Bond Mutual Fund Winners and Losers: an Examination of Manager Risk-Shifting

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Abstract

Do bond mutual fund managers shift risk once they become mid-year 'losers' or mid-year 'winners'? In an annual tournament setting whereby managers compete for best performance, I find support that bond mutual fund managers increase risk in the second half of the year in an apparent attempt to increase returns and their relative position in the 'tournament' for the year. Fund managers have an incentive to shift risk to attract inflows, reduce outflows, and ultimately increase compensation which has been shown for equity mutual funds. The concave relationship associated with fund flow-performance in bond mutual funds (outflow sensitivity to poor performance is greater than inflow sensitivity to good performance), as opposed to convex for equity mutual funds, should be an extreme incentive for these bond mutual fund managers to avoid being 'losers' at the end of the year. This effect is most supported for high-yield bond mutual funds. This paper ultimately provides insight on how managers of bond mutual funds behave in consideration of a tournament setting.

Introduction

Mutual funds are a popular setting to test why investors allocate their money to managers, how the manager performs, and how this performance persists through time. While it has been shown that equity mutual fund managers appear to shift risk (Brown et al. 1996; Kempf et al 2009; Huang et al. 2011), the interesting question of whether bond mutual fund managers shift risk has yet to be fulfilled. The bulk of the mutual fund literature spends its time analyzing facets of equity mutual funds. The bond mutual fund literature is much less sparse, not due to prominence of monetary value, but possibly due to limited data and recent growth. While the prior literature focuses on equity funds, bond funds comprise a significant portion of mutual fund industry assets under management. The bond mutual fund industry consists of approximately $3.6 trillion in assets with extremely rapid growth from 2007 to 2013 having them possess the largest net inflows of any other type of fund in recent years (ICI Fact Book, 2016). Figures 1 and 2 show the rapid growth of bond mutual funds in the last decade and the percentage of all mutual fund assets held by bond mutual funds to be approximately 22% as of 2016 (ICI Fact Book, 2016).

As discussed, the bond mutual fund industry has become a major component of the fund world, with strong increases in assets under management over the past decade. Traditional investors of corporate bonds tended toward institutions, such as pension funds and insurance companies, in an attempt to find assets to match their long-term obligations (Bessembinder and Maxwell, 2008). However, Adrian, Fleming, Schachar and Vogt (2015) find that approximately 20% of outstanding bond issues are owned by mutual funds. This prominence among the growth of bond mutual funds, combined with a lack of academic research, serves as the first motivation of the current study.

This paper will examine the risk-shifting behavior of bond mutual fund managers. Risk-shifting may be a channel for fund managers to strategically attempt to increase fund flows under a tournament hypothesis as managers compete for future inflows that are associated with the appearance of superior performance. The risk-shifting by fund managers based on the tournament hypothesis has been shown for equity mutual funds by Brown, Harlow, and Starks (1996). The tournament hypothesis in equity funds motivates our first hypothesis of whether bond mutual fund managers shift risk; in other words, do poor (superior) performers from year-to-date attempt to increase (decrease) risk in the latter portion of the year in an attempt to increase return, subsequently inflows, and ultimately compensation.

A major motive for potential risk shifting behavior difference between bond and equity mutual funds is the fund flow-performance relationship of equity mutual funds being convex (inflow sensitivity to good performance is higher than outflow sensitivity to bad) and symmetric/concave for bond mutual funds. Recently, Chen and Qin (2017) and Goldstein, Jiang and Ng (2017) discover that this fund flow-performance sensitivity for bond funds is either symmetric or concave, respectively. The concavity is where outflow sensitivity is more sensitive to bad performance than inflow sensitivity is to good performance. This relationship is a potential major driver for bond mutual funds to avoid performing poorly relative to other bond mutual funds, and to do so by shifting risk.

Managers have multiple possible reasons for shifting risk and given an option like payoff for fund managers' compensation (a flat fee plus percentage of assets under management or based on performance benchmarks) they have reasons to attempt to have the highest relative performance for the year. Mutual fund managers may shift risk due to their skill in finding over/under valued securities or they may shift risk due to lack of skill or agency problem related

motives, such as a manger taking on more risk to simply 'hope' they choose correctly to increase returns and subsequently their personal compensation rather that may not benefit the fund holders.

First, I find support for risk-shifting among bond mutual fund managers when risk-shifting is measured by the changing composition of a weighted average bond rating for the fund. The empirical analysis shows that managers with poor year-to-date performance significantly increase risk relative to managers with superior year-to-date performance; finding an 18.26% increase in the weighted average bond rating for these 'loser' funds, on average (approximate shifting from a Moody's Aa3 (lower risk) to A1 (higher risk)). Another risk-shifting proxy, the risk adjustment ratio, shows that managers' risk-shifting activity is specific to high yield funds. Second, I find that the second half of the year return for loser funds is significantly lower than winner funds; where the losers have shifted risk levels significantly more than mid-year winner funds. This finding supports that risk shifting is a product of lack of skill or managers trading due to agency related motives and not related to shifts in risk due to manager skill.[1]

The paper will proceed as follows. The next section contains a review of the literature on equity and bond mutual funds, their progression and relationships. The following sections describes the data sample used and the methodology employed. Lastly, a description of empirical results and implications as well as additions for future research.

Literature Review

Finance literature is ripe with examinations on equity mutual funds. However, much less has been done to investigate bond mutual funds. This literature review first examines scholarship on equity mutual funds which serves as the foundation for the central research question advanced

[1] This test needs more to fully confirm this finding

in this paper. I then offer a review of the literature on bond mutual funds, comparing its findings with those of literature on equity mutual funds. Taken together, this leads to the central research questions advanced in this project: does risk shifting occur by bond mutual managers? If so, to what extent does it occur and what effect does it have on investors?[2]

Performance of equity mutual funds

Literature on mutual funds dates back to 1968 where Jensen concluded that active managers do not appear to outperform passive benchmarks. This evidence of underperformance, combined with a growth in actively managed mutual funds, leads to a puzzle as to why investors continue to place money in the hands of active management (Gruber, 1996). This puzzle has continued to be analyzed with scholars suggesting that underperformance is partially explained by the liquidity services provided by the fund managers (Edelen, 1999). However, Barras et al. (2010) and Busse et al. (2010) conclude that active management skill through time changes due to increased numbers of managers and possibly the result of luck rather than skill.

Persistence among mutual funds is an interesting feature of the literature due to its implications of understanding whether managers appear to continue performance of their past. There exists performance among the worst performing funds (Hendricks, Patel and Zeckhauser (1993); Carhart (1997)) and mixed evidence on persistence of performance among best performing funds (Hendricks,et al (1993); Malkiel (1995); Wermers (2003); Carhart(1997)). This lack of consensus in the literature on persistence permits logical arguments to study how investor flows fluctuate based on performance. Gruber (1996) and Zheng (1999) document the

[2] I have performed a test to discover that "loser" funds, based on quintile, experience significantly smaller returns than "winner" funds for the second half of the year. However, I am not confident in the explanation of this or if there is any bias in the tests I have done. I leave these results out of this version. Therefore, I have not yet found an answer to this question.

"smart money" effect where investors' capital flows have some ability to predict future performance.

Performance-flow relationship for equity mutual funds

The performance-flow relationship of mutual funds suggests that investors react non-symmetrically to winners' and losers' funds. The pervasive finding is that the performance-flow relationship is convex, that is, inflow sensitivity to good performance is greater than outflow sensitivity to poor performance. Sirri and Tufano (1992, 1998) find that investors respond to rankings of funds based on their performance where the mutual funds ranking relatively highest receive larger shares of new inflows in subsequent periods, but the worst performing funds do not experience the same sensitivity of outflows (see also: Ippolito 1992; Goetzmann and Peles 1997; Brown, Harlow and Starks 1996; Chevalier and Ellison 1997; Huang, Wei and Yan 2007). Chen, Goldstein and Jiang (2010) find that the convex shaped performance-flow relationship to be concave for equity mutual funds with high illiquidity.

Risk shifting in equity mutual funds

Fund flows are an important factor that may motivate managers to shift risk of a fund. Traditionally, management compensation is structured as a flat fee plus a percentage of assets under management. Considering the convex relationship of equity mutual funds, the managers have a higher reward for higher relative ranking of performance than they have penalization of poor performance by outflows. Thus, decisions of future investing made by a fund manager are predicated on a call option-like payoff structure, that is, they receive larger compensation with higher inflows and receive their flat fee regardless of poor performance and outflows (Brown, Harlow and Starks 1996). Given this fee structure and performance-flow relationship, fund managers can be seen as participants in a tournament where they are competing for inflows and

are willing to shift risk during the year to attempt to move upward- higher returns. Brown, Harlow and Starks (1996) confirm their hypothesis; managers who have performed poorly at interim portions of the year increase the risk of the fund (also Schwarz 2012). Their result is stronger for the 1986-1991 (final six years of data) due to increased competition of mutual funds and more awareness by investors to relative rankings based on returns. The risk-shifting result for equity funds is altered by the risk of employment and compensation schedule examined by Kempf, Ruenzi and Thiele (2009) where they find risk-shifting of loser portfolios appear to be more affected by compensation schemes when the employment risk is low for a manager. Risk shifting by equity fund managers is the result of either inferior ability or agency issues (Huang et al. 2011).

Bond Mutual Funds

To this point, the prior literature addressed relates specifically to equity mutual funds. While similarities exist among the structure of the funds, being they are mutual funds, there are many possible differences amongst performance, flow-to-performance relationships, and the risk-shifting incentives of the management. To date, bond mutual fund literature is sparse, partially due to potential data limitations in the past, and conceivably the result of the relative importance, measured by number and size, of bond mutual funds to equity mutual funds. However, the past decade has proven to be a period of significant growth for bond mutual funds, with scholarly literature following suit.

Bond mutual fund performance

At first glance, the similarities of bond and equity mutual funds appears to exist predominantly in relation to underperformance. Blake, Elton and Gruber (1993) find underperformance of bond mutual funds post-fees relative to related indexes. This finding is

echoed by Hiuj and Derwall (2008) who find negative alphas from 1990 to 2003 and by Dahlquist, Engstrom and Soderlind (2000) who observe underperformance of bond mutual funds in Sweden. Inflows appear smart for bond funds, similar to equity funds; however, outflows do not appear to provide any information about future performance of a fund (Fulkerson, Jordan and Riley (2013)). Findings related to the persistence of bond mutual fund performance are less conclusive. Blake, et al (2003) conclude no persistence in performance, Hiuj and Derwall (2008) conclude there exists persistence in performance and Lipton and Kish (2010) observe persistence in performance for high yield funds. This lack of consensus on persistence of performance in bond mutual funds may be attributed to the time frame, the sample selection or the procedure used to measure alpha (Fulkerson, Jordan and Riley (2013). Recently and related to performance, Comer and Rodriguez (2013) examine investment grade corporate and government bond funds to conclude that corporate bond funds outperform government bond funds on a risk-adjusted basis.

Performance-flow relationship for bond mutual funds

The performance flow relationship for bond mutual funds is quite different than equity mutual funds. Fulkerson, Jordan and Riley (2013) find that bond mutual funds do not exhibit a convex relationship of fund-flow performance and Chen and Qin (2017) echo this finding. These results support the belief that bond inflows and outflows do not exhibit significantly different magnitudes based on performance of the fund. However, recent work from Goldstein, Jiang and Ng (2017) shows a concave relationship between performance and fund flows. The authors conclude that the outflow sensitivity to poor performing bond mutual funds is greater than the inflow sensitivity of the better performing bond mutual funds.

Risk shifting in bond mutual funds

To date, the literature on risk-shifting in bond mutual funds is absent. While Choi and Kronlund's (2017) recent working paper illustrates some attempt to fill this void by examining when portfolios "reach for yield"-shifting their yields to higher than benchmarks. Choi and Kronlund find that funds that reach for yield receive higher returns due to higher risk. This higher return is followed by inflows especially for retail funds and, more specifically, in times of low market interest rates when yield is tougher to come by. However, my paper is different from their work, in my work attempt to examine risk-shifting by bond mutual funds in consideration of managers competing in an annual tournament for best performance (see Brown, et al 1996 for equity mutual funds). First, I provide a more comprehensive analysis focusing on the tournament behavior of managers. Second, I use different proxies of risk-shifting. Third, I extend the temporal coverage of the data.

The abundance of literature on equity mutual funds provides us with a template from which to investigate ideas on bond mutual funds. Based on prior literature, we observe that investors reward managers differently in bond mutual funds than in equity funds. The performance flow-relationship appears to be either be symmetrical or concave, but not convex. Simply stated, bond mutual fund investors either penalize and reward managers evenly for performance or penalize managers more than they reward managers for respective poor or superior performance. These findings serve as the foundation for my study which explores how this relationship, if at all, may affect the incentive for risk-shifting by bond fund managers.

Hypothesis Development

The above literature leads to three main principles that motivate the current study. First, the large growth of bond mutual funds provides us with economic importance in understanding how funds flows and how managers act. Second, the observed risk-shifting and tournament

behavior of equity mutual funds managers justifies curiosity about the risk-shifting of bond mutual fund managers. Lastly, the performance-flow relationship differential between bond and equity mutual funds provides the setting for an interesting exploration.

As noted, variance in risk-shifting by a fund manager may occur for numerous reasons. First, a manager may shift-risk to obtain the largest future fund flows. Next, a manager may be motivated to shift risk due to lack of skill or to reap their own reward, a classic agency problem. Alternatively, a manager may be skilled in the selection of buying bonds that are underpriced or selling bonds that are overpriced. These movements of buying and selling may change the risk of the portfolio, but not affect the performance adversely. Brown, et al (1996) find that equity mutual fund managers in an interim position of bad performance from year-to-date tend to increase risk more than managers in an interim of good performance. This risk-shifting behavior seen in equity mutual funds serves as the second motivation of the current study which aims to understand which mechanisms appear to drive the risk-shifting, if this risk-shifting does indeed exist.

When considering risk-shifting in equity mutual funds, this behavior occurs after year-to-date poor performance (Brown, et al 1996). One explanation may be that managers of equity funds do not need to concern themselves as much with poor performance due to the lower sensitivity of outflows after bad performance, a convex relationship. These managers may focus their attention more strictly on achieving superior performance and larger relative inflows. On the other hand, given the concave relationship of fund-flow performance of bond mutual funds, managers may need to worry less about striving for the top of the tournament performance and be more concerned about avoiding the bottom of the tournament performance. Essentially, equity

mutual fund managers have more incentives to achieve high returns than they may have to worry about losses; whereas, bond managers should not have that cushion.

Bond mutual fund managers may have different incentives to shift risk, as discussed above, in the tournament setting than equity mutual fund managers do as shown in Brown, et al (1996). I follow Brown, et al. (1996) setting where a manager is competing in a tournament from each January to December to compete for the best return. I take the example of 'winners' and 'losers' where winners are the funds with relatively high returns to other bond funds from January to June and losers are the funds with relatively poor returns from January to June. Loser managers, those who have performed poorly from January to June, have incentive to increase the relative risk level in order to try to increase their relative ranking by the end of the year. Restated simply, managers finding themselves in a poor position based on returns relative to other bond mutual funds through June of the year will need to generate a return over the remainder of the year, the tournament, that makes up for the deficit they have created the first period. One way to attempt to realize this increase in return would be to increase risk relative to the bond mutual funds that are performing well through the first six months of the year.

The winning managers, the fund managers with highest relative first six month returns, will strive to maintain those returns and will have less incentive to take on more risk for the second half of the tournament, months July to December, and may reduce risk in order to hold onto their present returns. However, these winner managers may also have an incentive to likewise increase risk in an anticipation of what the loser managers may do, although it would be expected to still see a lesser extent increase in risk-shifting. If we label the January to June winners and losers as L and W, respectively, and consider risk levels for first six months and second six months of a year to be σ_1 and σ_2, the central expectation of this paper is:

$$\frac{\sigma_{2L}}{\sigma_{1L}} > \frac{\sigma_{2W}}{\sigma_{1W}}$$

Specifically, the "risk-adjustment ratio" for the midway loser managers will be greater than the ratio for the midway winner managers. The concept of losers adopting higher risk strategies than winners is consistent with Bronars (1987) who finds that losing sports teams in interim positions will take greater risks toward the end of the game than they would if they had more time remaining.

In order to explore these possibilities, the first step is to investigate whether risk-shifting by bond managers actually exists. Choi and Kronlund (2017) find that the deviation from the Barclays' bond index has large heterogeneity among firms over time, risk-shifting exists, but our analysis is to only examine year-to-date performance and risk-shifting based on a tournament setting where managers are competing for best returns. Secondly, we examine the performance until year end to discover whether it appears risk-shifting is the product of ill-motivated trades by unskilled managers, agency prone managers, or skilled managers.

I conjecture there is an incentive for loser managers to shift risk more than winner managers in order to avoid the low relative returns and avoid the large sensitivity of outflows associated with the concave fund flow-performance relationship. Furthermore, I posit that the interim winners may significantly reduce risk in order to reduce the chance of moving to a loser position and experience the high outflow sensitivity. This leads to the first hypothesis:

H1: Managers will shift risk after good or poor interim performance.

The next hypothesis is to examine the performance of the funds based on risk-shifting to discover whether managers appear to be shifting risk for the right or wrong reasons. In finance, we would expect that more risk breeds more return. If I find that managers taking on more risk after an interim loser position and there subsequent second half year return is not higher than the

funds taking on less risk, these managers lack skill or are ill-motivated by agency problems. If I find that this increase in risk is associated with higher returns, combined with a risk-adjusted return measure, I may be able to conclude that these managers possess skill and risk-shifting could be beneficial for investors. This leads to hypothesis two:

H2: Risk-shifting behavior will affect the performance of the fund and will provide insight as to the mechanism through which risk-shifting occurs.

Lastly, I examine the characteristics of risk-shifting by fund managers based on proportions of institutional investors and retail investors in the fund. It is common for institutional investors to purchase bonds for a "buy and hold" strategy to attempt matching long-term liabilities to bond coupon payments (Bessembinder and Maxwell 2008). To the extent that institutions do invest in bond mutual funds, I expect a similar "buy and hold" mentality. This would alter the incentive for a manager to shift risk if he/she is less concerned with the investors leaving, the case of institutional investor ownership. Goldstein, et al (2017) find the sensitivity of outflows for funds held mostly by institutional investors to be less sensitive. Given this, there may be a difference in risk-shifting by managers of bond mutual funds with higher proportions of institutional investors. Here I hypothesize:

H3: Risk-shifting among mutual funds differs depending on the amount of retail or institutional investors.[3]

Data

To examine risk shifting behavior of bond mutual fund managers, we begin with the Center for Research and Security Prices (CRSP) mutual fund database. This database provides information of funds' net of expense returns, total net assets (TNA) and fund characteristics. The

[3] Not yet tested

Mergent Fixed Income Securities Database (FISD) provides the characteristics of individual bond issues specifically used for the creation of the weighted average bond rating for a fund (WABR).

I begin with the CRSP Survivorship-Bias-Free Mutual Fund Database with the first screening criteria to possess and objective code that could be considered a corporate bond fund. Following Chen and Qin (2017), I gather funds with these objective codes.[4] Table 1 and Table 2 summarize the fund characteristics of the final sample. Table 1 provides median returns by year for all bond mutual funds in my sample as well as returns of investment grade versus high yield funds separately. An increase in the number of all bond mutual funds over the sample is seen and shows the increase in prominence and growth of this investment vehicle. Table 2 provides the average semi-annual return and mean total net assets, TNA, for the sample for bond mutual funds, and investment and high yield separately. More importantly is the weighted average bond rating, WABR, which is a weighted measure of equal interval between successive bond ratings based on Moody's bond rating scale. The weighted average rating for all bond mutual funds in the sample over the years lies between an Aa3 and A1 rating. For funds classified as investment grade bond mutual funds, this rating lies between an Aa1 and Aa2. For funds classified as high yield bond funds, the weighted average rating is between Baa1 and Baa2 and slightly favoring toward Baa2.

Methodology

[4] Select mutual funds with the Weisenberger objective code (wbrger_obj) CHY or CBD, the strategic insight objective code (si_obj_cd) CSM, CMQ, CIM, CGN, CHQ, or CHY, or the; Lipper objective code (lipper_obj) SII, SID, IID, BBB, A, or HY. Funds are further categorized as high yield corporate bond funds if the codes are wbrger_obj = CHY, si_obj_cd = CHY or lipper_obj = HY. All other fund objective codes are considered to be investment-grade bond mutual funds.

In general, a mutual fund can shift risk in three ways. First, a fund can change the composition of assets and cash holds. Second, a fund can change the composition of the underlying holdings to more or less risky assets. Third, a mutual fund can shift risk by deviating from their benchmark (i.e. concentrating holdings in few industries or few positions). We examine the first two forms of potential risk-shifting in this study and suggest the third for further work due to the difficulty in finding appropriate benchmarks.

Cash Holding Risk-Shifting

Considering that corporate bonds tend to be relatively illiquid compared to treasury bonds and equities (Bessembinder and Maxwell (2008)), the change in liquidity of holdings of a bond fund should be one measure of the risk-shifting behavior of the fund. For example, if an investor decides to redeem his/her funds from a bond mutual fund and that fund does not hold enough cash or liquid instruments, selling a bond to fulfill the redemption may be costly for the fund due to illiquidity, a risky practice.[5] However, risk shifting measured by cash holdings may be the weakest form as it is common for fund managers to have restrictions on cash holdings for a fund. I first consider the combination holdings of cash and assets change during the year. I follow a tournament setting as established by Brown, et al (1996), whereby I consider the fund return from January to June, month 6 for each fund *j* in a given year *y*. The calculated six-month return is[6]:

$$RTN_{j6y} = \left[\left(1 + r_{j1y}\right)\left(1 + r_{j2y}\right) \ldots \left(1 + r_{j6y}\right)\right] - 1 \qquad (2)$$

[5] Bond mutual fund redemptions are completed at end of day for the investor, but the bond fund may take several days to adjust positions if need be and this is one of the rationales for SEC ### to allow swing pricing in bond mutual fund redemptions beginning in November 2018.

[6] Create rankings based on raw returns in consideration of Sirri and Tufano (1998) since investors can observe and easily analyze raw returns. I will make note to examine a risk-adjusted measure beginning with benchmark-adjusted using Barclay's Bond Indexes and following literature on bond factor analysis.

The next step involves ranking the funds, based on six-month return, into quintile portfolios for a given year. I then study the risk-shifting differences between the interim winner funds (top quintile) and the loser funds (bottom quintile) to explore if risk shifting appears to occur. The cash holding change measure employed are as follows where *j* and *y* are fund and year, respectively. The %cash is the percentage of TNA held as cash for a given reporting period where *W* and *L* are the relative winner and loser portfolios. Where I expect to see that the interim winner funds appear to significantly increase their cash holdings relative to the interim loser funds.

$$\%cash_{j12yW} - \%cash_{j6yW} > \%cash_{j12yL} - \%cash_{j6yL} \quad (3)$$

The above measure may be driven by managers that do not rebalance their cash holding each quarter and the percentage cash is changing due to change in TNA based on returns or flows. We next examine another measure which is the percentage change in raw cash holdings, rather than the percentage change of cash relative to TNA. I take the ending amount of cash for December as a percentage change in amount of cash held at June as follows and would expect to see the following relationship.

$$[Cash_{j12yW}/Cash_{j6yW}] - 1 > [Cash_{j12yL}/Cash_{j6yL}] - 1 \quad (4)$$

Bond Rating risk shifting

I follow a similar methodology to examine the second type of risk-shifting behavior where funds can adjust underlying holdings of bonds as a risk-shifting mechanism; switch to bonds with more or less risk. To examine this, I create a weighted average measure of bond-ratings (WABR) to capture risk for a portfolio for each period by assigning equal intervals of one for each bond rating with one being the highest rated (Aaa = 1, Aa1 = 2, etc) based on Moody's

bond rating[7]. The ratings scores are listed in Table 3. I then compare the weighted average on bond measures from June to December to create a ratio with weighted average bond ratings from June. I use the same quintile sorts on returns based on returns calculated in model (2) and expect that the bond ratings score will increase among funds that have the worst interim performance and/or decrease (increase less) among the funds that have had superior interim performance. The creation of the WABR by period studied is the summation of the weight of each bond in a fund at time 6 and time 12 multiplied by its rating score at the time of the holding where *q* is the bond, *X* is the weight and *RS* is the ratings score from table 3.[8] The model for the ratio to measure the risk shifting based on bonds holding ratings is in model (6) for fund *j* for year *y* among interim winner and loser funds, *W* and *L*.

$$WABR = \sum_{q=1}^{q} X_{qjy} * RS_{qy} \tag{5}$$

$$[WABR_{j12yW}/WABR_{j6yW}] > [WABR_{j12yL}/WABR_{j6yL}] \tag{6}$$

Risk Adjustment Ratio

The final measure of risk-shifting I employ is the "risk adjustment ratio". It is the ratio of each fund's volatility measured prior to June and after June for each tournament year. Volatility is measured as the standard deviation of returns for the second half of the year as a ratio of the standard deviation of returns for the first half of the year as follows:

$$RAR_{jy} = \sqrt{\frac{\sum_{m=6}^{12}(r_{jmy}-\bar{r}_{j(12-m)y})^2}{(12-6)-1}} \div \sqrt{\frac{\sum_{m=1}^{6}(r_{jmy}-\bar{r}_{j6y})^2}{6-1}} \tag{7}$$

where *r* is return for month *m* of fund *j* in a given year *y* and the deviations in the numerator and denominator are calculated relative to the mean return over the relevant interim period. The

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7 should use Dimitrov, Palia, and Tang (2015) method for raking and include not ranked bonds too.
Dimitrov, V., Palia, D. and Tang, L., 2015. Impact of the Dodd-Frank act on credit ratings. *Journal of Financial Economics*, *115*(3), pp.505-520.

8 Weight needs to be considered also as weight based on TNA of bonds. Currently it is weight invested in a security as a portion of fund TNA for the given period.

empirical conjecture for this equation (7) is that the RAR will be significantly higher for interim loser portfolios than winner portfolios. I employ the exact methodology of Brown, et al (1996) where instead of quintile portfolios as in my other tests, a winner (loser) portfolio is classified by having above (below) median returns for the first six-months of a given year. The RAR result is then placed into high and low categories based on whether the value is above or below median. Equations (2) and (7) are used to create an RTN, RAR pair for each of the annual tournaments. The procedure is to produce a 2x2 matrix contingency table in which each pairing is placed into one of four cells as shown below. The RTN variable captures the winners and losers through the first six months and the RAR variable is capturing the ratio of volatility in the second half of a year to the first half of the year.

Figure 3: 2x2 matrix of pair matching

High RTN, High RAR	Low RTN, High RAR
High RTN, Low RAR	Low RTN, Low RAR

The expectation is that each of these cells would contain an equal number of observations, 25% of the sample. However, if risk shifting exists, I would expect to see a significantly larger frequency of observations in the High RTN/Low RAR and Low RTN/ High RAR cells. The

statistical significance of this procedure is established using a chi-square test having one degree of freedom.

Robustness

Additional tests are to be performed to address alternative explanations for the results. I examine the stickiness of ratings and control for a rating change within a tournament-year to control for a non-active decision of risk-shifting.[9] I then exclude December from the sample each year to control for the possibility for window dressing by a fund at the end of a year to meet fund objective.[10] Incubation bias of Evans (2010) where firms privately initiate funds and release the best performers to the public.

Results

Risk Shifting of Cash

In unreported results, I examine the results from considering equations (2), (3) and (4) to determine if being categorized as a loser fund at the first six months of a year will lead managers to change the composition of holdings in cash and assets, my first proxy used for risk shifting. In an analysis of significant differences between the winners', top quintile performers based on returns for first six months, and losers' cash holdings change from June to December, I find no significant differences in the change in cash holdings between the two groups. This result does not support the notion of risk shifting by bond mutual fund managers after poor/superior interim performance. The result however, is not completely surprising due to the potential of cash holdings being regulated for funds and/or due to the inherent lack of rational as to why a winner fund manager would simply want to close out asset positions and sit on more cash.

Weighted Average Bond Rating

[9] Not yet completed.
[10] Can only do this for returns/standard deviation measure of risk shifting because I do not have monthly holdings.

The next test is an examination for the change in the weighted average bond rating (WABR)[11], my second measure of risk-shifting by bond mutual fund managers. Similarly to cash, I examine winner and loser portfolios based on quintiles of returns for the first six months of the year, based on equation (2), and examine if there are significant differences in the risk-shifting of the fund for the next since months measured as the funds WABR, model (5) and (6). Table 4 provides the empirical results. I find that both the winner and loser funds WABR ratio increases during the second six months of a year, on average. Furthermore, I do see that the loser portfolios appear to take on significantly more risk in the second half of the year than the winner funds. The coefficient for the mean WABR ratio for a loser fund is 1.1826, that is, they increase their WABR by 18.26% on average. Given a mean WABR for all funds of 4.52 (a Moody's Aa3 to A1), an 18% increase in this WABR would explain that loser funds appear to increase their WABR to 5.34, approximately a one full step rating change on average after poor performance. Examining the WABR change of winner portfolios is interesting. The average change in WABR for winner funds is 7.36% and while significantly smaller than loser funds, still significantly greater than zero. That is, the winner fund managers are still increasing risk in the second-half of the year, on average by about one-half a bond rating. This finding supports the notion that bond managers are in a competition whereby loser fund managers attempt to increase risk significantly more than winner funds in an attempt to increase relative ranking by the end of the tournament and winner fund managers appear to be adjusting their risk significantly less, but in possible anticipation of what those ranked as losers may do. Ultimately, this finding supports the notion that losers want to increase their relative ranking by the end of the tournament, year *y*, and attempt to do so by increasing the risk of their holdings. Table 4 panels B and C show

[11] This result will be considered under an alternative scale proposed by Sandow et al. (2006) by giving a score based on default rate rather than a linear step of scores between successive ratings.

qualitatively similar findings where the risk shifting is not sensitive to high-yield or investment grade funds. The high

Risk Adjustment Ratio

My next estimation of risk shifting in a tournament year is tested by using equation (2) for returns and equation (7) for the risk shifting measure as the risk adjustment ratio, RAR. I employ the methods of Brown, et al (1996) where a winner is classified as having above median returns for the first six months of a year and a loser is below the median, as opposed to using quintiles in my last two examinations[12]. Table 5 shows cell frequencies from Figure 3 for the entire dataset. The result for all sample bond funds is a bit confounding. It shows that there exists a larger number of loser funds possessing a lower than median RAR than loser funds possessing a higher than median RAR. To explore this result further, panels A and B show the RTN, RAR pair frequencies for investment grade versus high yield funds. It appears this result is driven by the investment grade firm sample where they show the same frequency relationship just described. The high yield fund result is consistent with my expectations. It is seen in PANEL C of TABLE X in that the frequency of Low RTN, High RAR pair is greater than 25% and the frequency of High RTN, Low RAR pair is greater than 25%. This result shows that when using RAR as the proxy for risk shifting, managers of high yield bond loser funds exhibit a greater frequency of increase in risk than loser funds exhibiting a decrease in risk and managers of winner funds exhibit a greater frequency of lowering risk in the next half of the year than winner funds who increase risk over the same period.

Overall, the measure of risk-shifting by bond mutual fund managers appears to be sensitive to what proxy is used as a measure of risk shifting, but seems to lend some support

[12] Results remain quantitatively similar for quintiles and RTN, RAR pairs

toward the risk-shifting similarities of equity mutual fund managers. It seems intuitive that an active management decision making proxy be most appropriate way to measure loser and winner fund managers decision to shift risk and thus I believe that the WABR measure or cash measure may offer more insight than the volatility measure of RAR. I have explained how the cash measure may not be the best proxy due to mandates of fund managers and I express more confidence in the WABR measure which does indeed show some forms of risk shifting by fund managers, along with RAR for high yield bond mutual funds.

Conclusion

In this paper, I follow the equity mutual fund literature to examine risk shifting by bond mutual fund managers. This study is one of the first to examine how bond mutual fund managers shift risk in a tournament setting. In this paper, I claim that a mutual fund year can be viewed as a tournament in which the funds each compete against the others for inflows, and subsequently larger compensation, based on inflows/outflows from their funds. I conjecture that managers will have incentives to shift risk based on their interim year performance where each year is a tournament. I expect managers of funds with poor interim performance for a year will increase their risk relative to funds that have superior performance during the same year.

This risk-shifting by fund managers is an unexplored topic in bond mutual funds, but well established in the equity mutual fund literature. A major difference between the two is the nature of flow sensitivity to performance between the two types of funds. It has been established that inflow sensitivity to equity mutual funds is larger for superior performing funds than outflow sensitivity for poorest performing funds, a convex relationship. The bond mutual fund literature has recently concluded that this convex relationship does not exist (Chen and Qin 2017) or is actually concave (Goldstein et al. 2017). A concave relationship means that outflow sensitivity to

the poorest performing funds is greater than inflow sensitivity to the best performing funds. This major difference of equity and bond mutual funds strongly motivates this study as the incentive to shift risk may be different than that of equity funds.

My central prediction is that bond mutual fund managers would have greater incentive to shift risk during interim periods of poor performance more than funds with interim superior performance. Using different techniques and proxies for risk-shifting from 2004 to 2016, I find evidence that bond mutual fund managers do shift risk after periods of relative poor interim performance. The support for risk-shifting using cash holdings as the proxy do not exist, I argue this is not completely surprising due to mandates on cash holdings. The support of risk-shifting using the risk adjustment ratio, RAR, appears to only exist for high yield bond mutual funds where funds in a loser position through the first six months of the year more frequently increase their risk adjustment ratio, RAR, than they decrease RAR. The third proxy of risk shifting is the weighted average bond rating, WABR. This measure shows significantly higher levels of risk-shifting by loser funds than winner funds for both investment grade and high yield bond mutual funds.

Overall, I find support that bond mutual fund managers appear to shift risk differently based on their relative ranking as a winner or loser fund during the first six months of the year. The motivations for a manager to shift risk is in part due to the compensation scheme of mutual fund managers and the concave nature of the fund flow-performance whereby managers are penalized more for bad performance than they are rewarded for good performance. My findings cannot reject that managers due appear to be competing in a tournament each year for highest relative performance. This risk-shifting behavior has possible implications on how management should be compensated and how investors should decide where to place their funds.

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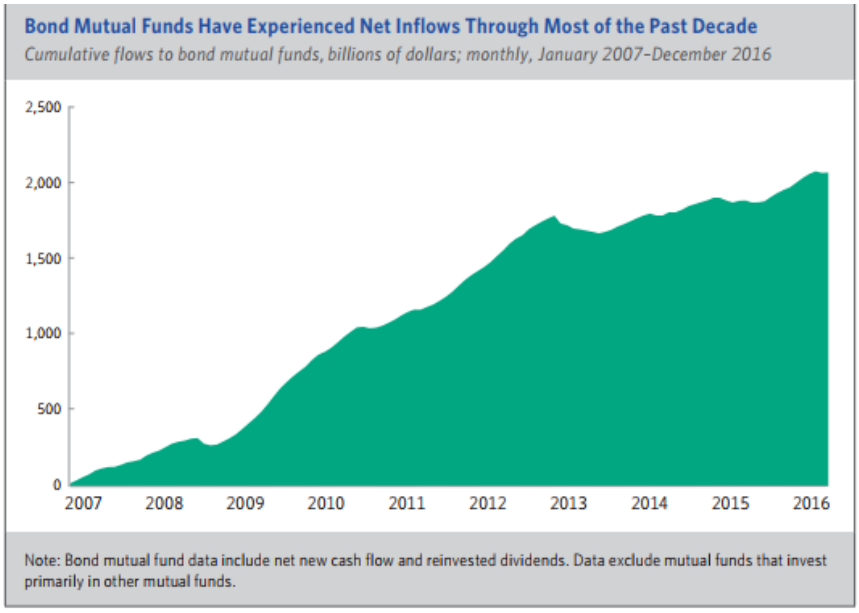
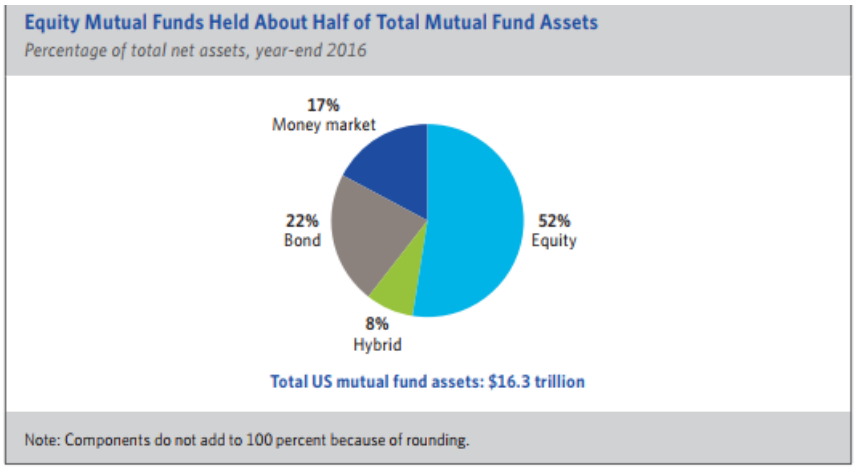
Figures and Tables

Figure 1: Flows to Bond Funds from 2007-2016



Source: Investment Company Institute FactBook 2016

Figure 2: Percent of All Funds Assets Held by Type of Mutual Fund



Source: Investment Company Institute FactBook 2016

Table 1 Summary Statistics
Summary information is reported for the sample of bond mutual funds by year.

	Number of Funds	Median Return		
Year		All Bond Funds	Investment Grade	High Yield
2004	290	0.200%	-0.020%	1.317%
2005	293	1.347%	1.860%	0.392%
2006	297	0.520%	-0.390%	2.579%
2007	303	1.600%	1.080%	3.008%
2008	510	-0.700%	0.030%	-1.706%
2009	591	6.635%	5.280%	23.160%
2010	748	4.485%	4.960%	3.540%
2011	757	2.999%	2.590%	4.423%
2012	789	3.770%	3.155%	6.660%
2013	786	-1.370%	-2.260%	1.250%
2014	838	4.200%	3.870%	5.040%
2015	887	0.534%	0.250%	2.432%
2016	924	5.299%	4.930%	6.585%

Table 2 Summary Statistics
Summary information is reported for the sample of bond mutual funds. Weighted average bond rating (WABR) is calculated using equation 5. This sample only contains data from 2008-2016.[13]

WABR Summary Statistics	Observations	Average semi-annual return	Average $WABR_{1\text{-}6}$	Fund TNA Mean
All Funds	2974	0.0298	4.52≈ between Aa3 and A1	2170
Investment Grade	2020	0.0228	2.58≈ between Aa1 and Aa2	2521
High Yield	954	0.0447	8.69≈ between Baa1 and Baa2	1427

[13] Trying to figure out why.

Table 3 Bond Rating Score Chart
The weighted average bond score (WABR) calculated in (5). This is the score assigned to each bond rating.

Moody's	Rating Score	Quality
Aaa	1	Investment-grade
Aa1	2	
Aa2	3	
Aa3	4	
A1	5	
A2	6	
A3	7	
Baa1	8	
Baa2	9	
Baa3	10	
Ba1	11	Non-investment grade AKA high-yield bonds AKA junk bonds
Ba2	12	
Ba3	13	
B1	14	
B2	15	
B3	16	
Caa1	17	
Caa2	18	
Caa3	19	
Ca	20	
	21	
C	22	

Table 4 Weighted Average Bond Rating

This table provides results using return quintiles from January to June of a year to create quintiles (eq (2)) and examine the WABRs ratio from December to prior June (eqs. (5), and (6)). The larger the ratio, the riskier the underlying holdings as it shows an increase in the WABR.

Weighted Average Bond Rating Analysis

Panel A: All Bond Mutual Funds

RTN Portfolio Quintile	Observations	Mean $WABR_{12}$ / $WABR_6$	t-statistic	p-value
1	591	1.1826***	14.26	0.0001
2		1.1658***	12.93	0.0001
3		1.1381***	13.86	0.0001
4		1.0953***	11.89	0.0001
5	590	1.0736***	10.51	0.0001
Q1-Q5		0.1089***	7.46	0.0001

Panel B: Investment Grade Bond Mutual Funds

RTN Portfolio Quintile	Observations	Mean $WABR_{12}$ / $WABR_6$	t-statistic	p-value
1	398	1.1894***	12.11	0.0001
2	405	1.1576***	11.11	0.0001
3	407	1.1705***	11.15	0.0001
4	403	1.1376***	10.85	0.0001
5	403	1.1339***	12.194	0.0001
Q1-Q5		0.0554***	2.91	0.0037

Panel C: High Yield Bond Mutual Funds

RTN Portfolio Quintile	Observations	Mean $WABR_{12}$ / $WABR_6$	t-statistic	p-value
1	185	1.1295***	6.11	0.0001
2	190	1.0592***	6.32	0.0001
3	192	1.0709***	6.89	0.0001
4	190	1.055***	4.75	0.0001
5	187	1.0591***	4.63	0.0001
Q1-Q5		0.0704***	2.85	0.0046

Table 5 Return and Risk Adjustment Ratio Pairs
This procedure directly follows Brown, et al (1996). Results are discovered from eqs. (2) and (7). Each category should contain 25% of the sample. The expectation is to find a higher frequency in the Low RTN/ High RAR and High RTN/ Low RAR categories.

		Sample Frequency (% of Observations)					
		Low RTN ("Losers")		High RTN ("Winners")			
Assessment Period[a]	Observations	"Low" RAR	"High" RAR	"Low" RAR	"High" RAR	x^2	p-value[b]
Panel A: Winners/Losers Ranked by Median							
(6,6)	8949	30.93%	23.65%	21.39%	24.04%	81.7886	0.0001
Panel B: Winners/Losers Ranked by Median for Investment Grade Funds							
(6,6)	6295	32.41%	22.41%	19.98%	25.19%	138.3976	0.0001
Panel C: Winners/Losers Ranked by Median for High Yield Funds							
(6,6)	2644	25.57%	28.52%	26.59%	19.33%	29.7603	0.0001

[a] The performance assessment period is listed as the first 6 months of a year to determine winner and loser funds and the second 6 months of a year to examine its ratio of standard deviation ratio to standard deviation of first 6 months

[b] The x^2 statistic is calculated based on a null hypothesis that each cell should receive an equal distribution (i.e. 25%) of the sample.