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Momentum in Corporate Bond Returns

ABSTRACT

This paper finds significant price momentum in US corporate bonds. The analysis is based on 3.2 million observations of 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, transaction data from TRACE reveal that losers are more actively traded than winners, giving them a greater share in momentum profitability when using trade-based data sets. Illiquidity is unlikely to explain bond momentum as it is equally profitable in quote- or trade-based data. Lack of information and transparency is also an unlikely explanation since momentum profits have increased in recent years, after the introduction of the TRACE reporting system.

Introduction

While some market anomalies disappear or attenuate upon discovery (Schwert 2003), momentum in stock prices has persisted and is economically and statistically among the strongest asset-pricing anomalies (see Avramov, Chordia, Jostova, and Philipov 2009). First documented by Jegadeesh and Titman (1993), who show that past stocks winners outperform past losers, the momentum anomaly challenges the foundation of the efficient market hypothesis. Moreover, momentum has been documented for a number of other asset classes: international equities (e.g. Rouwenhorst 1998, Chan, Hameed, and Tong 2000, Liew and Vassalou 2000), currencies (e.g. Okunev and White 2003), commodities (e.g. Miffre and Rallis 2007, Gorton, Hayashi, and Rouwenhorst 2008), international government bonds (e.g. Asness, Moskowitz, and Pedersen 2009), and residential real estate (e.g. Beracha and Skiba 2010). For US corporate bonds, however, there is scarce research on momentum centered around the study by Gebhardt, Hvidkjaer, and Swaminathan (2005b), who find no evidence of momentum among investment grade bonds from 1973 to 1996.

Using a multi-database sample of 77,150 individual investment grade and high-yield US corporate bonds issued by 11,672 companies from 1973 to 2008, we find strong evidence of momentum profitability. This 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.

Our sample combines both transaction and dealer-quote corporate bond information from Lehman Brothers, DataStream, Bloomberg, TRACE, and FISD.[1] It contains 3.23

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

million bond-month observations from 1973 to 2008, with a monthly average of 7,500 bonds from 2,000 issuers. Lehman Brothers, DataStream, and Bloomberg are quote-based and provide a combined price coverage over the full sample period. In contrast, TRACE and FISD are trade-based and together provide prices from actual bond transactions starting in 1994. The quote-based databases provide pricing information regardless of trading activity and thus offer a more comprehensive sample of both liquid and illiquid bonds. The trade-based databases, on the other hand, are biased towards more liquid bonds. In addition, since momentum strategies require continuous six months of return data to form portfolios, results using the trade-based sample are further biased toward the most liquid bonds.

We find that bond momentum is strong and profitable in both quote-based and trade-based sub-samples, producing profits of 60 (58) bps in quote- (trade-) based data sets over their common period from 1994 to 2008. Hence, illiquidity is unlikely to explain bond momentum as profits are very similar across samples of different liquidity.

Samples of different credit risk, on the other hand, produce strikingly different momentum profits. We find that momentum is strong and significant in non-investment grade (NIG) bonds and non-existent among investment grade (IG) bonds.[2] From 1991 to 2008, the momentum strategy yields a strongly significant profit of 190 bps per month in NIG bonds and insignificant 12 bps in IG bonds. Consistent with Gebhardt, Hvidkjaer, and Swaminathan (2005b), who study Lehman database IG bonds from 1973 to 1996, there is no evidence of momentum profitability for IG bonds. The far fewer NIG bonds between 1973 and 1990 compared to later periods could explain the lack of momentum profitability over that period in our overall sample. Indeed, we find significant momentum among the worst rated-bonds in the 1973-1990 period as well.

[2]We use bond credit ratings provided by the various databases or from Standard & Poor's bond issue ratings on WRDS. More than 92% of observations have credit rating.

We further subdivide the overall sample into credit rating quintiles. Over the 1991-2008 period, momentum strategy profits amount to strongly significant 173 bps per month in the highest credit risk quintile (Q5). In the remaining four credit risk quintiles the profits are economically small (between 1 and 21 bps) and statistically insignificant.

In fact, we find that momentum profitability is driven exclusively by the worst-rated bonds. After removing all bonds rated C and D from our investment universe, momentum profitability over the period from 1991 to 2008 drops from 63 to 26 bps per month and becomes insignificant at the 5% level. Momentum profits become insignificant at the 10% level when all bonds rated $B-$ or worse are removed. The excluded bonds represent only 8.27% of all bond-month observations and 6.92% of total amount outstanding. Yet momentum profits in these bonds are large enough to generate strongly significant momentum across the sample.

These worst-rated bonds have such a large effect on the overall sample results because they tend to appear mostly in the extreme winner and loser portfolios, which make up the momentum strategy. To illustrate, 79% (73%) [71%] of bonds rated D (C) [CC] appear in the extreme winner and loser momentum portfolios, while only 11% of bonds rated $A+$ (for example) enter these extreme portfolios. This pattern is analogous to recent findings in the equity literature that momentum profits are significant only for high credit risk stocks (see Avramov, Chordia, Jostova, and Philipov 2007). However, for corporate bonds, the sub-sample that drives momentum profits is even more extreme in terms of credit risk.

Moreover, unlike equities, momentum profitability in corporate bonds comes primarily from the long side of the strategy. More specifically, 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. The Q1 (Q5) losers earn 65

(60) bps per month, while the Q1 (Q5) winners realize 66 (233) bps per month. Note that the difference in momentum profitability between Q5 and Q1 bonds (172 bps $= 173 - 1$) is mostly attributable to the difference between Q5 and Q1 winners (167 bps $= 233 - 66$) rather than Q5 and Q1 losers (-5 bps $= 60 - 65$) . This is contrary to equities, where losers tend to contribute more towards momentum profitability in high credit risk stocks relative to low credit risk stocks (see Avramov, Chordia, Jostova, and Philipov 2007).

The contributions of winners and losers toward momentum profits differ across transaction and dealer-quote databases. When the momentum strategy is implemented only among bonds that actually trade, losers make a significant contribution toward momentum profits. Momentum profits from traded bonds amount to 132 bps per month for the worst-rated quintile (Q5) and insignificant 17 bps for the best-rated (Q1); again, momentum profits are only significant in Q5. However, losers have a larger share in these profits: Q1 (Q5) losers earn 37 (-60) bps per month – a difference of 97 bps – while Q1 (Q5) winners earn 54 (72) bps – a difference of 18 bps. In other words, the difference in momentum profitability between Q5 and Q1 is 115 bps ($= 132 - 17$), of which 97 bps come from the difference in losers and 18 bps come from the difference in winners.

Upon further investigation, this difference between transaction and dealer-quote subsamples arises not from data integrity issues but from losers trading more frequently than winners. This becomes evident when we compare transaction and quote databases across their common bond-month observations. Then the two types of databases provide indistinguishable returns, lower than the full sample average. The evidence suggests that investors tend to keep bond winners and trade losers. Interestingly, this 'disposition' effect in bonds counters evidence from equity markets (e.g. Shefrin and Statman 1985), where investors tend to keep losers and trade winners.

Momentum profits in corporate bonds are not limited to periods around rating changes, contrary to recent evidence in equities that most asset-pricing anomalies arise during periods around rating downgrades (see Avramov, Chordia, Jostova, and Philipov 2009). We find that bond momentum remains significant even after removing 12 months of data around rating upgrades, downgrades, or both.

Corporate bond momentum is robust to adjustments for risk, illiquidity, and transaction costs. Specifically, profitability remains strong and significant after adjusting returns by duration (as a proxy for interest rate risk) or by age and amount outstanding (as proxies for liquidity). We adjust individual monthly bond returns by subtracting the average monthly return of the characteristic decile to which the bond belongs. Bond momentum is also robust to adjustments for systematic risk. In particular, bond momentum remains strong and significant when we adjust for stock and bond risk factors, such as changes in the term and default risk premia, as well as the three Fama and French (1993) factors and the momentum factor of Carhart (1997). Finally, momentum profits are large enough to survive even the most extreme transaction costs estimates by Edwards, Harris, and Piwowar (2007) based on TRACE transactions.

Finally, momentum profits are not driven by any specific database – they survive the exclusion of any one of the five databases. Moreover, momentum profitability is unlikely the result of survivorship bias, as similar percentage of bonds (roughly 90%) in the loser and the winner portfolios survive through the holding period.

The remainder of the paper is structured as follows. Section I discusses the data. Section II.A analyzes bond momentum in the overall sample as well as in the two subsamples of quote- and trade-based returns. Section II.B investigates the link between bond momentum and credit risk, Section II.C examines momentum after the introduction of the TRACE reporting system, and Section II.D reports robustness tests. Section III offers concluding remarks.

I. Data

Our corporate bond sample is compiled from the following 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 over the period from January 1973 to December 2008 for a total of 77,150 different bonds issued by 11,672 companies. Next we detail the data sources, return calculation, and sample construction.

A. Bond database description

The Lehman Brothers Fixed Income Database reports monthly information on the major private and government debt issues traded in the United States from 1973 to December 1997. We identify all US corporate fixed-coupon non-convertible debentures that do not contain options. We collect data on month-end return, rating, duration, amount outstanding, issue date, and other characteristics. While most prices in the Lehman database reflect dealer quotes, some are "matrix" prices, which are estimated from price quotes of bonds with similar characteristics. As in Gebhardt, Hvidkjaer, and Swaminathan (2005b), we use both quote and matrix prices.[3] However, we do not exclude high-yield bonds.

Our second source of bond price information is DataStream. From DataStream, we extract all bonds listed in the database starting in January 1990, which satisfy a set

[3] Gebhardt, Hvidkjaer, and Swaminathan (2005b) report that their results are the same when using dealer quotes only.

of commonly implemented selection criteria[4]. 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, we collect price quotes and characteristics for bonds of publicly traded firms with available issuer credit ratings. We retain only fixed-coupon bonds, which are neither convertible nor callable.

The above three databases provide pricing information based on dealer quotes. This may raise concerns that the momentum strategy we identify using quote-based data cannot be easily implemented due to thin or infrequent trading, stale prices, or illiquidity. This is why we incorporate two additional databases, TRACE and FISD, which are strictly trade-based.[5]

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.[6] The system was implemented in phases and by February 2005 covered more than 99 percent of the OTC activity in US corporate bonds.[7] We collect bond prices starting at the inception of the TRACE system 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

[4]Although DataStream contains bond data going back to earlier years, data on individual bond returns before 1990 is limited.

[5]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.

[6]TRACE has been used in Bessembinder, Maxwell, and Venkataraman (2006), Edwards, Harris, and Piwowar (2007), and Goldstein, Hotchkiss, and Sirri (2007).

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

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.[8] 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, we first compute daily prices as the trade size-weighted average of intraday prices.[9] We then set the month-end trading price equal to the last available daily price of the month if it falls within the last five trading days.[10] We then compute monthly holding period

[8]This database has also been used by Campbell and Taksler (2003), Krishnan, Ritchken, and Thomson (2006), and Cai, Helwege, and Warga (2007).

[9]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.

[10]Using an end-of-month interval instead of the last day of the month (as in quote-based databases) helps increase the number of non-missing monthly observations. The conclusions of the paper are robust to modifying this restriction. See also section D.

returns as:

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

where $r_{i,t}$ is bond i's return over month t, $P_{i,t}$ is its price in month 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.[11]

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 as the only available source. 8% of the bond-month observations come from exactly two databases. The biggest overlap is between DataStream and TRACE (the overlapping observations are compared later in the paper to assess data consistency). Less than 1% of all bond-month 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 using the following sequence TRACE, FISD, Lehman,

[11] 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.

DataStream, Bloomberg. The results presented in the paper are based on the second aggregation method above, which gives precedence to the trade-based databases. However, our findings are virtually identical when the first method is used.

C. Descriptive statistics

The initial sample constructed by merging all five databases contains 3,233,082 bond-month observations, including potential data errors or outliers. To ensure that the results are not driven by these, we eliminate observations with returns above 50% per month.[12] This filtering eliminates less than 0.1% of all observations and results in a final sample containing 3,230,001 bond-month observations (see Table I). The number of available bonds each month ranges from 2,323 to 22,199 and averages 7,512 bonds from 2,043 issuers.

Table I reports summary statistics for bond returns, S&P rating, duration, age, and amount outstanding. 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. The available data on duration, age, and amount outstanding cover 81.99%, 85.26%, and 85.69% of the bond-month return observations, respectively.

Issue credit rating information is 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, ..., 10 = $BBB-$, 11 = $BB+$, ..., 21 = C, 22 = D. The investment-grade cut-off is 10 ($BBB-$). Our final sample contains rating information for 92.05% of

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

all bond-month observations. The mean (median) bond rating is 7.01 (6), corresponding approximately to an $A-$ (A) rating. 82.3% of rated bonds 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. Note that DataStream and TRACE, the databases covering the latter half of our sample period, contain the highest percentage of NIG bonds, 24.73% and 27.68%, respectively. In contrast, Lehman, the main data source of bond returns for the first half of our sample 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). FISD contains the youngest bonds (32.22 months on average). 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 the five databases are 0.79%, 0.60%, 0.64%, 0.02%, and 0.41%, respectively. For the most part they are similar, except for TRACE, which provides the lowest return over the sample period.

To understand whether the different TRACE average return is due to trading bias or data inconsistency, in Panel B of Table I we compare returns from DataStream and TRACE over their common bond-month observations. Their 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), as well as by return quintile, are quite similar, yet not identical since TRACE returns, as described earlier, are computed using month-end prices based on the last five trading days of the month, while DataStream returns are calculated using the last price quote of the month. Thus, the evidence in Panel B suggests that the relatively low returns in TRACE are not likely due to data inconsistencies. Rather, bonds with low returns are more likely to trade than bonds with high returns. That is, bond investors tend to hold onto winners but trade losers. Such a 'disposition' effect in bonds is opposite to what has been documented in stocks. For equities, Shefrin and Statman (1985) show that investors hold onto losers and dispose of winner stocks.

II. Results

In this section we examine the profitability of the momentum spread strategy of Jegadeesh and Titman (1993). Specifically, each month t, 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 strategies, 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. 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.

A. Momentum in US Corporate Bonds

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.

As revealed by a 48-month moving average in Figure I, momentum profits are close 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 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 a 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. Rated bonds yield similar momentum profits. Rating coverage for that period is about 90%. In unreported results, we find that bond momentum is also profitable if based on 3 to 12 month formation periods, and stays profitable up to a year after portfolio formation.

One concern in the analysis is that illiquidity can prevent bond momentum strategies from being exploited. Indeed, corporate bonds are among the least liquid asset classes.[13] 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) sub-samples 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 sub-samples.

The bond momentum strategy based on bonds that actually trade produces strongly 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) of rated bonds in the dealer-quote database. These results imply that lack of trading is unlikely to explain the presence of momentum in US corporate bonds. We later show that momentum profits are also robust to transaction costs considerations (see Section D).

One striking difference between trade-based and quote-based momentum profitability is the source of momentum profits. Notice in Panel B of Table II that holding period returns are uniformly smaller in the trade-based sample, especially for the extreme winner (P10) and loser (P1) 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 verify this difference between quote- and trade-based samples is not due to data inconsistency, Panel C compares momentum portfolio holding-period returns using only the bond-month observations that appear in both types of databases. Note that in Panel B of Table I we compared summary returns in DataStream and TRACE; here we compare

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

momentum portfolio holding period returns in quote- and trade-based data. Again, momentum holding-period returns from the trade-based and quote-based sub-samples are quite similar.

Next we examine whether the documented momentum profits are not simply compensation for systematic risk. We regress the returns of each momentum portfolio on bond market and stock market 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 and Newey-West adjusted standard errors, we estimate alphas from models of the following form:

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

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 $r_{pt} = R_{P10,t} - R_{P1,t}$ and $\boldsymbol{F}_t$ contains combinations of the following variables: the change in the term spread (difference between 10-year and 1-year Treasury yields); the change in the default spread (difference between BBB and AAA corporate yields); the market, SMB, and HML factors from Fama and French (1993); and the momentum factor from Carhart (1997). Table III reports the estimated portfolio alphas. The momentum strategy (P10-P1) alphas are strongly significant and range from 56 to 75 bps per month. They are similar to the equity alphas estimated by Jegadeesh and Titman (1993). We conclude that the observed momentum strategy profits are indeed abnormal and not simply compensation for systematic risk.

B. Credit Risk and Momentum Profitability

Recent studies of equity momentum (e.g. Avramov, Chordia, Jostova, and Philipov 2007) have highlighted a strong link between credit risk and momentum profitability. In this section, we investigate whether a similar link exists in the US corporate bond market.

Panel A of Table IV reports, within each momentum portfolio, the proportion of investment and non-investment grade 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 class. Then, for each momentum portfolio, we report the distribution of its constituent bonds across the IG, NIG, and unrated categories, as well as across the individual rating classes.[14]

The first part of Panel A of Table IV shows that the momentum portfolios contain on average 17.77% of NIG bonds ('Row Average' column). However, the loser portfolio (P1) contains 30.61% of NIG bonds and the winner portfolio (P10) contains 46.99% of 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 relatively less likely to appear in the momentum strategy portfolios: only 14.49% of IG bonds are part of them.

Refining the rating grid further, we compute the bond frequency distribution by

[14] Bonds are classified into rating categories or classes based on their credit rating at t when momentum portfolios are are formed.

momentum portfolio across all rating classes. The results in the second part of Panel A of Table IV 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 $A+$ (for example) appear in the extreme portfolios and ultimately affect the momentum strategy profitability.

The last part of Panel A of Table IV 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 credit risk. 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 $A-$. The 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. Notice in the figure that bonds in each NIG rating class have a much higher representation in the momentum strategy than the 20% implied by a uniform distribution. Moreover, the likelihood of ending up in the extreme momentum portfolios increases almost monotonically with credit risk. In contrast, bonds of almost all IG rating classes are less likely to be part of the momentum strategy than what a uniform distribution would imply.

Following the above evidence of a link between credit risk and momentum profits, we implement conditional momentum strategies in sub-samples of bonds based on ratings. Panel B of Table IV shows that bond momentum strategies are only profitable among NIG bonds, which provide monthly average return 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 our results for the early part of the sample period.

We further refine credit risk categories by dividing bonds into credit rating quintiles. We then repeat the momentum analysis separately for each quintile, across different sample periods. 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. Moreover, the conditional momentum strategy is profitable only in the worst-rated bond quintile (Q5), earning a highly significant 93 bps per month with a t-stat of 6.24 (compared to an 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 sub-samples contain investment-grade bonds.

As shown at the bottom of Panel A, the momentum profit for Q5 is 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 sub-sample 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, which is much more comparable to the worst-rated quintile in the later period. This worst-rated decile is the only one with non-investment grade average rating (the next decile has a rating of 9.4), and generates statistically significant 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 all rated bonds in that period are non-investment grade, compared to 22% in the second half of the sample period.

Focusing on the 1991-2008 sub-sample 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) realize 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, momentum profitability in equities is largely attributable to 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 sub-samples 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, trade-based momentum profitability in the worst quintile (bottom of Panel B of Table V) derives from the loser side of the momentum strategy, whereas quote-based profitability comes from the winner side of the strategy. Specifically, in the quote-based sub-sample, 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 sub-sample, 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 credit rating quintile. As shown earlier, since loser bonds appear to be much more actively traded, the loser portfolio (P1) has a larger share in momentum profits in the trade-based sub-sample. In the quote-based sub-sample, 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 return performance. To further isolate the segment of bonds that is driving momentum profitability, we implement the momentum strategy over sub-samples that sequentially exclude bonds with the worst credit rating. The results, reported 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 the momentum profit drops to 28 bps with a t-value of 2.03. After further removing all bonds rated C, the momentum payoff drops to 26 bps and is only significant at the 10% level, with a t-value of 1.90. Momentum profits become insignificant when bonds rated $B-$ or worse are removed. These bonds represent 8.27% of the rated bonds and 6.92% of amount outstanding. Strikingly, the momentum strategy is not profitable for the remaining 92% of the bonds. Similar findings for equities have recently been documented by Avramov, Chordia, Jostova, and Philipov (2007), who show that momentum disappears at the 5% level after excluding stocks of firms rated worse than $BB-$. However, in corporate bonds, the sample driving momentum profits is even more extreme in terms of credit risk.

To summarize so far, we document significant momentum from 1991 to 2008 in the overall US corporate bond sample, as well as in quote-based and trade-based subsamples. Bond momentum profits cannot be explained by systematic risk. However, credit risk has a strong impact on bond momentum profitability: momentum is only significant among the worst-rated bonds. 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. Yet, as Figure I shows, this increased transparency did little to abate bond momentum profitability, which has increased substantially in the latter part of the sample.

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 on trade-based data only to examine momentum profitability in the most liquid bonds in the period of highest transparency in bond markets. Momentum strategies, based on all rated bonds that actually traded, generate significant profits of 114 bps per month with a 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.

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

D. Robustness Checks

Corporate bond momentum is robust to adjustments for interest rate risk, illiquidity, and transaction costs. Specifically, profitability remains strong and significant after adjusting returns by duration (as a proxy for interest rate risk) or by age and amount outstanding (as proxies for liquidity). In addition, momentum profits do not appear to be concentrated in periods around rating changes, or to be susceptible to concerns about survivorship bias.

To control for interest rate risk, each month we compute duration-adjusted individual bond returns by subtracting from each bond return the average 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 profit in Q5 is 129 bps per month with a t-stat 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 is robust to adjusting for total 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.[15] Furthermore, Lee and Swaminathan (2000) show that liquidity affects the magnitude and persistence of momentum in equities, while Chen, Lesmond, and Wei (2007) show that less liquid bonds have higher yield spreads. Following Chen, Lesmond, and Wei (2007), we use bond 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 and amount-outstanding are only significant in Q5 amounting to 154 and 151 bps, respectively.

Evidence from equity markets suggests momentum profits may disappear after trading costs are taken into account (see Korajczyk and Sadka 2004). Although corporate bonds are much less liquid than equities, momentum profits from NIG bonds are high enough to survive transactions costs. To illustrate, consider the transaction costs 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 profit in NIG bonds is 1.90% per month. With a six-month holding period strategy, the cumulative six-month profit is 11.96% before transaction costs. To implement each momentum strategy, we need to buy the

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

bonds in P10 and sell them after six months and short the bonds in P1 and buy them back in six months. This amounts to four transactions, assuming a very conservative assumption of 100% turnover in P1 and P10.[16] With large trade sizes, the average 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 profit from NIG bonds. 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 will be small generates a net six-month momentum profit of 6.96% (=11.96% − 4 × 1.25%) from NIG bonds. With medium trades costing 0.5%, net momentum profits would be 9.96% (=11.96% − 2%).

Let us also consider the worst case scenario that all bonds in P10 and P1 are *D*-rated and the most expensive to trade. Edwards, Harris, and Piwowar (2007) estimate transaction costs of about 2.15% (1.2%) [0.3%] for small (medium) [large] trades of *D*-rated bonds. If all trades are small and in *D*-rated bonds, net momentum profits will be 3.36% (=11.96% − 4 × 2.15%). With medium trades, net momentum profits for a six-month holding period would be 7.16% (=11.96% − 4 × 1.2%). If large trades in *D*-rated bonds are possible, net momentum profits will be 10.76% (=11.96% − 4 × 0.30%) over six-months, again assuming 100% turnover in both the winner and loser portfolios. Hence, bond momentum strategies survive the most conservative transaction cost considerations.

Next we study the impact of rating changes on bond momentum profitability. For example, Hand, Holthausen, and Leftwich (1992) find that rating changes, especially

[16]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.

downgrades, have a substantial impact on bond returns. However, more recently Ambrose, Cai, and Helwege (2009) show that after controlling for information flow, price pressure effects from downgrading bonds to junk status are negligible, if not non-existent. 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.

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

Next we examine whether survivorship bias may impact our results. It is conceivable that some bonds disappear during the holding period because they default – a much more likely scenario for 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. If the retention rate for P10 is significantly different from that for P1, survivorship bias would disproportionately affect the returns of the winner or loser portfolio, ultimately affecting the observed profitability of a momentum strategy. 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 the retention rate in P10 is quite similar to that in P1 suggests that survivorship bias is not likely to be driving bond momentum profitability.

As with all empirical work, the quality of the results depends on the quality of the data used in the analysis. The consistency of the results across the trade-based and quote-based databases alleviates concerns about potential bias due to data issues in a particular database. In addition, in unreported results, we have verified that bond momentum is significant when data from any single database is excluded from the overall sample.[17]

III. 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 an extensive data set of 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 databases (TRACE and FISD) and three quote-based databases (Lehman, DataStream, and Bloomberg). Bond momentum momentum strategies generate similar profits of about 60 bps in either quote-based and trade-based databases. Hence, the momentum anomaly in US corporate bonds is not limited to a particular data set, and illiquidity is unlikely to explain it.

[17]Since a discussant raised several questions about the source of the DataStream bond data, we referred these questions to the DataStream database support team. Their data analysts confirmed that most U.S. corporate bond prices contained in the database are indicative prices (i.e. dealer quotes) reported by various market-makers trading the bonds. This data is further augmented with traded prices for exchange-traded bonds. Unfortunately, DataStream provides no indication of whether a recorded price is indicative or based on 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 based on quoted prices for securities with similar characteristics. As explained in the Data Section above, we exclude such matrix prices from our analysis.

Among rated bonds (92% of the sample), we find that the momentum strategy is only profitable in non-investment grade bonds, earning a significant 190 bps per month, and is non-existent among investment-grade bonds. The latter result is consistent with Gebhardt, Hvidkjaer, and Swaminathan (2005a). Stratifying the sample further, we find that momentum profitability is driven by the worst-rated bonds. Specifically, investment profitability disappears when bonds rated $B-$ or worse are removed from the sample. Although these bonds represent only 8.27% of the bond-month observations in our sample and 6.92% of the total amount outstanding, momentum profits in these bonds are large enough to generate strongly significant momentum for the overall corporate bond universe. The effect of this small fraction of bonds is so large because they concentrate in the extreme winner and loser portfolios. For example, only 11% of bonds rated $A+$ end up in either the P1 or P10 momentum portfolio. In sharp contrast, 79% (73%) [71%] of bonds rated D (C) [CC] appear in one of the extreme momentum portfolios and are part of the momentum strategy.

Momentum profits in the overall sample and in the quote-based databases 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) 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 Q1 and Q5 losers. In contrast, momentum profits derived from the trade-based data come primarily from losers. There, the difference in momentum profitability between Q1 and Q5 is 115 bps per month. Of these, 97 bps come from the difference between Q1 and Q5 losers and only 18 bps come from the difference in Q1 and Q5 winners. We find evidence that losers have a larger share in momentum profits when using transaction data because they trade more actively than winners.

Bond momentum is robust to risk, liquidity, and transaction costs considerations. It remains strong and significant when controlling for duration (as a proxy for interest rate risk), age and amount outstanding (as proxies for liquidity), and systematic risk (using both equity and bond factors). Momentum profits in non-investment grade corporate bonds are high enough to survive even the most extreme transaction costs estimated in the literature. Finally, unlike equities, momentum profits in corporate bonds do not derived from periods around rating changes and are significant even in stable credit conditions.

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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	Average	Momentum portfolios (P1=losers, P10 = winners)										
Sample	Rating	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	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P10 - P1
		Momentum portfolios (P1=losers, P10 = winners)										
							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**)

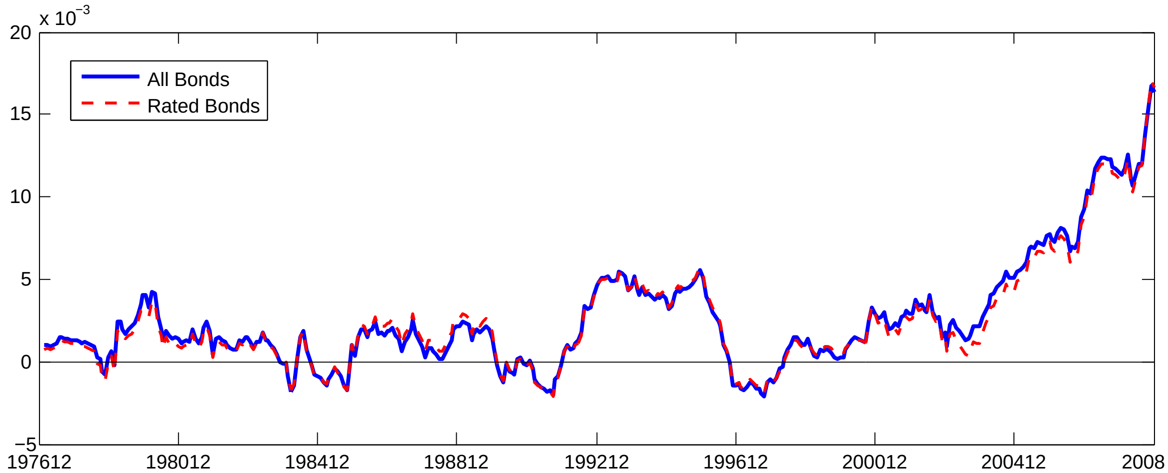

Figure I. Time-Series of Momentum Profitability. The figure presents the 48-month moving average momentum profit (P10-P1) for all bonds as well as for only rated bonds. The momentum strategy is based on all bonds from Lehman, Datastream, Bloomberg, FISD, and TRACE. The sample period is from January 1973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

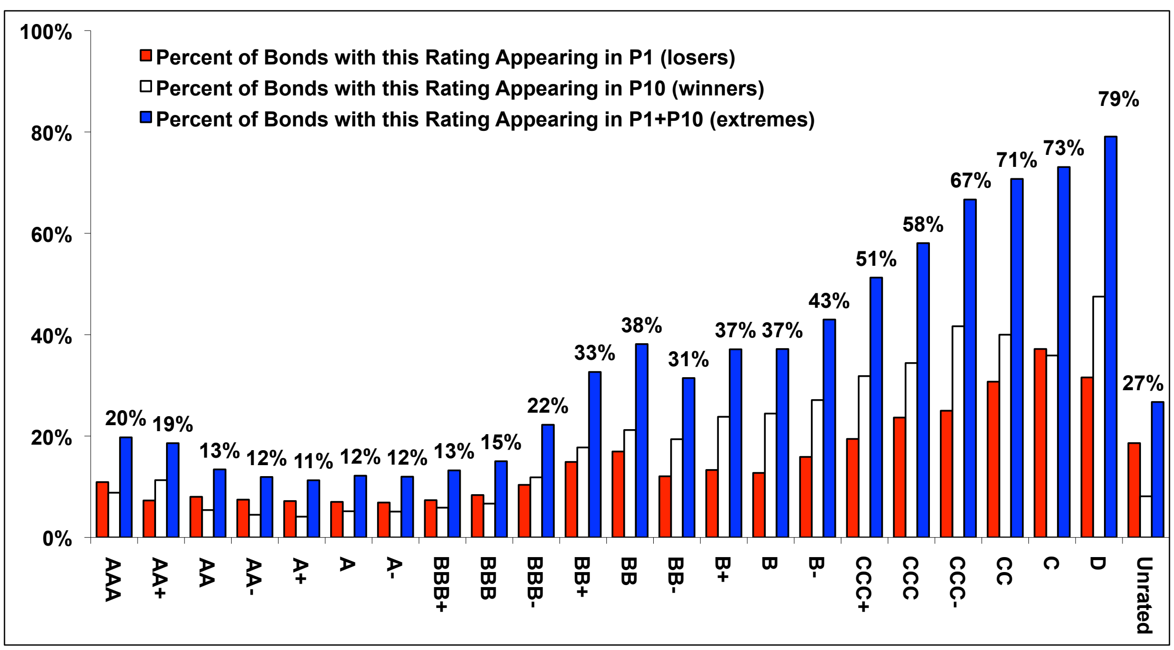

Figure II. Percentage of bonds of each rating class appearing in extreme momentum portfolios. The figure presents for each rating category, the percentage of bonds appearing in the loser (P1) [first (red) bar], the winner (P10) [second (white) bar], and both extreme (P1+P10) [third (blue) bar, also see 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 to December 2008.