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Rating-Based Investment Practices and Bond Market Segmentation

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This paper documents a new channel for rating-based bond market segmentation, which, in contrast to prior research, is based on nonregulatory investment management practices. A 2005 Lehman Brothers index redefinition provides a quasinatural experiment in which a number of previously high-yield split-rated bonds were mechanically relabeled as investment grade. Although their regulatory standing was unaffected, these bonds had abnormal yield declines of 21 basis points. These valuation changes can be traced to buying by asset-class-sensitive institutional investors for whom these bonds became investable. Reputation, regulation, indexation, and liquidity cannot explain the observed price and trading patterns. (*JEL* G12, G14)

Institutional investors face portfolio restrictions to curb conflicts of interest inherent in delegated asset management. A large body of theoretical research shows how such investment restrictions can lead to market segmentation and

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asset-class effects.[1] A central prediction of segmentation models is that labels used to describe a security's asset-class membership affect the clientele of investors willing to hold the security and, thus, affect security prices regardless of any fundamental information the labels may convey. In this paper, we present the first empirical evidence of nonregulatory and noninformational asset-management label effects in fixed income prices and trading.

Our analysis is based on a change in the mechanical rules Lehman Brothers used to classify split-rated bonds, that is, where different rating agencies disagree on a bond's creditworthiness. In particular, eligibility for inclusion in the Lehman (now Barclays Capital) investment-grade corporate bond index—an important benchmark for institutional investors—is based on a composite *index rating* label, which Lehman computes by aggregating a bond's credit ratings. On January 24, 2005, Lehman announced a significant change in the combinations of split ratings it would label as investment grade. Effective July 1, 2005, index ratings for split-rated bonds changed to the middle rating of the credit ratings issued by Moody's, S&P, and Fitch. Previously, Fitch ratings were ignored under the old Lehman rule, which set index ratings to be the more conservative of Moody's and S&P.

The Lehman redefinition is a rare opportunity to study the effect of a change in how investors *use* bond ratings, while holding the ratings themselves and their information content and regulatory effects fixed. Credit ratings by Nationally Recognized Statistical Rating Organizations (NRSROs) play a highly visible role in corporate bond markets.[2] The previous literature has largely focused on the informational content of bond ratings and the role of ratings in determining a bond's status under rating-based regulation.[3] However, rating-based labels are also used in contractual investment mandates and in internal investment procedures at insurance companies, mutual funds, pensions, and investment advisors. Our paper empirically documents, for the first time, bond market segmentation through nonregulatory rating-based investment practices in delegated asset management.

Two facts about the Lehman redefinition are important for our analysis. First, Lehman index ratings are derived from publicly available information and are mechanically computed based on known rules for designating a

[1] Gromb and Vayanos (2009), Duffie (2010), and Duffie and Strulovici (2012) show how market segmentation and capital immobility can affect the ownership distribution of assets and how this feeds back into asset prices. Basak and Pavlova (2013) show how trading by institutional investors can affect asset prices and generate indexation effects.

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

[3] Holthausen and Leftwich (1986) and Hand, Holthausen, and Leftwich (1992) measure the informational effects of bond rating announcements on bond and stock prices. Ambrose, Cai, and Helwege (2012) and Ellul, Jotikasthira, and Lundblad (2011) find mixed evidence of regulatory fire sales of downgraded bonds by insurance companies. Kisgen and Strahan (2010) documents a regulatory impact of bond ratings.

bond's asset-class label. Consequently, the Lehman redefinition was unaccompanied by any new information about bond fundamentals. Second, the change in Lehman's labeling of bonds as investment grade and high yield had no impact on official regulation. Bond regulations are based on the underlying NRSRO credit ratings, not on asset-class labels in Lehman's index methodology. However, given Lehman's prominence and benchmark status in bond markets, we hypothesize that Lehman's designation of which split-rated bonds it considered "investment grade" influenced which split-rated bonds asset-class-sensitive institutional investors considered to be investment grade and hence investable. Moreover, Lehman's old index rating rule (which depended on the lower of Moody's and S&P ratings) was more restrictive than prevailing official regulations (which focused on middle ratings). Thus, there was regulatory slack within which institutional investors could follow Lehman's lead vis-à-vis split-rated bonds and still satisfy the minimum standards for investment-grade status set by official regulations.

The financial press at the time corroborates this notion, commenting that the Lehman redefinition gave investment professionals the opportunity to "invest in attractive credits they otherwise would not be able to buy" and would force some "funds to rewrite their investment guidelines" (Calio 2005). We show that this increased both the immediate and the predictable future institutional investor demand for the relabeled split-rated bonds, and thereby created price pressure for these bonds. However, the impact of the Lehman rule change—and the associated relabeling of certain split-rating combinations as "investment grade"—is entirely noninformational and nonregulatory and driven by the investment management process.

The Lehman rule change affected a large number of bonds, because Fitch ratings were higher than the lower of the Moody's and S&P ratings for about two-thirds of the bonds rated by Fitch. We document price segmentation effects for two groups of bonds that were particularly affected by the Lehman label redefinition. The first group consists of 57 split-rated bonds that were immediately upgraded from high yield (HY) to investment grade (IG).[4] We find evidence for rating-based market segmentation in both prices and order flows for these bonds. First, there was an abnormal decline in the upgraded bonds' yield-to-maturity (YTM) of about 0.21% (0.64%) by the announcement (effective) date, which is roughly half (all) of the yield spread between BBB− and BB+ bonds. Second, a Kalman filter decomposition shows statistically significant permanent price increases for the upgraded bonds around both the Lehman announcement and effective dates, and also a time-varying premium that is contingent on the subsequent differential performance of the Lehman IG and HY indexes. Third, these price changes

[4] According to the financial press at the time of the Lehman announcement, 59 bonds were expected to switch index ratings (with a total market value of $33.4 billion comprising 2.1% of the IG index and 5.0% of the HY index). The difference between these 59 bonds and our sample is due to two bonds with no TRACE transactions data.

can be linked to trading patterns that are consistent with increased bond demands from asset-class-sensitive investor clienteles. Average daily volume temporarily doubled in the upgraded bonds, and there was abnormal buying by insurance companies and investment-grade bond mutual funds.

The Lehman redefinition also changed the future asset-class transition probabilities for bonds whose asset-class status did not change immediately. Under the new Lehman rule, HY bonds with a favorable Fitch rating need fewer Moody's and S&P credit rating upgrades to reach IG asset-class status in the future. Thus, the second group of bonds we study—bonds with BB+ ratings from both Moody's and S&P and a higher rating from Fitch—are bonds for which asset-class transition probability effects were likely to be large. Consistent with their improved asset-class transition probabilities—and the attendant prospect of increased future demand from the IG investor clientele—these bonds also had significant permanent abnormal returns around the Lehman announcement.

The Lehman redefinition also lets us examine more closely the role of specific label-based investment practices in market segmentation. *Indexation* is one widespread label-based investment practice. Since the Lehman index-rating redefinition changed the composition of the Lehman IG index, this changed the bond demands of passive index replicators. *Investability* is another investment practice affected by the Lehman event. To the extent that the Lehman labeling rules help define asset management norms regarding which bonds qualify as "investment grade" for portfolio managers and their clients, the Lehman redefinition also affected the bond demands of active IG bond asset managers. It effectively expanded the safe harbor of split-rated bonds considered to be investable as investment grade.

The financial press at the time explicitly discussed both indexation (and how distressed Ford and GM bonds would continue to be in the benchmark Lehman IG index after the redefinition) and the investability of newly upgraded smaller bond issues (see Eisinger 2005; Calio 2005). To test for the effects of these specific investment practices, we split our sample of immediately upgraded bonds into two subsamples: bonds that were ineligible for Lehman IG index membership due to their small issue size—we call these *orphan bonds* because they were left out of the IG index—and the remaining IG index-eligible bonds. Both groups of bonds had significant positive returns over time that were not significantly different from each other. Thus, asset-class status, not just index membership alone, matters for bond pricing.

Previous empirical research on asset-class and style labels and market segmentation has focused largely on stock markets.[5] The work most closely related to ours is Boyer (2011), which documents changes in return and trading comovement in stocks affected by regular rebalancings of the BARRA value and growth indexes based on known BARRA labeling

[5] See, for example, Barberis and Shleifer (2003) and Jame and Tong (2014).

rules. In contrast, our paper documents investment management label effects in fixed income markets using a change of the labeling rule itself. Kisgen and Strahan (2010) exploits a different quasinatural experiment—the SEC's 2003 designation of Dominion Bond Rating Service as an NRSRO—to investigate the regulatory role of bond ratings. In contrast, our analysis documents the empirical importance of nonregulatory investment practices in bond markets. In light of the Dodd-Frank Act of 2010 and ensuant SEC proposals to reduce regulatory reliance on ratings by NRSROs, such asset management practices are likely to have an even greater impact on financial markets in the future.[6]

Our results are also related to Bongaerts, Cremers, and Goetzmann (2012) which shows that multiple credit ratings play a "tie-breaking" role in bond pricing.[7] Our paper shows that the strength of the Fitch tie-breaking effect increased after the Lehman announcement. We also identify specific channels for tie-breaking. Moreover, the direction of causation is a concern in the relation of bond prices, ratings, and credit quality, all of which are highly persistent. The Lehman redefinition lets us directly document causal leads and lags in *changes* in rating-based practices and bond pricing and order flow.

1. Background and Hypotheses

The U.S. corporate bond market 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, shocks to the ownership structure of bonds lead to order-flow imbalances and price changes that may be larger and more persistent than demand shocks in the more liquid equity markets.[8] Thus, the corporate bond market is a natural venue for segmentation effects. In the following, we discuss the institutional setting and background for the Lehman redefinition and develop our empirical hypotheses.

1.1 Rating-based segmentation

Credit ratings from Nationally Recognized Statistical Rating Organizations (NRSROs) are widely used in both investment management practices and in regulatory oversight of financial institutions. Internal investment practices and official regulations both restrict institutional holdings of bonds with

[6] Section 939 of the Dodd-Frank Act, which amends the major acts governing the FDIC, SEC, Federal housing agencies and the World Bank, specifically directs Federal agencies to remove references to NRSRO credit ratings and replace them with an alternate standard. See SEC releases 34-58070 and 33-9193 for specific regulatory proposals.

[7] Other work on ratings includes the following: Becker and Milbourn (2011) shows that the quality of S&P and Moody's ratings gradually deteriorated after the entry of Fitch. Kisgen (2007) and Chernenko and Sunderam (2012) document real links between credit ratings, funding flows, and corporate capital budgeting.

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

low credit ratings and, thereby, have the potential to segment the bond market into high-yield and investment-grade investor clienteles. A majority of bonds (68%), however, have split ratings by the major NRSROs—Moody's, S&P, and Fitch. For split-rated bonds—where the rating agencies disagree on a bond's creditworthiness—some amount of judgement is called for in determining whether a bond is investment grade. Official regulations set minimum standards, but portfolio managers and investment committees have incentives to be more conservative to avoid potential litigation or to simplify contractual client relationships.[9] Prevailing asset management practices are, therefore, another channel, on top of official regulation, through which segmentation arises because only a subset of buyers is allowed—and *willing*—to hold large positions in risky bonds.

As an industry leader, Lehman Brothers had the standing and visibility to influence industry norms about bond ratings. Many investment mandates specifically benchmark relative to Lehman Brothers (now Barclays Capital) bond indexes.[10] However, whether Lehman caused investment practices to change or its policies were responding to evolving industry norms is not crucial for our purposes. In either case, if the bond market is segmented because of rating-based investment practices, then bonds relabeled from high yield to investment grade should have experienced increased investor demand.

1.2 Lehman's index rating rule change

The specific indexes of interest in this study are the investment-grade U.S. Corporate Index (IG index) and the U.S. Corporate High-Yield Index (HY index). The IG index is composed of investment-grade, U.S. dollar-denominated, fixed-rate, taxable corporate bonds that also meet par size, maturity, and other criteria. The HY index is composed of below investment grade corporate bonds that meet somewhat looser characteristic criteria than

9 Many official regulations are tied to middle ratings. For example, SEC Rule 15c3-1 (which sets "haircuts" for broker-dealer net worth) and SEC Rule 206(3)-3T (which sets disclosure and consent requirements for principle transactions involving investment advisors) require a bond to be rated in one of the four highest categories by at least two NRSROs to be investment grade. SEC Rule 3a-7 (which governs structured finance vehicles under the Investment Company Act) requires a rating in one of the four highest categories by at least one NRSRO for a bond to be investment grade. The National Association of Insurance Commissioners (NAIC) restricts junk bond holdings to less than 20% of insurance company assets (see Cantor and Packer 1994; Kisgen 2007), where the NAIC regulatory rating of a bond rated by three NRSROs is the second lowest rating (see NAIC 2009). See U.S. Senate (2002) for more on rating-based regulation. In contrast, the use of stricter rating standards by some investors (such as the "lower of two" old Lehman rule) could reflect coordination among money managers (seeking safety in numbers from litigation) or a response to investor ambiguity aversion.

10 The Lehman Brothers bond indexes began on January 1, 1973. On September 22, 2008, Barclays Capital acquired Lehman Brothers' North American investment banking and capital markets businesses. Barclays has continued the family of indexes and associated index services. A Lehman Brothers presentation, "The Role of Fixed Income Benchmarks" by Lev Dynkin dated May 2007, estimates that $6.1 trillion in assets under management were benchmarked to Lehman indexes as of December 2006.

for the IG index.[11] In particular, eligibility for the IG index requires par amounts outstanding of at least $250 million, while the threshold for the HY index is just $150 million.

A bond's asset-class status as investment grade or high yield at Lehman is based on its *index rating*. The Lehman index rating is simply a composite label computed mechanically from credit ratings issued by the major credit agencies. Index ratings do not provide any additional credit information beyond the underlying Moody's, S&P, and Fitch bond ratings. The timeline in Table IA.1 in the Internet Appendix provides a short history of Lehman index rating rules and other pertinent events surrounding the 2005 redefinition.

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

In this paper, we investigate the most recent rule change.[12] On January 24, 2005, Lehman Brothers announced that, effective July 1, 2005, index ratings would also depend on Fitch credit ratings. In particular, a bond's index rating would be redefined as the middle rating assigned by Moody's, S&P, and Fitch. (For bonds rated by only two agencies, the index rating is the more conservative of the two ratings. If rated by only one agency, a bond's index rating is simply the single rating.) We refer to the 2005 rule as the *new rule* and the corresponding index ratings as *new index ratings*. Depending on their Fitch ratings, the new rule caused some bonds to transition mechanically from a high-yield to an investment-grade index rating, even though there was no change in credit ratings by any of the major rating agencies and,

[11] Additional details on the Lehman (Barclays) bond indexes are available at https://ecommerce.barcap.com/indices/.

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

presumably, no change in credit fundamentals. The Lehman change also had no regulatory effect.

The Lehman redefinition was largely a surprise because index rule changes typically require consultation with three advisory councils, comprised of major fixed-income investment firms, which only meet once a year. On Monday, January 24, Lehman unexpectedly scheduled a conference call with its advisory councils to discuss the rule change. It had not had such a conference call for several years. The context in which this announcement occurred was one of market stress regarding potential GM and Ford downgrades and the threat of leakage of Lehman's action into the media.[13]

Figure 1 plots the Lehman investment-grade and high-yield indexes over time. We normalize them relative to their levels at the start of our control window, 50 trading days prior to the Lehman announcement. The vertical dotted lines indicate major events (as described in Table IA.1) relating to the Lehman index rating redefinition, the subsequent 2005 GM and Ford downgrades, and the three TRACE implementation phases. Clearly the performance of IG and HY debt diverged over this time period. This divergence lets us test whether the pricing and trading of split-rated bonds with favorable Fitch ratings changed around the time of the Lehman announcement.

1.3 Hypothesis development

Simply put, the question about bond market segmentation is: would bonds be priced differently if, holding fixed the available cash-flow information, the asset-class designations associated with bond ratings changed from high yield to investment grade? The 2005 Lehman index rating redefinition is an opportunity to examine asset-class segmentation in the absence of concurrent information about bond creditworthiness and confounding changes in rating-based regulation. All that the Lehman redefinition did is change an informationally meaningless label (see Boyer 2011), which summarizes how Lehman, and potentially other investors, use ratings to define "investment-grade" and "high-yield" asset classes. Since the official regulatory treatment of bonds was unaffected by the Lehman announcement, any changes in rating-induced segmentation occur through, what we call, an *investment practices* channel.

The investment practices hypothesis can be summarized as follows: before the Lehman redefinition, the asset-class status of bonds with split IG-HY ratings from Moody's and S&P and favorable Fitch ratings was ambiguous. Under official regulations, they qualified as investment grade (based on their

[13] An article (Eisinger 2005) in the *Wall Street Journal*—revealingly titled "GM bond worries fade with some magic from Lehman"—provides an explanation for the redefinition, its motivation, and timing: "Lehman long had contemplated including Fitch, and it was on the agenda for a meeting later this year. So why the rush? Word had filtered into the media that Lehman was considering adding Fitch. 'We wanted to remove any attention to our indices, as quickly as we could' said a person familiar with the matter. And this person says Lehman had taken note of the market's GM jitters. Along with Moody's, Fitch rates GM bonds higher than S&P, two notches above junk. Even if S&P downgrades GM, as long as the other two stand pat, the auto maker would remain in Lehman's investment-grade indexes under the new system."

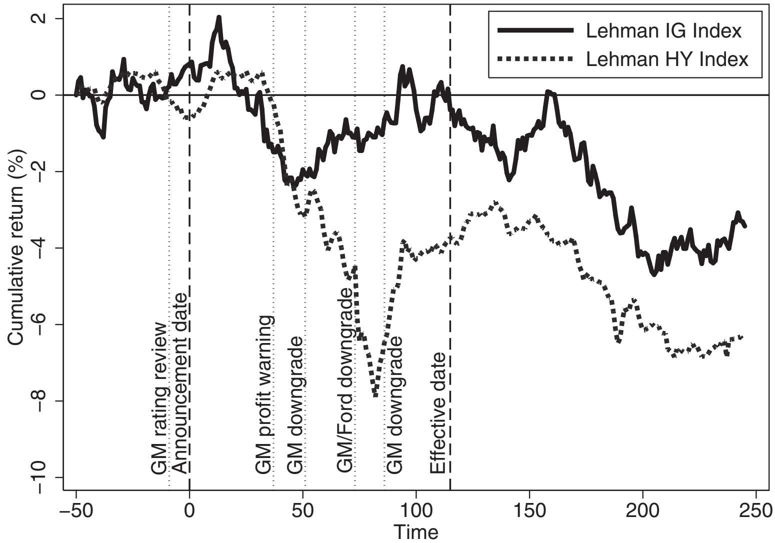

Figure 1
Index performance and timeline of events
This figure plots the cumulative return over time for the Lehman indexes for investment-grade (IG) and high-yield (HY) bonds normalized relative to the index level on November 15, 2004 ($t = -50$). The vertical dotted lines refer to important events in the corporate bond market (described in more detail in Internet Appendix Table IA.1). On the horizontal axis, day 0 is the Lehman announcement date (January 24, 2005) and day 114 is the effective date (July 1, 2005).

middle ratings), but some in the industry, most notably Lehman, held a more restrictive view of these bonds as below investment grade. This asset-class ambiguity increased internal holding and opportunity costs. More time and effort were required for portfolio managers to justify IG status internally with investment committees and externally with clients and future litigants. Once Lehman reduced this ambiguity and the associated shadow holding costs—by effectively expanding the safe harbor of IG bonds for asset managers—net demand for the upgraded bonds increased, leading to buying by asset-class sensitive institutions (denoted as hypothesis H1) and increased trading volume (H2). Given downward-sloping demand curves for bonds, this increased demand should, in turn, result in price appreciation (H3) for the upgraded bonds.[14]

Investor demand for these bonds should increase for two reasons. First, demand from passive index replicators should increase around the effective

[14] There is strong evidence of downward-sloping demand curves for bonds. Steiner and Heinke (2001) find price pressure in eurobonds associated with announcements of watchlistings and rating changes by Moody's and S&P. Mitchell, Pedersen, and Pulvino (2007) examine large capital redemptions of convertible bond hedge funds, and Newman and Rierson (2004) document a cross-bond pricing impact of large bond issuances by European Telecom firms. Relatedly, Coval and Stafford (2007) document price effects of asset fire sales and downward-sloping demand in equity markets.

date (although this could be anticipated and priced earlier than that). We call this the *indexation* hypothesis (H4). Second, demand from active bond investors may also have increased. Calio (2005) comments that the Lehman redefinition gave "fixed income managers benchmarked to the Lehman Aggregate" the opportunity to "invest in attractive credits they otherwise would not be able to buy." Thus, the redefinition moved these ambiguous split-rated bonds squarely into the asset-class universe of investable bonds for institutional managers of IG bond portfolios. This change could occur both at the level of contractual investment mandates and prospectuses and in terms of internal procedures operationalizing general investability rules. We call this the *investability* hypothesis. For active portfolio managers of IG bond portfolios, demand should increase gradually after the Lehman announcement as investors began to consider these upgraded bonds in their security selection process.[15] As a result, the upgraded bonds' prices should appreciate even if the bonds were not added to the Lehman investment-grade index itself (H5). Asset-class investability norms and indexation are both specific examples of the investment practices channel of market segmentation.

One further consequence of the Lehman redefinition is that it improved the transition probabilities of some HY bonds being upgraded to IG asset-class status in the future and of some IG bonds (on watch for downgrades) remaining IG in the future. In particular, asset-class transition probabilities changed because—holding future credit rating probabilities fixed for Moody's, S&P, and Fitch—the Lehman redefinition expanded the set of split-rating combinations that would be labeled investment grade in the future. A higher anticipated probability of investment-grade status in the future—and the associated demand from asset-class-sensitive investors in IG bonds—should cause current prices of Fitch-favorable HY bonds to appreciate even if their current asset-class status did not immediately change (H6).

2. Data

2.1 Corporate bond characteristics

To construct our sample, we start with all outstanding bonds as of the Lehman announcement date. We obtain bond characteristics (e.g., coupon, remaining maturity) from Mergent's Fixed Investment Securities Database

[15] Calio (2005) also mentions the need for some "pension funds to rewrite their investment guidelines" (suggesting slow-moving capital effects) because funds with investment guidelines that prohibited split-rated bonds would "have a more difficult time beating the [IG] index" benchmark after the index redefinition. Palmer and Murray (2005) poses a similar question: "Should plan trustees follow Lehman's example and include Fitch in their guidelines?" Consistent with an investment practices channel, they conclude that "the answer is yes. [...] We currently feel the best course of action for plan trustees is to adjust current guidelines that refer only to Moody's and S&P to include Fitch ratings as well, provided the investment manager has demonstrated sufficient risk control capabilities. Investment managers will now be compared to an improved family of indices, and should be allowed to manage with the same parameters as the benchmark."

(FISD), which contains comprehensive characteristic information on all bonds with CUSIPs. The FISD data also include a complete ratings history from Moody's, S&P, and Fitch for all corporate bond issues. We filter out redeemed bonds and bonds with special features. Specifically, we require that (1) the amount outstanding is positive at the announcement date,[16] (2) the remaining maturity is at least one year, (3) the bond is not convertible or floating-rate, (4) the bond is not a private-placement bond, unless it is an SEC Rule 144A bond with registration rights, (5) the bond is not issued by Ford, GM, or their financing arms and affiliated companies, and (6) the bond was added to TRACE at least 10 days before the Lehman announcement date. This last criterion ensures that bonds in our sample have transaction prices before the announcement date (see Table IA.1 and the next section for the different phases of TRACE). Our final universe consists of 8,767 bonds, of which 2,336 are in the IG index, 722 are in the HY index, and 5,709 are not in any Lehman index. Of these, 68% (5,943) are split-rated by Moody's, S&P, and Fitch.

Table 1, panel A, presents summary statistics of the bond characteristics for various samples used in our study. Index members have, by construction, larger issue sizes than bonds not in any Lehman index. Trading frequency also varies systematically between index and nonindex members. The vast majority of bonds in our sample, 99.5%, are rated by Moody's and S&P, but panel B shows that only 70% are rated by Fitch. Fitch assigned ratings higher than the lower of Moody's and S&P's to 4,149 (67%) of the 6,169 bonds Fitch rated. This difference is pervasive across rating categories.[17] Panel C summarizes bond index ratings calculated according to the old and new rules. Under the new rule, index ratings increased for 729 bonds by an entire letter and for 3,108 bonds by at least one notch. The total affected market value is \$640bn. In addition, 26 bonds have lower index ratings under the new rule.[18]

2.2 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 over-the-counter trades involving all TRACE-eligible corporate bonds (see Table IA.1 for details).[19] The data were filtered to eliminate

[16] We correct the par amount outstanding for a small number of bonds (for which the reported number in FISD is "1") by cross-checking with the official bond statement.

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

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

[19] Public dissemination of TRACE data was implemented in two stages. Transactions data on all corporate bonds considered to be reasonably liquid became publicly available on October 1, 2004. The remaining less liquid issues became publicly available on February 7, 2005. TRACE reported trades for around 4,100 bonds per day between

Table 1
Bond characteristics and anticipated index rating transitions

Panel A: Bond characteristics

	IG index members	HY index members	Index nonmembers	HY-to-IG upgraded bonds	Index-eligible bonds	Orphan bonds	Control bonds
Number of bonds	2,336	722	5,709	57	34	23	337
Amount outst. ($ MM)	580.43	426.49	54.70	392.59	582.30	112.14	364.48
	(481.72)	(301.40)	(87.24)	(344.21)	(324.13)	(78.39)	(307.45)
Maturity (years)	9.82	8.35	10.19	12.67	11.03	15.10	7.54
	(10.63)	(7.66)	(8.98)	(13.81)	(9.83)	(18.18)	(5.13)
Coupon (%)	6.12	8.15	5.59	6.95	6.88	7.05	8.19
	(1.51)	(1.79)	(1.78)	(1.07)	(0.91)	(1.29)	(1.62)
Age (years)	4.04	3.60	3.70	4.84	3.82	6.35	3.62
	(3.13)	(2.87)	(4.13)	(3.37)	(2.34)	(4.07)	(3.81)
Trading frequency (%)	55.58	66.87	17.00	52.44	66.01	32.37	55.32
	(33.48)	(28.76)	(20.58)	(35.50)	(29.01)	(35.20)	(31.57)

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

Old index rating	All	Rated by Fitch	Fitch rates better	Fitch rates worse
AAA	676	104	0	18
AA	568	376	247	19
A	4,400	3,526	2,727	42
BBB	2,264	1,724	882	121
BB	309	219	148	20
B	311	132	79	19
C–D	201	79	57	1
Unrated	38	9	9	0
Total	8,767	6,169	4,149	240

Panel C: Anticipated index rating transitions

Old index rating	New index rating								
	AAA	AA	A	BBB	BB	B	C–D	Unrated	Total
AAA	671	0	5	0	0	0	0	0	676
AA	4	560	4	0	0	0	0	0	568
A	3	433	3,961	3	0	0	0	0	4,400
BBB	2	0	170	2,092	0	0	0	0	2,264
BB	3	0	0	44	262	0	0	0	309
B	0	0	0	7	33	270	1	0	311
C–D	0	0	0	0	0	21	180	0	201
Unrated	0	3	0	0	0	1	5	29	38
Total	683	996	4,140	2,146	295	292	186	29	8,767

This table summarizes bond characteristics in our sample and the anticipated index rating transitions as of the Lehman announcement date. Panel A reports the mean values of the bond characteristics with standard deviations in parentheses. The sample of 57 bonds that were upgraded from high yield (HY) to investment grade (IG) is further split into subsamples of "Index-eligible" bonds (which could enter the IG index) and "Orphan" bonds (which did not satisfy the IG index characteristic criteria). The control bonds have HY old index ratings and either no Fitch rating or a Fitch rating below the old index rating. Trading frequency is measured as the percentage of days with trades during a 20-trading-day window around the Lehman announcement on January 24, 2005. Panel B compares bond ratings issued by Fitch with the more conservative of the ratings by Moody's and S&P. Panel C summarizes the index ratings of all bonds based on the old and new index rating rules. The old index rating is the more conservative of the Moody's and S&P ratings, and the new index rating is the middle of the Moody's, S&P, and Fitch ratings.

potentially erroneous entries. For instance, transactions flagged as canceled or corrected are deleted to ensure that our results are based on actual trades. We also truncated the price data at the 0.5% and 99.5% levels for the full sample of all bonds to mitigate the impact of outliers on our analysis.

Corporate bonds trade infrequently, with bonds in our sample trading every other day or less around the Lehman announcement (see Table 1). Consequently, when computing cumulative average returns, we use two imputation methods to compute returns and then verify our event study results are robust.[20] Both methods compute cumulative returns as percentage differences between a bond's daily prices and a pre-event reference price. When a bond does not trade on a given day, our baseline imputation sets the missing price to be the *last* prior daily par-weighted average transaction price. The alternative sets the imputed missing price to be the *next* subsequent daily average transaction price. The difference between the two approaches is the imputed timing of when missing returns are assumed to be realized. The first method delays imputed price changes to the end of the no-trade time interval, whereas the alternative method accelerates imputed price changes to the beginning of the no-trade interval.

TRACE does not provide explicit buy-sell indicators and gives no information on trader identities.[21] Hence, we cannot directly observe trading by particular types of investors. To impute trade direction, we follow a trade classification procedure similar to the one in Lee and Ready (1991): each transaction price is compared with the closing price on the most recent prior trading day. If the transaction price is higher, the transaction is classified as a buy, and otherwise as a sell. The buy/sell indicators are then used to compute daily order-flow imbalances.

We also examine identifiable trading by two specific groups of institutional investors. The National Association of Insurance Commissioners (NAIC) database includes all corporate bond trades involving insurance companies. The NAIC data allows us to track the portfolio decisions of this large group of asset-class sensitive investors. In addition, we obtain quarterly fixed income holdings for U.S. and European mutual funds from the Lipper eMAXX fixed income database.

October and February and 4,700 after February, but TRACE coverage was only roughly 1,600 bonds per day before October.

20 Infrequent trading is less problematic when computing returns over longer than daily horizons.

21 Another limitation is that, during our sample period, TRACE transaction volume is truncated at $5 MM for investment-grade bonds and at $1 MM for high-yield bonds. See Bessembinder, Kahle, Maxwell, and Xu (2009), Edwards, Harris, and Piwowar (2007) and Goldstein, Hotchkiss, and Sirri (2007) for more on TRACE.

3. Evidence from Upgraded Bonds

The Lehman rule change relabeled the index ratings of several thousand bonds. To test the segmentation hypotheses from Section 1.3, we first investigate high-yield bonds that were (prospectively) upgraded to investment-grade status given their credit ratings at the time of the Lehman announcement. The HY-to-IG upgraded bond sample consists of 57 bonds for which TRACE data are available, of which 47 have an old index rating of BB, 7 have an old index rating of B, and 3 have no prior index rating.[22] Although this sample is somewhat small, we will see it is sufficiently large to obtain statistical power.[23] These are the bonds most immediately affected by any asset-class demand effects after the Lehman announcement. Also, to the extent that the redefinition was a response to the GM and Ford crisis, these upgraded bonds were "bystanders" swept up in the Lehman redefinition. In other words, the upgrade should cause an exogenous demand shock.

We investigate returns, trading, ownership changes, and liquidity over event windows defined relative to five dates. The timing is the number of trading days before or after the Lehman announcement on January 24, 2005 (day $t=0$). A pre-announcement control window $(-50,-10]$ starts ten weeks and ends two weeks before the announcement date. The pre-announcement window is relatively short because of limited transaction price availability before TRACE Phase III Stage One which started on October 1, 2004. We use two weeks before the Lehman announcement (day $t=-10$) as the start of our event horizons because S&P watchlisted GM that week, which, in part, prompted the eventual Lehman redefinition and because of information leakage discussed explicitly in the press (see Eisinger 2005). The effective date for the redefinition is July 1, 2005 (day $t=114$), which marks the end of the announcement window $(-10,114]$. The posteffective window $(114,245]$ starts with the effective date and continues through the end of 2005 (day $t=245$).

3.1 Impact on bond prices

One challenge with an event study of the Lehman redefinition is that, because the event observations all line up in calendar time, it is important to control for other common sources of bond price variation. Thus, we compute abnormal valuation changes in two different ways and verify that our results are robust.

[22] The three bonds upgraded from BB− to AAA in Table 1 previously experienced material changes in creditworthiness, leading to downgrades from AAA to BB− by Moody's, while S&P and Fitch kept their ratings at AAA.

[23] The sample comprises all switching TRACE bonds, thus avoiding any sample selection bias. The sample size is comparable to other research using natural experiments, which, by their nature, are often rare (e.g., Kliger and Sarig 2000; Kisgen and Strahan 2010).

3.1.1 Regression approach. The first way we measure abnormal valuation changes is to estimate regressions for cumulative yield changes ΔY on bonds (indexed by i) over different particular time horizons (indexed by h) using the cross-section of all 8,767 bonds:

$$\Delta Y_i^h = \alpha + \beta \mathbf{I}_i^{\text{HY-to-IG}} + \gamma' X_i + \varepsilon_i^h. \quad (1)$$

The coefficient β on the upgraded bond indicator variable $\mathbf{I}_i^{\text{HY-to-IG}}$ measures the abnormal yield change on bonds switching from the high-yield to the investment-grade asset classes. We call the estimated $\hat{\beta}$s the *Cumulative Abnormal Yield* changes (CAYs) for the various horizons. The set of control variables X_i for bond i includes its old Lehman index rating (AAA, [AA, A], [BBB+, BBB], BBB−, BB+, BB, [BB−, B]), other bond and firm characteristics (remaining maturity, age, coupon rate, index beta, liquidity, issue size bins, market-to-book, firm size, profitability, tangibility, leverage ratio, interest coverage, interest-to-debt, and R&D), and industry fixed effects (see Appendix A for details). Our intent is to control for a wide range of potential factors affecting credit quality and bond pricing. These regressions are estimated using OLS and the full sample of all bonds with actual transaction prices (no imputed prices) at the beginning and end dates of the measurement horizon h. For this regression, we winsorized the distribution of cumulative yield changes for the full sample of all bonds and over all horizons, at the 0.5% and 99.5% levels.

Table 2 reports the cumulative abnormal yield changes over different horizons around the Lehman announcement. As a preliminary check on the adequacy of our control methodology, we compute the CAY over the pre-event control window (−50,−10]. If the controls are adequate, the expected CAY should be 0. The first column in Table 2 shows that the pre-event CAY is insignificant statistically and economically. This suggests the controls adjust adequately for the upgraded bonds' risk characteristics. The second column shows an initial abnormal decline in the upgraded bond yields of $\hat{\beta} = 0.21\%$ over (−10,0] around the announcement date. With a mean duration of over 10 years, this corresponds to an abnormal bond return of over 2%. The remaining columns show that, by the effective date, the yields on the 57 upgraded bonds had dropped on average by 0.64% and, respectively, 0.73% by year-end.[24] The average abnormal drop in yield on the upgraded bonds by the announcement (effective) date is economically significant as it represents roughly half (all) of the yield spread between BBB− and BB+

[24] The results are similar if we use dummy variables based on the new index ratings rather than on the old index ratings.

Table 2
Cross-sectional determinants of bond yield changes

	Control window	Event window						
	(−50,−10]	(−10,0]	(−10,10]	(−10,30]	(−10,60]	(−10,90]	(−10,114]†	(−10,245]
HY-to-IG upgraded	−0.02	−0.21	−0.08	−0.09	−0.63	−0.59	−0.64	−0.73
	[0.71]	[0.01]	[0.24]	[0.37]	[0.00]	[0.00]	[0.00]	[0.05]
Fitch favorable × AA - A	−0.03	−0.03	0.00	0.00	−0.04	0.02	0.00	−0.02
	[0.11]	[0.19]	[0.95]	[0.97]	[0.29]	[0.62]	[0.92]	[0.77]
Fitch fav. × BBB+ - BBB	0.01	0.00	−0.03	0.00	−0.08	−0.15	−0.09	−0.07
	[0.78]	[0.88]	[0.47]	[0.96]	[0.39]	[0.06]	[0.29]	[0.57]
Fitch fav. × BBB−	0.00	0.05	0.03	0.02	0.17	−0.19	−0.23	−0.13
	[0.98]	[0.28]	[0.56]	[0.81]	[0.36]	[0.13]	[0.11]	[0.52]
Fitch fav. × BB+	0.06	−0.23	−0.31	−0.16	−0.40	−0.54	−0.35	−1.21
	[0.60]	[0.02]	[0.00]	[0.33]	[0.12]	[0.00]	[0.34]	[0.01]
Fitch fav. × BB	0.00	0.22	0.10	0.05	−0.16	−0.39	−0.60	−0.35
	[0.95]	[0.19]	[0.55]	[0.79]	[0.53]	[0.17]	[0.05]	[0.67]
Fitch fav. × BB− - B	0.13	−0.05	−0.04	−0.12	−0.18	−0.50	−0.82	−0.65
	[0.01]	[0.38]	[0.54]	[0.12]	[0.26]	[0.01]	[0.00]	[0.22]
AA - A	0.11	−0.02	−0.05	−0.09	0.06	−0.13	0.01	−0.39
	[0.03]	[0.85]	[0.52]	[0.57]	[0.47]	[0.49]	[0.92]	[0.30]
BBB+- BBB	0.09	−0.04	−0.08	−0.14	0.23	−0.01	−0.02	−0.49
	[0.10]	[0.67]	[0.36]	[0.43]	[0.14]	[0.97]	[0.93]	[0.26]
BBB−	0.07	−0.02	−0.09	−0.12	0.18	0.09	0.21	−0.44
	[0.26]	[0.83]	[0.39]	[0.55]	[0.15]	[0.70]	[0.29]	[0.35]
BB+	0.07	0.13	−0.08	−0.18	0.76	0.28	0.38	−0.19
	[0.35]	[0.33]	[0.53]	[0.42]	[0.00]	[0.32]	[0.19]	[0.76]
BB	0.06	0.02	−0.13	−0.23	0.60	0.36	0.50	−0.41
	[0.49]	[0.90]	[0.29]	[0.34]	[0.00]	[0.30]	[0.13]	[0.65]
BB− - B	0.05	0.15	0.03	−0.27	0.71	0.55	0.70	−0.30
	[0.54]	[0.25]	[0.81]	[0.27]	[0.00]	[0.06]	[0.02]	[0.66]
Maturity	−0.01	−0.00	−0.01	−0.02	−0.02	−0.02	−0.02	−0.06
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Age	0.01	−0.01	−0.00	−0.01	−0.01	−0.02	−0.01	−0.05
	[0.00]	[0.23]	[0.33]	[0.50]	[0.12]	[0.15]	[0.49]	[0.09]
Coupon	−0.02	0.02	0.02	0.03	0.03	0.07	0.08	0.18
	[0.00]	[0.24]	[0.11]	[0.32]	[0.03]	[0.05]	[0.05]	[0.03]
Index beta	0.00	−0.06	−0.12	−0.02	−0.04	−0.07	−0.21	−0.19
	[0.94]	[0.00]	[0.02]	[0.28]	[0.21]	[0.04]	[0.02]	[0.15]
Liquidity	0.09	−0.22	−0.23	−0.15	−0.14	−1.19	−0.32	0.34
	[0.29]	[0.33]	[0.37]	[0.52]	[0.82]	[0.02]	[0.57]	[0.63]
Issue size \$150–250 MM	0.02	−0.08	−0.01	0.03	−0.08	0.10	−0.17	0.04
	[0.36]	[0.10]	[0.77]	[0.70]	[0.20]	[0.33]	[0.04]	[0.84]
Issue size ≥\$250 MM	0.01	−0.08	−0.04	−0.07	−0.03	−0.02	0.02	0.02
	[0.78]	[0.00]	[0.38]	[0.03]	[0.61]	[0.74]	[0.82]	[0.83]
Market-to-book	−0.02	−0.02	0.01	−0.02	−0.11	−0.06	−0.06	−0.18
	[0.42]	[0.43]	[0.75]	[0.62]	[0.06]	[0.40]	[0.46]	[0.46]
Firm size	0.01	−0.01	−0.00	−0.01	−0.02	−0.03	−0.01	−0.07
	[0.04]	[0.30]	[0.67]	[0.25]	[0.09]	[0.04]	[0.52]	[0.07]
Profitability	0.28	0.06	−0.18	0.64	1.43	0.87	1.16	3.16
	[0.31]	[0.88]	[0.76]	[0.46]	[0.16]	[0.46]	[0.42]	[0.50]
Tangibility	0.01	0.03	−0.09	−0.05	−0.20	−0.07	−0.27	−0.79
	[0.80]	[0.73]	[0.30]	[0.68]	[0.40]	[0.67]	[0.28]	[0.12]
Leverage	−0.10	0.11	0.08	0.20	0.37	0.39	0.17	0.82
	[0.13]	[0.20]	[0.35]	[0.12]	[0.05]	[0.06]	[0.44]	[0.16]
Interest coverage	−0.11	0.47	0.22	0.34	0.30	0.13	0.33	0.48
	[0.08]	[0.02]	[0.00]	[0.01]	[0.05]	[0.37]	[0.02]	[0.13]
Interest-to-debt	−1.36	0.33	1.32	0.44	0.51	1.46	−0.88	13.78
	[0.04]	[0.68]	[0.06]	[0.57]	[0.26]	[0.18]	[0.63]	[0.01]
R&D	0.74	−0.29	0.96	−0.29	1.14	−0.11	−1.91	1.58
	[0.15]	[0.71]	[0.08]	[0.84]	[0.66]	[0.95]	[0.29]	[0.68]
Constant	0.07	0.03	−0.01	0.26	0.35	0.33	0.22	0.64
	[0.26]	[0.72]	[0.91]	[0.01]	[0.02]	[0.09]	[0.27]	[0.10]

(continued)

Table 2 Continued

	Control window	Event window						
	(−50,−10]	(−10,0]	(−10,10]	(−10,30]	(−10,60]	(−10,90]	(−10,114]†	(−10,245]
Industry F.E.	yes	yes	yes	yes	yes	yes	yes	yes
R^2	0.073	0.120	0.174	0.147	0.241	0.216	0.216	0.239

This table reports determinants of cumulative yield changes, ΔY_i^h, for bond i over different horizons h based on the following cross-sectional regression:

$$\Delta Y_i^h = \alpha + \beta \mathbf{I}_i^{\text{HY-to-IG}} + \gamma' X_i + \varepsilon_i^h,$$

where $\mathbf{I}_i^{\text{HY-to-IG}}$ is an indicator variable for bonds upgraded from high-yield (HY) to investment-grade (IG) status, and X_i is a set of control variables described in Appendix A. The β coefficient is the estimated Cumulative Abnormal Yield (CAY) change for HY bonds upgraded to IG. For each horizon h, the sample used to estimate the regression consists of all bonds in the universe of 8,767 bonds that had actual transaction prices on the beginning and end dates for the horizon (no imputed prices). Missing values of regressors due to missing COMPUSTAT data are imputed with zero and a missing value dummy is included as additional regressor. The time horizons in the first row are in trading days. Day 0 is the Lehman announcement day (January 24, 2005). † indicates the effective date for the rule change (July 1, 2005). Two-sided p-values (shown in brackets) are computed using standard errors that are robust to heteroscedasticity and issuer clustering.

bonds (which equals $5.5\% - 5\% = 0.5\%$).[25] Thus, prediction H3 that the Lehman redefinition caused upgraded bond prices to increase is supported.

As a further check on the adequacy of our regression-based control approach, Table IA.2 in the Internet Appendix reports results from a battery of additional cross-sectional regressions. As in the CAY regression (1), the coefficient on the upgrade bond indicator shows if a characteristic of the upgraded bonds is special given the other controls. We find no evidence that the upgraded bonds are unusual in terms of their leverage ratios, interest coverage, maturity, liquidity, firm size, interest-to-debt ratio, or several other characteristics. The upgraded bonds are about a year older (p-value: 6%) and have somewhat lower coupons (p-value: 4%). In addition, the upgraded bond indicator is not statistically significant in explaining upgrade bond YTMs given the other control variables. Taken together, these results strengthen the conclusion that our RHS variables are effective in controlling for bond heterogeneity in regression (1).

3.1.2 Matched-sample approach. A second measure of abnormal valuation changes is the difference between the returns on a long portfolio of upgraded (treatment) bonds and a short matched portfolio of nonupgraded, but similar, (control) bonds. The advantage of this second approach is that it avoids potential selection bias in the regression-based CAY approach. To the extent that unobserved valuation-relevant characteristics are correlated with observed characteristics, the estimated $\hat{\beta}$s in (1) will be biased if the treatment sample has characteristics that differ from the average characteristics in the

25 The yield changes associated with the Lehman redefinition are also comparable to the 39 basis point decline in the average yield of bonds affected by the NRSRO designation of Dominion Bond Rating Service reported in Kisgen and Strahan (2010).

population (or in the control sample; see Barber and Lyon 1997; Heckman, Ichimura, and Todd 1997). A matched sample design avoids selection bias by explicitly constructing a control sample (the short portfolio leg) that is similar to the treatment sample (the long leg) in terms of the observed characteristics.

In our analysis, each bond in the treatment sample is matched to a set of control bonds chosen from the universe of all HY bonds that are either not rated by Fitch (the most numerous type of control bonds from Table 1) or have a Fitch rating below their Moody's and S&P ratings.[26] Bonds with Fitch ratings *equal* to the lower of their Moody's and S&P ratings are excluded from the baseline control group, because the Lehman redefinition mechanically increased the likelihood of the asset-class status of such bonds being upgraded in the future, and, thus, also potentially raised their prices.[27] In total, there are 337 HY control bonds. We then identify bond matches with similar credit based on two alternative criteria. The first is a baseline narrow-match criterion that matches treatment and control bonds based on their old Lehman index ratings up to the notch (e.g., BB+, BB, BB–, B+, etc.), their maturity bin (short = 1–5 years or long = 5 years or longer), and their size bin (<\$250 MM or ≥\$250 MM par value of bond issue outstanding). The number of matches ranges between 3 and 18 for each upgraded bond, with 10 matches on average. As a robustness check, we also match on an expanded set of criteria (the narrow criteria plus index beta, liquidity, coupon, and industry; see Appendix B), which should give a better match, but at the cost of fewer matches.

Our matched bonds appear similar to the upgraded bonds. Table IA.3 in the Internet Appendix explicitly shows that the upgraded bonds and the baseline- and extended-matched control bonds are similar across a range of issuer and bond characteristics, including interest coverage, interest-to-debt, tangibility, and profitability. Depending on the match criteria, the upgraded bonds do have lower coupons and some other characteristic differences (e.g., in maturity, firm size, and possibly lower YTMs) than the control bonds. Most importantly, however, the cumulative raw returns on the upgraded and control bonds, as shown in Figure 2, panel A, track each other closely over the pre-event window (−50,−10], indicating that the matched bonds are good controls for the upgraded bonds.

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

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

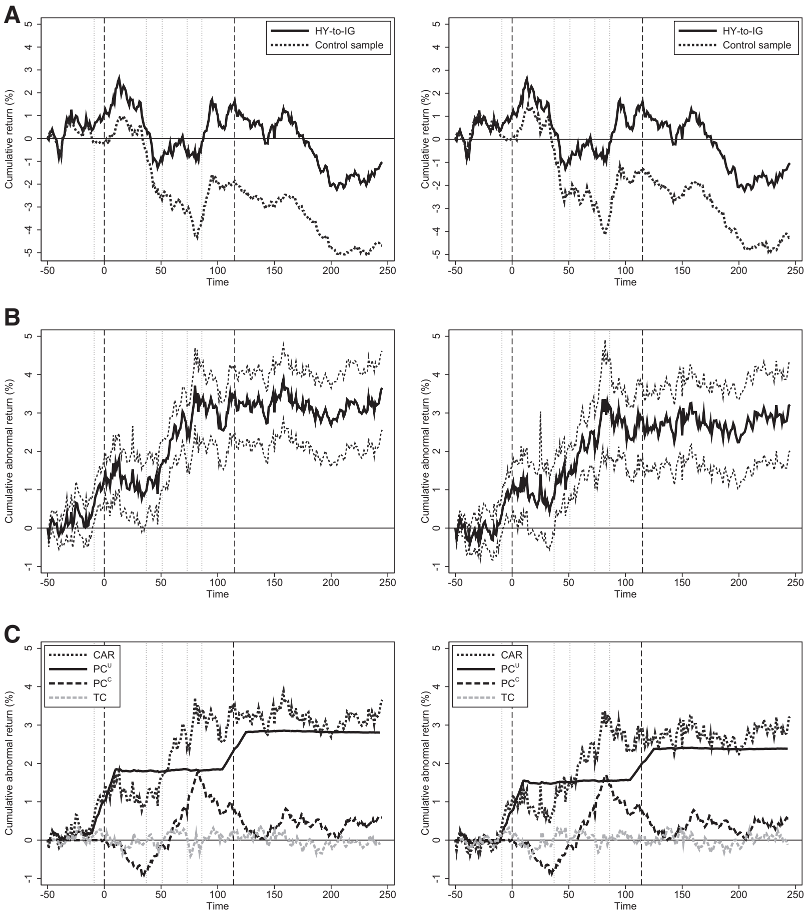

Figure 2
Announcement returns in bonds upgraded to investment grade
Panel A plots cumulative returns for the bonds upgraded from high-yield (HY) to investment-grade (IG) status and the associated matched-sample bonds described in Appendix B. Panel B shows cumulative abnormal returns calculated using the bootstrap approach described in Appendix B. The dotted lines are the bootstrapped confidence interval at 95% significance level. Panel C plots the decomposition of CARs (dotted line) into their permanent, contingent-permanent, and transitory components, PC_t^U, PC_t^C and TC_t, based on the Kalman filter estimation of specification E in Table 5. In each panel, the left plot is based on the baseline match, and the right plot is based on the expanded match. On the horizontal axis, day 0 is the Lehman announcement date (January 24, 2005) and day 114 is the effective date (July 1, 2005).

We estimate *Cumulative Abnormal Returns (CARs)* by averaging the long-short returns across 1,000 bootstrap rounds.[28] Barber and Lyon (1997), Lyon, Barber and Tsai (1999), and Chhaochharia and Grinstein (2007) show that

[28] Bessembinder, Kahle, Maxwell, and Xu (2009) finds that value-weighted portfolio-matching approaches are better specified and more powerful than equal-weighted approaches. We, therefore, use value weighting. However, we obtain similar results with equal weighting.

Table 3
Abnormal returns for bonds upgraded to investment-grade status

	Baseline long-short portfolio	Expanded long-short portfolio	Baseline, alternate imputation	Expanded, alternate imputation	Split by turnover		Split by maturity	
					Low (16)	High (39)	Short (20)	Long (37)
Control window:								
(−50,−10]	0.34	0.12	0.09	−0.14	−0.04	0.54	0.48	0.35
	[0.20]	[0.66]	[0.69]	[0.62]	[0.88]	[0.05]	[0.03]	[0.34]
Event window:								
(−10,0]	1.09	1.06	1.07	1.31	0.25	1.49	0.11	1.70
	[0.00]	[0.00]	[0.00]	[0.00]	[0.50]	[0.00]	[0.62]	[0.00]
(−10,10]	1.37	1.19	1.32	1.47	0.21	1.90	−0.13	2.31
	[0.00]	[0.00]	[0.00]	[0.00]	[0.54]	[0.00]	[0.64]	[0.00]
(−10,30]	0.60	0.47	0.58	0.60	−0.61	1.18	−0.53	1.37
	[0.07]	[0.24]	[0.14]	[0.13]	[0.21]	[0.00]	[0.02]	[0.00]
(−10,60]	1.99	1.91	1.58	1.63	1.66	2.15	1.07	2.47
	[0.00]	[0.00]	[0.00]	[0.00]	[0.05]	[0.00]	[0.02]	[0.00]
(−10,90]	2.61	2.46	2.60	2.57	1.03	3.33	0.51	3.81
	[0.00]	[0.00]	[0.00]	[0.00]	[0.20]	[0.00]	[0.12]	[0.00]
(−10,114]†	3.16	2.75	2.91	2.79	1.30	4.05	0.53	4.74
	[0.00]	[0.00]	[0.00]	[0.00]	[0.16]	[0.00]	[0.22]	[0.00]
(−10,245]	3.32	3.10	2.87	3.01	1.92	4.00	0.93	4.79
	[0.00]	[0.00]	[0.00]	[0.00]	[0.11]	[0.00]	[0.10]	[0.00]

This table reports cumulative abnormal returns for the bonds upgraded from high-yield (HY) to investment-grade (IG) status. Abnormal returns are calculated using the bootstrap approach (described in Appendix B) based on portfolios that are long the 57 upgraded bonds and short a set of matched control bonds. The control group used to form matches comprises all HY bonds that are either not rated by Fitch or have a Fitch rating below Moody's and S&P. The baseline specification matches each upgraded bond to a set of control bonds based on old index rating, maturity, and issue size. The expanded specification also matches on index beta, liquidity, coupon, and industry. The last two sets of columns split the upgraded bond sample based on turnover and, respectively, maturity. Missing bond prices are imputed using the two methods described in Section 2.2. Event time is measured in trading days relative to the Lehman announcement day 0 (January 24, 2005). † indicates the effective date for the Lehman rule change (July 1, 2005). Two-sided p-values (shown in brackets) are calculated using the bootstrap procedure described in Appendix B.

bootstrapping improves the accuracy of hypothesis tests with small sample sizes. We therefore bootstrap an empirical distribution of abnormal long-short returns in order to compute significance levels. As a pre-step, the distribution of cumulative returns for all bonds and all horizons is winsorized at the 0.5% and 99.5% levels. The details of the portfolio-based CARs and empirical p-values are described in Appendix B.

Table 3 reports cumulative abnormal returns around the Lehman announcement for the 57 upgraded bonds using the baseline matched-sample approach. These CARs are plotted over time in Figure 2, panel B, along with the associated 95% confidence intervals. We also obtained similar results for the expanded-match criterion and for the alternate missing price imputations from Section 2.2. First, the pre-event CARs in Table 3 are not statistically significant. This is consistent with the highly correlated pre-event upgraded and control bond returns in Figure 2, panel A, (and also with the insignificant pre-event CAY in Table 2). Second, the initial abnormal announcement returns on the upgraded bonds are economically significant, averaging about 1.06%–1.31% across the different specifications over the (−10,0] window.

Table 4
Announcement returns in bonds upgraded to investment grade

	HY-to-IG upgraded bonds	Control bonds	Long HY-to-IG, short control bonds
Return over event window (−1,0]	0.58	−0.10	0.68
	[0.03]	[0.11]	[0.00]
No. of bonds traded	22	153	175
Return over event window (−1,≥0]	0.52	−0.08	0.61
	[0.04]	[0.30]	[0.01]
No. of bonds traded	26	201	227

This table reports announcement returns for the bonds upgraded from high-yield (HY) to investment-grade (IG) status over two different announcement-day windows. Day 0 is the Lehman announcement day (January 24, 2005). The number of bonds in each portfolio is reported below the value-weighted portfolio returns. Two-sided p-values (shown in brackets) are computed using standard errors that are robust to heteroscedasticity and issuer clustering.

These returns are statistically significant at the 1% level or better. Third, following the Lehman announcement, abnormal returns on the upgraded bonds display a similar general pattern over time across the different specifications with some differences in timing and size.[29] Abnormal returns revert partially (around day +30), but then rebound around the time of the GM/Ford downgrades and stay economically and statistically large over longer horizons. The upgraded bond CARs reached roughly 2.75%–3.16% around the effective date. By the end of 2005, the CARs are still about 2.87%–3.32%. The abnormal returns on the upgraded bonds are economically large across all specifications. Hence, the evidence again strongly supports the predicted price appreciation after the Lehman redefinition (H3).

As might be expected, the segmentation effects are stronger in bonds that need to be held for a long time. Splitting the bonds into two maturity-based subsamples of 20 bonds with short maturities (1–5 years) and 37 bonds with long maturities (5 years or longer), Table 3 shows that the difference in abnormal returns for long- versus short-maturity bonds is 2.44% on day +10 and almost 4% by the year-end.

3.1.3 Short-horizon returns. Imputing prices on days that bonds do not trade lets us investigate CARs for the entire upgraded bond sample over time. However, price imputation does smooth returns on the actual announcement date. Table 4 reports the abnormal returns over two different short announcement windows using only bonds that traded. The first window

[29] To avoid lookback bias, our analysis of long-term price effects does not control for the fact that some upgraded bonds may subsequently experience downgrades and drop back into the HY index. Empirically, out of the 57 upgraded bonds in our sample, 56 maintained their new investment-grade index rating through the effective date but one dropped to high yield because of a downgrade before the effective date. In addition, four high-yield bonds were newly issued during the implementation period and entered the IG index on the effective date because of the Lehman redefinition. These later bonds are excluded from our analysis because of the requirement that bonds must have been in TRACE by day −10 before the Lehman announcement (i.e., so that their Lehman announcement returns can be computed).

(−1,0] is one day long, going from the day before the Lehman announcement through the day of the Lehman announcement. The sample consists of all 22 upgraded bonds and the 153 corresponding control bonds with trade prices on these two days. The mean abnormal announcement day return is 0.68%, which is statistically significant. The second window (−1,≥0] is the shortest possible announcement window, which excludes any pre-announcement price changes. For each bond that traded on the day before the Lehman announcement (day −1), we compute the return through the first day on or after the Lehman announcement on which that bond traded. The sample for this second window consists of 26 upgraded bonds and 201 control bonds. The mean abnormal return over this second window is 0.61%, which is again statistically significant. Thus, the evidence confirms positive and significant short-horizon abnormal announcement returns. These positive short-window abnormal returns for the traded bonds are not easily seen in Figure 2, panel B, because the CARs include the full sample of all upgraded bonds. Thus, the imputed zero returns for bonds that did not trade over (−1,0] smooth the CARs. The short-window abnormal returns understate the full valuation impact of the Lehman announcement due to pre-announcement leakage, infrequent trading, and slow-moving capital. As a result, the longer-window announcement CARs over (−10,0] and (−10,10] capture more of the full effect, but potentially with additional noise.

3.2 Kalman filter analysis

Although the CAR (and CAY) estimates on the effective date and at year-end are statistically large, the intervening fluctuations (e.g., around day +30) raise questions about whether the valuation impact of the Lehman redefinition really is permanent and, hence, whether long-term demand curves (in addition to short-term demand curves) are downward-sloping for corporate bonds. We investigate this issue next.

Bond returns affected by the Lehman redefinition may include a variety of different components. This lets us refine our basic pricing prediction H3 from Section 1.3. First, if the risk-bearing capacity reflected in the pricing kernel for the upgraded bonds increases (because of new demand from asset-class-sensitive investors), then we expect permanent price changes around the Lehman announcement date (denoted as hypothesis H7) and potentially around the effective date (denoted as H8). However, these permanent returns may accrete gradually due to pre-announcement information leakage and postannouncement slow-moving capital price effects. Second, we expect events after the Lehman announcement to interact with the Lehman redefinition in bond prices. For example, note that the upgraded bond CARs in Figure 2, panel B, peak around the time of the GM/Ford downgrades, which presumably affected the relative pricing of all IG and HY bonds. In particular, the upgraded bonds, as newly minted investment-grade bonds, should trade at a premium over otherwise similar high-yield bonds, where the magnitude of this premium should change over time with the overall relative performance of the IG and HY indexes. We call this a *contingent price effect* of the Lehman redefinition (denoted as H9). Controlling for the contingent price effect allows for sharper identification of the permanent component in the announcement return compared with just looking at raw long-horizon CARs as in Table 3. Third, bond returns include a transitory component due to illiquidity (Edwards, Harris, and Piwowar 2007).

To assess the magnitudes of the various permanent, transitory, and contingent components in the upgraded bond returns, we decompose cumulative abnormal returns using a Kalman filter as follows:[30]

$$\begin{aligned} CAR_t &= PC_t + TC_t, \\ PC_t &= PC_{t-1} + \alpha_{\text{Ann}}\mathbf{I}_t^{\text{Ann}} + \alpha_{\text{Eff}}\mathbf{I}_t^{\text{Eff}} + \beta_{-K} IMH_{t-K} + \ldots + \beta_K IMH_{t+K} + \eta_t, \\ TC_t &= \delta_1 TC_{t-1} + \ldots + \delta_L TC_{t-L} + \epsilon_t. \end{aligned} \tag{2}$$

The permanent component PC_t is an unobserved unit-root process, and the transitory component TC_t is an unobserved mean-reverting process with a zero long-run mean. $\mathbf{I}_t^{\text{Ann}}$ and $\mathbf{I}_t^{\text{Eff}}$ are daily indicator variables equal to $1/\Delta T$ in event windows (with length ΔT) around the Lehman announcement and effective dates respectively, and zero otherwise. This allows for pre-announcement leakage and postannouncement slow-moving capital drift via the coefficient α_{Ann}, which lets the initial permanent impact of the redefinition accrete linearly over the initial announcement window $(-10, 10]$ (i.e., $\Delta T = 20$ days).[31] Similarly, the coefficient α_{Eff} measures the permanent price impact of the redefinition over a window $(114 - 10, 114 + 10]$ around the effective date. IMH_t is the "investment-grade minus high-yield" excess return of a portfolio that is long the Lehman IG index and short the Lehman HY index on dates after the Lehman announcement ($t > 0$); and equal to 0 on or before the announcement date ($t \leq 0$). The coefficients $\beta_{-K}, \ldots, \beta_K$ allow, analogous to a Dimson beta, the permanent price component to respond to the differential IMH_t returns with K leads and lags. Although some variation in IMH_t comes from changing relative credit quality of the two indexes, IMH_t will also reflect changing pricing kernels for the two segmented markets. The permanent and transitory shocks η_t and ϵ_t are independent Gaussian random variables with variances σ_η^2 and, respectively, σ_ϵ^2. The coefficients $\delta_1, \ldots, \delta_L$ allow for autocorrelation in the transitory component TC_t.

[30] To the best of our knowledge, this is the first use of a Kalman filter to estimate this type of decomposition in an event study.

[31] Given the scaling of the $\mathbf{I}$ variables, the αs estimate the total permanent abnormal return over the full ΔT window.

Table 5
Decomposition of abnormal bond returns

	(A)	(B)	(C)	(D)	(E)
α_{Ann}	1.33	1.35	1.34	1.46	1.62
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
α_{Eff}	0.88	0.88	0.88	0.96	0.96
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
$\sum_i \beta_i$	0.25	0.25	0.25	0.29	0.34
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
β_{-2}	–	–	–	–	0.05
					[0.15]
β_{-1}	–	–	–	0.10	0.08
				[0.00]	[0.03]
β_0	0.25	0.25	0.25	0.22	0.22
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
β_1	–	–	–	−0.03	−0.06
				[0.36]	[0.08]
β_2	–	–	–	–	0.05
					[0.09]
δ_1	0.58	0.54	0.54	0.55	0.58
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
δ_2	–	0.14	0.15	0.18	0.20
		[0.05]	[0.04]	[0.01]	[0.00]
δ_3	–	–	−0.03	–	–
			[0.67]		
σ_η	0.04	0.04	0.04	0.03	0.00
	[0.14]	[0.19]	[0.17]	[0.48]	[1.00]
σ_ϵ	0.15	0.15	0.15	0.15	0.15
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Log-likelihood	118.11	120.11	120.20	125.62	128.70
AIC	−224.21	−226.21	−224.39	−233.24	−237.41
BIC	−202.34	−200.69	−195.23	−200.49	−201.09

This table reports Kalman filter estimates of the following decomposition of abnormal returns for bonds upgraded from high-yield (HY) to investment-grade (IG) status:

$$CAR_t = PC_t + TC_t,$$
$$PC_t = PC_{t-1} + \alpha_{\text{Ann}}\,\mathbf{I}_t^{\text{Ann}} + \alpha_{\text{Eff}}\,\mathbf{I}_t^{\text{Eff}} + \beta_{-K} IMH_{t-K} + \ldots + \beta_K IMH_{t+K} + \eta_t,$$
$$TC_t = \delta_1 TC_{t-1} + \ldots + \delta_L TC_{t-L} + \epsilon_t,$$

where CAR_t is the average cumulative abnormal return on the upgraded bonds computed using the baseline long-short matched-sample approach described in Appendix B, PC_t is a permanent (unit root) process, TC_t is a transitory (mean-reverting) process with long-run mean of zero, IMH_t is the excess return of a portfolio that is long the Lehman IG index and short the Lehman HY index on dates after the Lehman announcement ($t > 0$), and zero on dates on or before the announcement date ($t \leq 0$). $\mathbf{I}$ is an indicator for the event window $[t - \Delta T/2, t + \Delta T/2]$, with window size ΔT that takes value $1/\Delta T$ during announcement or effective date windows as indicated by the superscripts, and zero otherwise. The window length is $\Delta T = 20$. The error terms (η_t, ϵ_t) are independent Gaussian random variables. The number of trading day observations is 283. Two-sided p-values (shown in brackets) are computed using Kalman filter standard errors.

Table 5 reports Kalman filter estimates of the decomposition in (2). Each column corresponds to a different specification (with varying lead/lag lengths K and L). The Akaike information criterion (AIC) and the Bayesian information criterion (BIC) give mixed results. Specifications A and E give the best fit according to BIC and AIC, respectively. The $\hat{\alpha}_{\text{Ann}}$ estimates imply an initial permanent price reaction of 1.33%–1.62% (which supports hypothesis H7 with a p-value < 1%). An additional permanent price reaction $\hat{\alpha}_{\text{Eff}}$ of 0.88%–0.96% occurs around the effective date (which supports hypothesis

H8 with a p-value $< 1\%$). The Kalman filter $\hat{\beta}$ estimates indicate a statistically significant contingent impact of IMH_t on upgraded bond returns after the Lehman redefinition (supporting hypothesis H9). This contingent effect could be due to pre-existing differences in how the upgraded bonds load on the IG and HY indexes or, alternatively, because of a structural change in their co-movement with the IG and HY indexes caused by the Lehman label redefinition itself.[32] The estimated volatilities σ_η of the residual permanent shocks are small because most of the variation in the permanent component PC_t is due to IMH_t.[33]

The cumulative permanent returns $\widehat{PC}_t$ from the Kalman filter can be decomposed into a contingent component that depends on realized IMH_t returns, $\widehat{PC}_t^C = \sum_{s=t_0+1}^{t}(\hat{\beta}_{-K}\, IMH_{s-K} + \ldots + \hat{\beta}_K IMH_{s+K})$, and a residual, $\widehat{PC}_t^U = \widehat{PC}_t - \widehat{PC}_t^C$, reflecting events unrelated to the IMH_t performance. Figure 2, panel C, plots this decomposition for specification E with $L=2$ and $K=2$. As can be seen from the fitted $\widehat{PC}_t^C$ component, abnormal returns on the upgraded bonds are quite sensitive to fluctuations in the differential IMH_t return, consistent with upgraded bonds trading at a time-varying premium relative to their former HY peers (consistent with H9). In particular, the IMH_t-contingent price effect explains much of the reversion/rebound pattern of the upgraded bond CARs. Removing this contingent variability also sharpens our estimate of the initial permanent price impact ($\hat{\alpha}_{\text{Ann}}$). Visually, the price impact of the Lehman redefinition around both the announcement and effective dates is readily apparent in the plot of $\widehat{PC}_t^U$ in panel C. In summary, these plots show how the observed patterns in the upgraded bond CARs follow directly from the various permanent, contingent, and transitory components.

3.2.1 Robustness. Table IA.4 in the Internet Appendix reports further Kalman filter results for a battery of robustness checks using different control and treatment samples. In particular, we restrict the control group to (1) bonds with no Fitch ratings or, alternatively, (2) we also include bonds with Fitch ratings equal to their old index ratings, or (3) we exclude upgraded bonds whose underlying credit ratings were subsequently raised after the Lehman announcement. All of the results for the different bond samples,

32 As reported in Table 5, we only test whether IMH_t affects the postannouncement pricing of the upgraded bonds. In unreported results, we also compared pre- and postannouncement β coefficients to test for a label-induced structural change in index comovement (as in Boyer, 2011). The estimated postannouncement $\hat{\beta}$ is larger than the pre-announcement $\hat{\beta}$ but not statistically significantly so. However, this test has low power given the limited availability of pre-event data (due to the timing of TRACE Phase III) and the modest variation of pre-announcement returns.

33 The p-values do not reject the null of zero for σ_η^2 for any of the specifications. For specification E, the estimated value of σ_η^2 is very small. We also estimated specification E with η_t set to zero, so that IMH_t is the only source of permanent price variation, and the results are virtually identical.

with both the baseline (narrow) and expanded (broad) matching, confirm significant positive permanent abnormal announcement returns, a significant contingent effect, and (with one exception) a significant positive permanent effective-date abnormal return. Thus, the evidence for market segmentation pricing effects appears to be robust.

3.3 Impact on bond holdings and trading

The investment practices hypothesis attributes the price increase for upgraded bonds to increased demand from asset-class-sensitive bond investors. To test the trading hypotheses H1 and H2, we examine turnover and order-flow imbalances around the Lehman announcement. We also directly examine trading by insurance companies and investment-grade (style) bond mutual funds as specific examples of asset-class-sensitive investors. Because the Lehman redefinition had no impact on the regulatory treatment of these bonds, any purchases of these bonds cannot be due to insurance company or mutual fund regulation. Lastly, we present cross-sectional evidence linking the upgraded bond price appreciation to trading activity, which is a proxy for changes in bond ownership.

3.3.1 Trading activity. Our first measure of trading activity is relative turnover, defined as TRACE trading volume (winsorized) divided by the FISD total outstanding bond par value. Table 6, panel A, reports statistics for average daily turnover for the 57 upgraded bonds and the 337 HY control bonds over three time periods: the pre-announcement window $(-50,-10]$, the postannouncement window $(-10,114]$, and the posteffective window $(114,245]$. Consistent with the predicted demand shock, turnover for the upgraded bonds exhibits a significant transitory increase. Between the announcement and effective dates, daily turnover for the upgraded bonds roughly doubles, from 0.19% to 0.39% and then, after the effective date, reverts toward its pre-event level. The control bonds do not exhibit this same pattern. A formal difference-in-difference test rejects the null that changes in turnover in the upgraded and control bonds are the same. Thus, the upgraded bonds appear to have had a temporary abnormal increase in trading—and, thus, more ownership changes—following the Lehman announcement.

3.3.2 Trading by institutional investors. Trading data for insurance companies from NAIC let us investigate directly whether the increased bond turnover after the Lehman announcement is due, in part, to increased buying by asset-class-sensitive investors. Given their sizeable holdings, insurance companies are a prominent example of asset-class-sensitive investors. According to Federal Reserve data, insurance companies own 25%

Table 6
Bond turnover and institutional trading activity

Panel A: Turnover (% of issue)

	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.
HY-to-IG bonds	0.19	0.39	0.27	0.20	0.08	0.15	0.12
	[0.00]	[0.00]	[0.00]	[0.00]	[0.02]	[0.00]	[0.00]
Control bonds	0.26	0.31	0.23	0.05	−0.04	–	–
	[0.00]	[0.00]	[0.00]	[0.08]	[0.18]		

Panel B: Institutional purchases and sales

	Event window			Diff-in-Diff		
	Post-announce	Post-effective	Post-ann.+ post-eff.	Post-announce	Post-effective	Post-ann.+ post-eff.
Δ Insurance company holdings ($ MM)						
HY-to-IG bonds	2.27	11.05	13.32	4.89	12.43	17.32
	[0.46]	[0.04]	[0.07]	[0.12]	[0.02]	[0.02]
Control bonds	−2.63	−1.38	−4.01	–	–	–
	[0.00]	[0.09]	[0.00]	–	–	–
Δ Insurance company holdings (% of issue)						
HY-to-IG bonds	0.55	2.10	2.65	1.29	2.56	3.86
	[0.54]	[0.13]	[0.18]	[0.16]	[0.07]	[0.05]
Control bonds	−0.74	−0.46	−1.20	–	–	–
	[0.00]	[0.04]	[0.00]	–	–	–
Δ Mutual fund holdings ($ MM)						
HY-to-IG bonds	3.43	1.69	5.12	3.79	1.90	5.69
	[0.16]	[0.31]	[0.02]	[0.06]	[0.22]	[0.04]
Control bonds	−0.36	−0.21	−0.57	–	–	–
	[0.61]	[0.78]	[0.55]	–	–	–
Δ Mutual fund holdings (% of issue)						
HY-to-IG bonds	0.72	0.05	0.77	2.97	1.24	4.21
	[0.29]	[0.31]	[0.09]	[0.17]	[0.26]	[0.04]
Control bonds	−2.25	−1.19	−3.44	–	–	–
	[0.30]	[0.82]	[0.75]	–	–	–

This table reports statistics on daily turnover, insurance company trading, and changes in investment-grade-style mutual fund holdings for bonds upgraded from high-yield (HY) to investment-grade (IG) status. We report equal-weighted averages. For turnover and insurance company trading, the pre-announcement window is (-50,-10], the postannouncement window is (-10,114], and the posteffective window is (114,245], where day 0 is the Lehman announcement date (January 24, 2005). For the quarterly mutual fund trading, the postannouncement window is the first and second quarters in 2005 and the posteffective window is the third and fourth quarters. The control group comprises HY bonds that are either not rated by Fitch or have a Fitch rating below Moody's and S&P. Two-sided p-values (shown in brackets) are computed using standard errors that are robust to heteroscedasticity and issuer clustering.

of the corporate bonds outstanding over the 2004–2005 time period.[34] Insurance companies actively trade high-yield bonds for their own portfolios and in separate accounts for variable insurance and annuity products (see Wells Fargo, 2009).

Figure 3, panel A, shows cumulative trading by insurance companies around the Lehman announcement. Insurance companies clearly increased their holdings in the 57 upgraded bonds over the postannouncement and posteffective periods (solid line) and sold the 337 HY control bonds (dashed line). Table 6, panel B, reports changes in insurance company holdings of upgraded and control bonds, cumulated over the postannouncement window (−10,114] and posteffective window (114,245], and tests statistically for abnormal portfolio shifts. On average, insurance companies bought \$13.32 million of each bond upgraded to IG status (\$2.27 million after the announcement plus a further \$11.05 million after the effective date), or 2.65% of the issue size. In contrast, insurance companies shunned the HY control bonds. The abnormal increase in insurance company holdings of upgraded bonds relative to the control bonds is \$17.32 million per issue, or 3.86% of the issue size on average. A difference-in-difference test shows that the abnormal increase in insurance company upgraded bond holdings is statistically significant.

We note that, whereas the upgraded bond prices seem to have reacted around the Lehman announcement date, most of the insurance company order flow arrived after the effective date. This is consistent with the approval process for new investment policies taking time. It is also consistent with indexation and internal index-based benchmarking at insurance companies after these bonds actually entered the benchmark IG index on the effective date (consistent with hypothesis H4). Consequently, some of the future insurance company order flow may have been predictable at the time of the Lehman announcement. To investigate this, we regressed the cross-section of bond returns over the announcement window (−10,10] on insurance company net order flow for these bonds over three time-windows: (−10,10], (10,114], and (114,245]. The question is whether bonds with greater current and future buying had greater initial announcement returns. The results are in Table 7. First, most of the price-impact of order flow is concentrated in longer-maturity bonds. This makes sense because valuation effects are likely to be greater for these bonds. Second, the immediate order flow (over (−10,10]) and the large posteffective order flows (over (114,245]) both have significant explanatory power for the announcement returns. Moreover, the regression R^2s indicate that this explanatory power was substantial. Thus, it appears the market was able to predict which bonds would have future buying and factored that predictable demand into bond prices after the Lehman announcement.

[34] See Federal Reserve, Flow of Funds, Table L.212 Z.1.

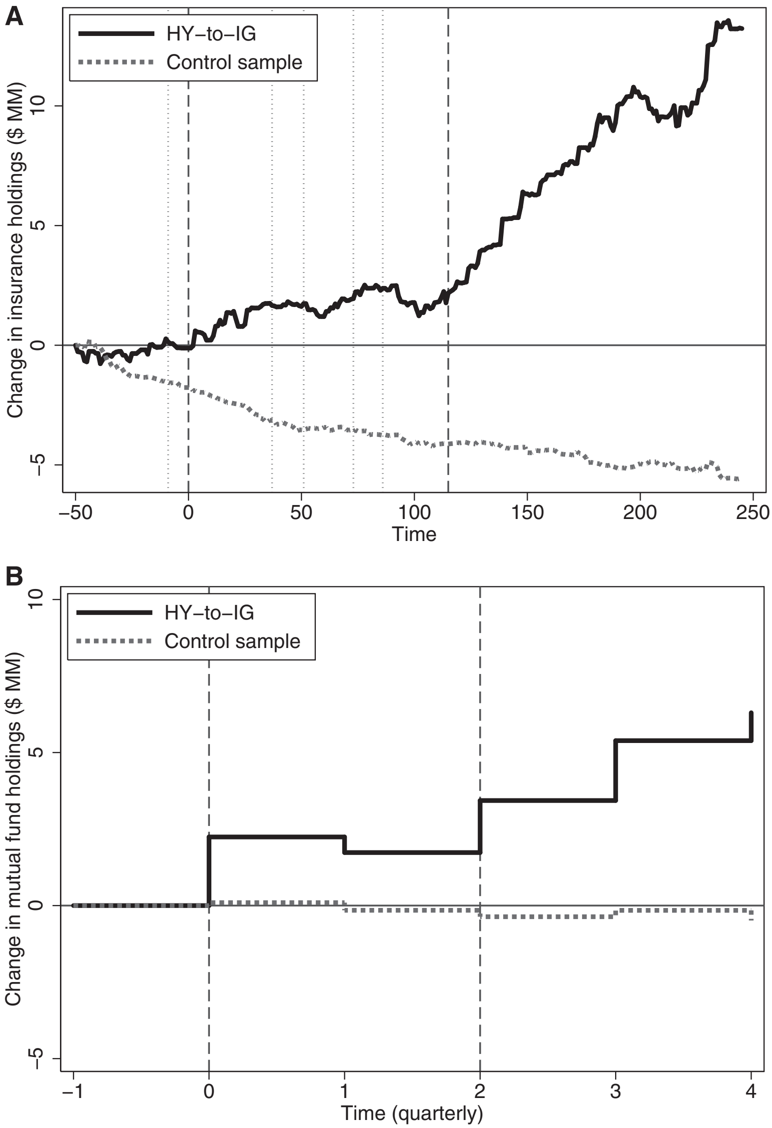

Figure 3
Institutional trading in bonds switching from HY to IG segment
Panel A plots the average cumulative change in the aggregate insurance company holdings (in units of $ MM per bond) of the bonds upgraded from high-yield (HY) to investment-grade (IG) status and, respectively, the HY control bonds with no Fitch rating or a lower Fitch rating. For insurance company holdings, time is measured in trading days, where day 0 is the Lehman announcement date (January 24, 2005) and day 114 is the effective date (July 1, 2005). Panel B plots the average cumulative change in the aggregate IG style mutual fund holdings (in units of $ MM per bond) for the upgraded bonds and control bonds. Mutual funds are identified as following an IG bond style if they have average quarterly holdings of investment-grade bonds in excess of 50% of their total holdings (both under the old rating and the new rating framework). For mutual fund holdings, time is measured in quarters, where quarter 1 is the first quarter of 2005.

Table 7
Insurance trading and returns

	(A)	(B)	(C)	(D)	(E)	(F)
Insurance NOF (−10,10]	3.27	−1.07	2.38	−2.11	2.98	−2.79
	[0.00]	[0.17]	[0.10]	[0.01]	[0.07]	[0.01]
Insurance NOF (−10,10]*maturity		0.21		0.21		0.21
		[0.00]		[0.00]		[0.00]
Insurance NOF (10,245]			0.53	0.20		
			[0.01]	[0.46]		
Insurance NOF (10,245]*maturity				0.03		
				[0.11]		
Insurance NOF (10,114]					−0.13	1.21
					[0.84]	[0.17]
Insurance NOF (10,114]*maturity						−0.01
						[0.94]
Insurance NOF (114,245]					0.71	−0.37
					[0.00]	[0.47]
Insurance NOF (114,245]*maturity						0.07
						[0.03]
Maturity	0.00	0.00	0.00	0.00	0.00	0.00
	[0.01]	[0.00]	[0.01]	[0.00]	[0.01]	[0.00]
Constant	−0.00	−0.01	−0.00	−0.01	−0.00	−0.01
	[0.81]	[0.00]	[0.56]	[0.00]	[0.55]	[0.00]
R^2	0.438	0.578	0.479	0.655	0.489	0.672

This table reports the relation between insurance company net order flow (NOF) over different horizons h and announcement returns on the upgraded bonds (indexed by i) over the announcement window (−10,10] (where day 0 is the Lehman announcement date) using the following cross-sectional regression:

$$CR_i^{(-10,10]} = \alpha + \beta\,\text{NOF}_i^h + \gamma\ \text{Controls}_i^h + \varepsilon_t.$$

The number of observations is 57. Two-sided p-values (shown in brackets) are computed using standard errors that are robust to heteroscedasticity and issuer clustering.

A second type of asset-class-sensitive investors is index and actively managed investment-grade bond mutual funds. Mutual funds are typically classified in terms of their investment style or objective. Bond funds that focus on IG bonds are likely to be influenced by the Lehman redefinition because they are routinely benchmarked against Lehman indexes. The Lipper eMAXX database does not provide explicit information on fund asset-class styles, so we identify IG bond mutual funds as funds with average quarterly holdings of IG bonds of more than 50% of their total holdings (under both the old and new rating rules).

Figure 3, panel B, shows cumulative holding changes at IG bond mutual funds. Unlike the daily NAIC data for insurance companies, the eMAXX database only has quarterly holding information. Changes in bond holdings are measured relative to the fourth quarter of 2004. The Lehman's announcement occurs in the first quarter of 2005 ($t = 1$). The rising stair-stepped line plots the equal-weighted average cumulative change in the aggregate par dollar holdings of the upgraded bonds at IG bond mutual funds. The slightly falling flat line is the corresponding average for the HY control bonds. Hence, over the postannouncement period, IG bond mutual funds increased their holdings in the upgraded bonds and roughly held constant their holdings of the HY control bonds.

Table 6, panel B, also reports cumulative trading statistics and a difference-in-difference test for changes in IG bond mutual fund holdings of the upgraded and control bonds. The postannouncement window covers the first and second quarter of 2005, and the posteffective window covers the third and fourth quarter of 2005. On average, IG bond funds bought \$5.12 million of each bond upgraded to IG status (\$3.43 million after the announcement plus a further \$1.69 million after the effective date), or 0.77% of the issue size. The abnormal increase in their holdings of upgraded bonds relative to the control bonds is \$5.69 million per issue (\$3.79 plus \$1.90 million), or 4.21% of the issue size on average. The difference-in-difference tests confirm that the increase at IG bond mutual funds in the upgraded bonds relative to the control bonds is statistically significant.

We also reviewed prospectuses for the ten mutual funds with the largest net purchases of the upgraded bonds (accounting for 70% of the total net purchases). Consistent with the idea of investability norms, the funds' descriptions of which bonds qualified as investment grade often allowed for considerable discretion.[35] Consistent with Lehman's potential influence in the funds' investment processes, five of the ten funds explicitly benchmark themselves to Lehman indexes (including three of the top four funds in net purchases).

3.3.3 Trading and prices. If there is an economic link between clientele changes in bond ownership and prices, then abnormal returns should covary positively with trading volume. To check this, we split the upgraded bond sample based on postannouncement turnover. The columns marked "Split by turnover" in Table 3 summarize these results. Consistent with segmentation-based trading, the upgraded bonds with high turnover have higher CARs than low turnover bonds, with the difference reaching 2.75% around the effective date. We also confirmed that the Kalman filter estimates of $\hat{\alpha}_{\text{Ann}}$ for announcement-date permanent price effects are positive and significant for bonds with high postannouncement trading volume (results omitted for brevity).

More generally, rating-based segmentation predicts that increased bond demand from asset-class-sensitive investors caused order-flow imbalances, which then, through the market microstructure price-order flow relation, drove bond prices higher. Table IA.5 in the Internet Appendix verifies that order flow and bond prices are indeed positively correlated. The R^2s in our price-order flow regressions are up to 45%. In particular, the price-order

[35] The Vanguard Fixed Income Funds prospectus dated May 2005 says that "Credit quality is evaluated by one of the independent bond-rating agencies (for example, Moody's or Standard & Poor's) or through independent analysis conducted by a fund's advisor." Another example is the Western Assets Fund prospectus dated August 2005 which says that "If securities are rated investment grade by one rating organization and below investment grade by others, a Portfolio's investment adviser may rely on the rating that it believes is more accurate and may consider the instrument to be investment grade."

flow relation is strongly positive for a variety of different specifications. The price-order flow is also positive for order flows based on different transaction size metrics, including large trades over $1 MM, which are predominantly institutional.

4. Segmentation Mechanisms

Market segmentation can occur through a variety of rating-based investment practices. One prominent rating-based practice is indexation. A large literature has studied the effects of passive indexation by equity investors when stocks are added or dropped from a major stock index.[36] While mechanical indexation is one way in which investors use bond index ratings (and, thus, the underlying bond credit ratings), other rating-based investment practices are also important. Calio (2005) suggests that active investors became more willing to consider positions in the upgraded bonds once the Lehman redefinition moved them into the investable IG asset class. We call this the *investability* hypothesis in Section 1.3. To test for the presence of these two mechanisms, we divide the upgraded bonds into a subsample of 34 upgraded bonds—which we call *IG index-eligible bonds*—which met the additional bond characteristic requirements to enter the IG index itself and a subsample of the remaining 23 upgraded bonds—which we call *orphan bonds*—which had IG asset-class status according to the Lehman index rating rules but were left out of the IG index because they did not satisfy the IG par size requirement.[37] The index-eligible bonds could be affected by both indexation and investability, but orphan bonds can only be affected by investability because they cannot enter the IG index. We further distinguish between 10 orphan bonds that were dropped from the HY index and 13 orphan bonds that were never in either index.

Table 8, panel A, compares returns on the orphan bonds and the IG index-eligible bonds. The announcement returns on the orphan bonds are significantly positive (in the "All orphans" column) and exhibit a similar trajectory as the IG index-eligible bonds. While the 34 IG index-eligible bonds outperformed the 23 orphan bonds immediately after the announcement (day 0), once we allow for slow-moving capital, the CARs on the IG index-eligible and orphan bonds are very similar by day +10 and remain similar for the rest of the year.[38] In fact, on some days, the 10 orphan bonds exiting from the HY index—for which indexation effects should be negative—actually

[36] See, for example, Shleifer (1986); Harris and Gurel (1986); Dhillon and Johnson (1991); Vijh (1994); Kaul, Mehrotra, and Morck (2000); Wurgler and Zhuravskaya (2002); Denis, McConnell, Ovtchinnikov, and Yu (2003); Chen, Noronha, and Singhal (2004); Mitchell, Pulvino, and Stafford (2004); Barberis, Shleifer, and Wurgler (2005); Greenwood (2005); Hendershott and Seasholes (2009).

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

[38] Formal *t*-tests cannot reject equality of the orphan and index-eligible bond CARs for most of the year.

Table 8
Asset class investability versus indexation

	Orphan bonds			**Index-eligible upgraded bonds**
	All orphans (23)	HY index members (10)	Index nonmembers (13)	(34)
Panel A: CAR on orphan and index-eligible upgraded bonds				
Control window:				
(−50,−10]	0.46	0.94	−0.38	0.30
	[0.14]	[0.02]	[0.40]	[0.36]
Event window:				
(−10,0]	0.38	0.64	0.14	1.23
	[0.25]	[0.14]	[0.71]	[0.00]
(−10,10]	1.55	1.87	1.09	1.34
	[0.00]	[0.00]	[0.13]	[0.00]
(−10,30]	1.16	1.50	0.78	0.56
	[0.01]	[0.01]	[0.18]	[0.13]
(−10,60]	2.48	1.81	4.21	1.93
	[0.00]	[0.01]	[0.00]	[0.00]
(−10,90]	4.05	4.11	3.91	2.30
	[0.00]	[0.00]	[0.00]	[0.00]
(−10,114]†	4.11	4.38	3.27	2.98
	[0.00]	[0.00]	[0.00]	[0.00]
(−10,245]	5.48	6.10	3.98	2.95
	[0.00]	[0.00]	[0.03]	[0.00]
Panel B: Decomposition of abnormal bond returns				
α_{Ann}	0.96	1.28	1.81	1.49
	[0.07]	[0.08]	[0.01]	[0.00]
α_{Eff}	0.98	0.95	1.12	0.93
	[0.09]	[0.22]	[0.03]	[0.00]
Panel C: Trading volume (diff-in-diff)				
Turnover post-ann. (%)	0.03	0.14	−0.05	0.22
	[0.41]	[0.03]	[0.19]	[0.00]
Turnover post-eff. (%)	0.05	0.11	0.01	0.16
	[0.27]	[0.25]	[0.72]	[0.00]
Panel D: Insurance company bond trading (diff-in-diff)				
Δ Holdings ($ MM)	4.31	3.30	5.09	26.12
	[0.18]	[0.64]	[0.00]	[0.03]
Δ Holdings (% of issue)	0.99	−0.24	1.93	5.80
	[0.60]	[0.95]	[0.02]	[0.04]

This table reports statistics for subsamples in which the bonds upgraded from high-yield (HY) to investment-grade (IG) status are divided into orphan bonds (that were not eligible for IG index inclusion) and, respectively, bonds that were eligible to enter the IG index. The number of bonds is reported in parentheses. Panel A reports cumulative abnormal returns on the orphan and index-eligible upgraded bonds, calculated using the bootstrap approach described in Appendix B. Matched samples are formed using bonds that are either not rated by Fitch or have a Fitch rating below Moody's and S&P and by matching on old Lehman index ratings, maturity, and issue size. Panel B reports permanent price impact estimates from a Kalman filter decomposition based on specification E in Table 5. Panel C reports statistics on daily turnover over the postannouncement window (−10,114] and posteffective window (114,245], and panel D reports aggregate insurance company bond trading over the combined postannouncement and posteffective window (−10,245]. Two-sided *p*-values (shown in brackets) are computed using the bootstrap distribution (in panel A), the Kalman Filter standard errors (in panel B), and standard errors that are robust to heteroscedasticity and issuer clustering (in panels C and D).

outperformed the 34 index-eligible bonds. Based on the evidence for the orphan bonds, it appears that investability, not just indexation alone, also affected the pricing of the upgraded bonds (corroborating hypothesis H5). At the same time, these comparisons do not imply the indexation effect H4 is zero, because the index-eligible bond issues are larger than the orphan bonds.

Panel B shows key parameter estimates for the Kalman filter decomposition for the different bonds. The orphan bond $\hat{\alpha}_{\text{Ann}}$ point-estimate is positive (*p*-value: 7%) and is roughly two-thirds of the corresponding $\hat{\alpha}_{\text{Ann}}$ for the index-eligible bonds. Moreover, the overall orphan $\hat{\alpha}_{\text{Ann}}$ may be depressed by the former HY-index orphan bonds (which experienced a positive investability shock, but a *negative* indexation shock because they left the HY index but could not enter the IG index). In particular, we note that $\hat{\alpha}_{\text{Ann}}$ is even bigger for the index nonmembers and has a strongly significant *p*-value (1%). This all supports the investability hypothesis H5.

The orphan and index-eligible $\hat{\alpha}_{\text{Eff}}$ point-estimates are very similar, although the orphan bond's *p*-value is weaker. To the extent that there is a permanent effective date effect in the orphan bonds, this suggests that the posteffective date price effect in the other upgraded bonds is not entirely due to indexation.

An alternative indexation-based explanation for the orphan bond returns, based on Greenwood (2005), is arbitrage-induced spillovers from indexation demand for the index-eligible bonds. Risk-averse arbitrageurs may have accommodated indexation-driven demand for the index-eligible bonds by shorting the index-eligible bonds and hedged by buying correlated bonds. Since some firms have orphan bonds as well as index-eligible bonds, these hedges potentially included orphan bonds and, thus, may have driven up orphan bond prices.

There are several counterarguments against the indexation-spillover explanation. First, given anecdotal claims that mechanical issue-by-issue index replication is uncommon for large bond indexes (in contrast to the S&P 500 and other equity indexes), strong index demand seems unlikely for the index-eligible bonds, which collectively constitute only 1.4% of the total IG index market capitalization (as opposed to, say, the large market-cap Ford and GM bonds, where indexation is likely to be first-order). Second, and perhaps more importantly, the price shocks experienced by the index-eligible bonds are persistent, so the index-eligible versus orphan "arbitrage" would involve maintaining long orphan bond positions until nonindexation orphan bond demand arrived to support the price increase, thereby allowing arbitrageurs to unwind their positions. Thus, arbitrage trading would just be front-running anticipated future nonindexation demand for orphan bonds. Third, these bonds are relatively illiquid, so they would be hard to short, and transaction costs could be substantial. Fourth, panels C and D show little evidence of significant abnormal trading for the orphan bonds, either in general or specifically by insurance companies. Rather, the abnormal trading seems to be concentrated in the index-eligible bonds. This suggests that the prices of the orphan bonds appreciated, not because of immediate price pressure (e.g., due to arbitrage-linked hedging), but rather because of the anticipated value of an enlarged set of potential buyers (active IG bond investors) in the future. Fifth, we also looked specifically at volume in non-orphan bonds issued by companies with index-eligible bonds—which could also be used as arbitrage hedges—and again do not find evidence of abnormal volume. (For brevity, these results are not reported here.) Taken together, the orphan bond price appreciation does not seem to be driven by arbitrageur hedging.

5. Further Evidence and Hypotheses

This section documents market segmentation effects in another group of bonds. These are high-yield bonds whose asset-class status did not change immediately, but whose future asset-class transition probabilities improved because of a favorable Fitch bond rating. To the extent that asset-class transition probabilities are reflected in bond prices, the prices of nonupgraded Fitch-favorable bonds should also react to the Lehman announcement in anticipation of future rating-based segmentation demand. This section also reports tests on two other hypotheses. First, we test whether the Lehman redefinition had any informational impact on the stock prices of the issuers of Fitch-favorable bonds. Second, we check for a *priced liquidity* effect.

5.1 Rating-based segmentation or Fitch reputation?

The *priced asset-class transition probability* hypothesis (H6 in Section 1.3) says that asset-class transition probabilities improved under the new Lehman rule due to the reclassification of some split-rating combinations from high yield to investment grade. As a result, a favorable Fitch rating mechanically increases the probability of current HY (IG) bonds reaching (maintaining) investment-grade status in the future. This increased probability of future IG status translates into a higher probability of high future bond demand from the asset-class-sensitive investor clientele and, thus, higher bond valuations. To the extent that these higher probabilities of future premium bond valuations are rationally anticipated by current investors, they should be impounded in current bond prices even if a bond's asset-class status and ownership structure did not immediately change under the new Lehman rule.

We do not, however, expect transition-probability-induced price appreciation to be equally large for all bonds. Under the new Lehman rule, the increased probability of future asset-class upgrades for BB+ bonds with favorable Fitch ratings—arguably the best of the BB+ bonds and, thus, most likely to have a future Moody's or S&P rating increase that would result in one of the redefined split-rating combinations—is likely to be larger than the *reduced* probability of asset-class *downgrades* for BBB− bonds with favorable Fitch ratings—arguably the best of the BBB− bonds and thus generally *less* likely to have future Moody's or S&P ratings cuts resulting in redefined split-rating combinations. Consequently, we expect returns to be *asymmetric* around the HY-IG boundary with BB+ bonds with favorable Fitch ratings outperforming BBB− bonds with favorable Fitch ratings. Appendix C has a formal explanation of this prediction.

An alternative hypothesis—which we call the *Fitch reputation* hypothesis—is that the Lehman announcement may, in fact, have indirectly changed the market's bond cash-flow beliefs. By including Fitch ratings in its index rating methodology, Lehman may have raised investors' perceptions of the informativeness of Fitch ratings for future bond cash flows and, thereby, increased the prices of bonds with favorable Fitch ratings (Kliger and Sarig 2000; Boot, Milbourn, and Schmeits 2006). In contrast to the asymmetric BBB− versus BB+ returns predicted by market segmentation, the Fitch reputation hypothesis implies that changes in the market's cash-flow expectations should be fairly symmetric around the IG-HY boundary. As in Bongaerts, Cremers, and Goetzmann (2012), we exploit this difference in predicted returns across ratings to distinguish between segmentation and informational effects.

Table 9, panel A, presents CARs for bonds rated favorably by Fitch but whose asset-class status did not initially change. We require the Fitch-favorable and matched bonds to be rated by both Moody's and S&P. The sample of bonds are split by their old index ratings. Comparing the columns, the CARs of Fitch-favorable BB+ bond after the Lehman announcement are positive and dwarf the much smaller CARs for the Fitch-favorable BBB− bonds.[39] To confirm that this asymmetry is robust, we compute modified CARs in the last column. The modified CARs differ from our standard matched-sample CARs in that now the Fitch-favorable BBB− bonds are used as a control sample for the Fitch-favorable BB+ bonds. We again match on size and maturity. Despite the small sample of 12 Fitch-favorable BB+ bonds, the valuation asymmetry is large enough that there is sufficient power to reject the symmetric performance null over most of the horizons.

The Kalman filter results in Table 9, panel B, show that, after controlling for the contingent-price effect, the BB+ bonds had a significant permanent response $\hat{\alpha}_{\text{Ann}}$ to the Lehman announcement that is much larger than for the Fitch-favorable BBB- (and other) bonds. Interestingly, $\hat{\alpha}_{\text{Eff}}$ is not significant, consistent with the fact that these BB+ bonds did not actually enter the IG index on the effective date. Overall, the significant asymmetry in bond returns above and below the HY-IG boundary strongly supports rating-based segmentation over the alternative Fitch reputation hypothesis.

39 Some of the CARs for nonupgraded Fitch-favorable BB+ bonds in Table 9 are larger than those for the HY-to-IG upgraded bonds in Table 3, but a formal test shows that this difference is typically not statistically significant.

Table 9
Rating-based segmentation versus Fitch reputation

	Investment-grade bonds			High-yield bonds			Long BB+, short matched BBB− bonds
	AAA - A (2,927)	BBB+ - BBB (599)	BBB− (270)	BB+ (12)	BB (40)	BB− - B (118)	
Panel A: CAR on Fitch-favorable bonds							
Control window:							
(−50,−10]	0.01	−0.24	0.05	0.27	−0.42	−0.36	0.23
	[0.56]	[0.01]	[0.66]	[0.58]	[0.01]	[0.16]	[0.55]
Event window:							
(−10,0]	0.17	−0.14	0.04	1.33	0.87	−0.15	1.02
	[0.00]	[0.02]	[0.71]	[0.00]	[0.00]	[0.36]	[0.01]
(−10,10]	0.11	−0.26	0.22	1.98	1.06	0.24	1.60
	[0.00]	[0.01]	[0.08]	[0.00]	[0.00]	[0.24]	[0.02]
(−10,30]	−0.26	−0.27	−0.17	2.67	0.95	0.62	2.75
	[0.00]	[0.01]	[0.34]	[0.00]	[0.00]	[0.01]	[0.00]
(−10,60]	−0.03	0.80	−0.50	0.65	0.84	0.54	−0.01
	[0.44]	[0.00]	[0.00]	[0.32]	[0.01]	[0.11]	[0.81]
(−10,90]	0.13	0.68	0.53	1.72	2.73	1.72	0.48
	[0.02]	[0.00]	[0.03]	[0.01]	[0.00]	[0.00]	[0.49]
(−10,114]†	−0.15	0.53	0.39	2.47	2.67	2.49	1.50
	[0.02]	[0.00]	[0.11]	[0.00]	[0.00]	[0.00]	[0.14]
(−10,245]	−0.31	0.63	−0.03	3.36	2.58	1.26	3.75
	[0.00]	[0.00]	[0.93]	[0.01]	[0.00]	[0.09]	[0.01]
Panel B: Decomposition of abnormal bond returns							
α_{Ann}	−0.08	−0.19	0.24	1.83	0.72	0.41	–
	[0.68]	[0.48]	[0.31]	[0.00]	[0.11]	[0.30]	–
α_{Eff}	−0.19	0.27	0.08	−0.08	0.48	0.96	–
	[0.55]	[0.34]	[0.73]	[0.86]	[0.31]	[0.02]	–
Panel C: Trading volume (diff-in-diff)							
Turnover post-ann. (%)	0.01	−0.01	0.01	0.02	0.03	−0.07	–
	[0.15]	[0.56]	[0.73]	[0.75]	[0.42]	[0.01]	–
Turnover post-eff. (%)	0.01	0.02	0.00	0.01	−0.02	−0.03	–
	[0.23]	[0.22]	[0.93]	[0.94]	[0.37]	[0.26]	–
Panel D: Insurance company bond trading (diff-in-diff)							
Δ Holdings ($ MM)	0.06	4.21	3.38	8.72	−7.69	2.60	–
	[0.92]	[0.02]	[0.42]	[0.29]	[0.25]	[0.24]	–
Δ Holdings (% of issue)	−0.15	1.70	0.81	2.03	−1.47	0.98	–
	[0.36]	[0.01]	[0.51]	[0.43]	[0.44]	[0.10]	–

This table reports statistics for bonds rated favorably by Fitch relative to Moody's and S&P, excluding the bonds upgraded from high-yield (HY) to investment-grade (IG) status. The sample is split by the old Lehman index rating. The number of Fitch-favorable bonds is reported in parenthesis. Panel A reports cumulative abnormal returns on the Fitch-favorable bonds, calculated using the bootstrap portfolio approach described in Appendix B. Matched samples are formed using bonds that are either not rated by Fitch or that have a Fitch rating below Moody's and S&P and by matching on old Lehman index ratings, maturity, and issue size. In the last column, modified CARs are computed for the Fitch-favorable BB+ bonds using Fitch-favorable BBB− bonds, matched on maturity and issue size, as control bonds. Panel B reports permanent price impact estimates from a Kalman filter decomposition based on specification E in Table 5. Panel C reports statistics on daily turnover over the postannouncement window (−10,114] and posteffective window (114,245], and panel D reports aggregate insurance company bond trading over the combined postannouncement and posteffective window (−10,245]. Two-sided *p*-values (shown in brackets) are computed using the bootstrap distribution (in panel A), the Kalman filter standard errors (in panel B), and standard errors that are robust to heteroscedasticity and issuer clustering (in panels C and D).

Other HY bonds may also have priced asset-class transition probability effects, since their probabilities of future upgrades to IG status also increased with the expansion of the IG split-rating combinations. For Fitch-favorable BB bonds, the price evidence is weaker. The CARs suggest a significant and persistent price increase, but one that is smaller than for the BB+ bonds (where we expect Lehman's impact on transition probabilities to be larger). The Kalman filter *p*-value for α_{Ann} is also weaker than for the BB+ bonds. Overall, the price impact of the Lehman announcement is concentrated in the upgraded bonds and in BB+ bonds close to the IG-HY boundary.

As a check for robustness, we included Fitch-favorable dummies interacted with the old index ratings in the regression-based CAY analysis in Section 3.1. The results in Table 2 generally confirm an asymmetric response for the BB+ bonds versus the BBB- bonds at the Lehman announcement date and over longer horizons.

5.1.1 Trading volume and priced transition probabilities. Market segmentation attributes the price appreciation in the HY-to-IG upgraded bonds (in Section 3) to changes in ownership as the IG investor clientele began buying the upgraded bonds. The abnormal volume documented in Table 6 is consistent with such ownership changes starting right after the Lehman announcement. In contrast, the priced asset-class transition probability hypothesis attributes the price appreciation in the Fitch-favorable BB+ bonds, not to immediate ownership changes, but rather to anticipation of possible *future* ownership changes (i.e., that the IG clientele will buy these bonds if, in the future, one of Lehman's reclassified split-rating states occur because of future Moody's or S&P ratings changes). Panels C to D in Table 9 repeat the abnormal trading analysis for the Fitch-favorable BB+ bonds. Consistent with future demand anticipation, abnormal volume is much smaller for Fitch-favorable BB+ bonds than for the upgraded bonds in Table 6, and the difference-in-difference test does not reject the null of no BB+ abnormal trading volume or insurance company trading.

5.2 Other hypotheses

In the Internet Appendix we report results from two additional sets of tests. First, we investigate whether stock prices for the issuers of Fitch-favorable bonds reacted to the Lehman announcement. Table IA.6 shows no evidence in equity CARs that stock prices reacted. A Fitch reputation effect or other information-based explanations for the Lehman announcement therefore are not supported since a reduced default risk at companies with bonds highly rated by Fitch should also affect equity values. Instead, the impact of the Lehman announcement appears to be confined to the bond market (consistent with rating-based segmentation) rather than indirectly providing cash-flow information to the stock market (as predicted by the Fitch reputation hypothesis). Second, another possible explanation for the price appreciation of the 57 immediately upgraded bonds is that increased turnover could have improved market liquidity for these bonds which, in turn, was priced. However, difference-in-difference tests in Table IA.7 for both the Roll (1984) and the Amihud (2002) liquidity measures show no evidence of abnormal changes in liquidity that could account for the price appreciation of the upgraded bonds.

6. Conclusion

The Lehman Brothers index rating redefinition in 2005 lets us test and confirm a new noninformational and nonregulatory transmission channel for rating-based market segmentation in the U.S. corporate bond market. The evidence is consistent with rating-based market segmentation through investment practices that include investability norms of active bond investors as well as passive indexation. Our findings suggest, more generally, that the valuation effects of market segmentation and asset-class labeling frictions in the corporate bond market are large and change over time.

Our work suggests a number of directions for future research. First, asset management practices—relating to ratings but also to other asset-class characteristics, such as maturity—may help explain other bond pricing puzzles (e.g., see Collin-Dufresne, Goldstein, and Martin 2001).[40] Second, other events may also change the relative importance of official regulation and industry practices. For example, the Dodd-Frank Act of 2010 and ensuant SEC regulations have reduced regulatory reliance on ratings issued by NRSROs and introduced softer criteria for determining capital requirements. As a consequence, asset management practices, rating-based or otherwise, are likely to become even more important in the future. Third, it would be interesting to model optimal contracting with endogenous investability restrictions and asset pricing feedbacks. Fourth, the real corporate consequences of bond labeling frictions are unknown.

Appendix A. Control Variables Definitions for CAY

The cumulative abnormal yield change (CAY) is estimated using regression (1) for yield changes ΔY_i^h on bonds indexed by i over different horizons h. The regressors X_i in this regression are control variables so that differences in ΔY across the treatment bonds and other bonds are not due to bond and issuer characteristics that vary systematically across these bonds. The following set of control variables—which have been used in the literature to explain bond yields and yield changes—are included as regressors:

- Credit risk: indicator variables for index ratings under the old rule or, alternatively, under the new rule: AAA, [AA, A], [$BBB+$, BBB], $BBB-$, $BB+$, BB, [$BB-$, B], and unrated by Moody's and S&P;
- Maturity: maturity of bond i in years.
- Age: age of bond i, measured in years since its offering date;

[40] For example, Section 2a-7 of the Investment Company Act restricts money market mutual funds to bonds with maturities of 397 calender days or fewer.

- Coupon: measured in percent;
- Index beta: return beta of bond i on Lehman IG bond index, computed using Dimson's method with one daily lead and lag;
- Liquidity: trading frequency for bond i measured as the percent of days with trades over the pre-event control window $(-50,-10]$;
- Issue size: indicator variables for the par amount of the bond outstanding, split into three categories (<150, $[150,250)$, ≥ 250 \$MM);
- Firm characteristics obtained from COMPUSTAT: market-to-book, size measured by log of total sales, profitability, tangibility, leverage, interest coverage, interest-to-debt, and R&D. We winsorize market-to-book, interest coverage, and interest-to-debt at the 0.5% and 99.5% levels for the full sample of all bonds because their distributions have fat tails. Missing values are imputed with zero and a missing value dummy is included as additional regressor.
- Industry: indicator variables for the 2-digit FISD industry codes.

Appendix B. Matched-Sample Portfolio Approach and Bootstrap for CARs

Cumulative abnormal returns (CARs) are computed based on the difference in cumulative returns between treatment (upgraded) bonds and a matched sample of control bonds. Our baseline match pairs treatment and control bonds by matching on their old Lehman index ratings up to the notch (e.g., BB+, BB, BB−, B+, etc.), their maturity bin (short = 1–5 years or long = 5 years or longer), and their size bin ($<$\$250 MM or $\geq$\$250 MM par value of bond issue outstanding).

In robustness checks, we also use an expanded match criterion that also matches on index betas, liquidity, coupon, and industry. Index betas for the IG index are estimated using Dimson's method with one daily lead and lag and are then used to define high-low bins (greater or less than 0.255). Liquidity is measured by the frequency of trading days over the pre-announcement window $[-50, -10]$ and then high-low bins are defined (more or less than 13%). Coupons are grouped into high-low bins (more or less than 5.9%). The industry-matching is based on three broad sectors (utility, financial, and industrial).

Using treatment bonds and matched samples of control bonds, we compute returns for long-short portfolios that are long the treatment bonds and short control bonds. For each treatment bond, there are multiple possible control bond matches. In each round, one potential match for each treatment bond is used as the control and then a bootstrap draws different matches from the set of potential matches. Each long-short portfolio provides a set of CARs for each day over the event window. The average of these returns across the 1,000 bootstrap rounds is the point estimates for our reported CARs.

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

- Form a matched sample for our portfolio of treatment bonds by randomly picking one control bond for each treatment bond. Calculate the CAR for this long-short portfolio on each event day. Denote the CAR in round j at date t by $CAR_{t,j}$.
- Repeat the matched sample formation procedure, using another random draw of control bonds and calculate the corresponding CAR for the long-short portfolio. We draw a total of $1,000$ times to form an empirical distribution for the CAR at each event day. The average CAR over the $n = 1,000$ simulations is the estimated expected CAR for the treatment bonds. That is, $CAR_t = \sum_{j=1}^{n} CAR_{t,j}/n$.

- Construct the empirical distribution, F_{CAR}, for the CAR on each event day and use $F_t = F_{CAR}(CAR_t)$ to compute empirical two-sided p-values to test whether the abnormal returns are statistically significant relative to the null hypothesis $H_0 : CAR_t = 0$ by computing $p = 2F_t$ if $F_t \leq .5$, and $p = 2(1 - F_t)$ otherwise, as proposed in Efron and Tibshirani (1993). Confidence bounds can be determined similarly as the values $[\underline{CAR}, \overline{CAR}]$ for which $F_{CAR}(\underline{CAR}) = 0.05$ and $F_{CAR}(\overline{CAR}) = 0.95$.

Appendix C. Predicted Asymmetric Response of Fitch-Favorable BB+ and BBB- Bonds

Consider the pricing of a pair of bonds—which we index as bonds 1 and 2—at three dates: $A - 1$ (before the Lehman announcement), A (the Lehman announcement date), and a more distant future date T (when Moody's, S&P, and Fitch may change their bond ratings). Bond 1 is a Fitch-favorable BB+ bond (i.e., initial BB+ ratings from Moody's and S&P and IG rating from Fitch). Bond 2 is a Fitch-favorable BBB- bond (i.e., the lower of its initial Moody's and S&P ratings is BBB- and its rating from Fitch is even better).

We partition the economic state space at date T into three sets consisting of states in which the associated combination of Moody's, S&P, and Fitch ratings for bond 1 would make it IG under both the new and old Lehman rules (denoted IG_1^B), states in which its ratings would make it HY under both rules (denoted HY_1^B), and states in which its ratings would make it IG under the new Lehman rule but HY under the old rule (denoted IG_1^N). Let $\pi_A(\mathrm{IG}_1^B)$ denote the conditional probability of future states IG_1^B for bond 1. Let $m_A(\mathrm{IG}_1^B)$ denote the pricing kernel at date A for future state IG_1^B. Similar probabilities and pricing kernels are defined for states HY_1^B and IG_1^N. Define $P_{1,T}^{\mathrm{IG}}$ as the future price of bond 1 if asset-class-sensitive investors at date T treat the bond as being investable as IG, and let $P_{1,T}^{\mathrm{HY}}$ denote the corresponding price when investors—given the same future cash flow information and ratings combination—instead treat the bond as HY.

According to the asset-class segmentation hypothesis, the only impact of the Lehman redefinition on bond 1 was to change prices in states IG_1^N from $P_{1,T}^{\mathrm{HY}}$ to $P_{1,T}^{\mathrm{IG}}$. Sets of analogous but potentially different economic states IG_2^B, HY_2^B, and IG_2^N and associated conditional probabilities, pricing kernels, and asset-class-contingent date T prices can be defined for Fitch-favorable BBB- bond 2. We assume that the Lehman rule change had no effect on rating agencies' rating-setting policies and, thus, on the respective IG and HY state sets for these two bonds. Lastly, note that it takes an upgrade by Moody's or S&P for bond 1 to get to its redefined states IG_1^N in the future, whereas it takes a downgrade by Moody's or S&P for bond 2 to get to its redefined states IG_2^N in the future.

At the time of the Lehman announcement, let $P_{1,A-1}$ and $P_{1,A}$ denote the prices of Fitch-favorable BB+ bond 1 at dates $A - 1$ and A respectively. Analogous bond prices are defined for the Fitch-favorable BBB- bond 2. For simplicity, we assume that the Lehman redefinition is the only news arriving at date A, so that prices only change due to abnormal returns caused by the Lehman announcement. In particular, the time between $A - 1$ and A is assumed to be short so that the conditional probabilities, pricing kernels, and expected treatment-contingent future prices do not change between dates $A - 1$ and A, but the time is also long enough so that there are no lags in price adjustments.

Under these conditions, the return on Fitch-favorable BB+ bond 1 between $A - 1$ and A is

$$\frac{P_{1,A} - P_{1,A-1}}{P_{1,A-1}} = \frac{\pi_A(\mathrm{IG}_1^N)\, m_A(\mathrm{IG}_1^N)\, [\mathrm{E}_A(P_{1,T}^{\mathrm{IG}} | \mathrm{IG}_1^N) - \mathrm{E}_A(P_{1,T}^{\mathrm{HY}} | \mathrm{IG}_1^N)]}{P_{1,A-1}}, \tag{A1}$$

while the return on Fitch-favorable BBB- bond 2 is

$$\frac{P_{2,A}-P_{2,A-1}}{P_{2,A-1}}=\frac{\pi_A(\mathrm{IG}_2^N)\,m_A(\mathrm{IG}_2^N)\,[\mathrm{E}_A(P_{2,T}^{\mathrm{IG}}|\mathrm{IG}_2^N)-\mathrm{E}_A(P_{2,T}^{\mathrm{HY}}|\mathrm{IG}_2^N)]}{P_{2,A-1}}. \tag{A2}$$

Because the only change between $A-1$ and A is the Lehman announcement, the terms associated with the two bonds' respective future IG^B and HY^B states at dates $A-1$ and A cancel in the numerators. In addition, since the probabilities and pricing kernels for the two bonds' respective IG^N states are unaffected by the Lehman redefinition, the numerators are nonzero due solely to the IG premium/HY discount in pricing depending on how investors treat the bonds.

Consider the case in which the two bonds are symmetric with the same dollar IG premium/HY discounts and same total pricing kernel valuations of their respective IG^N states, and where the two bonds' coupons are such that they have the same date $A-1$ prices. If $\pi_A(\mathrm{IG}_1^N)$ (the probability of the redefined split-rating states for a Fitch-favorable BB+ bond associated with an *upgrade* by Moody's or S&P) equals $\pi_A(\mathrm{IG}_2^N)$ (the probability of the redefined split-rating states for a Fitch-favorable BBB- bond associated with a *downgrade* by Moody's or S&P), then the predicted returns after the Lehman redefinition would be equal for the two bonds. However, it seems likely that $\pi_A(\mathrm{IG}_1^N) > \pi_A(\mathrm{IG}_2^N)$. To see why, suppose that the probability of a future Moody's or S&P upgrade for the average bond with BB+ Moody's and S&P ratings is equal to the corresponding probability of a Moody's or S&P downgrade for the average bond with BBB- Moody's and S&P ratings. However, BB+ bonds that also have IG Fitch ratings should have a *higher* future Moody's or S&P *upgrade* probability than the average BB+ bond. Similarly, a Fitch-favorable BBB- bond should have a *lower* Moody's and S&P *downgrade* probability than the average BBB- bond. It follows then that the abnormal announcement-date return for Fitch-favorable BB+ bonds should be greater than the corresponding return for Fitch-favorable BBB- bonds.

References

Ambrose, B., K. Cai, and J. Helwege. 2012. Fallen angels and price pressure. *Journal of Fixed Income* 21:74–86.

Amihud, Y. 2002. Illiquidity and stock returns: Cross-section and time series effects. *Journal of Financial Markets* 5:31–56.

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* 43:341–72.

Barberis, N., and A. Shleifer. 2003. Style investing. *Journal of Financial Economics* 68:161–99.

Barberis, N., A. Shleifer, and J. Wurgler. 2005. Comovement. *Journal of Financial Economics* 75:283–317.

Basak, S., and A. Pavlova. 2013. Asset prices and institutional investors. *American Economic Review* 103: 1728–58.

Becker, B., and T. T. Milbourn. 2011. How did increased competition affect credit ratings? *Journal of Financial Economics* 101:493–514.

Bessembinder, H., K. M. Kahle, W. Maxwell, and D. Xu. 2009. Measuring abnormal bond performance. *Review of Financial Studies* 22:4219–58.

Bongaerts, D., K. J. M. Cremers, and W. Goetzmann. 2012. Tiebreaker: Certification and multiple credit ratings. *Journal of Finance* 67:113–52.

Boot, A., T. T. Milbourn, and A. Schmeits. 2006. Credit ratings as coordination mechanisms. *Review of Financial Studies* 19:81–118.

Boyer, B. 2011. Style-related comovement: Fundamentals or labels? *Journal of Finance* 66:307–32.

Calio, V. 2005. New inclusion in Lehman index cuts bond managers both ways: More opportunities but performance stall also possible. *Pension & Investments* February 21, 2005.

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

Chen, H., G. Noronha, and V. Singhal. 2004. The price response to S&P 500 index additions and deletion: Evidence of asymmetry and a new explanation. *Journal of Finance* 59:1901–29.

Chernenko, S., and A. Sunderam. 2012. The real consequences of market segmentation. *Review of Financial Studies* 25:2041–69.

Chhaochharia, V., and Y. Grinstein. 2007. Corporate governance and firm value: The impact of the 2002 governance rules. *Journal of Finance* 62:1789–825.

Collin-Dufresne, P., R. S. Goldstein, and S. J. Martin. 2001. The determinants of credit spread changes. *Journal of Finance* 56:2177–207.

Coval, J., and E. Stafford. 2007. Asset fire sales (and purchases) in equity markets. *Journal of Financial Economics* 86:479–512.

Denis, D.K., J.J. McConnell, A. Ovtchinnikov, and Y. Yu. 2003. S&P 500 index additions and earnings expectations. *Journal of Finance* 58:1821–40.

Dhillon, U., and H. Johnson. 1991. Changes in the Standard and Poor's 500 list. *Journal of Business* 64:75–85.

Duffie, D. 2010. Asset price dynamics with slow-moving capital. *Journal of Finance* 65:1238–68.

Duffie, D., N. Garleanu, and L. H. Pedersen. 2007. Valuation in over-the-counter markets. *Review of Financial Studies* 20:1865–900.

Duffie, D., and B. Strulovici. 2012. Capital mobility and asset pricing. *Econometrica* 80:2469–509.

Edwards, A., L. Harris, and M. Piwowar. 2007. Corporate bond market transaction costs and transparency. *Journal of Finance* 62:1421–51.

Efron, B., and R. Tibshirani. 1993. *An introduction to the bootstrap*. Boca Raton: Chapman and Hall.

Eisinger, J. 2005. Long & short: GM bond worries fade with some magic from Lehman. *Wall Street Journal*, Feb 2, 2005, page C1.

Ellul, A., C. Jotikasthira, and C. Lundblad. 2011. Regulatory pressure and fire sales in the corporate bond market. *Journal of Financial Economics* 101:596–620.

Goh, J., and L. Ederington. 1993. Is a bond rating downgrade bad news, good news, or no news for stockholders? *Journal of Finance* 48:2001–8.

Goldstein, M. A., E. S. Hotchkiss, and E. R. Sirri. 2007. Transparency and liquidity: A controlled experiment on corporate bonds. *Review of Financial Studies* 20:235–73.

Greenwood, R. 2005. Short-and long-term demand curves for stocks: Theory and evidence on the dynamics of arbitrage. *Journal of Financial Economics* 75:607–49.

Gromb, D., and D. Vayanos. 2009. Financially constrained arbitrage and cross-market contagion. Working Paper, London School of Economics.

Hand, J., R. Holthausen, and R. Leftwich. 1992. The effect of bond rating agency announcements on bond and stock prices. *Journal of Finance* 47:733–52.

Harris, L., and E. Gurel. 1986. Price and volume effects associated with changes in the S&P 500: New evidence of price pressure. *Journal of Finance* 41:815–29.

Heckman, J. J., H. Ichimura, and P. E. Todd. 1997. Matching as an econometric evaluation estimator: Evidence from evaluating a job training programme. *Review of Economic Studies* 64:605–54.

Hendershott, T., and M. S. Seasholes. 2009. Market predictability and non-informational trading. Working Paper, University of California at Berkeley.

Holthausen, R. W., and R. W. Leftwich. 1986. The effect of bond rating changes on common stock prices. *Journal of Financial Economics* 17:57–89.

Jame, R., and Q. Tong. 2014. Industry-based style investing. *Journal of Financial Markets* 19:110–30.

Kaul, A., V. Mehrotra, and R. Morck. 2000. Demand curves for stocks do slope down: New evidence from an index weights adjustment. *Journal of Finance* 55:893–912.

Kisgen, D. J. 2007. The influence of credit ratings on corporate capital structure decision. *Journal of Applied Corporate Finance* 19:65–73.

Kisgen, D. J., and P. E. Strahan. 2010. Do regulations based on credit ratings affect a firm's cost of capital? *Review of Financial Studies* 23:4324–47.

Kliger, D., and O. Sarig. 2000. The information value of bond ratings. *Journal of Finance* 55:2879–902.

Lee, C. M. C., and M. J. Ready. 1991. Inferring trade direction from intraday data. *Journal of Finance* 46:733–46.

Lyon, J. D., B. M. Barber, and C. L. Tsai. 1999. Improved methodology for tests of long-run abnormal returns. *Journal of Finance* 54:165–201.

Mitchell, M., L. H. Pedersen, and T. Pulvino. 2007. Slow moving capital. *American Economic Review* 97:215–20.

Mitchell, M., T. Pulvino, and E. Stafford. 2004. Price pressure around mergers. *Journal of Finance* 59:31–63.

National Association of Insurance Commissioner. 2009. NAIC use of NRSRO ratings in regulation. Staff Report dated March 10, 2009.

Newman, Y., and M. Rierson. 2004. Illiquidity spillovers: Theory and evidence from european telecom bond issuance. Working Paper, Stanford University.

Palmer, A., and T. Murray. 2005. Considerations regarding Fitch inclusion in the Lehman credit index. Newsletter, ASB Capital Management.

Roll, R. 1984. A simple implicit measure of the effective bid-ask spread in an efficient market. *Journal of Finance* 39:1127–39.

Shleifer, A. 1986. Do demand curves for stocks slope down? *Journal of Finance* 41:579–590.

Steiner, M., and V. Heinke. 2001. Event study concerning international bond price effects of credit rating actions. *International Journal of Finance and Economics* 6:139–57.

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* 7:215–51.

Wells Fargo. 2009. A guide to investing in high-yield bonds. Technical Report, Wells Fargo Advisors.

Wurgler, J., and E. Zhuravskaya. 2002. Does arbitrage flatten demand curves for stocks? *Journal of Business* 75: 583–608.