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 or D	0	0	0	0	0	19	159	178
Total	603	773	3,254	2,805	267	274	160	8,136

Table 3: Announcement returns for bonds upgraded to investment-grade

Table 3 reports the variation in price of a 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 a matched sample approach that controls for credit risk, issuer sector effects, and bond maturity and size effects. The *p*-values are calculated using a bootstrap procedure. Returns marked with a *, ** or *** are significantly different from zero at the 10%, 5% or 1% level, respectively. The sample consists of the 30 bonds eligible for IG index inclusion.

Event Day	AR	p value	CAR	p value
-5	0.27	1.00	0.27	1.00
-4	0.03	0.44	0.29	1.00
-3	-0.27	1.00	0.02	0.39
-2	-0.12	0.83	-0.10	0.76
0	0.76***	0.00	0.67***	0.00
1	-0.29	1.00	0.38***	0.01
2	-0.02	0.62	0.36***	0.01
3	-0.23	1.00	0.13	0.17
4	0.23***	0.00	0.36***	0.00
5	0.24***	0.00	0.61***	0.00
6	-0.03	0.63	0.57***	0.00
7	0.25**	0.03	0.82***	0.00
8	-0.32	1.00	0.50***	0.00
9	0.36***	0.00	0.86***	0.00
10	0.08	0.29	0.93***	0.00
11	0.36***	0.01	1.29***	0.00
12	0.21***	0.01	1.51***	0.00
13	-0.46	1.00	1.04***	0.00
14	-0.61	1.00	0.43*	0.08
15	0.08	0.31	0.51**	0.04
16	0.08	0.19	0.59**	0.03
17	-0.11	0.84	0.47**	0.03
18	-0.35	1.00	0.13	0.30
19	-0.34	1.00	-0.22	0.77
21	-0.31	1.00	-0.53	0.98

Table 4: BOND RETURNS AND ORDER FLOW IMBALANCES.

Table 4 examines the relation between the daily returns and order imbalances in the portfolio of bonds upgraded to investment-grade. The dependent variable is the daily portfolio return over the event windows [-1,+30). We show estimation results using both pooled OLS and time-series Fama-MacBeth methodology (reported is the average slope coefficient from time-series OLS on each bond). To compute order 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 imbalances. All variables are expressed as logarithms. Standard errors are shown in parentheses. *, **, *** indicate significance at the 10%, 5%, and 1% level, respectively.

	OLS	TSFM	OLS	TSFM	OLS	OLS	OLS	OLS
Volume	0.08***	0.10***						
	(0.02)	(0.03)						
Order imbalance			0.04***	0.04***				
			(0.00)	(0.00)				
No. of trades					0.16***			
					(0.06)			
No. of trades $\geq$ \$1 MM						0.24***		
						(0.05)		
Order imbalance in #trades							0.32***	
							(0.02)	
Order imbalance in #trades $\geq$ \$1 MM								0.36***
								(0.03)
Observations	533	533	533	533	533	533	533	533
R^2	0.04	0.16	0.33	0.47	0.01	0.04	0.26	0.15

Table 5: CR Regressions on bonds issued by GM and Ford.

Table 5 reports CR Regressions on bonds issued by GM and Ford. *, **, *** indicate significance at the 10%, 5%, and 1% level, respectively.

	CR[-5,3]	p-value	CR[-5,5]	p-value	CR[-5,20]	p-value
Moody's BBB	124.84***	0.00	110.36***	0.01	133.04***	0.01
Moody's BBB+	32.32*	0.09	37.68	0.23	60.82*	0.07
Amount outstanding [50M, 150M)	-60.61***	0.00	-65.10***	0.00	-32.75*	0.07
Amount outstanding [150M, 250M)	-135.99***	0.00	-133.52***	0.00	-145.16***	0.00
Amount outstanding [250M, 1000M)	-67.93*	0.09	-82.24	0.14	-47.47	0.40
Amount outstanding [1000M, ∞)	66.12***	0.00	63.97***	0.00	75.34***	0.00
Maturity	7.12***	0.00	6.48*	0.10	7.21	0.11
Age	1.37	0.79	5.58	0.43	4.79	0.47
Coupon	12.79	0.37	22.16	0.30	15.81	0.50
Constant	-124.26*	0.08	-164.89	0.15	-122.35	0.33
F statistic	34.46***		23.22***		26.71***	
R^2	0.59		0.49		0.50	

Table 6: Reputation hypothesis test.

Table 6 documents the cross-sectional determinants of cumulative returns over the [-5,+10] day window surrounding the announcement date. The regressors include Fitch rated dummy variable, the old Lehman rating class interacted with an indicator for a superior Fitch rating, an indicator for Fitch rating below Moody's and S&P, and Fitch rating worse than Moody's and S&P's. Control variables include bond maturity, age, coupon, dummy for issue size, dummies for the old Lehman rating class, dummy for leaving the HY index and not entering the IG index, for entering IG index, for industry, and four dummy variables for GM, Ford and their financial arms GMAC and FMCC. Description of explanatory variables are presented in Appendix A. Standard errors are shown in the parentheses. *, **, *** indicate significance at the 10%, 5%, and 1% level, respectively.

	CR[-5, +10]
Fitch rated	2.07
	(13.23)
AA & Fitch better	17.95
	(14.34)
A & Fitch better	-1.13
	(6.11)
BBB / BBB+ & Fitch better	-11.01
	(9.27)
BBB- & Fitch better	3.08
	(13.30)
BB+ & Fitch better	-28.01
	(34.45)
BB / BB- & Fitch better	34.45*
	(19.71)
B & Fitch better	38.18*
	(20.27)
C / D & Fitch better	26.83
	(31.09)
No old rating & Fitch rated	243.19**
	(116.45)
Fitch worse than Moody's & S&P	3.06
	(12.84)
Control variables	-
Const.	-3.03
	(24.16)
Observations	4081
R^2	.14
F statistic	11.46

Table 7: Abnormal stock returns around announcement.

Table 7 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 regressors include Fitch rated dummy variable, the old Lehman rating class interacted with an indicator for a superior Fitch rating, an indicator for Fitch rating below Moody's and S&P, and Fitch rating worse than Moody's and S&P's. Control variables include dummies for the old Lehman rating class. Standard errors are shown in the parentheses. *, **, *** indicate significance at the 10%, 5%, and 1% level, respectively.

	Event window		
	[-5,+10]	[-5,+20]	[-5,+30]
Fitch rated	.04	.04	-.29
	(.36)	(.44)	(.51)
AA & Fitch better	1.53	2.47	1.78
	(1.49)	(1.83)	(2.12)
A & Fitch better	-.25	-.60	-1.43*
	(.58)	(.71)	(.82)
BBB/BBB+ & Fitch better	.21	-.30	-1.23
	(.58)	(.71)	(.82)
BBB- & Fitch better	.74	.008	-.62
	(.61)	(.75)	(.87)
BB+ & Fitch better	.56	.51	1.21
	(1.09)	(1.34)	(1.55)
BB/BB- & Fitch better	-.21	-.69	.30
	(.94)	(1.16)	(1.34)
B & Fitch better	-.57	-1.07	-1.28
	(1.04)	(1.27)	(1.48)
C/D & Fitch better	2.16	.86	.54
	(1.73)	(2.12)	(2.45)
Fitch worse than Moody's & S&P's	-.67	-.36	-.10
	(.90)	(1.10)	(1.28)
Control variables	-	-	-
Constant	-.87	.15	-1.71
	(1.41)	(1.73)	(2.00)
Observations	561	561	561
R^2	.03	.02	.04
F statistic	.86	.75	1.17