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Abstract

This is the first study of corporate-bond mutual fund performance that examines detailed security-level holdings and returns. The new database allows us to decompose the costs and benefits of active management. In contrast to prior research on equity funds that shows evidence of stock-selection ability, we do not find evidence consistent with bond fund managers, on average, being able to select corporate bonds that outperform other bonds with similar characteristics. We find neutral to weakly positive evidence of ability to time corporate bond characteristics. Overall results show that the costs of active management on average appear larger than the benefits.

Bonds are an important asset class, yet we know little about the ability of bond market investors to select bonds that outperform other bonds with similar characteristics. In this paper, we provide such evidence for an important category of investors, mutual funds. Bond mutual funds are roughly half as large as equity mutual funds in terms of total net assets.[1] Despite the economic importance of bond funds, the literature is at a comparatively much earlier stage in its understanding of the costs and benefits of active bond-fund management. The first studies by Elton, Gruber, and Blake (1993, 1995) and more recent studies including Ferson, Henry, and Kisgen (2006), Gutierrez, Maxwell, and Xu (2008), and Huij and Derwall (2008) find that bond funds reported returns that on average slightly underperformed benchmarks. The pattern of underperformance parallels that found in early studies of equity fund returns.[2] Research that digs deeper into active bond-fund management, however, has been impeded by an inability to employ holdings-based measures of performance analogous to those used in equity fund studies. Our paper is the first to examine holdings of bond funds at the individual security level. By doing so, we deepen our understanding of the costs and benefits of active bond-fund management.

We focus on corporate bond holdings for two reasons. First, an important research question in this paper is whether fund managers can successfully select bonds that outperform other bonds with similar characteristics. Corporate bond markets afford fund managers another venue to capitalize on firm-specific research. Just as fund mangers analyze corporate fundamentals in an attempt to identify individual stocks likely

[1] As of March 2009, worldwide bond fund total net assets (TNA) of $3,381 billion were 57.2% of worldwide equity fund TNA of $5,912 billion. As of June 2009, US bond fund TNA of $1,822 billion were 45.4% of US equity fund TNA of $4,0102 billion (Investment Company Institute, 2009).

[2] Well-known papers that examine equity fund returns include Jensen (1968), Lehman and Modest (1987), Ippolito (1989), Grinblatt and Titman (1989, 1992, 1993), Malkiel (1995), Gruber (1996), Carhart (1997), and Chen, Hong, Huang, and Kubik (2004).

to outperform other stocks with similar characteristics, managers engage in such analysis in an attempt to identify individual corporate bonds likely to outperform. Less clear is the extent to which fund managers engage in such fundamental analysis for other types of bonds such as municipal bonds or asset-backed bonds. Second, characteristics such as credit rating, coupon rate, maturity date, and issue size are available to academics through commercial databases such as Mergent Fixed Income Securities Database (FISD) only for corporate bonds. These characteristics along with prices, both required for our bond-return benchmarking methodology, are currently unavailable for other types of bonds such as municipal bonds or asset-backed bonds.[3]

The question of whether fund managers can identify corporate bonds that outperform is important given the considerable resources funds expend on the research and trading of corporate bonds. Even if bond fund managers were unable to provide investors with positive risk-adjusted returns after expenses, the question of bond-picking ability before expenses is important. As Wermers (2006) points out, fund managers able to generate excess returns may face structural handicaps that prevent the returns from reaching investors. For example, perhaps the fund manager is handicapped by volatile net investor flows that force costly bond trading.[4] If altering the fund's structure can mitigate such handicaps, then perhaps the fund manager's ability to generate excess returns can benefit investors.

The detailed holdings we study allow us to comprehensively examine the performance of corporate bond funds, including fund managers' bond-selection abilities.

[3] Although databases covering other bond types may be available to commercial entities, such databases currently are either unavailable to academic users or cost prohibitive.

[4] Chordia (1996), Edelen (1999), Nanda, Narayanan, and Warther (2000), Alexander, Cici, and Gibson. (2007), and Coval and Stafford (2008) all provide evidence suggesting that volatile net investor flows force equity funds to trade, decreasing funds' reported returns.

We merge information from multiple sources to create a new database spanning 1995 to 2006 that contains quarterly snapshots of fund corporate bond holdings; the returns reported by funds; fund characteristics such as total net assets and expense ratios; returns for individual corporate bond issues; and corporate bond characteristics such as age, time to maturity, and credit rating. Not only does the database contain the first corporate bond fund security-level holdings studied to date, it also contains a new comprehensive set of corporate bond returns.

In this paper, we provide a comprehensive assessment of bond fund performance. Similar to Wermers' (2000) empirical decomposition of equity fund reported returns, we decompose corporate bond fund reported returns into six components: Specifically, returns attributable to the fund's (1) bond-selection ability, (2) characteristic-timing ability, (3) average style, (4) transaction costs, (5) management fees, and (6) net return gap. Our bond-selection and characteristic-timing measures assess ability within the portfolio of corporate bonds held by the fund. The average style return measure is the return on a hypothetical portfolio comprised of bonds with characteristics reflecting the fund's long-term investment style within its corporate bond portfolio. Together these first three listed components sum to a fund's holdings returns on its corporate bond portfolio, i.e. the gross buy-and-hold returns on a hypothetical corporate bond portfolio created using the fund's most recently reported holdings. The difference between a fund's holdings return and its reported return, called the return gap, is attributable to the last three listed components. The net return gap is the unexplained difference after accounting for transaction costs and management fees. Much of the unexplained part of the return gap is attributable to the performance of corporate bond trades that took place

after the most recent holdings report.[5] Short-term trading gains will favorably impact the return gap, whereas short-term trading losses will unfavorably impact the return gap. Another contributor to the unexplained part of the return gap is the performance of holdings other than corporate bonds for which we do not have return data.

Our study makes several important contributions to our understanding of the performance of corporate bond funds. We are the first to report evidence on the selection ability of bond fund managers. Our new comprehensive database makes this possible by allowing us to benchmark the performance of each corporate bond held by the fund using a methodology similar to the one developed for stocks by Daniel, Grinblatt, Titman, and Wermers (1997). We create characteristic-based benchmark portfolios using duration and credit ratings, the two characteristics shown by Gebhardt, Hvidkjaer, and Swaminathan (2005) to explain the cross-section of corporate bond returns. Our benchmarking methodology evaluates the performance of each corporate bond held by a fund relative to a portfolio of bonds with like durations and credit ratings, thus providing insights into the bond-selection ability of fund managers.

Our results contrast sharply with prior research on equity funds that shows evidence of stock-selection ability. We do not show evidence consistent with bond fund managers, on average, being able to select corporate bonds that outperform. Lack of ability is observed for both investment-grade and high-yield corporate bonds. In addition to examining the corporate bond picks of individual fund managers, we also examine the aggregate holdings of all funds in particular bonds to proxy for fund managers' collective valuation assessments. Consistent with funds' collective security-selection insights

[5] See, for example, Kacperczyk, Sialm, and Zheng (2008) for an application of the return gap methodology in a setting of equity mutual funds.

failing to identify outperforming corporate bonds, investment-grade bonds with the highest aggregate fund ownership performed no better than those with the lowest ownership. Interestingly, high-yield bonds with high aggregate fund ownership underperformed while those with low ownership outperformed.

These results at first blush may appear surprising, but perhaps not when important differences between equity and debt markets are considered. For one, the counterparties with which mutual funds trade in bond markets include a much smaller percentage of uninformed or liquidity traders. Households, often considered uninformed traders apt to engage in liquidity trading, hold much larger percentages of outstanding equities than corporate bonds and account for only a small percentage of corporate-bond trade volume.[6] Life insurance companies, often considered professional investors unlikely to engage in liquidity trading, are the single largest holders of corporate bonds.[7] Perhaps the more informed counterparties that mutual funds face in bond markets are collectively more capable researchers of corporate fundamentals. Or perhaps the counterparties are more patient traders, requiring compensation for taking the other side of mutual fund trades forced by unexpectedly large net investor inflows or outflows. When data becomes available, future research examining the bond trading interplay across different categories of institutional investors is warranted.

The second contribution we make is evidence on the abilities of fund managers to time bond characteristics such as credit rating or duration. With our database, we can

[6] Households held 51.0% of equities in 1996, the first year of our sample period, and 29.6% of equities in 2006, the last year of our sample period. In contrast, households held 17.4% and 15.1% of corporate bonds in 1996 and 2006, respectively (Source: Federal Reserve, 2008). Households accounted for only 1.2% of TRACE dollar trade volume in corporate bonds over the 2003-2004 sample period studied by Edwards (2006).

[7] Insurance companies held 29.6% of corporate bonds in 1996 and 18.9% in 2006. (Source: Federal Reserve, *2009 Statistical Abstract: Equities, Corporate Bonds, and Treasury Securities–Holdings and Net Purchases, by Type of Investor*, available at census.gov)

track changes in the characteristic weights of a fund's corporate bond portfolio, and calculate how these weight shifts affect portfolio returns. For example, suppose fund managers possess the ability to anticipate yield-spread movements across the corporate credit-rating spectrum. Managers can enhance fund returns by tilting portfolio weights towards those credit-rating categories with yield spreads that will narrow on a relative basis. We can detect such portfolio shifts and measure their impact on portfolio returns, gaining insights into the characteristic-timing ability of fund managers.

Results show no evidence of characteristic-timing ability for investment-grade bond funds. Evidence does, however, prove consistent with managers of high-yield bond funds showing an ability, on average, to time characteristics. Overall, though, when we combine the contributions from security selection and characteristic timing, we find rather modest return contributions for corporate bond funds in comparison to those for equity funds. Specifically, we find security selection and characteristic timing added 27 basis points per year to the performance of investment-grade portfolios and 4 basis points per year to the performance of high-yield portfolios. In contrast, Wermers (2000) finds that from 1976 to 1994 equity funds added 77 basis points per year to the performance of their stock portfolios.

A third contribution is that we estimate the costs of active management more directly than prior studies. Rather than relying on reported fund turnover (as prior studies have done), we infer the dollar amount of purchases or sales of each bond each quarter. Also, rather than using time-invariant bid-ask spread estimates for broad sets of bonds (as prior studies have done), we estimate quarter-specific spreads for each bond using methods that account for its credit rating, time to maturity, issue size, and age.

Combining trade and spread estimates specific to each period and bond, we obtain an estimate of the overall transaction costs incurred on the fund's corporate bond portfolio during the quarter.

Our results show transaction-cost estimates that are lower than those reported in prior studies. Much of the difference is attributable to our use of actual sales and purchases of bonds rather than CRSP turnover measures, which treat bond maturities as sales. By way of illustration, for all corporate bond funds in our sample, CRSP turnover averaged 134.87% per year; our turnover measure that excludes maturities averaged only 43.20% per year.

Our results show that the costs of active management on average appear larger than the benefits. For active investment-grade bond funds, management fees and transaction costs totaled 88 basis points per year, 51 basis points greater than the 27 basis points of combined return contribution from bond selection and characteristic timing. Comparatively for passive investment-grade bond funds, management fees and transaction costs totaled 33 basis points per year. For active high-yield bond funds, management fees and transaction costs totaled 138 basis points per year, 134 basis points greater than the 4 basis points of combined return contribution from bond selection and characteristic timing. No passive high-yield funds operated during the sample period for comparison.

The remainder of the paper is organized as follows: Section I describes the data. Section II provides insights into the benefits and cost of active management by decomposing the returns reported by bond funds. Section III evaluates fund performance conditional on the extent to which it turns over its corporate bond portfolio. Section IV

investigates individual bond performance conditional on aggregate fund ownership. Section V concludes.

I. Data

First, we describe the sources of information used to build our database. We then explain how the sample of funds was constructed and provide sample descriptive statistics. Finally, we describe the methods used to calculate bond returns and report descriptive statistics on the set of bond returns.

A. Sources of information

Our database is constructed using six sources, all free of survivorship bias: (1) the Morningstar Mutual Fund Holdings Database, (2) the Center for Research in Security Prices (CRSP) Survivor-Bias Free US Mutual Fund Database, (3) the Mergent Fixed Income Securities Database (FISD), (4) the Trade Reporting and Compliance Engine (TRACE) database, (5) Bloomberg, and (6) hand-collected information from mutual fund prospectuses.

From Morningstar, we obtain fund holdings from January 1995 to December 2006 for 2,268 bond funds. For each fund and date, Morningstar reports the CUSIP identifier of each security held and the market and face values of the holding. Although funds were mandated to publicly report holdings only semiannually until 2004 and quarterly thereafter, some funds voluntarily reported holdings to Morningstar as often as monthly. The Morningstar database includes both surviving and dead funds. The database also reports each fund's Morningstar investment category; statistics such as average credit quality and duration of the fund's holdings; and portfolio composition variables such as

the percentage of total net assets invested in government bonds, corporate bonds, bonds of a particular credit rating (e.g., AAA or BBB), etc.

From the CRSP Survivor-Bias Free Mutual Fund Database, we obtain monthly fund returns from January 1995 to December 2007. The Morningstar and CRSP databases are merged using algorithms based on matching fund tickers and fund names. Out of the 2,268 funds in the Morningstar database, we find a match for 2,123 funds in the CRSP Database.[8] As indicated by the investment objective categorization provided by Morningstar, this group of funds includes funds that invest primarily in corporate bonds, government bonds, municipal bonds, and bonds from emerging markets and other countries. The CRSP database also contains historical information on each fund's management fees, turnover, and total net assets.

From Mergent FISD, we obtain information on a corporate bond's credit rating, coupon rate, maturity date, and issue size. The database covers our entire bond-return sample period from January 1995 to December 2007. We merge bonds in Mergent FISD with those in the Morningstar database using bond CUSIPs. We use the Mergent FISD bond characteristics in our bond-return benchmarking procedure and in the estimation of bid-ask spreads. Mergent FISD also reports the price, date, and time of bond trades made by insurance companies from January 1995 to December 2007. This trade information serves as one source of bond prices in our bond-return calculations.

From the TRACE database, we obtain the price, date, and time of over-the-counter secondary market transactions for a select set of corporate bonds beginning in

[8] CRSP mutual fund return data is reported at the fund share class level and not at the portfolio level. We computed a single portfolio return each month by averaging the returns of all share classes belonging to a common portfolio after weighting the returns of each share class by the assets of each share class.

July 2002.[9] The TRACE trading information expands to include all corporate bonds in September 2004. Bonds in the TRACE database are linked to the rest of our data using CUSIPs. We use the TRACE trade information as another pricing source in our bond-return calculations.

From Bloomberg, we download end-of-month bond bid and ask prices. Bloomberg bid and ask prices are composite quotes that combine prices from different dealers and/or other sources such as pricing services. Bloomberg reports bid and ask prices over our entire bond-return sample period from January 1995 to December 2007. Bonds in Bloomberg are merged with the rest of the data using CUSIPs. We use Bloomberg information as another pricing source in our bond-return calculations and to estimate bond bid-ask spreads.

Finally, from prospectuses filed with the SEC from January 1995 to December 2007, we hand collected information about how each fund marked bond values for NAV purposes. As we later explain, some funds explicitly describe a practice of marking their debt securities using mid marks, whereas others describe a practice of marking debt securities using bid marks. We use funds' marking practices to generate a second estimate of bond bid-ask spreads.

B. Fund sample

To construct our fund sample, we start with the 2,268 U.S. bond funds in the Morningstar database. Next, we use Morningstar investment objectives to exclude all government bond, municipal bond, emerging markets, and foreign countries bond funds, with the remaining group including all bond funds with significant U.S. corporate bond

[9] The Financial Industry Regulatory Authority (FINRA) phased in the implementation of TRACE over the 27-month period extending from July 1, 2002 to September 30, 2004. FINRA rolled out TRACE reporting guidelines that differed for four bond groups that were differentiated by bond-characteristic criteria.

investments. We further require that for inclusion in our sample, a fund must have data sufficient to calculate at least one quarter of holdings-based performance statistics. We then categorize a fund as a high-yield fund if it meets either or both of the following two conditions: the Morningstar investment objective identifies the fund as a high-yield fund, or the fund on average invested at least half of its corporate bond portfolio in high-yield bonds. Funds not categorized as high yield are categorized as investment grade. The methods we use to decompose fund reported returns require a one-year look back on holdings, so our evaluation of fund performance begins in January 1996 and runs to December 2006. Our corporate bond fund sample totals 746, of which 537 are investment-grade funds and 209 are high-yield funds.

Table 1 reports fund sample statistics. Panel A shows the number and size of funds by year. The number of investment-grade and high-yield funds both increase dramatically in the early years of our sample before leveling off in the later years. Panel B breaks out funds' portfolio composition by asset category. Over 1996 to 2006, both investment-grade and high-yield funds on average held slightly more than 90 percent of assets in bonds. Panel C shows that over 1996 to 2006, investment-grade and high-yield funds' bond portfolios were comprised of 7.88% and 4.49%, respectively, of bonds that matured within one year. Morningstar does not break out the percentage of these near-maturity bonds that were issued by corporations or other entities. On average, longer-maturity corporate bonds made up 53.78 percent of investment-grade bond portfolios and a higher 82.43 percent of high-yield bond portfolios. Investment-grade funds held higher percentages of US government bonds and asset backed securities, particularly after 2002. Finally Panel D shows, as expected, that investment-grade funds tend to invest in

investment-grade corporate bonds and high-yield funds tend to invest in high-yield corporate bonds.

[Insert Table 1 about here.]

C. Bond returns

To compute monthly historical bond returns, we search the Bloomberg, Mergent FISD, TRACE, and Morningstar Mutual Fund Holdings datasets for information on month-end prices on fixed-coupon, non-convertible corporate bonds over 1995 to 2007. Appendix A describes the intermediate steps and fraction of prices that came from each data source. We then combine bond prices with coupon information from Mergent FISD to compute a time series of monthly returns for each bond. To be included in our bond return database, each bond must have at least one year to maturity. As Gebhardt, Hvidkjaer, and Swaminathan (2005) point out, short time-to-maturity bonds may be less liquid and are thus more prone pricing errors. Our final dataset includes returns for 24,146 corporate bonds.

Table 2 reports descriptive statistics for the corporate bonds in our returns dataset. Panel A shows substantial coverage each year of the 1995 to 2007 period, with the number of bonds covered at a low of 6,899 in 1995 and a high of 9,663 in 1998. Bond characteristics by year are also shown. Average issue size, as expected, shows a steady increase over the sample period; the average credit rating, duration, time to maturity, and the fraction of high bonds all are fairly stable. Panel B reports correlations between Lehman bond indices and aggregate value-weighted portfolios created from the investment-grade and high-yield bonds in our dataset. We use two Lehman indices for comparisons. The Lehman U.S. Corporate Index includes fixed-rate, non-convertible

investment grade corporate bonds with an issue size at least $250 million. The Lehman U.S. Corporate High-Yield Index includes fixed-rate, non-convertible high-yield corporate bonds with an issue size at least $150 million. As expected, the Lehman indices are highly correlated with the corresponding aggregate portfolios we create. Specifically, the aggregate investment grade portfolio from our sample has a correlation of 97% with the corresponding index and aggregate high-yield portfolio from our sample shows a correlation of 96% with the corresponding index.[10]

[Insert Table 2 about here.]

II. Bond fund performance

First we provide an overview of the returns reported by funds. To gain insights into costs and benefits of active management, we then decompose reported returns into six components: Specifically, returns attributable to the fund's (1) bond-selection ability, (2) characteristic-timing ability, (3) average style, (4) transaction costs, (5) management fees, and (6) net return gap.

A. Reported returns

We benchmark reported returns using a four-factor model adapted by Gutierrez, Maxwell, and Xu (2008) from the Elton, Gruber, and Blake (1995) six-factor model.[11]

[10] The reason our aggregate portfolios do not correlate 100% with the Lehman indices is because the bonds in the Lehman indices were priced by Lehman traders only. To the contrary, our bond prices come from a diverse set of sources. Another reason is that our sample of bonds is perhaps larger than the set of bonds included in the Lehman indices. For example, the index factsheet for the U.S. Lehman corporate index states that "…up to 1,000 actively traded benchmark corporate securities continue to be priced by traders on a daily basis. Less liquid bonds are model/ matrix priced daily using these actively traded benchmark securities to generate issuer pricing curves and populate a spread matrix algorithm that accounts for changes in the yield and swap curves." (see http://www.lehman.com/fi/indices/global.htm#)

[11] Gutierrez, Maxwell, and Xu (2008), who use the model to benchmark returns reported by corporate-bond mutual funds, drop two factors based on the Composite Index of Leading Indicators and the Consumer Price Index, noting the difficulty in reliably estimating macroeconomic risk premiums. Moreover, Gutierrez, Maxwell, and Xu (2008) report that results differ inconsequentially when using the two additional macroeconomic factors.

$$R_t = \alpha + \beta_1 STK_t + \beta_2 BOND_t + \beta_3 DEF_t + \beta_4 OPTION_t + \varepsilon_t$$

where *STK* is the excess return on the CRSP value-weighted stock index, *BOND* is the excess return on the Lehman Aggregate index, *DEF* is the return difference of the Lehman High-Yield and Intermediate Government indices, and *OPTION* is the return difference of the Lehman GNMA and Intermediate Government indices.

Table 3 provides an overview of fund reported returns. Every fund with valid returns in a given quarter is used to compute return measures for that particular quarter. Recognize that using all funds regardless of how long it is in the database mitigates survivorship bias. We compute reported returns by averaging across all funds every quarter using both equal weighting and value weighting by the fund's total net assets at the beginning of the quarter. For comparative purposes, we include information on the 20 passive investment-grade corporate bond funds that operated during our sample period. Note that no passive high-yield corporate bond funds operated during our sample period.

[Insert Table 3 about here.]

In Panel A.1, we see that the active investment-grade funds reported returns below the Lehman-index returns over the entire sample period regardless of whether funds are value-weighted or equal-weighted. Of course, the lower reported returns for investment-grade funds relative to the index might be attributable to risk exposures for investment-grade funds that differ from the index. To investigate this possibility, we control for risk using the four-factor model applied to monthly fund returns that have

been value-weighted or equal-weighted every month. We find negative alphas for the value-weighted and equal-weighted portfolios, although only the equal-weighted alpha differs from zero at conventional statistical significance levels. Panel A.2 shows that passive investment-grade funds also display a pattern of underperformance, but the economic magnitude is smaller and alphas statistically do not differ from zero.

Panel B shows that the active high-yield funds also reported returns below the Lehman-index returns over the entire sample period regardless of whether funds are value or equal-weighted. Controlling for risk, we find positive but statistically insignificant alphas in the 2002-2006 period. Alphas are, however, negative over the entire sample period and weakly significant for only the value-weighted portfolio.

Overall, Table 3 evidence shows reported returns that on average slightly underperformed benchmarks, consistent with Blake, Elton, and Gruber (1993), Elton, Gruber, and Blake (1995), Ferson, Henry, and Kisgen (2006), and Gutierrez, Maxwell, and Xu (2008). However, given that reported returns are a function of many factors, this finding of underperformance does not rule out that fund managers possess bond-selection or characteristic-timing abilities. We now turn to an investigation of the components that together combine to determine reported returns.

Holdings returns are the buy-and-hold returns on a hypothetical portfolio created using the fund's most recently reported holdings. As pointed by Grinblatt and Titman (1989), the first to use holdings returns to study mutual fund performance, holdings returns provide a measure of investment talent that is unaffected by transaction costs,

fees, and other expenses. We can view holdings returns as being built up from three return components.[12]

The first is the return contribution from manager's ability to identify bonds that will outperform other bonds with similar characteristics. For example, through analysis of corporate fundamentals, the fund manager may successfully identify the bonds of a firm with improving operating cash flows. We evaluate fund managers' bond-selection abilities using a methodology similar to the one developed for stocks by Daniel, Grinblatt, Titman, and Wermers (1997). Our benchmarking methodology evaluates the performance of each bond held by a fund relative to a portfolio of bonds with like credit ratings and durations, the two characteristics shown by Gebhardt, Hvidkjaer, and Swaminathan (2005) to explain the cross-section of corporate bond returns. The bond-selection (BS) return measure is calculated during quarter *t* as

$$BS_t = \sum_{b=1}^{N} w_{b,t-1}\left(R_{b,t} - R_t^{p_{b,t-1}}\right),$$

where $w_{b,t-1}$ is the portfolio weight on bond *b* at the end of quarter $t-1$, $R_{b,t}$ is the buy-and-hold return of bond *b* during quarter *t*, and $R_t^{p_{b,t-1}}$ is the buy-and-hold return of the characteristic-based benchmark portfolio matched to bond *b* at the end of quarter $t-1$. To construct benchmark portfolios, every month each bond is assigned to one of seven credit-quality categories: AAA; AA; A; BBB; BB; B; and below B (i.e., all CCC, CC, C and D rated bonds). Every month each bond is also assigned to one of five duration categories, formed by ranking and sorting bonds into quintiles based on their modified

[12] Because our methodology creates fund portfolios based on calendar quarters and because some funds report their holdings at monthly frequencies and some others at quarterly frequencies, we focus on holdings snapshots as of the end of each calendar quarter. Our approach is similar to Wermers (2000) such that if a fund did not have a report at the end of a given calendar quarter, we approximate its holdings at the end of that quarter using the most recent holdings report from the previous two months.

duration, calculated as the Macaulay duration divided by one plus the yield to maturity. As in Gebhardt, Hvidkjaer, and Swaminathan (2005), the credit-quality and duration sorts are conducted independently. The result is 35 benchmark portfolios categorized by the seven credit-quality categories and five duration categories. The benchmark-adjusted return for each bond is its buy-and-hold return minus the value-weighted buy-and-hold return of the appropriate benchmark portfolio over the same holding period.

The second contributor to holdings returns is the manager's ability to time corporate bond characteristics. For example, by anticipating corporate credit rating yield-spread shifts, the manager may successfully tilt the portfolio towards bonds with credit ratings that experience a relative narrowing of yield spreads. We evaluate fund managers' characteristic-timing abilities by adapting a methodology applied by Wermers (2000) to equity funds. The method measures how changes in portfolio characteristic weights affect holdings returns. The characteristic-timing (CT) return measure is calculated during quarter *t* as

$$CT_t = \sum_{b=1}^{N} \left(w_{b,t-1} R_t^{P_{b,t-1}} - w_{b,t-5} R_t^{P_{b,t-5}} \right)$$

The CT measure subtracts the quarter *t* return of the quarter $t-5$ matching characteristic portfolio for bond *b* (times the portfolio weight at the end of quarter $t-5$) from the quarter *t* return of the quarter $t-1$ matching characteristic portfolio for bond *b* (times the portfolio weight at the end of quarter $t-1$). Thus, the measure captures the contribution to holdings returns from changes in portfolio characteristic weights that occurred over the prior year. The CT measure will be positive for the manager who tilts portfolio weights towards those characteristics that subsequently exhibit high payoffs.

The third and final contributor to holdings returns is the tendency for the manager to follow an investment style that entails holding bonds with certain characteristics. For example, one fund manager may tend to hold long-duration bonds rated BB or below, whereas another fund manager following a more conservative style may tend to hold intermediate-duration bonds rated A or better. The two portfolios will generate returns that differ not only from each other, but also from more broadly based indices such as the Lehman indices. Again following Wermers (2000), we calculate the average-style (AS) return measure during quarter *t* as

$$AS_t = \sum_{b=1}^{N} w_{b,t-5} R_t^{P_{b,t-5}}$$

The AS measure computes the return on a hypothetical portfolio constructed by matching each corporate bond held by the fund at the end of quarter $t-5$ with its benchmark portfolio of that date. The end of quarter $t-5$ portfolio weight is then multiplied by the quarter *t* return of this benchmark portfolio. The resulting product is summed over all corporate bonds held by the fund at the end of quarter $t-5$.

Table 4 presents results. Again, to minimize survivorship bias, every fund with valid returns in a given quarter is used to compute return measures for that particular quarter. We compute reported returns by averaging across all funds every quarter, value weighting by the fund's total net assets at the beginning of the quarter. All the quarterly buy-and-hold return measures are compounded into annual returns.

[Insert Table 4 about here.]

Panel A.1 shows investment-grade funds' holdings return averaged 6.91 percent per year over 1996 to 2006, 37 basis points more than the Lehman Investment-Grade index average return of 6.54 percent. Twenty-seven basis points of the differential are

attributable to funds selecting bonds that outperformed their characteristic-based benchmark portfolios, with most of the bond-selection gains occurring in the later part of the sample period. The bond-selection contribution to holdings returns differs from zero at the 10% significance level only in the later part of the sample period. Overall, results do not provide convincing evidence of bond-selection ability. None of the differential between the investment-grade funds' holding return and index return is attributable to characteristic timing. The remaining 10 basis points of the differential are attributable to funds following styles that called for holding bonds having characteristics associated with higher average returns than the index.

Panel A.2 allows for a comparison of active and passive investment-grade funds. Active funds' average holdings return of 6.91% was 58 basis points more than passive funds' 6.33%. Most of the return differential is attributable to active funds' average style diverging from passive funds'. Noteworthy, passive funds show negative characteristic timing ability in the 2002-2006 period. The negative-timing result is consistent with passive fund managers trading more liquid corporate bonds in response to net investor flows that are positively associated with overall bond market returns (see Warther, 1995). Consistent with this explanation, unreported results show that net investor flows for passive funds are positively associated with contemporaneous changes in portfolio weights on high credit-quality corporate bonds, which tend to be more liquid than lower credit-quality bonds. We do not find the same positive association for active funds.

Panel B shows high-yield funds' holdings returns exceeded the Lehman High-Yield index by an average of 89 basis points per year. High-yield funds held corporate bonds that underperformed their characteristics by 45 basis points per year. Again, we do

not find convincing evidence of bond-selection ability. However, high-yield funds show successful characteristic timing that added 49 basis points per year. Only the market timing results differ significantly from zero. The remaining 85 basis points of outperformance are attributable to the average style followed by high-yield funds vis-à-vis the index.

In sum, Table 4 evidence shows that fund managers' active management of corporate bond holdings generated return contributions that were rather modest in comparison to those generated by equity fund managers. Wermers (2000) finds that equity fund managers' security selection and characteristic timing combined to add 77 basis points per year to the performance of stock holdings from 1976 to 1994. In contrast, we find that investment-grade and high-yield fund managers' security selection and characteristic timing combined to add 27 and 4 basis points, respectively, per year to the performance of corporate bond holdings.

B. Return gap decomposition

Now that we better understand the return contributions of active management, we examine the costs. We do this by decomposing the return gap, defined as the difference between reported returns and holdings returns (see Kacperczyk, Sialm, and Zheng (2008)). The three components that make up the return gap are transaction costs, management fees, and the residual net return gap. Much of the residual net return gap is likely attributable to the performance of corporate bond trades that took place after the most recent holdings report and to the performance of holdings other than corporate bonds for which we do not have return data.

A key advantage of our database is that it allows us to estimate transaction costs more directly by mitigating data limitations faced in other studies such as Chen, Ferson, and Peters (2010) and Moneta (2009). Rather than using time-invariant bid-ask spread estimates for broad sets of bonds, our database allows us to estimate quarter-specific spreads for each bond using methods that account for its credit rating, time to maturity, issue size, and age. Also, rather than using CRSP fund turnover to approximate aggregate fund-level trading, we use consecutive holdings reports to infer the dollar amount of purchases or sales of each bond each quarter.

Appendix B describes our methods for estimating transaction costs in detail. We provide an overview here. We start by estimating bond bid-ask spreads. For robustness, we use two alternative methods to derive bid-ask spread estimates. The first uses bid and ask quotes obtained from Bloomberg. A caveat is that Bloomberg bid and ask quotes are indicative, meaning that the dealer is not bound to honor the quote. Thus, particularly in situations in which a fund traded a large block under time pressure, our transaction-cost estimate is likely low. However, in situations in which the transaction occurs at a price inside the bid-ask spread, our transaction-cost estimate is likely high. The second method we use to estimate spreads uses bond prices employed by funds to compute net asset values. As Appendix B describes, some funds mark bonds at bid prices, while others mark bonds at the mid point of bid and ask prices. We use prices on identical bonds held simultaneously by both bid-marking and mid-marking funds to make inferences about spreads. Recognize that both methods generate bid-ask spread estimates for each month.

Other studies such as Moneta (2009) and Chen, Ferson, and Peters (2010) use time-invariant bid-ask spread estimates. For example, for corporate bonds Moneta

(2009) and Chen, Ferson, and Peters (2010) both use 48 basis points and for high-yield bonds they use 75 basis points as bid-ask spread estimates, which are averages from Edwards, Harris and Piwowar (2007), Bessembinder, Maxwell and Venkataraman (2006) and Goldstein, Hotchkiss, and Sirri (2007) for intermediate trade sizes estimated during 2003. Nonetheless, our average bid-ask spread estimates are in line with the estimates for medium to large trade size from these previous studies. More specifically, over the entire sample period from 1996 to 2006, our average spread estimate is 38 basis points for all corporate bonds and 68 basis points for high-yield bonds.

Next, we use consecutive quarterly holdings reports to infer each fund's trading activity for each bond during the quarter. A caveat is that our estimate of trading activity will exclude any round trip buy and sell orders of the same bond that occur within the same quarter. Given the illiquidity of corporate bonds, such intra-quarter round-trip trading may be limited, but nevertheless this is a limitation imposed by the quarterly frequency of the holdings data. Bonds that reached maturity during the quarter are not treated as trades for the purposes of computing transactions costs. To compute the transaction cost of each trade, we multiply the par value traded by the fund during the quarter by the estimated half spread for that particular bond during that particular quarter. To compute the dollar value of all trades made by the fund during the quarter, we sum transaction costs across all corporate-bond trades undertaken by the fund during the quarter. Finally our estimate of the fund's quarterly transaction costs as a percentage of assets is obtained by dividing its total transaction costs for the quarter by the average market value of its corporate bond portfolio for the quarter.

To complement statistics on transaction costs, we also report two turnover statistics. 'CRSP turnover', reported by the fund, is the minimum of total sales or purchases of all securities held by the fund over the calendar year divided by the average assets of the fund over the calendar year. Noteworthy, funds typically treat bonds that mature as sales when computing turnover.[13] We also report 'corporate bond turnover', which we calculate each calendar year for each fund as the minimum of total sales or purchases of corporate bonds divided by the average assets of the non-maturing corporate bond portfolio. When we infer sales from consecutive quarterly holdings reports, we exclude from sales any bonds that matured during the quarter. Thus, the corporate bond turnover measure does not treat maturing bonds as sales.

In sum, our method for calculating corporate bond turnover differs in two ways from the method used to compute CRSP turnover, which is used in other studies such as Chen, Ferson, and Peters (2010) and Moneta (2009) to estimate bond fund transaction costs. First, corporate bond turnover excludes maturing bonds from sales, whereas CRSP turnover includes maturing bonds in sales. Second, corporate bond turnover is based only on the corporate bond portion of fund holdings, whereas CRSP turnover is based on all fund holdings, including short-term fixed-income securities such as Treasury Bills typically held by corporate bond funds for liquidity purposes. Naturally, these short-term securities will roll over multiple times per year, resulting in higher CRSP turnover compared to corporate bond turnover. In such instances, transaction costs estimates for corporate bond portfolios that use CRSP turnover would be overstated.

[13] The fund turnover reported by CRSP is sourced from Lipper, which collects turnover statistics directly from funds. In a written reply to our questioning, Lipper states "…the SEC's definition stops short of defining how maturing bonds are to be handled in turnover calculation" and that the turnover calculation "…is left up to the funds themselves to determine." Conversations with fund complexes including Fidelity and Vanguard reveal that funds typically treat bonds that mature as sales when computing turnover.

The management fees we report are based on information received directly from CRSP. The residual net return gaps we report are computed by subtracting transaction costs and management fees from return gaps. Again, the net return gap is attributable in large part to the performance of holdings other than corporate bonds and to the performance of corporate bond trades that took place after the last holdings report.

Table 5 presents results. As in Tables 3 and 4, we include all funds and value-weight results by the fund's total net assets as of the beginning of the quarter. Panel A.1 shows that investment-grade funds' average return gap over 1996 to 2006 was 103 basis points per year. Management fees accounted for 68 basis points of the return gap. Transaction costs averaged 22 basis points per year when estimated using Bloomberg information and 18 basis points per year when using mutual fund NAV information. Averaging the two estimates, transaction costs accounted for 20 basis points of the return gap. Noteworthy, corporate bond turnover averaged 43.20% per year, about a third of the CRSP turnover of 134.87% per year. Much of the difference, of course, is due to the fact that CRSP turnover treats bond maturities as sales. This difference results in transaction cost estimates based on CRSP turnover to be higher than our estimates.

[Insert Table 5 about here.]

To put management fees and transaction costs for the active investment-grade funds in perspective, consider the evidence in Panel A.2 for their passive counterparts. Management fees for passive funds were 20 basis points per year, 48 basis points less than for active funds. As expected given the lower active turnover of their corporate bond portfolios, passive funds' average transaction costs were 13 basis points per year, 7 basis points less than for active funds. Taken together with Table 4 evidence, Table 5

results are consistent with the hypothesis that the costs of active management incurred by investment-grade funds fell short of the benefits. Active investment-grade funds incurred combined management fees and transaction costs that were 55 basis points per year higher than their passive counterparts, yet generated return contributions from bond selection and characteristic timing that totaled 27 basis points per year.

Panel B shows that high-yield funds' average return gap over 1996 to 2006 was 165 basis points per year. Management fees accounted for 100 basis points of the return gap. Although the turnover of corporate bond portfolios was slightly lower for high-yield funds than for investment grade funds, higher bid-ask spreads for high-yield bonds resulted in average transaction costs that were higher at 38 basis points per year. Although passive high-yield corporate bond funds are unavailable for cost comparison, the magnitude of combined management fees and transaction costs of 138 basis points per year for active high-yield funds far outstripped their bond selection and characteristic timing returns of only 4 basis points per year. Taken together, evidence from Tables 4 and 5 is consistent with the hypothesis that the benefits of active management failed to justify the costs.

III. Fund performance conditional on turnover

So far evidence is consistent with the hypothesis that active bond funds, as a group, incurred costs that failed to generate commensurate return contributions. In this section, we investigate whether the active-management cost-benefit equation appears more favorable for fund subgroups that more actively turned over corporate bond portfolios. Fund managers who more actively engage in bond-selection and

characteristic-timing strategies naturally turnover portfolios more frequently than fund managers who follow more passive strategies. Is higher turnover associated with better bond-selection or characteristic-timing ability? To investigate, we separately rank investment-grade and high-yield funds each quarter by prior calendar-year corporate bond turnover. Then, each quarter, we apply decile breakpoints, forming ten value-weighted portfolios for both investment-grade and high-yield funds.

Table 6 presents performance results for turnover-sorted portfolios. Panel A shows significant dispersion in turnover across investment-grade funds. The average annual corporate bond turnover was 135.50% for funds in the most active decile versus only 5.79% for funds in the least active decile. Again, CRSP turnover, which treats bond maturities as sales, is considerably higher than our measure of corporate bond turnover for all turnover portfolios; fund reported turnover is as high as 324.88% for funds in the most active decile. As expected, transaction costs differ significantly across the turnover portfolios. The average annual transaction costs were 46 basis points for most active funds versus 11 basis points for least active funds. Expense ratios also differ significantly, with the most active funds levying expense ratios that were 32 basis points higher than the least active funds. Despite the costs associated with more active trading, funds in the most active decile generated bond-picking and characteristic-timing returns that differed insignificantly from those of funds in the least active decile. Looking across the ten turnover portfolios, we do not observe a pattern consistent with the hypothesis that more active trading generates higher bond-selection and characteristic-timing returns.

[Insert Table 6 about here.]

Panel B shows a similar pattern for high-yield funds: Higher turnover and higher transaction costs are not accompanied by higher bond-selection or characteristic-timing returns. In sum, the active-management cost-benefit equation does not appear more favorable for fund subgroups that turned over corporate bond portfolios more frequently.

IV. Bond returns conditional on aggregate fund holdings

Individual fund managers are more likely to build larger positions in corporate bonds perceived to be most underpriced relative to their fundamental values. By aggregating individual positions in a particular bond across all funds, we obtain a proxy for fund managers' collective valuation assessments for that bond. Thus, bonds with the strongest collective value convictions are reflected in high aggregate fund ownership. In this section, we investigate whether bonds with high aggregate fund ownership outperform bonds with lower aggregate fund ownership.

Our procedure for stratifying corporate bonds by aggregate fund ownership is carried out separately for investment-grade and high-yield bonds. The procedure controls for issue size: First, each quarter, all sample bonds are ranked and placed into deciles based on issue size. Then, each quarter within each size decile, bonds are ranked and placed into deciles based on beginning-of-quarter aggregate fund ownership measured as a fraction of its par value. Finally, we form ten ownership-stratified portfolios by combining corresponding ownership deciles from each of the size deciles. To clarify, the highest ownership portfolio is constructed by combining the highest ownership decile from each size decile. This ensures bonds of similar issue sizes in all ten ownership portfolios. Bonds in each ownership portfolio are value-weighted, and characteristic-

adjusted portfolio returns are calculated for one to four-quarter holding periods after portfolio formation. The characteristic-adjusted return for each bond is its buy-and-hold return minus the value-weighted buy-and-hold return of the appropriate benchmark portfolio to which it belongs over the same holding period.

Table 7 presents results. Panel A shows that all sample funds combined to hold on average 15.63% of par value for investment-grade bonds in the top ownership portfolio and only 0.12% for investment-grade bonds in the bottom ownership portfolio. As expected given earlier results showing bond-picking ability for investment-grade funds, bonds in nine of the ten ownership portfolios show statistically significant positive characteristic-adjusted returns over the four-quarter buy-and-hold period. The positive returns, however, are fairly tightly bunched, without a clear pattern of higher outperformance for bonds in the higher ownership portfolios. The characteristic-adjusted return of 51 basis points for bonds in the top ownership portfolio differed insignificantly from the characteristic-adjusted return of 40 basis points for bonds in the bottom ownership portfolio.

[Insert Table 7 about here.]

Panel B shows that funds' aggregate ownership averaged 41.26% of par value for high-yield bonds in the top ownership portfolio and only 0.73% for high-yield bonds in the bottom ownership portfolio. Again, we do not find a clear pattern of higher outperformance for bonds in the higher ownership portfolios. The result is consistent with funds' collective bond-selection insights on average failing to identify outperforming bonds. In fact, perhaps surprisingly, bonds in the bottom ownership portfolio significantly outperform those in the top ownership portfolio. The four-quarter buy-and-

hold characteristic-adjusted return for bonds in the bottom ownership portfolio was 117 basis points, a significant 219 basis points higher than the -102 basis point characteristic-adjusted return for bonds in the top ownership portfolio. The poor performance of bonds with the greatest mutual fund ownership is possibly related to the fact that counterparties in debt markets include a large percentage of informed, patient traders such as life insurance companies and pension funds. Perhaps these informed counterparties collectively were more capable bond selectors than mutual funds. Or perhaps these patient counterparties required compensation for taking the other side of mutual funds' liquidity-driven trades. When data becomes available, future research examining the trading interplay across different categories of institutional investors is warranted.

V. Conclusion

This study is the first to examine bond fund performance using holdings of individual corporate bond issues. The use of detailed security holdings allows for a decomposition of fund reported returns not previously possible, offering insights into the benefits and costs of funds' active management of corporate bond portfolios.

Although investment-grade funds show evidence of bond-selection ability in the later part of the 1996-to-2006 sample period, the overall pattern of results proves consistent with an inability of fund managers as a group to select corporate bonds that outperform other bonds sharing similar characteristics. The evidence on characteristic timing is consistent with high-yield fund managers on average possessing ability, but inconsistent with investment-grade managers showing ability. The magnitude of the combined return contribution from bond selection and characteristic timing for both

investment-grade and high-yield funds, however, appears to fall short of the magnitude of combined management fees and transaction costs. Additional doubts about the cost-benefit trade-off of active management are raised by evidence showing no clear association between the turnover of corporate bond portfolios and either bond-selection or characteristic-timing ability. Finally, using aggregate fund ownership of individual bond issues as a proxy for fund managers' collective valuation assessments, we find evidence consistent with funds' collective bond-selection insights on average failing to identify outperforming bonds. In fact, evidence for high-yield bonds shows that high aggregate fund ownership is associated with subsequent underperformance and that low aggregate fund ownership is associated with subsequent outperformance, raising questions about whether mutual funds as a group are either at an informational or liquidity disadvantage relative to other categories of institutional investors in fixed-income markets. The trade interaction among mutual funds and other institutional-investor groups is worthy of future research when more data becomes available.

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Table 1
Bond Fund Sample Statistics

Panel A. Annual Sample Statistics

	All Funds		Investment Grade Funds				High Yield Funds			
				TNA (in $ millions)				TNA (in $ millions)		
Year	Number	Total Assets (in $ billions)	Number	10th Percentile	Median	90th Percentile	Number	10th Percentile	Median	90th Percentile
1996	31	31	16	188	520	2,802	15	188	520	2,802
1997	66	79	43	116	614	3,105	23	116	614	3,105
1998	151	148	112	136	914	3,096	39	136	914	3,096
1999	264	197	197	49	435	2,669	67	49	435	2,669
2000	369	211	271	32	218	1,840	98	32	218	1,840
2001	433	242	317	29	168	1,301	116	29	168	1,301
2002	476	296	345	28	188	1,504	131	28	188	1,504
2003	525	381	386	35	240	1,832	139	35	240	1,832
2004	586	511	430	38	257	1,921	156	38	257	1,921
2005	589	538	423	41	275	2,145	166	41	275	2,145
2006	577	564	403	40	275	2,166	174	40	275	2,166
1996-2006	746		537				209			

Panel B. General Portfolio Composition (in %)

Panel B.1 Investment Grade Funds

Period	Bond	Common Stock	Preferred Stock	Cash	Other
1996-2001	93.07	0.12	1.01	0.44	5.37
2002-2006	86.91	0.12	0.64	2.18	10.14
1996-2006	90.21	0.12	0.84	1.25	7.59

Panel B.2 High Yield Funds

1996-2001	91.73	1.16	3.59	0.29	3.23
2002-2006	88.34	1.65	3.09	1.43	5.49
1996-2006	90.15	1.39	3.35	0.82	4.28

Table 1-continued

Panel C. Bond Composition (in %)								
Panel C.1 Investment Grade Funds								
		Bonds maturing > 1 year						
Period	Bonds maturing < 1 year	Corporate	US Government	Foreign Corporate	Foreign Government	Asset Backed	Convertible	Municipal
1996-2001	5.48	61.44	10.64	5.07	0.00	16.70	0.43	0.24
2002-2006	10.64	44.97	12.87	2.79	1.16	26.56	0.25	0.75
1996-2006	7.88	53.78	11.68	4.01	0.54	21.28	0.35	0.48
Panel C.2 High Yield Funds								
1996-2001	3.39	83.90	2.49	7.36	0.00	1.52	1.31	0.01
2002-2006	5.75	80.74	1.85	5.87	1.49	2.33	1.90	0.07
1996-2006	4.49	82.43	2.19	6.67	0.69	1.90	1.58	0.04

Panel D. Corporate Bond Composition by Credit Rating Categories (in %)								
Panel D.1 Investment Grade Funds								
Period	AAA	AA	A	BBB	BB	B	Below B	Not Rated
1996-2001	32.08	9.90	25.60	21.28	5.22	4.16	0.48	1.28
2002-2006	47.14	9.19	19.39	17.56	2.87	2.22	0.47	1.17
1996-2006	39.08	9.57	22.71	19.55	4.13	3.25	0.48	1.23
Panel D.2 High Yield Funds								
1996-2001	5.09	0.49	0.77	4.15	23.67	56.14	5.56	4.10
2002-2006	5.65	0.44	1.07	6.19	28.16	46.03	9.27	3.20
1996-2006	5.35	0.47	0.91	5.10	25.76	51.44	7.28	3.68

This table reports descriptive statistics for our sample of mutual funds. In Panel A information is provided on the total number of funds and cross-sectional distribution properties for fund assets in the Investment-Grade and High-Yield fund categories. Our sample of 746 corporate bonds funds is based on all corporate bond funds from Morningstar for which at least one valid (non-missing) quarterly return measure could be computed. Panel B reports the average fraction of sample fund portfolios held in Bonds, Common Stock, Preferred Stock, Cash, and Other securities. Information on the portfolio composition for each fund and date was obtained from Morningstar. Panel D reports the average fraction of the bond portion of the portfolio held in the various types of bonds. Panel D reports the average fraction of the corporate bond portion of the portfolio held in the various corporate bond classes categorized by credit rating.

Table 2
Corporate Bond Descriptive Statistics

Panel A. Bond Characteristics

Year	Number of bonds	Issue size	Credit rating	Duration	Time to maturity	Fraction of High Yield bonds (in %)
1995	6,899	140.1	A-	5.8	10.5	25.1
1996	7,637	141.7	A-	5.7	10.4	22.0
1997	8,851	141.8	BBB+	5.7	10.4	22.5
1998	9,663	157.2	BBB+	5.8	10.4	24.1
1999	9,418	199.0	BBB+	5.5	10.1	24.2
2000	9,354	273.9	BBB+	5.3	9.7	24.6
2001	9,610	296.3	BBB+	5.3	9.6	23.0
2002	9,588	351.5	BBB	5.3	9.4	26.8
2003	9,657	347.8	BBB	5.5	9.4	27.1
2004	9,533	337.3	BBB	5.5	9.1	26.9
2005	9,393	349.9	BBB	5.5	8.9	28.1
2006	9,130	384.1	BBB	5.4	9.1	27.0
2007	8,964	401.4	BBB+	5.5	9.2	24.7
1995-2007	24,146					

Panel B. Correlations with Lehman Bond Indices

	Sample investment grade bonds	Lehman corporate investment grade index	Sample high yield bonds	Lehman corporate high yield index
Sample investment grade bonds	1			
Lehman U.S. Corporate Index	0.97 *(0.0001)*	1		
Sample high yield bonds	0.42 *(0.0001)*	0.43 *(0.0001)*	1	
Lehman U.S. Corporate High-Yield Index	0.38 *(0.0001)*	0.40 *(0.0001)*	0.96 *(0.0001)*	1

This table reports descriptive statistics for our sample of corporate bonds used for the construction of the monthly bond returns series covering the 1995-2007 period. To compute monthly historical bond returns, we first construct historical monthly bond prices using data from Bloomberg, Mergent FISD, Trace, and Morningstar Mutual Fund Holdings datasets. Next, prices are combined with coupon information from Mergent FISD and returns are computed for each bond each month. Panel A reports characteristics for the set of bonds in our historical returns dataset. Panel B reports correlations between the Lehman indices and aggregate portfolios created using sample bonds from our returns database.

Table 3
Bond Fund Reported Returns

Panel A. Investment-Grade Bond Fund Reported Returns and Alphas (%/year)					
Panel A.1 Actively Managed					
Period	Lehman U.S. Corporate Index Return	TNA-Weighted Reported Return	Equal-Weighted Reported Return	TNA-Weighted 4 Factor Alpha (*t*-statistic)	Equal-Weighted 4 Factor Alpha (*t*-statistic)
1996-2001	7.05	6.57	6.42	-0.17 *(-0.53)*	-0.40 *(-1.66)*
2002-2006	5.95	5.05	4.44	-0.37 *(-1.96)*	-0.47*(-1.96)*
1996-2006	6.54	5.88	5.52	-0.33 *(-1.61)*	-0.47 *(-3.19)*
Panel A.2 Passively Managed					
Period	Lehman U.S. Corporate Index Return	TNA-Weighted Reported Return	Equal-Weighted Reported Return	TNA-Weighted 4 Factor Alpha (*t*-statistic)	Equal-Weighted 4 Factor Alpha (*t*-statistic)
1996-2001	7.05	7.41	7.14	0.21 *(1.24)*	-0.09 *(-0.64)*
2002-2006	5.95	4.71	4.83	-0.60 *(-3.74)*	-0.34 *(-3.88)*
1996-2006	6.54	6.18	6.09	-0.06 *(-0.42)*	-0.14 *(-1.51)*

Panel B. High-Yield Bond Fund Reported Returns and Alphas (%/year)					
Period	Lehman U.S. Corporate High-Yield Index Return	TNA-Weighted Reported Return	Equal-Weighted Reported Return	TNA-Weighted 4 Factor Alpha (*t*-statistic)	Equal-Weighted 4 Factor Alpha (*t*-statistic)
1996-2001	4.31	4.43	3.91	-0.76 *(-1.26)*	-0.82 *(-1.40)*
2002-2006	10.67	8.86	8.78	0.16 *(0.40)*	0.37 *(0.79)*
1996-2006	7.20	6.44	6.12	-0.75 *(-1.70)*	-0.73 *(-1.59)*

Average performance measures are reported for investment-grade funds in Panel A and for high-yield funds in Panel B. Results for actively managed funds are reported in Panel A.1 and for index funds in Panel A.2. Average historical returns are also provided for the Lehman U.S. Corporate and Lehman U.S. Corporate High-Yield indices, which include fixed-rate, non-convertible investment grade corporate bonds. Fund reported returns are averaged across all funds every quarter, using both value weighting by the fund assets and equal weighting. The weights are updated at the beginning of each quarter. Also reported are the intercept from a four-factor time-series regression of monthly fund excess net returns on the excess return associated with the CRSP value-weighted stock index, the excess return on the Lehman Aggregate index, the return difference of the Lehman High-Yield and Intermediate Government indices, and the return difference of the Lehman GNMA and Intermediate Government indices. *T*-statistics are reported in parentheses.

Table 4
Bond Fund Return Decomposition

Panel A. Investment Grade Bond Funds					
Panel A.1 Actively Managed					
Period	Lehman U.S. Corporate Index Return	Holdings Return (%/year)	BS (%/year)	CT (%/year)	AS (%/year)
1996-2001	7.05	6.90	0.04	0.12	6.76
2002-2006	5.95	6.93	0.55*	-0.15	6.49
1996-2006	6.54	6.91	0.27	0.00	6.64
Panel A.2 Passively Managed					
Period	Lehman U.S. Corporate Index Return	Holdings Return (%/year)	BS (%/year)	CT (%/year)	AS (%/year)
1996-2001	7.05	6.96	0.21	-0.05	5.97
2002-2006	5.95	5.58	-0.02	-0.51**	6.10
1996-2006	6.54	6.33	0.11	-0.26*	6.03

Panel B. High Yield Bond Funds					
Period	Lehman U.S. Corporate High-Yield Index Return	Holdings Return (%/year)	BS (%/year)	CT (%/year)	AS (%/year)
1996-2001	4.31	6.07	-0.33	0.39**	5.90
2002-2006	10.67	10.52	-0.60	0.61*	10.53
1996-2006	7.20	8.09	-0.45	0.49***	8.01

This table decomposes returns for our sample of corporate-bond mutual funds. Statistics are reported for investment-grade funds in Panel A and for high-yield funds in Panel B. Performance measures reported here are weighted by funds' total net assets as of the beginning of each quarter. The performance measures reported in this table include: Holdings Return (buy-and-hold return of the most-recently reported corporate bond portfolio); BS (bond selection measure), CT (characteristic timing measure), AS (average style measure). We include every fund that existed in a given quarter and had valid returns to compute the return measure for that particular quarter. This inclusion applied even to funds that did not survive past any given quarter for which they had valid data. All the quarterly buy-and-hold return measures are compounded into annual returns. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. The statistical inferences are based on Newey-West-corrected standard errors.

Table 5
Explaining the Difference between Holdings and Reported Returns

Panel A. Investment Grade Bond Funds

Panel A.1 Actively Managed

					Transaction Costs Estimates					
Period	Holdings Return (%/year)	Reported Return (%/year)	Return Gap (%/year)	Expense Ratio (%/year)	Bloomberg (%/year)	MF NAV Pricing (%/year)	Average (%/year)	Corporate Bond Turnover (%/year)	CRSP Turnover (%/year)	Net Return Gap (%/year)
1996-2001	6.90	6.57	0.33	0.69	0.21	0.19	0.20	41.89	130.36	-0.56
2002-2006	6.93	5.05	1.88	0.66	0.23	0.17	0.20	44.78	140.27	1.02
1996-2006	6.91	5.88	1.03	0.68	0.22	0.18	0.20	43.20	134.87	0.15

Panel A.2 Passively Managed

					Transaction Costs Estimates					
Period	Holdings Return (%/year)	Reported Return (%/year)	Return Gap (%/year)	Expense Ratio (%/year)	Bloomberg (%/year)	MF NAV Pricing (%/year)	Average (%/year)	Corporate Bond Turnover (%/year)	CRSP Turnover (%/year)	Net Return Gap (%/year)
1996-2001	6.96	7.41	-0.45	0.20	0.12	0.10	0.11	19.20	58.92	-0.76
2002-2006	5.58	4.71	0.87	0.19	0.17	0.10	0.14	39.53	85.26	0.54
1996-2006	6.33	6.18	0.15	0.20	0.15	0.10	0.13	28.44	70.89	-0.18

Panel B. High Yield Bond Funds

					Transaction Costs Estimates					
Period	Holdings Return (%/year)	Reported Return (%/year)	Return Gap (%/year)	Expense Ratio (%/year)	Bloomberg (%/year)	MF NAV Pricing (%/year)	Average (%/year)	Corporate Bond Turnover (%/year)	CRSP Turnover (%/year)	Net Return Gap (%/year)
1996-2001	6.07	4.43	1.64	0.97	0.26	0.36	0.31	35.08	64.71	0.36
2002-2006	10.52	8.86	1.66	1.03	0.36	0.57	0.47	49.35	68.39	0.16
1996-2006	8.09	6.44	1.65	1.00	0.31	0.46	0.38	41.56	66.38	0.27

This table reports statistics on the corporate-bond fund return gap and its components. Statistics are reported for investment-grade funds in Panel A and for high-yield funds in Panel B. The return gap is defined as the difference between reported returns and holdings returns. Holdings return is the return of the most-recently reported bond portfolio. Reported return is the fund return reported in the CRSP Mutual Fund Database (CRSP MF) and is net of expense ratios. The expense ratio is the annual expense ratio reported in CRSP MF. Transaction costs are computed using two alternative data sources, Bloomberg and Mutual Fund NAV Pricing (MF NAV Pricing). The two alternative data sources were first used to derive bid-ask spread estimates. Next, we use consecutive quarterly holdings reports to infer each fund's trading activity for each bond during the quarter. Bonds that reached maturity during the quarter were not treated as sales for the purposes of computing transactions costs. To compute the transaction cost of each trade, we multiply the par value traded by the fund during the quarter by the estimated half spread for that particular bond during that particular quarter. To compute the dollar value of all trades made by the fund during the quarter, we sum transaction costs across all corporate-bond trades undertaken by the fund during the quarter. Finally, we divide the fund's total transaction cost estimate for the quarter by the average market value of its corporate bond portfolio for the quarter to compute the fund's quarterly transaction cost estimate expressed as a percentage of assets. The net return gap reported in the last column represents the portion of the return gap not explained by transaction costs and expense ratios. Corporate Bond Turnover is calculated each calendar year for each fund as the minimum of total sales or purchases of corporate bonds divided by the average assets of the non-maturing corporate bond portfolio. When we infer sales from consecutive quarterly holdings reports, we exclude from sales any bonds that matured during the quarter. The CRSP Turnover is the fund-reported turnover and is the minimum of total sales or purchases of all securities held by the fund over the calendar year divided by the average assets of the fund over the calendar year. Funds typically treat bonds that mature as sales when computing turnover. Statistics reported here are weighted by funds' total net assets as of the beginning of each quarter. We include every fund that existed in a given quarter and had valid returns to compute the return measure for that particular quarter. This inclusion applied even to funds that did not survive past any given quarter for which they had valid data. All the quarterly buy-and-hold return measures and transactions costs measures are compounded into annual numbers.

Table 6
Performance by Turnover Categories

Panel A. Investment Grade Bond Funds

Turnover Deciles	Corporate Bond Turnover	CRSP Turnover	Expense Ratio (%/year)	BS (%/year)	CT (%/year)	AS (%/year)	Transaction Cost (%/year)
Decile 1 (Top)	135.50	324.88	0.93	0.42	0.00	6.41	0.46
Decile 2	97.15	309.48	0.87	-0.17	0.19	6.08	0.31
Decile 3	73.33	212.66	0.80	0.94**	0.00	5.82	0.31
Decile 4	53.01	163.06	0.77	0.26	0.02	5.60	0.23
Decile 5	42.28	128.27	0.78	0.19	0.09	5.86	0.20
Decile 6	37.24	139.42	0.74	-0.85	0.00	6.16	0.20
Decile 7	26.73	87.25	0.69	0.68*	0.06	5.95	0.16
Decile 8	21.61	130.95	0.72	0.74**	0.01	5.99	0.16
Decile 9	12.41	98.08	0.73	0.48	-0.10	6.68	0.13
Decile 10 (Bottom)	5.79	68.27	0.61	0.38	-0.04	5.80	0.11
Top-Bottom			0.32	0.04	0.04	0.61	0.35
			(8.10)	*(0.03)*	*(0.15)*	*(0.04)*	*(10.86)*

Panel B. High Yield Bond Funds

Turnover Deciles	Corporate Bond Turnover	CRSP Turnover	Expense Ratio (%/year)	BS (%/year)	CT (%/year)	AS (%/year)	Transaction Cost (%/year)
Decile 1 (Top)	114.40	175.07	1.13	-1.03	0.53	7.96	0.61
Decile 2	78.06	115.07	1.14	0.07	0.54*	6.37	0.48
Decile 3	65.52	114.07	1.17	-0.75	0.52	6.85	0.46
Decile 4	49.83	75.61	1.07	-0.75	0.58*	6.42	0.41
Decile 5	46.18	75.36	1.24	-1.28	0.10	6.78	0.40
Decile 6	37.05	69.79	1.09	-0.87	0.31	6.80	0.37
Decile 7	30.47	66.44	0.96	-0.66	0.64***	7.44	0.36
Decile 8	27.22	59.35	1.04	-0.24	0.76***	6.92	0.31
Decile 9	19.05	58.09	0.94	-0.70	0.47**	6.88	0.31
Decile 10 (Bottom)	11.47	59.66	1.19	0.29	0.52**	6.57	0.37
Top-Bottom			-0.06	-1.32	0.01	1.39	0.24
			(-1.03)	*(-0.81)*	*(0.06)*	*(0.52)*	*(4.20)*

This table reports return and transaction cost measures for our sample of corporate bond funds stratified by corporate bond portfolio turnover. Statistics are reported for investment-grade funds in Panel A and for high-yield funds in Panel B. Performance measures reported here are weighted by funds' total net assets as of the beginning of each quarter. Two turnover measures are reported. The Corporate Bond Turnover is calculated each calendar year for each fund as the minimum of total sales or purchases of corporate bonds divided by the average assets of the non-maturing corporate bond portfolio. When we infer sales from consecutive quarterly holdings reports, we exclude from sales any bonds that matured during the quarter. The CRSP Turnover is the fund-reported turnover and is the minimum of total sales or purchases of all securities held by the fund over the calendar year divided by the average assets of the fund over the calendar year. Funds typically treat bonds that mature as sales when computing turnover. Funds are ranked into deciles at the beginning of every quarter based on Corporate Bond Turnover measured over the previous calendar year. The performance measures reported in this table include: Holdings Return (buy-and-hold return of the most-recently reported corporate bond portfolio); BS (bond selection measure), CT (characteristic timing measure), AS (average style measure). The transaction costs reported here and their

computation are described in Table 5. We include every fund that existed in a given quarter and had valid returns to compute the return measure for that particular quarter. This inclusion applied even to funds that did not survive past any given quarter for which they had valid data. All the quarterly buy-and-hold return measures and transactions costs measures are compounded into annual numbers. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. The statistical inferences are based on Newey-West-corrected standard errors.

Table 7
Performance of Bonds by Mutual Fund Ownership Level

Panel A. Investment Grade Bond Funds					
Mutual Fund Ownership Deciles	Aggregate Mutual Fund Ownership	Quarter +1	Quarter +1 through Quarter +2	Quarter +1 through Quarter +3	Quarter +1 through Quarter +4
Decile 1 (Top)	15.63	0.10	0.32*	0.41*	0.51*
Decile 2	7.75	0.09	0.24***	0.37***	0.42***
Decile 3	5.12	0.09	0.15*	0.18	0.32**
Decile 4	3.61	0.09*	0.23***	0.37***	0.44***
Decile 5	2.54	0.15**	0.13	0.26**	0.26**
Decile 6	1.77	0.01	0.08	0.22*	0.36**
Decile 7	1.19	0.16**	0.23**	0.26**	0.24**
Decile 8	0.75	0.11*	0.12	0.12	0.11
Decile 9	0.40	0.14	0.15	0.34**	0.34**
Decile 10 (Bottom)	0.12	0.12*	0.22**	0.20	0.40**
Bottom-Top		-0.02	0.10	0.20	0.10
		(-0.17)	*(0.65)*	*(0.90)*	*(0.35)*

Panel B. High Yield Bond Funds					
Mutual Fund Ownership Deciles	Aggregate Mutual Fund Ownership	Quarter +1	Quarter +1 through Quarter +2	Quarter +1 through Quarter +3	Quarter +1 through Quarter +4
Decile 1 (Top)	41.26	-0.25	-0.56*	-0.69*	-1.02**
Decile 2	26.97	-0.21	-0.32	-0.61*	-0.49
Decile 3	21.51	0.02	-0.30	-0.56	-0.59
Decile 4	17.43	-0.06	-0.07	-0.18	-0.36
Decile 5	14.16	0.14	0.16	0.21	-0.04
Decile 6	11.03	0.01	-0.17	0.17	0.16
Decile 7	8.00	0.03	0.60**	0.47*	0.37
Decile 8	5.19	0.19*	0.42***	0.50***	0.96***
Decile 9	2.63	0.16	0.23	0.57	0.44
Decile 10 (Bottom)	0.73	0.68**	0.61*	0.87**	1.17*
Bottom-Top		-0.93**	-1.17**	-1.56	-2.19
		(-2.58)	*(-2.60)*	*(-3.10)*	*(-3.56)*

This table reports bond characteristic-adjusted returns for our sample of corporate bonds stratified by aggregate mutual fund ownership. Corporate bonds in our sample were ranked into deciles based on their aggregate mutual fund ownership at the beginning of the quarter. To control for bond issue size, the ranking took place within each issue size decile. Bonds in each aggregate ownership decile were placed in a value-weighted portfolio that was held for 3 to 12 months after portfolio formation. The characteristic-adjusted return for each bond is its buy-and-hold return minus the value-weighted buy-and-hold return of the appropriate benchmark portfolio to which it belongs over the same holding period. Aggregate mutual fund ownership for a given bond at point in time is computed as the fraction of the total bond par value held by our sample mutual funds. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. The statistical inferences are based on Newey-West-corrected standard errors.

Appendix A: Bond Return Construction Methodology

This appendix describes the methodology used to compute monthly returns for non-convertible corporate bonds over 1995 to 2007. We obtain information on month-end bond prices from four sources: Bloomberg, Mergent FISD, TRACE, and Morningstar Mutual Fund Holdings datasets. A description of the pricing information reported by each source follows.

Bloomberg reports daily composite bid and ask quotes that combine prices from multiple bond dealers and/or pricing services. Occasionally Bloomberg will set the bid and ask quotes equal to each other when it is unable to obtain bid and ask quotes but is able to obtain a price from a trade that occurred that day (which occurs more frequently after the implementation of TRACE). Bloomberg pricing data span the entire sample period from 1995 to 2007.

Mergent FISD reports daily transaction prices of trades by insurance companies. Trades are not time stamped. Thus if multiple trades occur on a given day, we cannot identify the last trade of the day. Trades are coded as either buyer or seller initiated. Mergent FISD pricing data span the entire sample period from 1995 to 2007.

TRACE reports daily transaction prices of trades by all market participants. Transactions are time stamped, but no indication is provided as to whether the trade was buyer or seller initiated. TRACE pricing data starts in July 2002 and continues to the end of the sample period in 2007.

The *Morningstar Mutual Fund Holdings* dataset reports prices used by mutual funds to compute net asset values. The date of record for the fund holdings report is always the last day of the month. Although funds were mandated to publicly report

holdings only semiannually until 2004 and quarterly thereafter, some funds voluntarily reported holdings to Morningstar as often as monthly. For each fund and each reporting period, the Morningstar Mutual Fund Holdings dataset includes the market value of each bond holding together with the face value of the position. To calculate the reported price of a bond, we divide the reported market value of the holding by the reported face value of the holding and then multiply by 100. The reported price measure is thus interpreted as the price per each 100 dollars of face value. This is the same pricing format used by Bloomberg, Mergent FISD, and TRACE. The Morningstar Mutual Fund Holdings data we use covers 1995 to 2006.

We follow a six-step procedure for collecting and processing bond pricing information from the above sources. The steps are described below in sequential order. If the data required to estimate the price of a particular bond for a given month-end date is unavailable in step (1), we proceed to step (2). If the data required is unavailable in step (2), we proceed to step (3), et cetera.

1) Bloomberg is searched for all instances of a bond having valid month-end bid and ask quotes. When a bond has valid bid and ask quotes, its month-end price is computed by averaging the quotes.

2) Mergent FISD is searched for all instances of a bond trading at least once on the last day of the month. We average the transaction prices of all trades coded as seller initiated to estimate the bond's month-end bid price and all trades coded as buyer initiated to estimate its month-end ask price. In instances when both bid

and ask price estimates are available, we compute the month-end bond price by averaging the inferred bid and ask prices. If only an inferred bid or ask price is available, we use it as the month-end price estimate.

3) TRACE is searched for all instances of a bond trading at least once on the last day of the month. We average the transaction prices of all trades to estimate the bond's month-end price.

4) Mergent FISD is searched for all instances of a bond trading at any point during the month. We use the transactions from the day closest to the end of the month, and follow the process in step (2) to estimate the bond's price for that day. To estimate the month-end bond price, we use the daily returns on the associated bond index: The Lehman U.S. Corporate Index for investment-grade bonds and the Lehman U.S. Corporate High-Yield Index for high-yield bonds. For example, consider an investment-grade bond that last traded in January on the 25th. Suppose that the last possible trading day was January 31st. We apply the compounded daily returns from the Lehman U.S. Corporate Index between January 25th and January 31st to the estimated January 25th price to come up with an estimated January 31st price.[14]

5) TRACE is searched for all instances of a bond trading at any point during the month. We use the transactions from the day closest to the end of the month, and follow the process in step (3) to estimate the bond's price for that day. As

[14] None of the main results of the paper are affected by this adjustment.

described in step (4), to estimate the month-end bond price, we use the daily returns on the associated bond index.

6) The Morningstar Mutual Fund Holdings dataset is searched for all instances of a bond being held by at least one mutual fund as of the end of the month. We compute the bond's month-end price by taking the median value of all prices reported by all mutual funds holding that particular bond on that day.

To be included in our bond return database, each bond must have at least one year to maturity. As Gebhardt, Hvidkjaer, and Swaminathan (2005) point out, short time-to-maturity bonds may be less liquid and are thus more prone pricing errors. Over the period from 1994 to 2007, steps (1) through (6) produce 910,748 monthly price observations for 27,028 corporate bond issues with at least one year to maturity. The percentages of prices coming from each source are reported below.

Price Source	Fraction of Prices
Bloomberg	65.54%
Mergent FISD	19.13%
TRACE	4.00%
Morningstar Mutual Fund Holdings	11.33%

Before calculating monthly bond returns, we generate post-default prices for any bonds that defaulted. In cases of a bond default, we first search Bloomberg, Mergent FISD, TRACE, and Morningstar Mutual Fund Holdings datasets for price information after the default event. If valid post-default price information is available, we proceed as described above and estimate the bond's post-default price. If valid post-default price

information is unavailable, we set the bond's post-default price equal to the median recovery rate for defaulting bonds with valid post-default pricing information. In the sample we examine, the median recovery rate is 36%. Thus, when pricing information is unavailable after default, we set the bond's price as of the end of its default month to $36 (i.e., 36% per $100 of bond face value).

To calculate monthly bond returns, we combine month-end prices with coupon payment information obtained from Mergent FISD. The return is calculated for a particular bond in a given month only if it has a valid beginning-of-month price, end-of-month price, and coupon payment information for that month. To mitigate possible data errors, we windsorize returns each month by dropping the 0.1% of bonds with the highest return and the 0.1% of bonds with the lowest return. We are left with 906,008 observations corresponding to 24,146 corporate bond issues. Summary statistics for the final bond-return database are reported in Table 2.

Appendix B: Estimation of Transaction Costs

In this appendix we describe the methodology used to estimate mutual fund transaction costs. The methodology can be broken into three steps as follows.

Step1. Estimate individual bond issue bid-ask spreads

We start by estimating month-end bid-ask spreads for individual bond issues. For robustness, we use two alternative methods to derive bid-ask spread estimates. The first uses bid and ask prices obtained from Bloomberg. Bloomberg reports daily composite bid and ask quotes that combine prices from multiple bond dealers and/or pricing services. Occasionally Bloomberg will set the bid and ask quotes equal to each other when it is unable to obtain bid and ask quotes but is able to obtain a price from a trade that occurred that day (which occurs more frequently after the implementation of TRACE). In such instances, we treat the bid and ask quotes from Bloomberg as missing values.

The second method for estimating bid-ask spreads is based on the bond prices used by funds to compute net asset values. From Cici, Gibson, and Merrick (2009), we know that some funds mark bonds at bid prices, while others mark bonds at the mid point of bid and ask prices. For each of the 946 corporate-bond funds in our sample, we searched the historical prospectuses filed with the SEC for information about how it marked bond values for NAV purposes. Following Cici, Gibson, and Merrick (2009), each fund was categorized each reporting period as following one of four marking standards: *mid markers* clearly stated the use of averaged bid and ask quotes when valuing debt securities for NAV purposes, *bid markers* clearly stated the use bid quotes,

mid/bid markers used language that implied a combination of averages of bid and ask quotes and/or bid quotes, and *ambiguous markers* used only general language to describe their marking policy. For the purposes of calculating bid-ask quotes we focus only on the funds we identify as mid or bid markers. There were 264 mid markers and 335 bid markers. We use prices on identical bonds held simultaneously by both bid-marking and mid-marking funds to make inferences about spreads. For each bond that is held by at least one mid-marking fund, we estimate a mid quote as the median of all prices reported by all the mid marking funds. Similarly for each bond that is held by at least one bid-marking fund, we estimate a bid quote as the median of the prices reported by all bid-marking funds. If our estimates produce a mid and bid quote for a given bond on a particular period, a half spread estimate is computed which is then multiplied by 2 to come up with a bid-ask spread.

Step 2. Form bond cohorts to mitigate estimation error

To mitigate bid-ask spread estimation error for individual bond issues, each month we form cohorts of bonds with similar characteristics and apply the average bid-ask spread to all bonds in the cohort. The bond characteristics we use to form cohorts are credit quality, time to maturity, issue size, and age of bond. First, every month, bonds are categorized into seven credit quality groups by the following credit ratings: (1) AAA, (2) AA, (3) A, (4) BBB, (5) BB, (6) B, and (7) C or D. Second, every month, bonds are categorized into four maturity groups by time to maturity as follows: (1) less than or equal to two years; (2) greater than two years but equal to or less than five years; (3) greater than five years but less than or equal to ten years, and (4) greater than ten years.

Third, every month, bonds are categorized into two size groups each month as follows: (1) large issues (above the cross-sectional median issue size) and (2) small issues (below the cross-sectional median issue size). Fourth, every month, bonds are categorized based on age, measured as the time since issuance, into two groups: (1) bonds with an age of one year or less and (2) bonds older than one year. Combined, these four categorizations define 112 buckets (i.e., 7*4*2*2) to which a bond could belong to in a particular month. To avoid idiosyncratic errors in the estimation of the bid-ask spread we estimate the bid-ask spread for a bond as the average bid-ask spread of all the bonds in the bucket to which the bond belongs.

Step 3. Infer fund bond trading and estimate transaction costs

We then use consecutive quarterly holdings reports to infer each fund's trading activity for each bond during the quarter. Bonds that reached maturity during the quarter are not treated as sales for the purposes of computing transactions costs. To compute the transaction cost of each trade, we multiply the par value traded by the fund during the quarter by the estimated half spread for that particular bond during that particular quarter. To compute the dollar value of all trades made by the fund during the quarter, we sum transaction costs across all the trades undertaken by the fund during the quarter. Finally our estimate of the fund's quarterly transaction costs as a percentage of assets is obtained by dividing its total transaction costs for the quarter by the average market value of its corporate bond portfolio for the quarter.

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