Momentum in Corporate Bond Returns

ABSTRACT

This paper finds significant price momentum in US corporate bonds. The analysis is based on 3.2 million monthly observations from 77,150 bonds from two transaction and three dealer-quote databases over the period from 1973 to 2008. Bond momentum profits are significant in the second half of the sample period, 1991 to 2008, and amount to 64 basis points per month. Momentum strategies are only profitable among non-investment grade bonds, where they yield 190 basis points per month. Similar to recent findings in equities, profits disappear after removing the worst-rated bonds – about 8% of all observations. Contrary to equities, bond momentum profits derive primarily from winners. However, losers trade more than winners, giving them a greater share in momentum profitability in trade-based data. Our findings do not support market opaqueness, illiquidity, investor under-reaction, and systematic risk as explanations of corporate bond momentum.

While some market anomalies disappear or attenuate upon discovery (Schwert 2003), price momentum remains among the strongest asset-pricing anomalies, challenging the efficient markets paradigm. Documented for US equities by Jegadeesh and Titman (1993), momentum is also present in international equities (Rouwenhorst 1998, Chan, Hameed, and Tong 2000), currencies (Okunev and White 2003), commodities (Miffre and Rallis 2007, Gorton, Hayashi, and Rouwenhorst 2008), sovereign bonds (Asness, Moskowitz, and Pedersen 2009), and residential real estate (Beracha and Skiba 2010). For US corporate bonds, however, Gebhardt, Hvidkjaer, and Swaminathan (2005b) find no momentum in investment grade bonds of publicly-traded firms from 1973 to 1996.[1] However, Avramov, Chordia, Jostova, and Philipov (2007) find no momentum in investment grade equities either and show momentum is restricted to high credit-risk stocks.

We find strong evidence of momentum profitability using a sample of 77,150 investment grade and high-yield US corporate bonds issued by 11,672 companies from 1973 to 2008. Our sample combines both dealer-quote (Lehman, DataStream, Bloomberg) and transaction (TRACE and FISD) corporate bond data.[2] It contains 3.23 million bond-month observations, with a monthly average of 7,500 bonds from 2,000 issuers.

Momentum profitability comes mostly from the second half of the sample period. Specifically, from 1991 to 2008, past six-month winners outperform past six-month losers by 64 basis points (bps) per month. However, the strategy is not profitable for investment-grade (IG) bonds, consistent with Gebhardt, Hvidkjaer, and Swaminathan (2005b). Profitability is driven exclusively by the worst-rated bonds: the momentum strategy yields strongly significant 190 bps per month in non-investment grade (NIG)

[1]Gebhardt, Hvidkjaer, and Swaminathan (2005b) document small bond reversal of 12 bps per month and stock-bond momentum spillover of 11 bps for six-month formation and holding periods.

[2]The Lehman Database is the *Lehman Brothers Fixed Income Database*. FISD stands for Mergent's *Fixed Income Security Database/National Association of Insurance Commissioners Database*.

bonds.[3] Profits disappear when bonds rated $B-$ or worse are removed from the sample. These bonds represent only 8.27% of all observations, yet they have a large impact on the overall results since they appear mostly in the extreme winner and loser portfolios, which make up the momentum strategy. To illustrate, 79% (73%) of bonds rated D (C) appear in the extreme portfolios versus 11% of bonds rated $A+$.

Bond momentum profits are significant in both quote-based (60 bps) and trade-based subsamples (58 bps) over their common period of coverage from 1994 to 2008. Hence, illiquidity is unlikely to explain bond momentum as profits are very similar across samples of different liquidity.

Momentum profits in corporate bonds arise primarily from the long side of the strategy. Between 1991 and 2008, the best-rated quintile (Q1) earns insignificant momentum profits of 1 bp per month, while the worst-rated quintile (Q5) earns strongly significant 173 bps. Q1 (Q5) losers earn 65 (60) bps, while Q1 (Q5) winners realize 66 (233) bps. The difference in momentum profits between Q5 and Q1 is almost entirely attributable to the difference between Q5 and Q1 winners – contrary to equities, where losers tend to contribute more towards momentum profits in high relative to low credit risk firms.[4]

When the momentum strategy is implemented only among bonds that trade, momentum profits are again significant only in Q5, but losers now contribute more. This difference between transaction and dealer-quote subsamples is not due to data integrity issues, since over their common bond-month observations, the trade- and quote-based databases provide indistinguishable returns and momentum portfolio payoffs. Rather, the results suggest that losers trade more actively than winners giving them a greater

[3] We find no momentum in the 1973-1990 period, which we attribute to the far fewer NIG bonds in that period relative to later periods. The small set of worst-rated bonds exhibit significant momentum in the 1973-1990 period as well, but are too few to affect the overall sample results.

[4] See Avramov, Chordia, Jostova, and Philipov (2007).

share in momentum profitability when using trade-based data.

Momentum remains strong after adjusting for bond-level interest-rate risk and liquidity, as well as for systematic risk using bond and equity factors. Momentum profits are not concentrated in periods around rating changes.[5] Neither are they driven by any specific database – they persist after excluding any one database. They also withstand survivorship concerns and adjustments for microstructure noise (following Asparouhova, Bessembinder, and Kalcheva 2010b). Finally, momentum profits are large enough to survive the largest transaction costs estimates in Edwards, Harris, and Piwowar (2007).

To summarize, this paper contributes to the literature by showing that bond momentum is highly profitable; momentum profitability comes exclusively from the worst-rated bonds, and mostly from the long-side of the strategy. In addition, our findings shed light on potential explanations for bond momentum. First, market opaqueness is an unlikely explanation since profitability increased after the introduction of the TRACE reporting system in 2002 – monthly momentum profits are 114 bps in the most liquid bonds in the period of highest market transparency, compared to 64 bps in the overall sample between 1991 and 2008. Second, risk-based explanations also seem unlikely as bond momentum alphas – after adjusting for equity and bond risk factors – are similar to raw momentum profits. While profits come from high-credit risk bonds, these bonds appear in both the winner and loser portfolios, resulting in a limited net exposure to credit risk – the default premium alpha is only slightly smaller than raw momentum profits. Third, illiquidity, stale prices, or infrequent trading are unlikely explanations in view of the similarity of profits in quote- and trade-based data. Fourth, no link between bond momentum and investor under-reaction to news is evident in our findings. Momentum profits are similar whether we include or exclude periods around rating changes – among

[5]This is contrary to evidence in equities that most asset-pricing anomalies arise during periods around rating downgrades (see Avramov, Chordia, Jostova, and Philipov 2009).

the most important news events for a corporate bond. Fifth, while transaction costs in the corporate bond market are high, NIG momentum profits are much larger than NIG transaction costs. Finally, short-selling in the US corporate bond market is difficult, yet this cannot fully account for the persistence of bond momentum, since a large portion of momentum profits come from the long side of the strategy.

In the rest of the paper, Section I discusses the data. Section II.A analyzes bond momentum. Section II.B investigates the link between bond momentum and credit risk. Section II.C examines momentum after the introduction of TRACE. Section II.D reports robustness tests. Section III discusses potential explanations, and Section IV concludes.

I. Data

Our corporate bond sample is compiled from five databases: the Lehman Brothers Fixed Income Database [Lehman], DataStream, Bloomberg, TRACE, and Mergent's Fixed Income Securities Database/National Association of Insurance Commissioners Database [FISD]. To the best of our knowledge, our sample has the largest cross-section and longest time-series of US corporate bond data used in empirical studies. It includes 3.23 million bond-month observations from January 1973 to December 2008 from 77,150 US bonds issued by 11,672 public and private firms.

A. Bond database description

The Lehman database reports monthly information on US bonds from 1973 to 1997. We extract all corporate fixed-coupon bonds that are not convertible, putable, or backed by mortgages or other assets. We collect data on month-end return, rating, duration, amount outstanding, and issue date. While most prices in the Lehman database reflect dealer quotes, some are "matrix" prices, which are derived from price quotes of bonds with similar characteristics. Like Gebhardt, Hvidkjaer, and Swaminathan (2005b), we use both quote and matrix prices and similarly find that results are the same when matrix prices are excluded. Unlike them, we do not exclude high-yield bonds.

Our second source of bond price information is DataStream.[6] From DataStream we extract all bonds starting in January 1990 and satisfying a set of common selection criteria.[7] Specifically, we exclude non-US dollar denominated bonds, bonds with unusual coupons (e.g. step-up, increasing-rate, pay-in-kind, and split-coupons), and bonds backed by mortgages or other assets. We also eliminate convertible bonds, bonds with warrants, and bonds part of unit deals. From Bloomberg, our third data source, we collect price quotes and characteristics for US fixed-coupon non-convertible bonds.

The above three databases provide pricing information based on dealer quotes. Quote-based data may fail to reveal infrequent trading, stale prices, or illiquidity, which are important considerations for implementing a momentum strategy. This is why we incorporate two additional databases, TRACE and FISD, which are strictly trade-based.[8]

Introduced in July of 2002, TRACE collects and distributes consolidated information on secondary market transactions in publicly traded TRACE-eligible securities, such as investment-grade, high-yield, and convertible corporate bonds.The system was implemented in phases and by February 2005 covered more than 99 percent of the OTC

[6] We had extensive discussions with the DataStream support team about the source of their data. Their data analysts confirmed that most U.S. corporate bond prices in their database are dealer quotes reported by market-makers trading the bonds. These data are further augmented with traded prices for exchange-traded bonds. DataStream provides no indication of whether a price is based on a quote or a trade, which is similar to how trader quotes are reported in the Lehman database. Unlike DataStream, the Lehman database also contains unambiguously identifiable matrix prices.

[7] Although DataStream contains bond data going back to earlier years, data on individual bond returns before 1990 are scarce.

[8] Bessembinder, Kahle, Maxwell, and Xu (2009) document that trade-based and quote-based databases are highly consistent with regards to bond price reaction to corporate news events.

activity in US corporate bonds.[9] We collect bond prices starting at the inception of TRACE up to December 2008. We use the CUSIP Master File, which contains bond characteristics, to identify and eliminate non-US dollar denominated bonds, bonds with unusual coupons (e.g. step-up, increasing-rate, pay-in-kind, and split-coupons), and bonds backed by mortgages or other assets. We also eliminate convertible bonds, bonds with warrants, bonds that are part of unit deals and preferred shares. We follow the data cleaning procedure in Bessembinder, Kahle, Maxwell, and Xu (2009) and eliminate canceled, corrected, and commission trades.

Our final data source is Mergent's FISD/NAIC database. The FISD portion of the database contains a comprehensive set of bond characteristics. The NAIC portion of the database maintains prices for all trades in publicly traded corporate bonds made by insurance companies since 1994. Insurers are required to report this information to the National Association of Insurance Commissioners (NAIC) on a quarterly basis.We collect bond prices and characteristics from FISD for the period of 1994-2008 excluding non-US dollar denominated bonds, bonds backed by mortgages or other assets, and bonds that are convertible, pay-in-kind, or part of a unit deal.

From all databases, we eliminate observations that are obvious data entry errors, e.g. with negative prices, with maturity dates prior to issuance or trade dates, etc.

B. Return Calculation

While quote-based databases provide monthly prices and returns, trade-based databases only provide intraday clean prices. To compute monthly returns for TRACE and FISD,

[9] See FINRA news release http://www.finra.org/Newsroom/NewsReleases/2005/P013274.

we first compute daily prices as the trade size-weighted average of intraday prices.[10] The month-end price is the last available daily price from the last five trading days of the month.[11] Using this month-end price, we compute monthly holding period returns as:

$$r_{i,t} = \frac{(P_{i,t} + AI_{i,t} + Coupon_{i,t}) - (P_{i,t-1} + AI_{i,t-1})}{P_{i,t-1} + AI_{i,t-1}} \quad (1)$$

where $r_{i,t}$ is bond i's return over month t, $P_{i,t}$ is its price at month-end t, $AI_{i,t}$ is its accrued interest at month-end t, and $Coupon_{i,t}$ is any coupon payment made between month-end $t-1$ and month-end t.

Computing accrued interest requires the bond's first coupon date, coupon size, coupon payment frequency, and day count convention. If information on these characteristics cannot be found in any of the databases, we make the following assumptions. If the first coupon date is missing, we assume that coupons start accruing from the bond's issuance date, and if the payment frequency is missing, we assume that the bond pays interest semi-annually. If there is no available information on the day count convention used for coupon accrual, we assume that it is 30/360.[12]

The degree of overlap between the databases is low – 87% of all bond-month observations are single database observations. This large percentage is due to the fact that Lehman, the largest database, spans the first 18 years of our sample period as the only available source. About 8% of the bond-month observations come from exactly two databases. The biggest overlap is between DataStream and TRACE. We use this overlap later in the paper to assess data consistency. Less than 1% of all bond-month

[10]This approach is consistent with the findings in Bessembinder, Kahle, Maxwell, and Xu (2009) that a daily price based on trade-size weighted intraday prices is less noisy than the last price of the day.

[11]Using the last price within the 5-day end-of-month interval instead of that on the last day of the month helps increase the number of non-missing monthly observations. The conclusions of the paper are robust to extending/contracting this month-end window.

[12]We have verified that our findings remain the same if we limit our sample to the subset of observations for which we can unambiguously calculate accrued interest without the above assumptions.

observations come from 3 or 4 sources. There are no cases in which all five databases have returns for the same bond in the same month. When there are returns for the same bond-month available from multiple sources, we compute a single bond-month return by either (1) averaging the returns from the different databases, or by (2) taking the first available return for this bond for this month in the following sequence: TRACE, FISD, Lehman, DataStream, and Bloomberg. The results in the paper are based on the second aggregation method, which gives precedence to trade-based returns, but our findings are virtually identical when the first method is used.

Our analysis of corporate bond momentum is based on individual bond returns, rather than on firm-level average bond returns.[13] We do so because individual bond level analysis allows for a readily implementable and less costly trading strategy. In comparison, firm-level bond prices are not obtainable in practice since the firm's 'average bond' is not a traded asset. If investors have to buy all bonds of a firm to create their own portfolios mimicking the firm's average bond, they will incur substantially larger transaction costs or require much more capital.[14] Furthermore, it will be inefficient to include bonds that may otherwise not qualify for the momentum strategy and that may have low correlation with the company's bonds that qualify for the strategy. Moreover, looking at 'the average bond' implicitly assumes that momentum is generated at the company level, while we take an agnostic view on whether bond momentum is company or asset specific. Nevertheless, for robustness, we have implemented the momentum strategy using firm-level bond returns and find that the results are qualitatively the same and quantitatively much stronger.

[13]Gebhardt, Hvidkjaer, and Swaminathan (2005b) aggregate bond returns at the company level before implementing the momentum strategy, but report that results are robust to using individual bond returns.

[14]Edwards, Harris, and Piwowar (2007) find that smaller bond trades are much more expensive.

C. Descriptive statistics

The initial sample constructed by merging all five databases contains 3,233,082 bond-month observations. To ensure that the results are not driven by outliers or data errors, we eliminate observations with returns above 50% per month.[15] This filtering eliminates less than 0.1% of all observations and results in a final sample of 3,230,001 bond-month observations. The number of available bonds each month ranges from 2,323 to 22,199, with an average of 7,512 bonds from 2,043 issuers.

Table I reports summary statistics for our corporate bond sample. The mean (median) monthly return in the sample is 0.66% (0.62%). The mean (median) duration, age, and amount outstanding are 6.15 (6.02) years, 83.55 (54) months, and \$182,120 (\$90,000), respectively. Data on duration, age, and amount outstanding are available for 81.99%, 85.26%, and 85.69% of the bond-month return observations, respectively.

S&P issue-level credit ratings are provided in the individual databases or collected from Standard & Poor's *RatingsXpress* in WRDS. We convert credit ratings into a numerical scale from 1 to 22 with larger numbers reflecting higher credit risk: 1 = AAA, 2 = $AA+$, 3 = AA, ..., 21 = C, 22 = D. The investment-grade cut-off is 10 ($BBB-$). Our sample contains rating information for 92.05% of all bond-month observations. The mean (median) bond rating is 7.01 (6), corresponding to an $A-$ (A) rating. 82.3% of rated bonds in our sample are investment-grade and 17.7% are non-investment grade.

The number of bond-month observations in Lehman, DataStream, Bloomberg, TRACE, and FISD are 1.7, 1.3, 0.15, 0.36, and 0.06 million, respectively. The corresponding average ratings are 6.33, 7.96, 6.35, 8.22, and 6.08. DataStream and TRACE, which cover the latter half of the period, contain the highest percentage of NIG bonds, 24.73% and

[15] Using alternative cut-offs of 75%, 100%, or 150% per month has very little impact on the sample size and results.

27.68%, respectively. In contrast, Lehman, the main data source for the first half of the period, has much fewer NIG bonds (12.13% of rated bonds).

The average bond age in DataStream, Bloomberg, and TRACE, is similar – 51.40, 58.18, and 51.62 months, respectively. Lehman contains a larger fraction of older bonds (104.04 months on average), while FISD contains the youngest bonds (32.22 months). Finally, FISD and TRACE bonds have the largest amounts outstanding, suggesting that larger issues are more frequently traded. The smallest average amount outstanding is in Lehman. Duration is similar across the databases, averaging about 6 years. The average returns in Lehman, DataStream, Bloomberg, TRACE, and FISD are 0.79%, 0.60%, 0.64%, 0.02%, and 0.41%, respectively. For the most part they are similar, except for TRACE, which has the lowest average returns.

To examine the source of the relatively low average returns in TRACE, in Panel B of Table I we compare returns from DataStream to those from TRACE over their common bond-month observations. This common sample contains 235,472 bond-months observations from 10,569 bonds. The minimum, mean, median, and maximum returns for the overall common sample (last row), and by return quintile, are quite similar, especially considering that TRACE returns, as described earlier, are based on the last available price within the last five trading days of the month, while DataStream returns are calculated using the price quote on the last day of the month. The evidence in Panel B suggests that the relatively low returns in TRACE are not due to data inconsistencies. Rather, bonds with low returns are more likely to trade than bonds with high returns, resulting in a lower transaction-based return average.

II. Momentum in US Corporate Bonds

In this section we examine the profitability of the momentum strategy of Jegadeesh and Titman (1993). Specifically, each month t, individual bonds are ranked into decile portfolios, P1 (losers) through P10 (winners), based on their cumulative returns over months $t-6$ through $t-1$ (formation period). Following the literature on equity momentum, we skip one month (month t) between the formation and holding periods to avoid potential biases from bid-ask bounce and short-term price reversal[16]. The portfolios are then held for six-months from month $t+1$ to $t+6$ (the holding periods for strategy t). Each month, we calculate portfolio returns as the equally-weighted averages across their constituent bonds. Following Jegadeesh and Titman (1993), the overall momentum strategy return for month t is the equally-weighted average month-t return of strategies implemented in the prior month and all strategies formed up to six months earlier. This allows for standard statistical inference based on non-overlapping returns.

A. Bond Momentum Profitability

Table II summarizes momentum profits in US corporate bonds. Considering the full sample (1973-2008) from all databases (first row of Panel A), momentum profits amount to significant 35 bps per month with a t-statistic of 3.56. The P1 (losers) portfolio averages 67 bps per month, while the P10 (winners) portfolio generates 102 bps. The results are virtually identical if we only consider rated bonds.

As revealed by a 48-month moving average in Figure I, momentum profits are close

[16] Short-term stock price reversal has been documented in the first month following the formation period. This first month is skipped when examining subsequent six-month momentum. Similarly, Gebhardt, Hvidkjaer, and Swaminathan (2005b) observe price reversal of 45 bps in investment grade bonds in the first month following the formation period. When skipping a month, they report a reversal of 12 bps per month over a six-month holding period.

to zero in the first half of the sample but show significant positive returns in the second half and a steady and substantial increase towards the end of the sample period. Hence, we examine bond momentum profitability separately for the first and second half of our sample and report the results in the bottom part of Panel A of Table II. As expected from Figure I, the bond momentum strategy is not profitable over the period from 1973 to 1990, earning insignificant 11 (10) bps per month among all (rated) bonds. The results are based on an average of 4,990 bonds per month (a minimum of 3,639 and a maximum of 6,027 bonds) with a rating coverage of 97.25%.

In contrast, the bond momentum strategy earns strongly significant 64 bps per month with a t-value of 4.53 over the 1991-2008 period. The average monthly holding period returns increase almost monotonically from P1 (47 bps) to P10 (111 bps). The biggest jump in returns occurs between P9 and P10 – from 62 to 111 bps. These results are based on an average of 8,426 bonds per month with a minimum of 1,853 and a maximum of 19,100 bonds. About 90% of bonds in that period are rated and provide similar momentum profits. In unreported results, we find that bond momentum is also profitable if based on 3 to 12-month formation and holding periods.

The significance of momentum profitability, however, needs to be assessed with respect to bond illiquidity as corporate bonds are among the least liquid asset classes.[17] Moreover, bond price momentum could be the result of dealers smoothing quotes through time when no actual trades take place. To address these concerns, we examine momentum profits separately for trade-based (TRACE and FISD) and quote-based (Lehman, DataStream, and Bloomberg) subsamples over their common period of coverage from 1994 to 2008. Panel B of Table II presents the results for the full, as well as the quote-based and trade-based subsamples.

[17] See http://www.sifma.org/uploadedFiles/Research/Statistics/SIFMA_USBondMarketIssuance.pdf

The bond momentum strategy based on bonds that actually trade produces statistically significant and economically large profits of 58 bps per month with a t-value of 2.03. The momentum profits based on dealer quotes are almost identical: 60 bps with a t-value of 4.14. Furthermore, rated bonds that trade earn similar momentum profits of 64 bps (t-value of 1.99) compared to 58 bps (t-value of 3.89) for rated bonds in the dealer-quote database. These results imply that quote-smoothing or lack of trading are unlikely to explain the presence of momentum in US corporate bonds.

One striking difference between trade-based and quote-based momentum profitability is the source of momentum profits. In Panel B of Table II, holding period returns are uniformly smaller in the trade-based sample, with a more pronounced difference in the extreme portfolios. The P1 holding-period returns based on quotes (trades) are 60 (-7) bps and the P10 holding-period returns are 120 (51) bps. To again verify that this difference between quote- and trade-based samples is not due to data inconsistencies, Panel C compares momentum portfolio holding-period returns using only bond-months that appear in both types of databases. Recall that in Panel B of Table I we compared returns in DataStream and TRACE; here we compare momentum portfolio holding period returns in quote- and trade-based subsamples and again find that they are quite similar. Therefore, differences in the source of momentum profits in the two data sets are not due to data inconsistencies. Instead, they derive from the lower overall returns in the trade-based data. This suggests that bond investors tend to hold on to winners but trade losers. Such a 'disposition' effect in bonds is opposite to what has been documented in stocks (see Shefrin and Statman 1985).

Next, we examine whether bond momentum profits compensate for systematic risk. We regress the returns of each momentum portfolio on bond and equity risk factors as in Fama and French (1989) and Gebhardt, Hvidkjaer, and Swaminathan (2005a). We focus on the period 1991-2008, when bond momentum is significant. Using OLS with Newey-West adjusted standard errors, we estimate alphas from the following model:

$$r_{pt} = \alpha_p + \boldsymbol{\beta}_p' \boldsymbol{F}_t + e_{pt} \tag{2}$$

where $r_{pt} = R_{pt} - R_{rf,t}$ is the momentum portfolio excess return over the risk-free rate or the momentum strategy return difference $r_{pt} = R_{P10,t} - R_{P1,t}$. $\boldsymbol{F}_t$ contains combinations of bond factors such as the change in the term spread (difference between 10-year and 1-year Treasury yields) and the change in the default spread (difference between BBB and AAA corporate yields) and equity factors such as the market, SMB, and HML factors of Fama and French (1993) and the momentum factor of Carhart (1997). Table III reports the estimated portfolio alphas.

We find that the momentum strategy profits are abnormal and not compensation for systematic risk. The momentum strategy ($P10 - P1$) alphas are strongly significant and range from 56 to 75 bps per month. The alphas are highest – higher even than the raw momentum profits of 64 bps – when equity risk factors are considered, suggesting that the bond momentum strategy has negative exposure to equity risk. The alphas are lowest, although still large and significant, when the bond default factor is included, suggesting a link between credit risk and momentum profitability.

B. Credit Risk and Bond Momentum Profitability

Recent studies of equity momentum have highlighted a strong link between credit risk and momentum profitability. In particular, Avramov, Chordia, Jostova, and Philipov (2007) show that equity momentum is significant and strong among non-investment grade companies and non-existent among investment-grade firms. In this section, we investigate whether a similar link exists in the US corporate bond market.

We start by examining the composition of the momentum portfolios. Panel A of Table IV reports, within each momentum portfolio, the proportion of IG and NIG bonds, as well as the bond distribution across the rating spectrum. Specifically, each month t, decile momentum portfolios, P1 to P10, are formed across all bonds, regardless of rating. Then, for each momentum portfolio, we report the distribution of its constituent bonds across the IG, NIG, and unrated categories, as well as across individual ratings.[18]

The first part of Panel A of Table IV shows that the momentum portfolios contain on average 17.77% NIG bonds ('Row Average' column). However, the loser portfolio (P1) contains 30.61% NIG bonds and the winner portfolio (P10) contains 46.99% NIG bonds. NIG bonds appear disproportionately in the extreme winner and loser portfolios, similar to what Avramov, Chordia, Jostova, and Philipov (2007) find in equity momentum portfolios. Almost half (43.66%, see last column) of all NIG bonds are in P1 or P10. NIG bonds are much more likely to appear in the extreme winner and loser portfolios (i.e. in the momentum strategy) than a uniform distribution would suggest (in which case we would expect to see equal numbers of NIG bonds in P1 through P10, with 20% of them as part of the momentum strategy). Conversely, IG bonds are less likely to appear in the momentum strategy portfolios: only 14.49% of IG bonds are part of them.

Refining the rating grid, we compute for each momentum portfolio the bond frequency distribution across all individual ratings. The results in the second part of Panel A show that bonds with better ratings more often populate the middle portfolios. In contrast, the worse a bond's credit rating, the more likely is the bond to appear in the winner (P10) or loser (P1) momentum portfolios. Of bonds rated D (C) [CC], 79.05% (72.72%) [70.52%] end up in P1 or P10, while only 11.28% of bonds rated $A+$ appear

[18]Bonds are classified into rating classes based on their credit rating at the time portfolios are formed.

in the extreme portfolios and ultimately affect the momentum strategy. This strong positive relationship between a bond's credit risk and its likelihood of appearing in the extreme winner or loser portfolios is further illustrated in Figure II. The figure presents the percentage of bonds of a particular rating appearing in the loser, winner, or both extreme portfolios relative to the total number of bonds in that rating category. Notice in the figure that bonds in each NIG rating class have a much higher representation in both the winner and loser momentum portfolios than the 10% implied by a uniform distribution. The likelihood of ending up in the extreme momentum portfolios increases almost monotonically with credit risk.

The last part of Panel A shows the average numerical and letter rating of each momentum portfolio. There is a distinct U-shape in the credit risk of the portfolios – the extreme P1 and P10 portfolios have the highest credit risk, while the middle portfolios have the lowest. The loser portfolio (P1) has an average rating of 8.77 (equivalent to BBB), the winner portfolio (P10) has an average rating of 10.54 (equivalent to $BB+$), and most of the P2-P9 portfolios have average ratings of A or $A-$. Following the above evidence of a link between credit risk and momentum portfolio composition, we implement conditional momentum strategies in subsamples of bonds based on ratings.

Panel B of Table IV shows that bond momentum strategies are only profitable among NIG bonds, which provide monthly momentum profits of 190 bps with a t-value of 7.84. Momentum profits are non-existent among IG bonds. This result parallels what Avramov, Chordia, Jostova, and Philipov (2007) document for equity momentum. It is also consistent with the absence of momentum documented by Gebhardt, Hvidkjaer, and Swaminathan (2005b) for a sample of IG bonds. Finally, it could potentially explain the lack of momentum profitability in the early part of the sample period, which is characterized by fewer NIG bonds.

We further refine credit risk categories by dividing bonds into credit rating quintiles. We then repeat the momentum analysis separately for each quintile. Specifically, each month, for momentum strategy t, bonds are ranked into quintiles based on rating at time $t-1$, and then sorted into momentum portfolios based on their cumulative returns over the formation period $t-6 : t-1$. Bonds remain in the same credit risk quintile and momentum portfolio throughout the holding period, even if their rating changes. The top of Panel A of Table V shows that, for the full 1973-2008 sample period, the first quintile contains bonds with an average numeric rating of 2.30, approximately a $AA+$ rating, while the last quintile contains bonds with an average rating of 12.31, which roughly corresponds to a non-investment grade rating of BB.

The conditional momentum strategy is profitable only in the worst-rated bond quintile (Q5), earning highly significant 93 bps per month with a t-value of 6.24 (compared to the overall 35 bps in Panel A of Table II). Momentum profits for the other four rating groups are insignificant ranging from 7 to 12 bps per month. The average ratings in the four best-rated quintiles Q1 through Q4 indicate that on average these subsamples contain investment-grade bonds. As shown at the bottom of Panel A, the momentum profits for Q5 are much larger over the second half of our sample period (1991 to 2008) – 173 bps per month with a t-value of 7.40. Again, the profits in the other four better-rated quintiles are insignificant, ranging from 1 to 21 bps per month.

Notably, from 1973 to 1990 bond momentum profits are insignificant in all quintiles (middle of Panel A). However, the worst-rated quintile (Q5) for this period has an average rating of 10.93, while Q5 over the 1991-2008 subsample has an average rating of 13.61. If we divide the risk categories in the first half of the sample period into deciles (unreported results), then the worst-rated decile has an average rating of 12.46, more comparable to the worst-rated quintile in the later period. This worst-rated decile is the only one with a non-investment grade rating average (the next decile has a rating of 9.4) and generates statistically significant momentum profits of 42 bps with a t-value of 2.10. Profits in all other deciles are non-existent. Hence, the absence of momentum profits in the overall sample during the first half of the period could be due to the insufficient number of high credit risk bonds. Indeed, only 10% of rated bonds in that period are non-investment grade, compared to 22% in the 1991-2008 period.

Focusing on the 1991-2008 period in the bottom of Panel A of Table V, we observe that bond momentum profitability comes primarily from the long side of the strategy. In particular, the best-rated winners (portfolio P10 in Q1) return on average 66 bps per month, while the worst-rated winners (portfolio P10 in Q5) earn 233 bps – a difference of 167 bps. The losers, on the other hand, earn 65 bps per month in Q1 and 60 bps in Q5, a difference of only 5 bps per month. The overall difference in momentum profitability between Q5 and Q1 of 172 bps per month ($= 173 - 1$) is almost entirely attributable to the difference between Q5 and Q1 winners. In contrast, differences in momentum profits in best- and worst-rated equities are largely attributable to differences between best- and worst-rated losers (see Avramov, Chordia, Jostova, and Philipov 2007).

Panel B of Table V compares trade- and quote-based momentum profitability by quintiles over their common period from 1994 to 2008. Momentum profits in Q5 based on subsamples using all, quote-based, and trade-based databases are 193, 189, and 132 bps per month, respectively, and are all strongly significant. Momentum profits in the better-rated quintiles, Q1 to Q4, for the same samples are all insignificant.

As in the overall sample results in Panel B of Table II, quote-based momentum profitability in the worst quintile (bottom of Panel B of Table V) derives from the winner side of the momentum strategy, whereas trade-based profitability comes from the loser side of the strategy. Specifically, in the quote-based subsample, the difference in momentum profits between Q5 and Q1 is 194 bps (= 189 − (−5)). The difference between Q5 and Q1 winners is 196 bps (= 263 − 67), whereas the difference between Q5 and Q1 losers is only 2 bps (= 74 − 72). In the trade-based subsample, the difference in momentum profits between Q5 and Q1 is 115 bps (= 132 − 17). However, the difference between Q5 and Q1 winners is only 18 bps (= 72 − 54), whereas the difference between Q5 and Q1 losers is 97 bps (= 37 − (−60)).

To summarize, bond momentum is significant and strong but only in the the worst-rated quintile. As shown earlier, since loser bonds appear to be much more actively traded, the loser portfolio accounts for a larger share of momentum profits in the trade-based subsample. In the quote-based subsample, momentum profits come from winners.

So far we have documented a positive relationship between credit risk and bond momentum profitability using portfolio strategies based on a sequential double sort: first by credit risk, then by past 6-month returns. To further isolate the segment of bonds driving momentum profitability, we implement the momentum strategy over subsamples that sequentially exclude bonds with the worst credit rating. The results in Panel A of Table VI show that momentum profitability decreases sharply as the worst-rated bonds are removed. The profit over the 1991-2008 period using all rated bonds is 63 bps per month with a t-value of 4.33. Once bonds rated D are removed from the sample, momentum profits drop to 28 bps with a t-value of 2.03. After further removing bonds rated C, the momentum payoff drops to 26 bps, significant at the 10% level (t-value of 1.90). Momentum profits become insignificant at the 10% level when bonds rated $B-$ or worse are removed. These bonds represent 8.27% of rated bond observations and 6.92% of amount outstanding. The average size of these issues is not negligible since about 8% of observations represent about 7% of amount outstanding. Strikingly, the momentum strategy is not profitable for the remaining 92% of rated bonds. Similar findings have been documented for equities by Avramov, Chordia, Jostova, and Philipov (2007).

We have further investigated whether the worst-rated bonds driving momentum profitability are original-issue junk bonds or 'fallen angels' (i.e. junk bonds that were originally issued as investment-grade). In unreported results, we find that original-issue junk bonds and 'fallen angels' equally contribute toward momentum profitability. Specifically, removing the subsample of all 'fallen angels' decreases momentum profits by a similar magnitude as removing a similarly sized control sample of original-issue junk bonds.

To summarize, we document that credit risk has a strong impact on bond momentum profitability: momentum is significant only among NIG bonds, where it returns 190 bps per month over the 1991-2008 period. Momentum profitability disappears after bonds rated $B-$ or worse (8.27% of all rated bonds) are removed from the investment universe.

C. Bond Momentum After the Introduction of TRACE

Prior to 2002, bonds traded primarily in dealer markets with little information on actual trading or volume. The introduction in July 2002 of the TRACE bond transaction reporting system infused substantial transparency in the US corporate bond market (e.g. Edwards, Harris, and Piwowar 2007). Yet, as Figure I shows, this increased transparency did little to abate bond momentum profitability, which has increased substantially in the latter part of our sample period.

Extending the evidence from Figure I, Panel B of Table VI shows momentum profitability based on the trade-based databases from July 2002 to 2008 as we sequentially remove the worst-rated bonds. We focus only on trade-based data to examine momentum profitability among the most liquid bonds in the period of highest bond market transparency. Momentum strategies, based on all rated bonds that actually traded, generate profits of 114 bps per month (t-value of 2.05). After removing bonds rated $CCC+$ or worse (4.4% of rated bonds), momentum profits lose significance at the 5% level but remain economically large. Momentum profitability becomes insignificant at the 10% level once all bonds rated BB or worse are removed from the investment universe.

Momentum profitability and its strong dependence on the worst-rated bonds did not diminish after the introduction of TRACE. On the contrary, momentum is stronger than in earlier periods, which leads us to conclude that the lack of information and market transparency in the pre-TRACE period may not explain the presence of price momentum in the US corporate bond market.

D. Robustness Checks

Corporate bond momentum is robust to adjusting for interest rate risk, illiquidity, and transaction costs. Specifically, profits remain strong and significant after adjusting by duration (as a proxy for interest rate risk), or by age and amount outstanding (as proxies for liquidity). Moreover, momentum profits do not concentrate in periods around rating changes and are unsusceptible to concerns about microstructure noise or survivorship.

To control for interest rate risk, each month we compute duration-adjusted individual bond returns by subtracting from each bond return the average monthly return of the duration decile to which the bond belongs. We then compute the average holding period returns of the momentum strategy using duration-adjusted rather than raw returns. As shown in the top part of Table VII, duration-adjusted momentum profits in Q5 are 129 bps per month with a t-value of 5.73. Momentum payoffs in the remaining quintiles range from 11 to 27 bps and are insignificant at the 5% level. The significance of Q5 duration-adjusted momentum profits shows that bond momentum and its dependence on credit risk are robust to adjusting for interest rate risk.

Next, we test if bond momentum and its link to credit risk are robust to liquidity considerations in light of the documented liquidity effects on returns and equity momentum.[19] Following Chen, Lesmond, and Wei (2007), we use age and amount outstanding as proxies for liquidity. Each month, we adjust individual bond returns for liquidity by subtracting the average return of the age or amount-outstanding decile to which the bond belongs. As with duration, Table VII shows that adjusting for liquidity has little effect on momentum profits and their relation to credit risk. Momentum profits adjusted by age (amount-outstanding) are only significant in Q5 and amount to 154 (151) bps.

Evidence from equity markets suggests that momentum profits may disappear after trading costs are taken into account (see Korajczyk and Sadka 2004). Although corporate bonds are much less liquid than stocks, momentum profits from NIG bonds are high enough to survive transactions costs. To illustrate, consider the transaction cost estimates by Edwards, Harris, and Piwowar (2007) based on actual trades in TRACE. They find that transaction costs increase with worsening credit rating but improve with trade size. Recall from Table IV that the momentum profits in NIG bonds are 1.90% per month. With a six-month holding period strategy, the cumulative six-month profits are 11.96% before transaction costs. To implement each momentum strategy, we need to buy the bonds in P10 and sell them after six months, as well as short the bonds in P1 and buy them back in six months. Assuming 100% turnover in P1 and P10, which we never observe in our sample[20], amounts to four transactions. For large trade sizes, the average

[19] See, among others, Amihud and Mendelson (1986), Lee and Swaminathan (2000), Acharya and Pedersen (2005), Pastor and Stambaugh (2003), Chen, Lesmond, and Wei (2007).

[20] If a strategy includes some of the P10 or P1 bonds of the strategy six-months prior, we will not have to sell and buy these bonds or buy and sell them again as part of the new strategy, thus saving on transaction costs. We do find that of the NIG bonds appearing in P1 (P10), 67.5% (69%) appear in the same momentum portfolio the following month and 19.3% (27.7%) appear in the same momentum portfolio after six months.

transaction costs for NIG bonds are about 12 bps according to Edwards, Harris, and Piwowar (2007) – or 48 bps for the four trades. This translates into 11.48% (=11.96% − 0.48%) after-transaction-costs six-month momentum profits from NIG bonds. With medium-size trades costing 0.5%, net momentum profits would be 9.96% (=11.96% − 2%). Edwards, Harris, and Piwowar (2007) further estimate roughly 1.25% transaction costs for small trades in NIG bonds. Taking the conservative view that all trades are small generates net six-month momentum profits of 6.96% (=11.96% $-\ 4 \times 1.25$%) from NIG bonds. This conservative estimate translates into a monthly profit of 1.13%, which is still strongly significant (t-value of 4.66).

Next we study the impact of rating changes on bond momentum profitability. Hand, Holthausen, and Leftwich (1992) find that rating changes, especially downgrades, have a substantial impact on bond returns. Still, for equities, Avramov, Chordia, Jostova, and Philipov (2009) show that most asset-pricing anomalies derive their profitability from short positions in high credit risk stocks around rating downgrades. Since our results are driven by non-investment grade bonds, it is possible that they simply reflect similar price reaction to rating changes.

To investigate the effect of rating changes on momentum profits, we exclude from our sample bond-month observations from twelve months prior to twelve months after a rating change and re-evaluate the momentum strategy. In unreported results, we find that bond momentum profits remain significant and of similar magnitude after periods around rating upgrades, downgrades, or both, are removed. Hence, bond momentum profits are not driven by returns around rating changes as is the case for equities.

We recognize that using matrix prices can be problematic, since they can induce serial correlation which could spuriously enhance momentum results. This issue is specific to the quote-based databases. Only one of the three – the Lehman database –

unambiguously identifies matrix prices. We replicate the analysis presented in Table II after excluding all matrix prices from our sample and observe that momentum profits are lower by an average of 3 bps and at most by 5 bps. Therefore, we conclude that matrix prices have little effect on our findings.

While the concern of matrix prices is irrelevant for transaction data, the two transaction databases come with their own issue – the possibility of bias due to microstructure noise. Asparouhova, Bessembinder, and Kalcheva (2010b) suggest that characteristics-sorted portfolio returns may be biased if the characteristic is correlated with microstructure noise. The bias could be either positive or negative depending on the correlation between the sorting variable and microstructure noise. Asparouhova, Bessembinder, and Kalcheva (2010b) show that it is sufficient to weigh portfolio returns by gross past returns to correct for such bias. For equities, Asparouhova, Bessembinder, and Kalcheva (2010a) show that this correction increases the reported momentum profits. Using their approach, we recompute the momentum profits reported in Table II. The microstructure noise-corrected profits are slightly larger (not reported) but only by a few basis points. Specifically, momentum profits for the 1991-2008 period increase from 64 bps to 67 bps for all bonds and from 63 bps to 65 bps for rated bonds, while retaining their strong significance. This suggests that even if transaction data contained considerable microstructure noise, this has little impact on bond momentum profitability.

Finally, we examine whether survivorship may impact our results. Conceivably, some bonds disappear during the holding period because they default – a much more likely scenario for the riskier bonds. This could pose a problem since we have no record of recovery rates and the databases contain no returns comparable to equity delisting returns in CRSP. To investigate whether this is indeed an issue, in unreported results, we count the number of bonds that are in each of the momentum portfolios in month

$t+1$ and $t+6$ and assess their retention rate. If the retention rate for P10 is significantly different from that for P1, survivorship would disproportionately affect the returns of the winner or loser portfolio, ultimately affecting the observed momentum profitability. We find that of the bonds that enter the P1 (P10) portfolio in month $t+1$ about 88% (91%) remain in the portfolio in $t+6$. The fact that retention rates for P1 and P10 are quite similar suggests that survivorship is not likely to be driving momentum profitability.

III. Potential Explanations

While the main focus of this paper is to document the existence of price momentum in the US corporate bond market, our findings can also shed light on the potential explanations for its persistence.

First, risk-based explanations seem unlikely since bond momentum alphas are of similar magnitude to raw momentum profits after adjusting for bond risk factors (e.g. the term spread and default spread factors), and even higher than raw profits after adjusting for equity risk factors (as in Fama and French (1993) and Carhart (1997)). While momentum profits come primarily from high-credit risk bonds, these bonds appear in both the winner and loser portfolios, resulting in a limited net exposure to bond credit risk. Specifically, exposure to the bond default spread factor results in alphas that are only marginally smaller than raw momentum profits.

Second, market opaqueness is also an unlikely explanation. Profitability has increased since the introduction of TRACE – monthly momentum profits are 114 bps in the most liquid bonds in the period of highest market transparency versus 64 bps in the overall sample over 1991-2008. Third, infrequent trading, stale prices, and illiquidity are not likely to explain the persistence of bond momentum since profits in quote- and trade-based data are of similar magnitude.

Fourth, investor under-reaction to news appears plausible. After all, there is a lot more uncertainty in high-credit risk bonds. While a full exploration of behavioral biases in the corporate bond market is beyond the scope of this paper, the evidence suggests that investor under-reaction is not the most viable explanation. Specifically, while a rating change is probably one of the biggest news events for a bond,[21] we find that bond momentum profitability during periods of rating changes (upgrades, downgrades, or both) is quite similar to that outside of such periods.

Could short-sale constraints explain the persistence of bond momentum or prevent investors from exploiting it? Indeed, short-selling in the corporate bond market is difficult and could explain the persistence of abnormal returns from the short side of the momentum strategy. However, short-sale constraints cannot explain the high returns and significant alphas of winner bonds and the momentum profitability resulting from them. In addition, investors can benefit from both side of the momentum strategy without short-selling if they implement it as an 'add-on' to a passive or benchmark-relative strategy, rather than as a 'stand-alone' zero-investment strategy. In fact, the US corporate bond market is dominated by institutional investors, who typically hold large diversified portfolios of bonds. An active 'add-on' momentum strategy would involve overweighting/underweighting specific bonds in the winner/loser portfolio. Thus, momentum investors can generate significant alpha relative to their 'benchmark' with no additional capital or the need to short sell.

In sum, while trading frictions, such as short-sale constraints and high transaction costs, appear to be the most plausible explanations for the existence of bond momentum, they cannot fully account for its persistence since a large portion of momentum profits

[21] See Hand, Holthausen, and Leftwich (1992) and Dichev and Piotroski (2001).

come from the long side of the strategy and NIG momentum profits are much larger than NIG transaction costs.

IV. Conclusions

This paper documents strong evidence of momentum in US corporate bonds. From 1991 to 2008, past six-month winners outperform past six-month losers by 64 basis points per month over a six-month holding period. Results are based on 77,150 individual investment-grade and high-yield bonds with an average of 7,500 bonds per month issued by 2,000 companies. Our data consists of more than 3.2 million bond-month observations from two transaction-based (TRACE and FISD) and three quote-based databases (Lehman, DataStream, and Bloomberg). Bond momentum strategies generate similar profits of about 60 bps in either quote-based and trade-based databases.

Among rated bonds (92% of the sample), we find that the profitability of the momentum strategy is concentrated in non-investment grade bonds, which earn significant 190 bps per month, and is non-existent in investment-grade bonds. The latter result is consistent with Gebhardt, Hvidkjaer, and Swaminathan (2005a). In fact, momentum profitability is driven by the worst-rated bonds and disappears when bonds rated $B-$ or worse are removed from the sample. Although these bonds represent only 8% of all observations, their impact on the overall results is large because they concentrate in the extreme winner and loser portfolios. Specifically, 79% (73%) of bonds rated D (C) appear in one of the extreme momentum portfolios versus only 11% for $A+$ rated bonds.

Momentum profits in the overall sample come primarily from winners, contrary to momentum profits in equities. Specifically, the difference in momentum profitability between the worst-rated (Q5) and best-rated (Q1) bond quintiles is 197 bps. Of these, 194 bps come from the difference in Q1 and Q5 winners and only 3 bps come from the difference in losers. In contrast, momentum profits derived from the trade-based data come primarily from losers. Losers have a larger share in momentum profits when using transaction data because they trade more actively than winners.

Bond momentum is robust to adjustments for bond-level interest rate risk and liquidity, equity and bond systematic risk, and microstructure noise. Unlike equities, momentum profits in corporate bonds are not concentrated in periods around rating changes. Finally, momentum profits in non-investment grade corporate bonds are high enough to survive even the most extreme transaction costs estimated in the literature.

Our findings suggest that corporate bond momentum is likely not the result of market opaqueness, illiquidity, systematic risk, or investor under-reaction. Short-sale constraints, a more plausible explanation, also cannot fully account for the persistence of corporate bond momentum.

References

Acharya, Viral V., and Lasse H. Pedersen, 2005, Asset Pricing with Liquidity Risk, *Journal of Financial Economics* 77.

Amihud, Yakov, and Haim Mendelson, 1986, Asset Pricing and the Bid-Ask Spread, *Journal of Financial Economics* 17, 223–249.

Asness, Clifford S., Tobias J. Moskowitz, and Lasse H. Pedersen, 2009, Value and Momentum Everywhere, Working Paper.

Asparouhova, Elena, Hendrik Bessembinder, and Ivalina Kalcheva, 2010a, Do Asset Pricing Anomalies Reflect Microstructure Noise?, Working Paper, University of Utah.

Asparouhova, Elena, Hendrik Bessembinder, and Ivalina Kalcheva, 2010b, Liquidity Biases in Asset-Pricing Tests, *Journal of Financial Economics* 96, 215–237.

Avramov, Doron, Tarun Chordia, Gergana Jostova, and Alexander Philipov, 2007, Momentum and Credit Rating, *Journal of Finance* 62, 2503–2520.

Avramov, Doron, Tarun Chordia, Gergana Jostova, and Alexander Philipov, 2009, Anomalies and Financial Distress, Working Paper.

Beracha, Eli, and Hilla Skiba, 2010, Momentum in Residential Real Estate, The Journal of Real Estate Finance and Economics, forthcoming.

Bessembinder, Hendrik, Kathleen M. Kahle, William F. Maxwell, and Danielle Xu, 2009, Measuring Abnormal Bond Performance, *Review of Financial Studies* 22, 4219–4258.

Carhart, Mark M., 1997, On Persistence in Mutual Fund Performance, *Journal of Finance* 52, 57–82.

Chan, Kalok, Allaudeen Hameed, and Wilson Tong, 2000, Profitability of Momentum Strategies in the International Equity Markets, *Journal of Financial and Quantitative Analysis* 35, 153–172.

Chen, Long, David A. Lesmond, and Jason Wei, 2007, Corporate Yield Spreads and Bond Liquidity, *Journal of Finance* 62.

Dichev, Ilia D., and Joseph D. Piotroski, 2001, The Long-Run Stock Returns Following Bond Rating Changes, *Journal of Finance* 56, 55–84.

Edwards, Amy, Lawrence E. Harris, and Michael S. Piwowar, 2007, Corporate Bond Market Transaction Costs and Transparency, *Journal of Finance* 62, 1421–1451.

Fama, Eugene F., and Kenneth R. French, 1989, Business Conditions and Expected Returns on Stocks and Bonds, *Journal of Financial Economics* 25, 23–49.

Fama, Eugene F., and Kenneth R. French, 1993, Common Risk Factors in the Returns on Stocks and Bonds, *Journal of Financial Economics* 33, 3–56.

Gebhardt, William R., Soeren Hvidkjaer, and Bhaskaran Swaminathan, 2005a, The cross-section of expected corporate bond returns: Betas or characteristics?, *Journal of Financial Economics* 75, 85–114.

Gebhardt, William R., Soeren Hvidkjaer, and Bhaskaran Swaminathan, 2005b, Stock and Bond Market Interaction: Does Momentum Spill Over?, *Journal of Financial Economics* 75, 651–690.

Gorton, Gary B., Fumio Hayashi, and Geert K. Rouwenhorst, 2008, The Fundamentals of Commodity Futures Returns, Yale ICF Working Paper No. 07-08.

Hand, John R. M., Robert W. Holthausen, and Richard W. Leftwich, 1992, The Effect of Bond Rating Agency Announcements on Bond and Stock Prices, *Journal of Finance* 47, 733–752.

Jegadeesh, Narasimhan, and Sheridan Titman, 1993, Returns to Buying Winners and Selling Losers: Implications for Stock Market Efficiency, *Journal of Finance* 48, 65–91.

Korajczyk, Robert A., and Ronnie Sadka, 2004, Are Momentum Profits Robust to Trading Costs?, *Journal of Finance* 59, 1039–1082.

Lee, Charles M.C., and Bhaskaran Swaminathan, 2000, Price Momentum and Trading Volume, *Journal of Finance* 55, 2017–2069.

Miffre, Joelle, and Georgios Rallis, 2007, Momentum Strategies in Commodity Futures Markets, *Journal of Banking and Finance* 31, 1863–1886.

Okunev, John, and Derek White, 2003, Do Momentum-Based Strategies Still Work in Foreign Currency Markets?, *Journal of Financial and Quantitative Analysis* 38, 425–447.

Pastor, Lubos, and Robert F. Stambaugh, 2003, Liquidity Risk and Expected Stock Returns, *Journal of Political Economy* 111, 642–685.

Rouwenhorst, K. Geert, 1998, International Momentum Strategies, *Journal of Finance* 53, 267 – 284.

Schwert, G. William, 2003, Anomalies and Market Efficiency, in George Constantinides, Milton Harris, and René Stulz, eds.: *Handbook of the Economics of Finance* (North-Holland, Amsterdam) Simon School Working Paper No. FR 00-21; NBER Working Paper No. W7935.

Shefrin, Hersh, and Meir Statman, 1985, The Disposition to Sell Winners Too Early and Ride Losers Too Long: Theory and Evidence, *Journal of Finance* 40, 777–790.

Table I
Descriptive Statistics

The sample includes 77,150 individual US corporate bonds by 11,672 companies and covers the period from January 1973 to December 2008. There's a average of 7,512 individual bonds per month issued by an average of 2,043 companies. The minimum number of bonds per month is 2,323 and the maximum is 22,199. The numerical ratings increase with credit risk: i.e. 1=AAA, 2=$AA+$, 3=AA, 4=$AA-$, ..., 19=$CCC-$, 20=CC, 21=C, 22=D. Ratings 11=$BB+$ or higher (worse) are considered non-investment grade (NIG). Ratings 10=$BBB-$ or lower (better) are investment-grade (IG). Panel B compares returns in Datastream and TRACE over 235,472 bond-month observations (10,569 bonds in total) for which both databases have return observations.

Panel A: All Available Observations

	All Databases	Lehman	Datastream	Bloomberg	TRACE	FISD
Period Covered	1973-2008	1973-1997	1990-2008	1987-2008	2002-2008	1994-2008
Bond-Month Observations	3,230,001	1,712,705	1,312,826	150,205	359,878	59,432
Return - mean (%/month)	0.66	0.79	0.60	0.64	0.02	0.41
Return - median (%/month)	0.62	0.74	0.53	0.67	0.32	0.41
S&P rating - mean	7.01	6.33	7.96	6.35	8.22	6.08
S&P rating - median	6.00	6.00	7.00	6.00	7.00	6.00
% rated	92.05	97.22	87.56	83.61	95.04	92.23
% of rated that are IG	82.30	87.87	75.27	95.17	72.32	86.85
% of rated that are NIG	17.70	12.13	24.73	4.83	27.68	13.15
Duration - mean (years)	6.15	6.27	6.05	6.02	5.24	5.86
Duration - median (years)	6.02	6.38	5.46	5.71	4.54	5.72
% obs with duration	81.99	100.00	65.27	51.87	82.00	54.65
Age - mean (months)	83.55	104.04	51.40	58.18	51.62	32.22
Age - median (months)	54.00	70.00	40.00	51.00	40.00	22.00
% obs with age	85.26	98.38	70.96	93.63	85.48	99.85
Amt Outst. - mean ($1,000s)	182.12	99.10	334.56	240.89	430.44	1143.88
Amt Outst. - median ($1,000s)	90.00	50.00	200.00	100.00	298.71	700.00
% obs with Amt Out.	85.69	99.70	70.48	92.69	85.52	77.20

Panel B: Datastream and TRACE compared over common bond-month observations

	Datastream				TRACE			
Quintile	Minimum	Mean	Median	Maximum	Minimum	Mean	Median	Maximum
1	-99.40	-4.14	-2.05	-0.76	-99.89	-4.63	-2.43	-0.98
2	-0.76	-0.17	-0.11	0.22	-0.98	-0.36	-0.31	0.06
3	0.22	0.42	0.42	0.60	0.06	0.34	0.35	0.63
4	0.60	0.96	0.93	1.46	0.63	1.06	1.03	1.64
5	1.46	3.70	2.52	49.38	1.64	4.20	2.85	49.63
Overall	-99.40	0.15	0.42	49.38	-99.89	0.12	0.35	49.63

Table II
Bond Momentum

Each month, t, bonds are ranked into decile portfolios P1 through P10 based on their cumulative returns over months $t-6$ through $t-1$ (formation period). The momentum strategy is long the winner portfolio, P10, and short the loser portfolio, P1. These positions are held over a six-months holding period ($t+1$ through $t+6$, i.e. after one month lag). Portfolio returns are equally weighted across their constituent bonds. The overall strategy portfolio return for month t is the equally-weighted average month-t return of strategies implemented in the prior month and all strategies formed up to six months ago. The table presents the average raw monthly profits during the holding period of the momentum portfolios, P1 to P10, as well as the momentum strategy returns (P10-P1). t-statistics are in parentheses (bold if indicating 5% level of significance). The databases included are Lehman, Datastream, Bloomberg (Quote-Based), and TRACE, and FISD (Trade-Based). The overall sample period is from January 1973 to December 2008. Panel A presents results for All Databases for the overall sample (1973-2008), as well as for the first (1973-1990) and second (1991-2008) halves of the sample. Panel B compares momentum profits in All, Quote-Based, and Trade-Based datasets over their common period of coverage of 1994 to 2008. Panel C assess the data consistency across databases and reports average momentum portfolio returns based on the Quote- and Trade-Based datasets for bond-months when both types of databases have observations – an average of 859 bonds per month, 97.45% of which are rated.

Panel A: Bond Momentum Across Time

	Momentum portfolios (P1=losers, P10 = winners)										
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P10 - P1
					1973-2008						
All Databases	0.67	0.65	0.68	0.70	0.71	0.71	0.73	0.74	0.77	1.02	0.35
	(5.20)	**(6.03)**	**(6.50)**	**(6.79)**	**(7.00)**	**(7.14)**	**(7.50)**	**(8.00)**	**(8.74)**	**(11.64)**	**(3.56)**
All Rated	0.66	0.65	0.68	0.70	0.71	0.71	0.72	0.74	0.76	1.01	0.35
	(5.07)	**(6.03)**	**(6.45)**	**(6.71)**	**(6.95)**	**(7.09)**	**(7.42)**	**(7.90)**	**(8.57)**	**(11.54)**	**(3.47)**
					1973-1990						
All Databases	0.79	0.77	0.78	0.81	0.82	0.83	0.85	0.87	0.88	0.89	0.11
	(3.92)	**(3.90)**	**(3.97)**	**(4.10)**	**(4.21)**	**(4.38)**	**(4.72)**	**(5.18)**	**(5.71)**	**(6.25)**	(0.76)
All Rated	0.78	0.77	0.78	0.81	0.81	0.82	0.85	0.87	0.88	0.88	0.10
	(3.88)	**(3.91)**	**(3.97)**	**(4.08)**	**(4.19)**	**(4.34)**	**(4.67)**	**(5.11)**	**(5.60)**	**(6.10)**	(0.75)
					1991-2008						
All Databases	0.47	0.49	0.54	0.56	0.57	0.56	0.56	0.57	0.62	1.11	0.64
	(2.77)	**(4.78)**	**(6.13)**	**(6.90)**	**(7.15)**	**(6.91)**	**(6.69)**	**(6.53)**	**(6.62)**	**(10.16)**	**(4.53)**
All Rated	0.47	0.50	0.54	0.56	0.57	0.56	0.56	0.57	0.61	1.10	0.63
	(2.64)	**(4.75)**	**(5.96)**	**(6.65)**	**(7.05)**	**(6.86)**	**(6.63)**	**(6.46)**	**(6.52)**	**(10.30)**	**(4.33)**

Table II (continued)

Panel B: Bond Momentum Across Databases

	Momentum portfolios (P1=losers, P10 = winners)										
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P10 - P1
					1994-2008						
All Databases	0.54	0.50	0.56	0.58	0.59	0.58	0.58	0.58	0.64	1.19	0.65
	(**2.72**)	(**4.12**)	(**5.40**)	(**6.16**)	(**6.53**)	(**6.38**)	(**6.25**)	(**6.15**)	(**6.37**)	(**9.85**)	(**4.08**)
All Rated	0.54	0.50	0.55	0.58	0.59	0.58	0.57	0.58	0.63	1.17	0.63
	(**2.59**)	(**4.08**)	(**5.23**)	(**5.91**)	(**6.38**)	(**6.27**)	(**6.11**)	(**6.04**)	(**6.19**)	(**9.91**)	(**3.84**)
Quote-Based Databases	0.60	0.52	0.57	0.59	0.59	0.58	0.58	0.58	0.64	1.20	0.60
	(**3.32**)	(**4.39**)	(**5.53**)	(**6.23**)	(**6.42**)	(**6.37**)	(**6.20**)	(**6.08**)	(**6.26**)	(**10.19**)	(**4.14**)
Quote-Based Rated	0.61	0.52	0.56	0.58	0.58	0.58	0.57	0.57	0.62	1.19	0.58
	(**3.24**)	(**4.39**)	(**5.34**)	(**6.07**)	(**6.32**)	(**6.29**)	(**6.07**)	(**5.96**)	(**6.06**)	(**10.28**)	(**3.89**)
Trade-Based Databases	-0.07	0.16	0.35	0.40	0.41	0.39	0.42	0.51	0.48	0.51	0.58
	(-0.18)	(0.71)	(1.91)	(**2.60**)	(**2.87**)	(**3.06**)	(**3.67**)	(**4.37**)	(**3.51**)	(**2.41**)	(**2.03**)
Trade-Based Rated	-0.11	0.14	0.36	0.37	0.32	0.44	0.40	0.49	0.47	0.53	0.64
	(-0.25)	(0.53)	(1.76)	(**2.18**)	(**1.99**)	(**3.37**)	(**3.24**)	(**3.96**)	(**3.30**)	(**2.32**)	(**1.99**)

Panel C: Comparing Returns in Quote- and Trade-Based Databases For Bond-Month Observations Appearing in Both Databases

	Momentum portfolios (P1=losers, P10 = winners)									
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
					1994-2008					
Quote-Based Databases	0.17	0.30	0.35	0.37	0.39	0.43	0.40	0.39	0.50	0.46
	(0.46)	(1.29)	(1.85)	(**2.09**)	(**2.55**)	(**2.96**)	(**2.93**)	(**2.79**)	(**3.28**)	(**2.31**)
Quote-Based Rated	0.16	0.29	0.37	0.38	0.39	0.45	0.46	0.46	0.48	0.48
	(0.40)	(1.23)	(**1.99**)	(**2.15**)	(**2.64**)	(**3.25**)	(**3.52**)	(**3.41**)	(**3.21**)	(**2.36**)
Trade-Based Databases	0.06	0.23	0.34	0.42	0.43	0.42	0.48	0.48	0.48	0.47
	(0.15)	(0.84)	(1.58)	(**2.23**)	(**2.44**)	(**2.86**)	(**3.25**)	(**3.24**)	(**2.90**)	(**2.07**)
Trade-Based Rated	0.01	0.15	0.30	0.33	0.36	0.38	0.42	0.41	0.43	0.44
	(0.03)	(0.55)	(1.34)	(1.76)	(**2.12**)	(**2.65**)	(**2.88**)	(**2.86**)	(**2.73**)	(1.88)

Table III
Alphas of Bond Momentum Portfolios

Bond momentum portfolio returns are computed as in Table II. We then run time-series regressions of these portfolio excess returns on systematic factors. We estimate coefficients using OLS and Newey-West adjusted standard errors. The table shows the estimated alphas (with their associated t-statistics in parentheses) from time-series regressions based on the following model specifications:

$$r_{pt} = \alpha_p + \boldsymbol{\beta}_p'\boldsymbol{F}_t + e_{pt}$$

where $r_{pt} = R_{pt} - R_{rf,t}$ is the momentum portfolio excess return over the risk free rate or the momentum strategy return difference $r_{pt} = R_{P10,t} - R_{P1,t}$ and $\boldsymbol{F}_t$ is a vector of factors. For each model $\boldsymbol{F}$ are represented by the following specifications:

1. $mTERM$
2. $mDEF$
3. $mTERM, mDEF$
4. Mkt, SMB, HML
5. Mkt, SMB, HML, MOM
6. $mTERM, mDEF, Mkt, SMB, HM$
7. $mTERM, mDEF, Mkt, SMB, HML, MOM$
8. $\Delta TERM, \Delta DEF, Mkt, SMB, HML, MOM$

where Mkt is the excess return on the market, SMB, HML, and MOM are the returns on the size and book-to-market factors of Fama and French (1993), and momentum factor of Carhart (1997), respectively. $\Delta TERM_t = (TERM_t - TERM_{t-1})$ and $\Delta DEF_t = (DEF_t - DEF_{t-1})$, $mTERM_t = \Delta TERM_t/(1 + TERM_{t-1})$ and $mDEF_t = \Delta DEF_t/(1 + DEF_{t-1})$, respectively. The sample period is from January 1991 to December 2008.

	Momentum portfolios (P1=losers, P10 = winners)										
Model	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P10 - P1
					All Bonds						
1	0.15	0.18	0.23	0.25	0.26	0.25	0.25	0.26	0.31	0.80	0.64
	(0.93)	(1.85)	**(2.77)**	**(3.30)**	**(3.46)**	**(3.29)**	**(3.18)**	**(3.16)**	**(3.50)**	**(7.65)**	**(4.51)**
2	0.30	0.26	0.28	0.29	0.29	0.28	0.28	0.29	0.34	0.87	0.57
	(2.09)	**(2.93)**	**(3.46)**	**(3.70)**	**(3.65)**	**(3.39)**	**(3.26)**	**(3.27)**	**(3.58)**	**(8.08)**	**(4.28)**
3	0.29	0.24	0.26	0.27	0.27	0.26	0.26	0.27	0.32	0.85	0.56
	(2.00)	**(2.83)**	**(3.38)**	**(3.63)**	**(3.59)**	**(3.33)**	**(3.20)**	**(3.21)**	**(3.54)**	**(8.21)**	**(4.24)**
4	-0.09	0.09	0.17	0.21	0.22	0.21	0.21	0.20	0.24	0.65	0.75
	(-0.61)	(0.75)	(1.71)	**(2.33)**	**(2.61)**	**(2.53)**	**(2.40)**	**(2.29)**	**(2.56)**	**(6.19)**	**(5.02)**
5	-0.08	0.06	0.14	0.17	0.18	0.16	0.15	0.15	0.18	0.60	0.68
	(-0.47)	(0.52)	(1.29)	(1.77)	(1.87)	(1.73)	(1.61)	(1.49)	(1.75)	**(5.24)**	**(4.34)**
6	0.05	0.17	0.21	0.23	0.24	0.23	0.22	0.22	0.25	0.69	0.65
	(0.33)	(1.95)	**(2.61)**	**(2.94)**	**(2.97)**	**(2.72)**	**(2.55)**	**(2.46)**	**(2.61)**	**(6.46)**	**(4.50)**
7	0.10	0.18	0.21	0.23	0.22	0.20	0.20	0.19	0.22	0.67	0.57
	(0.64)	(1.90)	**(2.35)**	**(2.52)**	**(2.39)**	**(2.13)**	**(1.98)**	(1.89)	**(2.04)**	**(5.72)**	**(3.74)**
8	0.10	0.18	0.21	0.23	0.22	0.20	0.20	0.19	0.22	0.67	0.57
	(0.64)	(1.90)	**(2.35)**	**(2.52)**	**(2.39)**	**(2.13)**	**(1.98)**	(1.89)	**(2.04)**	**(5.72)**	**(3.74)**
					Rated Bonds						
1	0.15	0.18	0.22	0.24	0.25	0.25	0.25	0.25	0.30	0.78	0.63
	(0.87)	(1.85)	**(2.67)**	**(3.12)**	**(3.40)**	**(3.27)**	**(3.13)**	**(3.08)**	**(3.39)**	**(7.74)**	**(4.31)**
2	0.30	0.26	0.28	0.28	0.28	0.28	0.28	0.28	0.33	0.85	0.55
	(2.04)	**(2.95)**	**(3.40)**	**(3.56)**	**(3.60)**	**(3.37)**	**(3.22)**	**(3.20)**	**(3.47)**	**(8.24)**	**(4.09)**
3	0.29	0.24	0.26	0.26	0.27	0.26	0.26	0.27	0.31	0.84	0.54
	(1.95)	**(2.84)**	**(3.32)**	**(3.48)**	**(3.53)**	**(3.31)**	**(3.15)**	**(3.14)**	**(3.41)**	**(8.40)**	**(4.04)**
4	-0.11	0.09	0.16	0.20	0.22	0.21	0.20	0.20	0.23	0.64	0.75
	(-0.68)	(0.74)	(1.58)	**(2.15)**	**(2.53)**	**(2.48)**	**(2.35)**	**(2.23)**	**(2.46)**	**(6.40)**	**(4.92)**
5	-0.08	0.06	0.13	0.16	0.17	0.16	0.15	0.14	0.17	0.59	0.67
	(-0.48)	(0.51)	(1.18)	(1.60)	(1.81)	(1.69)	(1.57)	(1.45)	(1.67)	**(5.42)**	**(4.25)**
6	0.04	0.17	0.21	0.23	0.24	0.23	0.22	0.22	0.24	0.68	0.64
	(0.27)	**(1.96)**	**(2.54)**	**(2.80)**	**(2.92)**	**(2.70)**	**(2.51)**	**(2.40)**	**(2.49)**	**(6.85)**	**(4.45)**
7	0.10	0.19	0.21	0.22	0.22	0.20	0.19	0.19	0.21	0.66	0.56
	(0.62)	(1.92)	**(2.29)**	**(2.39)**	**(2.36)**	**(2.12)**	**(1.97)**	(1.86)	**(1.96)**	**(6.06)**	**(3.69)**
8	0.10	0.19	0.21	0.22	0.22	0.20	0.19	0.19	0.21	0.66	0.56
	(0.62)	(1.92)	**(2.29)**	**(2.39)**	**(2.36)**	**(2.12)**	**(1.97)**	(1.86)	**(1.96)**	**(6.06)**	**(3.69)**

Table IV
Composition of Momentum Portfolios

Each month t, all bonds (rated and unrated) with returns for months $t-6$ through $t-1$ (formation period) are ranked into decile portfolios according to their return during the formation period. The first three rows in Panel A show for each decile portfolio the percentage of bonds that are rated investment-grade (IG), rated non-investment grade (NIG), or unrated. The middle part of Panel A presents for each momentum portfolio the percentage of bonds of each particular credit rating. The column 'Row Average' averages across the 10 momentum portfolios (each row). The last column represents the percentage of bonds of a particular rating appearing in the extreme portfolios (P1 or P10) relative to the total for all momentum portfolios (sum of each row: P1 to P10). The last part of Panel A presents the average (numeric and letter) rating of the constituents of each momentum portfolio. For Panel B, we implement the momentum strategy separately among IG and NIG bonds and report the momentum portfolios holding-period returns. Their associated t-statistics are in parenthesis. IG represents S&P rating of BBB- or better and NIG represents S&P rating of BB+ or worse. The sample period is from January 1991 to December 2008, i.e. the second half of the sample when momentum is significant.

Panel A: Composition of Momentum Portfolios

	Momentum portfolios (P1=losers, P10 = winners)										Row	% in
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	Average	P1 or P10
Composition of momentum portfolios by rating category												
IG	65.71	87.06	89.18	89.68	89.39	88.61	86.89	81.69	72.94	51.41	80.25	14.59
NIG	30.61	10.38	8.68	8.45	8.97	9.96	11.72	16.71	25.27	46.99	17.77	43.66
Unrated	3.67	2.56	2.15	1.87	1.64	1.43	1.39	1.61	1.80	1.60	1.97	26.74
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00		
Composition of momentum portfolios by individual ratings												
AAA	15.02	15.90	15.55	14.86	14.96	13.71	12.90	11.37	11.16	12.14	13.76	19.75
AA+	0.80	1.20	1.18	1.17	1.08	1.15	1.16	1.06	0.93	1.24	1.10	18.60
AA	2.76	3.95	4.14	4.10	3.83	3.68	3.76	3.41	2.93	1.86	3.44	13.43
AA-	4.47	7.01	7.42	7.19	7.17	6.95	6.35	5.83	4.89	2.68	6.00	11.94
A+	6.88	10.97	11.48	11.68	11.50	10.81	10.65	10.19	7.76	3.93	9.58	11.28
A	9.86	15.44	16.12	16.57	16.18	16.48	15.77	14.42	12.46	7.26	14.06	12.18
A-	6.21	9.39	10.21	10.60	10.43	10.49	10.48	9.60	8.19	4.60	9.02	11.98
BBB+	6.41	9.28	9.15	9.66	9.60	10.01	9.86	9.51	8.57	5.12	8.72	13.23
BBB	7.62	9.04	9.23	9.08	9.83	10.21	10.47	10.11	9.46	6.08	9.11	15.04
BBB-	5.67	4.87	4.71	4.77	4.79	5.13	5.47	6.19	6.58	6.48	5.47	22.23
BB+	4.12	2.08	1.89	1.81	1.79	2.03	2.29	2.99	3.75	4.91	2.76	32.65
BB	3.24	1.42	1.12	1.07	1.07	1.15	1.37	2.05	2.57	4.05	1.91	38.16
BB-	2.34	1.25	1.16	1.14	1.25	1.35	1.57	2.39	3.19	3.76	1.94	31.42
B+	2.98	1.35	1.12	1.17	1.30	1.42	1.65	2.42	3.65	5.33	2.24	37.13
B	3.25	1.53	1.34	1.34	1.45	1.60	1.87	2.67	4.24	6.24	2.55	37.16
B-	3.57	1.23	1.01	0.91	1.08	1.24	1.50	2.11	3.73	6.09	2.25	43.02
CCC+	2.07	0.58	0.41	0.37	0.39	0.50	0.59	0.78	1.57	3.39	1.07	51.22
CCC	1.32	0.27	0.17	0.16	0.17	0.21	0.24	0.40	0.72	1.92	0.56	58.01
CCC-	0.84	0.11	0.09	0.07	0.08	0.08	0.13	0.19	0.37	1.40	0.34	66.51
CC	0.63	0.07	0.05	0.04	0.04	0.06	0.06	0.07	0.21	0.82	0.21	70.52
C	0.58	0.05	0.05	0.05	0.04	0.03	0.04	0.05	0.11	0.56	0.16	72.72
D	5.66	0.44	0.27	0.31	0.31	0.28	0.41	0.58	1.15	8.52	1.79	79.05
Unrated	3.67	2.56	2.15	1.87	1.64	1.43	1.39	1.61	1.80	1.60	1.97	26.74
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00		
Average Rating per Momentum Portfolio												
Letter	BBB	A	A	A	A	A-	A-	A-	BBB+	BB+		
Numeric	8.77	6.40	6.24	6.27	6.34	6.53	6.75	7.27	8.12	10.54		

Panel B: Momentum portfolio holding-period returns (in percent)

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P10 - P1
IG	0.54	0.52	0.55	0.56	0.56	0.55	0.54	0.53	0.55	0.66	0.12
	(3.88)	**(5.01)**	**(5.86)**	**(6.31)**	**(6.44)**	**(6.29)**	**(5.98)**	**(5.65)**	**(5.35)**	**(5.54)**	(1.04)
NIG	0.44	0.38	0.39	0.56	0.64	0.65	0.75	0.75	0.93	2.34	1.90
	(1.54)	(1.73)	**(2.20)**	**(4.38)**	**(7.53)**	**(7.63)**	**(9.08)**	**(8.75)**	**(7.86)**	**(14.24)**	**(7.84)**

Table V
Bond Momentum by Rating Groups

Each month, t, bonds from all databases are first divided into quintiles. Within each quintile, we repeat the momentum analysis described in Table II. The average numeric S&P rating of each quintile is presented in the second column. The numerical ratings increase with credit risk: i.e. 1=AAA, 2=AA+, 3=AA, ..., 21=C, 22=D. Ratings 11=BB+ or higher (worse) are considered non-investment grade. The second column provides the time-series average of the cross-sectional mean rating for the particular rating quintile. Panel A presents results based on all databases over different subsample periods. Panels B and C provide results based on Quote- and Trade-Based subsamples over common periods of coverage.

Panel A: All Databases: Different Subperiods

Rating Sample	Average Rating	Momentum portfolios (P1=losers, P10 = winners) P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P10 - P1
							1973-2008					
Q1	2.30	0.70	0.71	0.69	0.70	0.70	0.70	0.71	0.72	0.73	0.77	0.07
		(6.11)	**(6.44)**	**(6.36)**	**(6.40)**	**(6.36)**	**(6.40)**	**(6.71)**	**(7.10)**	**(7.41)**	**(7.47)**	(0.70)
Q2	4.38	0.63	0.65	0.67	0.69	0.69	0.70	0.70	0.71	0.72	0.75	0.12
		(5.46)	**(5.92)**	**(6.17)**	**(6.34)**	**(6.40)**	**(6.56)**	**(6.75)**	**(7.28)**	**(7.64)**	**(8.02)**	(1.37)
Q3	6.28	0.64	0.64	0.67	0.69	0.70	0.70	0.70	0.71	0.72	0.75	0.11
		(5.56)	**(5.98)**	**(6.25)**	**(6.43)**	**(6.60)**	**(6.68)**	**(6.83)**	**(7.22)**	**(7.68)**	**(8.32)**	(1.32)
Q4	7.91	0.67	0.66	0.67	0.69	0.70	0.71	0.73	0.75	0.76	0.78	0.12
		(5.11)	**(5.98)**	**(6.23)**	**(6.48)**	**(6.75)**	**(6.97)**	**(7.34)**	**(7.85)**	**(8.36)**	**(8.90)**	(1.20)
Q5	12.31	0.75	0.61	0.73	0.75	0.80	0.82	0.84	0.88	0.94	1.68	0.93
		(4.20)	**(3.85)**	**(6.28)**	**(7.23)**	**(8.40)**	**(9.02)**	**(9.34)**	**(10.11)**	**(10.74)**	**(14.77)**	**(6.24)**
							1973-1990					
Q1	2.38	0.72	0.73	0.76	0.79	0.79	0.80	0.83	0.84	0.85	0.84	0.12
		(3.67)	**(3.64)**	**(3.73)**	**(3.78)**	**(3.79)**	**(3.90)**	**(4.17)**	**(4.59)**	**(5.06)**	**(5.27)**	(0.79)
Q2	3.90	0.75	0.74	0.77	0.79	0.80	0.82	0.84	0.85	0.86	0.85	0.10
		(3.87)	**(3.78)**	**(3.81)**	**(3.87)**	**(3.92)**	**(4.09)**	**(4.34)**	**(4.81)**	**(5.28)**	**(5.77)**	(0.75)
Q3	5.83	0.76	0.76	0.78	0.80	0.81	0.82	0.83	0.85	0.87	0.85	0.09
		(4.00)	**(3.90)**	**(3.94)**	**(4.04)**	**(4.09)**	**(4.22)**	**(4.43)**	**(4.81)**	**(5.36)**	**(5.92)**	(0.67)
Q4	6.97	0.81	0.79	0.80	0.81	0.81	0.84	0.86	0.88	0.89	0.86	0.05
		(4.19)	**(4.05)**	**(4.09)**	**(4.14)**	**(4.22)**	**(4.40)**	**(4.69)**	**(5.10)**	**(5.62)**	**(6.18)**	(0.42)
Q5	10.93	0.77	0.88	0.89	0.88	0.90	0.92	0.92	0.95	0.94	0.98	0.21
		(3.28)	**(4.21)**	**(4.43)**	**(4.59)**	**(4.92)**	**(5.29)**	**(5.46)**	**(5.83)**	**(6.19)**	**(6.37)**	(1.22)
							1991-2008					
Q1	2.21	0.65	0.66	0.59	0.58	0.56	0.55	0.55	0.55	0.58	0.66	0.01
		(4.92)	**(6.23)**	**(6.40)**	**(6.76)**	**(6.70)**	**(6.26)**	**(6.19)**	**(5.74)**	**(5.08)**	**(4.77)**	(0.05)
Q2	4.82	0.47	0.53	0.55	0.56	0.55	0.54	0.53	0.53	0.54	0.61	0.14
		(3.39)	**(4.66)**	**(5.49)**	**(5.96)**	**(6.12)**	**(6.04)**	**(5.73)**	**(5.62)**	**(5.21)**	**(5.01)**	(1.25)
Q3	6.72	0.46	0.49	0.53	0.54	0.55	0.54	0.53	0.53	0.53	0.61	0.14
		(3.35)	**(4.66)**	**(5.35)**	**(5.63)**	**(5.98)**	**(5.82)**	**(5.58)**	**(5.46)**	**(5.15)**	**(5.27)**	(1.25)
Q4	8.84	0.46	0.49	0.50	0.53	0.55	0.55	0.56	0.57	0.59	0.66	0.21
		(2.49)	**(4.25)**	**(4.89)**	**(5.44)**	**(5.99)**	**(6.15)**	**(6.27)**	**(6.33)**	**(6.07)**	**(5.85)**	(1.39)
Q5	13.61	0.60	0.25	0.51	0.58	0.66	0.68	0.71	0.76	0.89	2.33	1.73
		(2.19)	(1.02)	**(4.05)**	**(6.28)**	**(9.53)**	**(9.96)**	**(9.86)**	**(10.43)**	**(9.32)**	**(14.36)**	**(7.40)**

Table V (continued)

Panel B: 1994-2008: Different Databases

Rating Sample	Average Rating	Momentum portfolios (P1=losers, P10 = winners) P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P10 - P1
						All Databases						
Q1	2.08	0.70	0.71	0.63	0.61	0.59	0.57	0.57	0.57	0.60	0.66	-0.04
		(4.48)	**(5.72)**	**(5.86)**	**(6.20)**	**(6.18)**	**(5.84)**	**(5.85)**	**(5.39)**	**(4.75)**	**(4.49)**	(-0.26)
Q2	4.73	0.49	0.55	0.57	0.58	0.57	0.56	0.54	0.54	0.55	0.63	0.14
		(2.91)	**(4.08)**	**(4.87)**	**(5.33)**	**(5.49)**	**(5.49)**	**(5.25)**	**(5.20)**	**(4.80)**	**(4.66)**	(1.14)
Q3	6.76	0.46	0.50	0.54	0.56	0.57	0.56	0.54	0.53	0.54	0.62	0.16
		(2.79)	**(4.02)**	**(4.69)**	**(4.95)**	**(5.34)**	**(5.27)**	**(5.08)**	**(4.97)**	**(4.71)**	**(4.92)**	(1.20)
Q4	8.91	0.43	0.50	0.50	0.53	0.56	0.56	0.57	0.58	0.60	0.68	0.25
		(1.95)	**(3.59)**	**(4.15)**	**(4.68)**	**(5.25)**	**(5.48)**	**(5.68)**	**(5.86)**	**(5.65)**	**(5.32)**	(1.40)
Q5	13.52	0.67	0.40	0.48	0.57	0.68	0.70	0.73	0.77	0.90	2.60	1.93
		(1.99)	(1.59)	**(3.17)**	**(5.42)**	**(9.48)**	**(10.27)**	**(10.20)**	**(9.70)**	**(8.37)**	**(14.04)**	**(7.02)**
						Quote-Based						
Q1	2.10	0.72	0.71	0.64	0.61	0.59	0.57	0.58	0.57	0.59	0.67	-0.05
		(4.68)	**(5.53)**	**(5.98)**	**(6.16)**	**(6.04)**	**(5.72)**	**(5.79)**	**(5.28)**	**(4.58)**	**(4.48)**	(-0.35)
Q2	4.74	0.53	0.57	0.58	0.57	0.57	0.55	0.54	0.54	0.55	0.64	0.11
		(3.35)	**(4.35)**	**(4.99)**	**(5.29)**	**(5.47)**	**(5.49)**	**(5.36)**	**(5.06)**	**(4.76)**	**(4.74)**	(0.94)
Q3	6.81	0.48	0.50	0.54	0.56	0.56	0.55	0.53	0.52	0.53	0.62	0.13
		(3.13)	**(4.10)**	**(4.65)**	**(5.01)**	**(5.28)**	**(5.17)**	**(5.00)**	**(4.79)**	**(4.59)**	**(4.95)**	(1.06)
Q4	8.91	0.50	0.51	0.52	0.55	0.56	0.56	0.57	0.58	0.59	0.67	0.17
		(2.71)	**(3.81)**	**(4.39)**	**(4.98)**	**(5.38)**	**(5.50)**	**(5.69)**	**(5.81)**	**(5.64)**	**(5.41)**	(1.17)
Q5	13.55	0.74	0.51	0.56	0.64	0.70	0.71	0.73	0.78	0.91	2.63	1.89
		(2.47)	**(2.36)**	**(4.42)**	**(7.57)**	**(10.46)**	**(10.45)**	**(10.37)**	**(10.02)**	**(8.49)**	**(14.27)**	**(7.59)**
						Trade-Based						
Q1	2.21	0.37	0.28	0.43	0.40	0.39	0.41	0.42	0.43	0.40	0.54	0.17
		(1.36)	(1.30)	**(2.55)**	**(2.75)**	**(3.00)**	**(3.16)**	**(3.45)**	**(3.71)**	**(3.24)**	**(2.81)**	(0.81)
Q2	3.26	0.19	0.16	0.35	0.37	0.38	0.39	0.44	0.44	0.40	0.51	0.32
		(0.62)	(0.65)	(1.62)	**(2.17)**	**(2.61)**	**(2.77)**	**(3.42)**	**(3.67)**	**(3.28)**	**(2.73)**	(1.21)
Q3	4.17	0.34	0.28	0.40	0.39	0.40	0.42	0.43	0.45	0.42	0.56	0.21
		(1.02)	(1.23)	**(2.17)**	**(2.34)**	**(2.88)**	**(3.01)**	**(3.33)**	**(3.80)**	**(3.26)**	**(2.88)**	(0.79)
Q4	5.95	-0.04	-0.12	0.15	0.29	0.20	0.31	0.44	0.42	0.47	0.51	0.55
		(-0.10)	(-0.32)	(0.51)	(1.29)	(0.98)	(1.81)	**(2.71)**	**(2.54)**	**(2.48)**	**(2.06)**	(1.59)
Q5	8.58	-0.60	-0.45	-0.46	-0.27	-0.36	-0.15	0.02	0.13	0.24	0.72	1.32
		(-0.80)	(-0.71)	(-0.77)	(-0.56)	(-0.77)	(-0.42)	(0.06)	(0.45)	(0.89)	(1.84)	**(2.08)**

Table VI
Bond Momentum in Improving Rating Subsamples

We compute momentum as in Table II sequentially excluding the worst rated bonds. The first column characterizes the subsample. The second column reports the momentum profits (returns of P10-P1) for the corresponding subsample. The next column provides the percentage of rated firms included in the subsample. The last column reports the percentage of amount outstanding of rated bonds included in the subsample. All numbers are in percentages.

Panel A: All Databases: 1991-2008

Sample	Momentum Profits P10-P1	% of Bonds removed	% of Amount Outstanding removed
AAA-D	0.63 (**4.33**)		
AAA-C	0.28 (**2.03**)	2.18	1.61
AAA-CC	0.26 (1.90)	2.35	1.75
AAA-CCC-	0.25 (1.86)	2.58	1.91
AAA-CCC	0.25 (1.82)	3.01	2.38
AAA-CCC+	0.24 (1.81)	3.80	3.04
AAA-B-	0.22 (1.67)	5.27	4.23
AAA-B	0.19 (1.48)	8.27	6.92
AAA-B+	0.16 (1.30)	11.57	10.22
AAA-BB-	0.13 (1.11)	14.31	12.74
AAA-BB	0.15 (1.21)	16.70	15.07
AAA-BB+	0.13 (1.09)	19.15	17.23
AAA-BBB-	0.12 (1.04)	22.19	20.24
AAA-BBB	0.12 (1.03)	28.03	26.17
AAA-BBB+	0.13 (1.08)	37.38	35.30
AAA-A-	0.13 (1.04)	45.28	43.09
AAA-A	0.14 (1.11)	53.22	50.42

Table VI (continued)

Panel B: Trade-Based Databases: 2002-2008

Sample	Momentum Profits P10-P1	% of Bonds removed	% of Amount Outstanding removed
AAA-D	1.14 (**2.05**)		
AAA-C	1.09 (**1.98**)	0.98	0.65
AAA-CC	1.08 (**1.97**)	1.09	0.70
AAA-CCC-	1.09 (**1.96**)	1.32	0.81
AAA-CCC	1.08 (**1.96**)	1.79	1.17
AAA-CCC+	1.10 (**2.01**)	2.91	1.95
AAA-B-	1.07 (1.91)	4.40	3.05
AAA-B	0.89 (1.85)	7.62	5.41
AAA-B+	0.73 (1.68)	12.18	8.62
AAA-BB-	0.68 (1.68)	15.13	10.55
AAA-BB	0.71 (1.66)	17.79	12.62
AAA-BB+	0.65 (1.63)	23.92	15.33
AAA-BBB-	0.53 (1.63)	29.31	18.76
AAA-BBB	0.51 (1.58)	34.23	24.30
AAA-BBB+	0.49 (1.49)	41.36	33.30
AAA-A-	0.48 (1.40)	47.68	41.47

Table VII
Bond Momentum based on Characteristic-Adjusted Returns

Each month, characteristic-adjusted returns are computed by subtracting from each monthly bond return the average monthly return of the characteristic decile to which the bond belongs. Bond momentum is then computed as in Table V using characteristic-adjusted, rather than raw returns, to compute portfolio holding period returns. The different subpanels present results after adjusting for bond duration, age, and amount outstanding. The sample period is from January 1991 to December 2008.

	Momentum portfolios (P1=losers, P10 = winners)										
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P10 - P1
					Duration-Adjusted Returns						
Q1	-0.06	-0.04	0.02	0.02	0.03	0.01	0.01	-0.00	0.02	0.04	0.11
	(-0.87)	(-0.55)	(0.20)	(0.25)	(0.32)	(0.14)	(0.12)	(-0.02)	(0.20)	(0.48)	(1.33)
Q2	-0.12	-0.10	-0.10	-0.05	-0.03	-0.02	-0.04	-0.03	-0.01	0.03	0.15
	(-1.07)	(-1.71)	(-1.91)	(-0.90)	(-0.58)	(-0.38)	(-0.56)	(-0.47)	(-0.11)	(0.53)	(1.15)
Q3	-0.15	-0.11	-0.04	-0.02	-0.02	0.00	0.00	-0.00	0.02	0.06	0.21
	(-1.71)	(**-3.31**)	(-1.23)	(-0.63)	(-0.39)	(0.01)	(0.00)	(-0.07)	(0.31)	(1.10)	(1.82)
Q4	-0.17	-0.08	-0.06	-0.04	-0.02	-0.02	-0.01	0.01	0.02	0.10	0.27
	(-1.21)	(-1.74)	(-1.71)	(-1.01)	(-0.57)	(-0.44)	(-0.31)	(0.27)	(0.36)	(1.95)	(1.70)
Q5	0.02	-0.25	-0.02	0.02	0.06	-0.01	0.01	0.03	0.07	1.31	1.29
	(0.07)	(-1.27)	(-0.23)	(0.29)	(1.03)	(-0.09)	(0.21)	(0.43)	(0.77)	(**9.16**)	(**5.73**)
					Age-Adjusted Returns						
Q1	0.02	0.04	0.03	-0.00	-0.01	-0.00	-0.02	-0.01	-0.00	-0.16	-0.18
	(0.22)	(0.43)	(0.37)	(-0.00)	(-0.10)	(-0.03)	(-0.20)	(-0.07)	(-0.04)	(-0.76)	(-0.88)
Q2	-0.10	-0.05	-0.05	-0.05	-0.05	-0.06	-0.06	-0.05	-0.03	-0.07	0.03
	(-1.09)	(-0.65)	(-0.77)	(-0.84)	(-0.95)	(-1.08)	(-1.09)	(-0.81)	(-0.46)	(-0.44)	(0.17)
Q3	-0.12	-0.09	-0.06	-0.05	-0.05	-0.05	-0.06	-0.06	-0.07	0.00	0.13
	(-1.43)	(-1.84)	(-1.29)	(-1.09)	(-1.04)	(-1.03)	(-1.13)	(-1.03)	(-1.02)	(0.05)	(1.08)
Q4	-0.19	-0.11	-0.08	-0.06	-0.05	-0.05	-0.06	-0.06	-0.05	0.05	0.24
	(-1.39)	(**-2.23**)	(**-2.21**)	(-1.69)	(-1.21)	(-1.07)	(-1.28)	(-1.31)	(-1.01)	(0.83)	(1.50)
Q5	-0.14	-0.37	-0.08	-0.03	0.00	-0.00	0.00	0.06	0.14	1.40	1.54
	(-0.54)	(-1.71)	(-0.81)	(-0.43)	(0.07)	(-0.03)	(0.03)	(0.94)	(1.33)	(**8.35**)	(**6.67**)
					Amount-Outstanding-Adjusted Returns						
Q1	0.05	0.09	0.05	0.03	0.03	0.03	0.03	0.01	0.02	-0.29	-0.35
	(0.43)	(0.93)	(0.61)	(0.34)	(0.34)	(0.33)	(0.34)	(0.12)	(0.25)	(-0.74)	(-0.93)
Q2	-0.09	-0.03	-0.03	-0.01	-0.01	-0.02	-0.02	-0.03	-0.01	-0.20	-0.12
	(-0.89)	(-0.43)	(-0.44)	(-0.19)	(-0.22)	(-0.35)	(-0.33)	(-0.52)	(-0.21)	(-0.67)	(-0.38)
Q3	-0.11	-0.07	-0.03	-0.02	-0.02	-0.02	-0.03	-0.04	-0.03	0.04	0.15
	(-1.28)	(-1.61)	(-0.82)	(-0.59)	(-0.51)	(-0.47)	(-0.60)	(-0.68)	(-0.46)	(0.73)	(1.33)
Q4	-0.14	-0.08	-0.07	-0.04	-0.03	-0.03	-0.04	-0.03	-0.02	0.06	0.20
	(-1.07)	(-1.75)	(**-2.33**)	(-1.59)	(-1.00)	(-1.03)	(-1.06)	(-0.90)	(-0.53)	(1.23)	(1.34)
Q5	-0.07	-0.35	-0.10	-0.05	-0.01	-0.02	-0.01	0.05	0.16	1.44	1.51
	(-0.29)	(-1.67)	(-1.11)	(-0.76)	(-0.19)	(-0.28)	(-0.17)	(0.81)	(1.64)	(**8.55**)	(**6.83**)

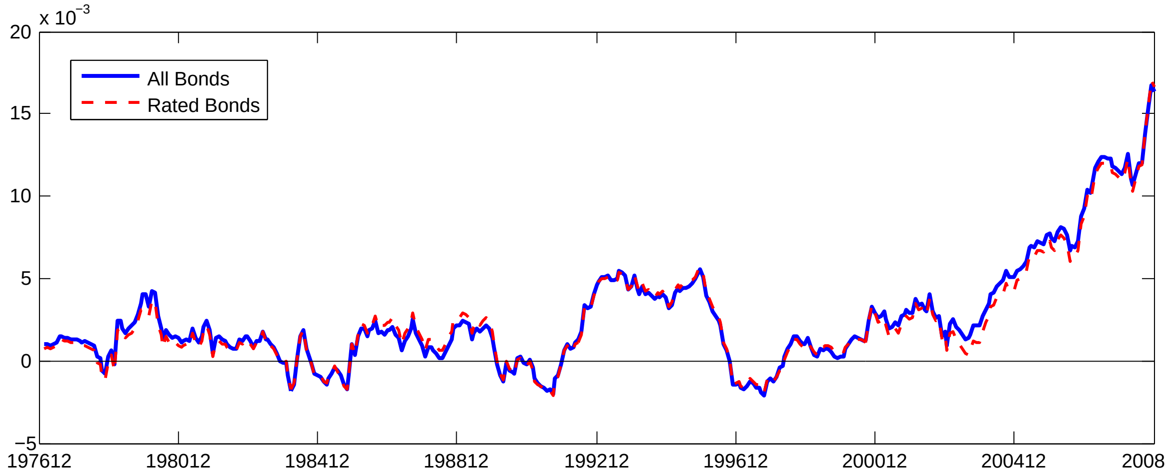

Figure I. Time-Series of Momentum Profitability. The figure presents the 48-month moving average momentum profit (P10-P1) for all bonds (solid blue line) as well as for only rated bonds (dashed red line). The momentum strategy is based on all bonds from Lehman, Datastream, Bloomberg, FISD, and TRACE. The sample period is from January 1973 to December 2008.

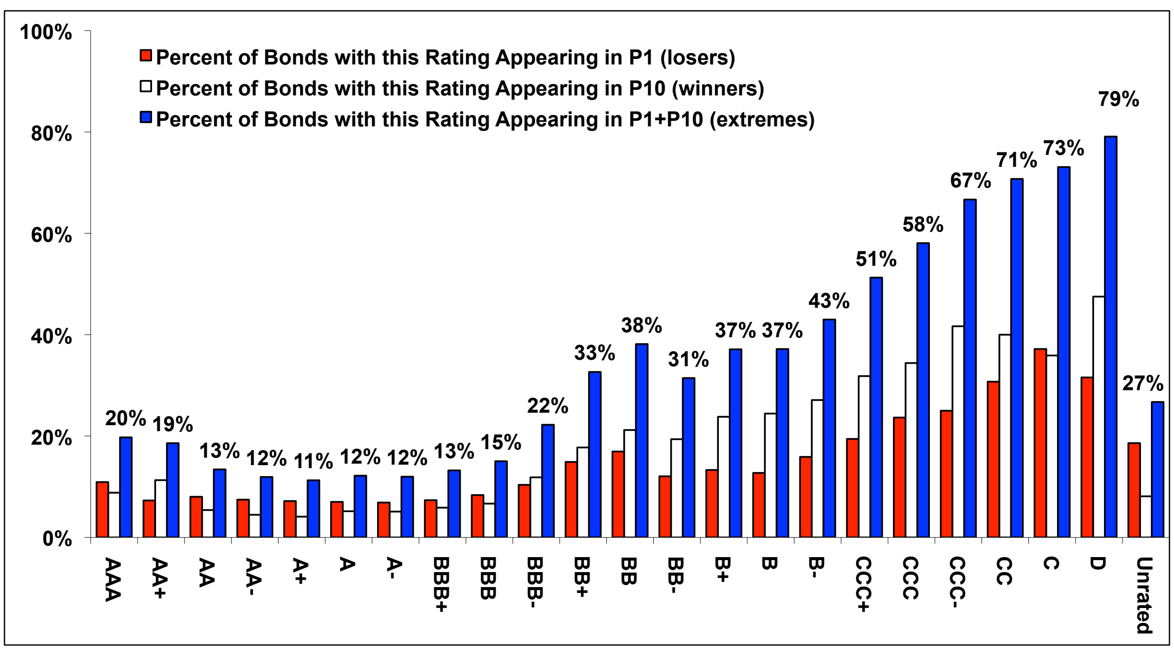

Figure II. Percentage of bonds of each rating class appearing in extreme momentum portfolios. The figure presents for each rating category, the percentage of bonds appearing in the loser (P1) [first (red) bar], the winner (P10) [second (white) bar], and both extreme (P1+P10) [third (blue) bar, also see last column in Table IV, middle of Panel A] momentum decile portfolios. The momentum strategy is based on all bonds from Lehman, Datastream, Bloomberg, FISD, and TRACE, from January 1991 to December 2008.