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Tournament behavior of US corporate bond mutual funds: A non-parametric analysis

A study of tournament behavior in US corporate bond funds from 1999 to 2014 following the methodology of Brown, Harlow and Starks (1996).

Alexander Lötvall[1] David Eklund[2]

Abstract: This thesis tests the tournament hypothesis on a data set of corporate bond mutual funds. According to the tournament hypothesis portfolios ranked as "losers" at an interim date will increase portfolio volatility to a greater extent than funds ranked as "winners". Our analysis shows that small investment grade funds exhibit significant tournament behavior. Large investment grade funds exhibit no tournament behavior, either because they have less adverse incentive or because it is more difficult for them to adjust their portfolio volatility. High yield funds exhibit tournament behavior regardless of size and historical performance seems to not significantly impact a manager's decision to adjust volatility. This suggests that investors in high yield funds are more concerned with short-term than long term performance.

Keywords: Tournament behavior, risk shifting, adverse incentives, corporate bond funds

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[1] 22842@student.hhs.se

[2] 22992@student.hhs.se

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1. Introduction

The behavior of mutual fund managers as a response to economic incentives has been of interest in the academic and professional community for a long time. In 2014, 53% of American households were invested in mutual funds. Consequently, the behavior of mutual fund managers have profound impact on the growth and preservation of wealth for millions of Americans. Studies in the area have specifically focused on the adverse incentives of managers in equity funds. However, other mutual fund categories such as bond funds have recently experienced high growth in assets under management.

Brown, Harlow and Starks first introduced the tournament hypothesis in 1996. The hypothesis states that since fund managers are rewarded with a fixed percentage of assets under managements they have an incentive to maximize assets under management rather than risk-adjusted returns. Furthermore, investors use annual performance as an indicator of fund quality and invest disproportionately in the high performing funds. The hypothesis predicts that early year losers increase risk to a greater extent than early year winners in order to be able to compete for future fund flows. Brown, Harlow and Starks found evidence of tournament behavior using the non-parametric model that we follow in this thesis.

This paper further contributes to the field of adverse incentives of mutual fund managers by specifically looking at the tournament behavior of corporate bond fund managers. Chevalier & Ellison (1997) argue that the convex flow-performance incentivizes equity fund managers to shift risk. However, a recent paper by Chen & Qin (2016) finds that mutual bond funds lack this convex relationship. Furthermore, corporate bond funds exhibit different risk and return characteristics than equity funds and therefore likely attract a different clientele. This suggest examining risk shifting behavior among corporate bond funds is of particular interest.

The starting point of the analysis is the null hypothesis that bond fund managers do not alter portfolio volatility depending on cumulative performance at an interim date. The competing hypothesis is that bond fund managers do alter portfolio volatility depending on cumulative performance at an interim date. The prediction of the tournament hypothesis is that the risk adjustment ratios for the interim losers are greater than that of the interim winners. In Figure 1, W (L) denotes a winner (loser). 2 (1) denotes the period in the annual tournament after (before) the interim assessment date.

$$(\sigma_{2L}/\sigma_{1L}) > (\sigma_{2W}/\sigma_{1W}) \quad (1)$$

Two other hypotheses emerge from the characteristics of the funds in our dataset. First, there are reasons to believe that investment grade funds and high yield funds compete in separate tournaments. An A rated corporate bond fund is unlikely to increase risk to catch up to high yield funds in a tournament. Our hypothesis is that high yield funds exhibit stronger tournament behavior as they are seen as a more risky investment vehicle, thus investors require a higher return. Furthermore, it's possible that fund size influence willingness or ability to adjust portfolio risk, as a manager of a large fund who is an interim loser in a yearly tournament might be unable to shift risk because of a specific investor clientele or liquidity reasons. Moreover, a small fund might want to pursue aggressive strategies to grow, while a larger fund might be more concerned to protect assets already under management.

Data is collected from the Center for Research in Security Prices (CRSP) survivor-bias free US mutual fund database over the period 1999-2014. The sample includes 151 investment grade and 81 high yield funds. Funds older than 3 years and assets under management over $10mn are removed from the data set in order to account for incubation bias. Following Brown, Harlow and Starks (1996), funds are denoted as a "winner" or a "loser" each annual tournament based on its gross return ranking at an interim assessment date. Funds are denoted as "risk shifters" or "non-risk shifters" based on its ratio of volatility after the interim assessment date divided by volatility before the interim assessment date. Both the risk adjustment ratio and the return ratio are divided into groups using the median for each annual tournament. Multiple interim assessment dates (M = 4, 5, 6, 7, 8, 9) are evaluated to assess when fund managers tend to alter portfolio volatility. The result is that each funds is allocated into one of four groups each year: losers and non-risk shifters, losers and risk shifters, winners and non-risk shifters, and winners and risk shifters. A 2x2 contingency table is formed and the null-hypothesis is tested with a chi-square test comparing the predicted table with the actual cell frequency table to observe if they have a significantly different distribution. The same test is conducted by ranking the funds gross return using the top and bottom quartile to check if the risk shifting behavior is the same for extreme winners and extreme losers.

Looking at RTN ranked by either median or the top-quartiles we find evidence of risk shifting behavior for Assessment dates M=7, 8, 9. In April, however, we find evidence of anti-tournament behavior where winners risk shift more than losers. It's possible that extreme winners want to catch the opportunity to become one of the best performing funds of the year. As the funds approach the end of the year, the realistic chance of adjusting the yearly ranking

decreases, making it less attractive to gamble for the "extreme winner" funds. When analyzing the influence of cumulative returns on risk adjustment behavior the results indicate that high historical return performance increases the probability of a fund increasing portfolio volatility. This contradicts our prediction. This is likely explained by high yield funds being consistently ranked as historical winners in the RTN ranking. At the same time they might be more prone to shift risk as investors require high returns. This creates a bias which justifies that we repeat the tests with investment grade and high yield funds ranked and analyzed separately.

When looking at high yield funds and investment grade funds separately, we find indications that investment grade and high yield funds exhibit different tournament behavior. High yield funds exhibit the strongest tournament behavior in the end of June while investment grade funds exhibit the strongest tournament behavior in the month of August. High yield funds start to increase volatility earlier in the year to catch up to their competition. This is in line with the notion that high yield funds are more volatile and should be analyzed separately from investment grade funds.

In order to see if our findings are persistent over time, we split our data into shorter non-overlapping time periods by using assessment date M=8 for investment grade funds and M=6 for high yield funds. When split into 4-year periods investment grade funds exhibit insignificant tournament behavior over the sub-periods 1999 – 2002 and 2011 – 2014. High yield funds exhibit different behavior with significant tournament behavior in all sub-periods except for 1999-2002 where we observe significant anti-tournament behavior. We argue that since high yield funds have higher required performance, they experience comparatively stronger employment and compensation incentives resulting in the tests being consistently more significant for high yield funds. A plausible explanation for the anti-tournament behavior observed in 1999-2002 for high yield funds and the insignificant results for investment grade funds is that the bear markets around the burst of the dot-com bubble made the employment incentive relatively stronger for both fund types leading to more anti-tournament like behavior. We expected similar results for 2007-2010 due to the financial crisis following the fall of Lehman Brothers, but neither investment grade nor high yield funds exhibited anti-tournament behavior in this sub period. However, the crisis of 2008 was a credit crunch while 2001 was an equity crisis. The majority of the changes in portfolio volatility in 2008 was due to the systematic increase in risk for all corporate bonds, making it more difficult to analyze how much of the volatility changes was from managers shifting risk.

When analyzing if fund size affects risk shifting behavior, we find that small investment grade funds exhibit consistent and significant tournament behavior in all sub-periods. Large investment grade funds on the other hand exhibit neither significant tournament nor anti-tournament behavior in any of the sub-samples. This is consistent with the notion that small funds have more incentives to aggressively grow assets under management and are less constrained than large funds. For high yield funds it seems like the risk adjustment behavior is not limited by size. However, large high yield funds exhibit more significant results which we find puzzling.

The influence of historical performance remains odd among investment grade funds as high cumulative performance seems to increase the probability of increasing risk. We conclude that it is likely that investment grade funds compete in different volatility sub-samples. The market needs to be segmented further to understand which investment grade funds compete against each other. In contrast, we don't find significant evidence that risk shifting behavior of high yield funds are influenced by historical performance. We argue this is could be because investors in high yield funds are more concerned with short term performance than with long term performance when choosing a fund, chasing recent performance.

The most important implication of our research is that we provide evidence that managers in corporate bond funds are affected by adverse incentives and the competitive structure in the mutual fund industry. Interestingly the behavior of corporate bond fund managers is complex and there is more to learn about tournament behavior in the sector. Specifically it would be interesting to see a more detailed analysis of the influence of historical performance on risk shifting behavior for high yield funds and more detailed analysis of sub-samples for investment grade funds.

2. Background

This paper is based on the tournament hypothesis, originally proposed by Brown, Harlow and Starks in 1996. They analyze the potential agency conflict by viewing fund management as a multi-period, multi-game, yearly tournament between funds. Fund managers are ranked and evaluated based on their yearly return performance and compete over inflow of new investment. Similar to a sports tournament, the payoff for fund managers does not only depend on how well they perform, but also on how well competitors perform. The hypothesis assumes that mutual fund managers earn a fixed percent of assets under management (AUM). The compensation

scheme incentivizes fund managers to maximize the inflow of investments rather than maximizing risk-adjusted returns.

The effect of performance on net flow of investments is well documented. Sirri and Tufano (1992) found that short term and long term past performance affects which funds investors decide to invest in. Furthermore, the relationship is not symmetric as the well performing funds experience higher net inflows than the poor performing funds experience outflows. During the same year, Ippolito (1992) further strengthened the notion that investors use previous poor performance as an indicator of low product quality in the mutual fund industry, and that investors allocate capital disproportionately to funds with recent good performance. Goetzman, Greenwald and Huberman (1992) confirm the relationship between past performance and inflow of new investments by polling investors on their decision criteria. They find that past performance is an important factor that investors take into account when investing in mutual funds. As noted above, several authors have found evidence on how annual performance affect future fund flows, and since net fund flows is linked to assets under management, short term fund performance directly affects the value of the mutual fund as a concern.

According to the tournament hypothesis, fund managers that are ranked as a "loser" at an interim assessment date have higher incentives to increase volatility during the remainder of the year than a fund that ranked as a "winner" at the same interim assessment date. Brown, Harlow and Starks (1996) find an apparent tournament behavior among equity funds, and confirm that the competitive structure of the mutual fund industry provides incentives for fund managers to change their objectives because of recent performance. Brown, Harlow and Starks further confirm the robustness of their model by using a logistic regression that takes into account interim performance ranking, 5 year performance ranking and 3 year performance ranking. The results indicate that annual interim performance as well as cumulative long term performance ranking influence the probability that a fund will increase its volatility in the middle of the year, where 3-year and 5-year losers are more likely to risk shift than the corresponding winners. This is consistent with the findings of Ippolito (1992) who also shows that both short term and long term performance are used in the investor decision making process.

The "Tournament Hypothesis" has been empirically verified in studies by Chevalier and Ellison (1997), Koski and Pontiff (1999) and Li and Tiwari (2005) among others. Chevalier and Ellison use the convex flow-performance relationship, i.e. the asymmetric relationship between fund flows and performance, as an implicit incentive for fund managers to increase or decrease the riskiness of their fund depending on the fund's year-to-date returns. They argue that the convexity of the flow – performance relationship is a key factor for the apparent risk shifting behavior among equity funds. However, the semi-parametric model used by Chevalier & Ellison (1997) shows that the risk-shifting behavior of equity mutual fund managers are more complex than previous literature. According the Chevalier & Ellison (1997) extreme winners will increase risk in order to compete over the extreme fund flows attributed to the absolute top-performing funds that year. Extreme loser are predicted to decrease risk in order to avoid becoming one of the bottom funds during that year and consequently risk negative fund flows. Other research includes Koski and Pontiff (1999), who found results in line with Brown, Harlow and Stark (1996) but found that funds using derivatives for hedging purposes altered risk to a lesser extent. Li and Tiwari (2005) find support for tournament behavior and conclude that mutual fund tournaments can be welfare enhancing when informational costs are moderately high.

Sirri and Tufano (1998) conduct more detailed research on the flow performance relationship. First, they find that consumers invest disproportionately in high performing funds over poor performing funds. They find that consumer's respond negatively to risk adjustment behavior and consequently it leads to negative fund flows. This somewhat offsets the incentive for fund managers to increase risk. Furthermore, the authors find that media coverage has a positive impact on fund flows. They also find that being part of a large fund family decreases the search cost for the investor and therefore positively impacts fund flows.

Further complexities are added by Kempf and Ruenzi (2008). They argue that there are two types of incentives for mutual fund managers. The employment incentive and the compensation incentive. Fund managers have an incentive to keep their employment and they have an incentive to maximize their earnings. Interestingly, these incentives contradict each other. The employment incentive implies that interim losers have incentives to decrease their risk in order to keep their employment. If performance decreases further they face the risk of getting fired. Interim winners however, don't need to be concerned about losing their job and are predicted to not change their portfolio risk. According to the compensation incentive interim

losers are predicted to increase risk in order to compete for future fund flows. Interim winners are predicted to decrease risk in order to protect their gains and secure their positive fund flows. Kempf and Ruenzi conclude that risk adjustment behavior depends on the relative strength of the two incentives. They find that during bull-markets funds exhibit tournament behavior due to the higher relative strength of the compensation incentive. During bear-markets funds exhibit anti-tournament behavior because of the higher relative strength of the employment incentive. Earlier research from Kempf and Ruenzi (2005) also examines the competitive behavior in the mutual fund industry. Specifically they examine tournament behavior within mutual-fund families. They find that the direction of the risk adjustment behavior of a fund depends on the competitive situation in that family. They find that risk shifting behavior is particularly strong in funds with high expense ratios and managed by a single manager, which belong in a large fund family.

Elton et al. (2010) use monthly holding data, in contrast to return data, to examine tournament behavior. They use two methods of measuring risk shifting behavior. The change in the percentage of assets under management invested in cash, as well as the estimated standard deviations of the actual portfolio securities. Following the methodology of Brown, Harlow and Starks (1996) they find that high-return funds increase risk while low-return funds decrease risk. This is inconsistent with the standard tournament model. The results suggest that the benefit of being a top winner in a tournament is much higher than the benefit of being a moderate winner. It also suggests that the cost of being the worst loser is much higher than being a moderate loser. The results are somewhat consistent with Chevalier and Ellison's (1997) model implying an importance of the convex flow-performance relationship in equity funds.

Busse (2001) challenges the methodology of Brown, Harlow and Starks (1996) by looking at both monthly and daily returns. His results were consistent with the tournament hypothesis when using monthly returns, but the effect disappeared when using daily data. He argues this is due to bias in the monthly volatility estimates because of daily return autocorrelation. Goriav, Nijman and Werker revisit the tournament hypothesis in 2005. They use both daily and monthly returns and find, in contrast to Busse (2001), that tests based on monthly returns are more robust to autocorrelation effects than if daily returns were used. However, like Busse (2001) they find little empirical evidence for U.S. equity funds engaging in tournament behavior. Furthermore, the convex relationship used as a key incentive by Chevalier and Ellison has been subject to critique. Spiegel and Zhang (2012) revisit the flow-

performance relationship previously examined by Chevalier and Ellison (1997) and Sirri and Tufano (1998). They find that previous research is erroneous and has yielded false convexity because of the heterogeneous linear response functions. Analyzing fractional flows and controlling for heterogeneity they find no evidence of convexity and show that the flow-performance is linear rather than convex.

Guercio and Tkac (2008) examine the effect of Morningstar ratings on mutual fund flows. They find that an upgrade or a downgrade of the rating has an abnormal effect on fund flows. In contrast to previous literature they find that investors punish poor performance immediately in the month of the rating downgrade. Huang, Sialm and Zhang (2011) investigate the performance consequences of risk shifting. They find that funds that increase risk perform worse than funds that keep stable risk levels over time. The implication of their research is that risk shifting behavior is either a sign of inferior ability or motivated by agency issues. They also find that funds with larger incentives to shift risk are more likely to increase risk and perform particularly poorly after increasing risk. In addition, risk shifting is particularly costly for funds that tend to be more active (e.g. higher active share or higher industry concentration) and that otherwise might be identified as skilled. Therefore, risk shifting is not a necessary consequence when skilled fund managers take advantage of changing investment opportunities. Instead, risk shifting is more likely a signal of ill-motivated trades, either due to inferior ability of fund managers or due to agency issues in delegated money management.

As previously mentioned, extensive research has been conducted for the risk-shifting behavior of equity funds, but corresponding research for bond funds is rare. However, corporate bond funds have recently experienced high growth in assets under management. According to the ICI fact book (2014) corporate bond funds managed about $50 billion in 1990 and have since then grown to manage $1.9 trillion in 2013. This suggests that corporate bond funds grew at a compounded average growth rate (CAGR) of 16% per year while the US mutual fund industry as a whole grew at a CAGR of 12% per year over the same time period.

Fulkerson, Jordan and Riley (2013) aim to increase the understanding of behavior among corporate bond funds. They find that similar to equity funds, fund flows chase past return. However, they don't observe the convex relationship commonly observed for equity funds, which is in line with the findings of Chen & Qin (2016). They also find that gross fund flows in relationship to net fund flows are larger for corporate bond funds with low correlation between inflows and outflows, making it difficult for fund managers to predict future fund

flows. Chen and Qin (2016) document some differences between equity funds and bond funds. First, investors in corporate bond funds are likely to be a different type of clientele than equity fund investors. This is because bonds have different risk and return characteristics from equity. Furthermore, Chen and Qin (2016) examine investor flows in corporate bond funds. They find that, similarly to Fulkerson, Jordan and Riley that investors allocate capital disproportionately to funds with high past performance and unlike the case for equity funds, the flow-performance relationship is not convex for corporate bond funds. Research for equity funds emphasizes the convex flow-performance relationship as an incentive scheme for mutual fund managers to alter their risk during the year to maximize utility in terms of growth in assets under management.

Jostova et al. (2013) find that momentum in corporate bonds is not a manifestation of equity momentum but rather that corporate bond momentum is an effect of other underlying mechanisms. Ellul et al. (2012) find that price pressure is weak in corporate bonds. Furthermore, corporate bond funds are usually actively managed and thereby they should value fund performance in their decision-making in a similar way that equity funds value performance. These differences in characteristics could manifest in a different tournament behavior and risk shifting behavior.

Previous research has found several similarities and discrepancies between bond funds and equity funds. The lack of the convex flow-performance relationship for corporate bond funds as well as other differences in characteristics leads us to believe that risk-shifting behavior could be different for corporate bond funds than for equity funds. Methodologically the analysis follows Brown, Harlow and Starks (1996). The rest of the test is organized as follows: Section 3 describes the data set, section 2 describes the methodology and section 5 describes the empirical findings. Section 5 is split into two parts. 5.1 starts by analyzing tournament behavior among corporate bond funds as a whole. 5.2 analyzes tournament behavior among investment grade and high yield funds separately.

3. Data

The data of corporate bond mutual funds has been collected from the Center for Research in Security prices (CRSP) survivor-bias free US mutual fund database. The database contains information on the funds' net returns after expenses, total net assets (TNA), expense ratio per year, as well as various other fund characteristics. The sample covers monthly data of US corporate bond mutual funds, turnover ratio per year, the date the fund was first offered and

the strategic objective over the period 1999-2014. The sample includes data on both live and defunct funds.

The funds strategic objective code is used to identify funds investing in corporate bond funds. Pure index funds, index based funds and enhanced index funds are excluded from the sample. Funds with a minimum TNA of less than $10 million and observations less than 36 months after the fund was first offered are removed. We remove young and small funds in order to avoid data biases, such as incubation bias (Evans 2010), associated with young and small funds. There is some data on fund holdings (not complete). The funds with reported holdings in the CRSP database and more than 30% of their assets in government bonds and equities combined are excluded. They have different risk exposure from corporate bond funds. Our sample includes 232 corporate bond funds, where 151 funds invest primarily in investment grade bonds while 81 funds invest primarily in high yield bonds with a rating lower than investment grade.

Table 1 summarizes fund characteristics of our sample. The mean Total Net Assets (TNA) is $687 million while the median is $244 million. This suggests that the sample is skewed towards larger funds. The mean (median) age of the fund is 16 (14) years. The expense ratio has an average of 1.03% per year. The average turnover ratio is 135%. Observations with -9900% in turnover are changed to missing as this is likely misreported due to liquidation or similarly, note that the observations for other parameters are kept. High Yield funds have a turnover ratio of 74% Investment Grade funds have a turnover ratio of 171%. This is consistent with the lower liquidity associated with corporate bonds.

Table 3.1: Descriptive statistics, fund characteristics
This table shows the descriptive statistics of fund characteristics for the full sample from 1999 to 2014. TNA is total Net Assets, Age is time since fund inception, Expense ratio is total expenses over TNA, Turnover Ratio is how large fraction of the holdings that have been replaced over a given year.

	Total		High Yield		Investment Grade	
	Mean	Median	Mean	Median	Mean	Median
TNA ($mn)	687	244	842	324	605	211
Age (months)	202	167	170	153	219	176
Expense ratio	1.03%	0.92%	1.17%	1.03%	0.96%	0.86%
Turnover Ratio	135%	80%	74%	65%	171%	113%

The data is divided into annual tournaments. An assumption that follows Brown, Harlow and Stark is that all funds have their perceived quality judged on yearly returns, as it's the most accessible information to investors. We include a fund in the tournament only if it has return data for the entire year. Funds delisted during that year are removed from that specific annual tournament. Table 2, 3 and 4 summarize statistics of yearly tournaments for all funds, high yield funds and investment grade funds respectively. The median return does not vary too much in the sample including all funds, however it is varies widely among high yield funds. Notable outliers are the years 2008 and 2009. The 90th percentile (10th percentile) performance in 2008 was 1.41% (-28.47%) for all funds. In 2009 the equivalent performance was 49.47% (7.62%). The degree of volatility will be important as we will use this to distinguish winners from loser samples in the yearly tournaments. Another interesting observation is that even though the number of funds are declining, the TNA almost doubles, suggesting increasing economies of scale among corporate bond funds.

Table 3.2: Descriptive Statistics, data set

Descriptive statistics of the data set year by year. TNA is the aggregated Total Net Assets for all funds during each year. IG is Investment Grade funds, HY is High Yield funds, Total is the sum of high yield and investment grade funds.

		Number of Funds			Median Return (%)		
Year	TNA ($bn)	Total	IG	HY	Total	IG	HY
1999	88.9	163	117	46	-1.04	-1.82	5.15
2000	86.6	184	128	56	7.98	9.75	-6.68
2001	96.9	205	142	63	7.02	7.51	1.63
2002	104.7	228	152	76	6.66	8.29	-1.15
2003	121.5	227	151	76	6.99	4.90	23.78
2004	122.0	219	147	72	4.80	4.25	9.73
2005	108.1	199	129	70	2.06	1.94	2.37
2006	110.9	181	118	63	4.61	4.04	9.75
2007	111.9	173	112	61	4.01	4.98	2.03
2008	81.4	157	99	58	-12.00	-7.15	-24.31
2009	116.5	151	93	58	22.86	12.66	43.92
2010	134.0	146	88	58	10.76	8.07	13.79
2011	146.6	137	82	55	5.13	6.05	3.35
2012	170.1	131	79	52	10.73	8.63	14.48
2013	151.0	124	74	50	0.407	-0.55	6.39
2014	153.0	124	74	50	4.94	5.80	1.97

4. Methodology

The paper examines the traditional tournament hypothesis for corporate bond funds following the methodology of Brown, Harlow and Starks (1996). The analysis tests whether funds classified as relative losers at an interim assessment date increase portfolio risk to a greater extent than funds classified as relative winners at the same interim assessment date. An interim loser is represented by the subscript L and a winner is represented by a subscript W. Portfolio risk is measured as the standard deviation of returns for the fund. The portfolio risk levels in the first and second interim periods are denoted by σ_1 and σ_2 respectively. The central prediction in the traditional tournament hypothesis and in the following analysis is seen in equation (1). The risk adjustment ratios for the interim losers are predicted to be greater than that of the interim winners.

$$(\sigma_{2L}/\sigma_{1L}) > (\sigma_{2W}/\sigma_{1W}) \quad (1)$$

The analysis starts with all funds and looks at different interim assessment dates for each annual tournament. The end of April (M=4.8), May (M=5.7), June (M=6.6), July (M=7.5), and August (M=8.4) are examined as different interim assessment dates. By analyzing a variety of interim assessment dates it is possible to understand which month's managers tend to change the riskiness of their portfolio in, as a response to the year-to-date returns.

The first variable relevant to the analysis is a return ranking (*RTN*). Subgroups of interim winners and losers are created for each of the interim assessment date and each of the 16 annual tournaments. The subgroups are created based on a fund's relative return performance between January and month *M*. For each fund *j* and year *y*, we calculate the *M*-month cumulative return as follows in equation (2) where r_j is the monthly return for the fund as reported in the CRSP database. After calculating a different set of *RTN* for each tournament year and interim assessment date the funds are ranked from highest to lowest in each sub tournament. The funds are classified as winner or loser based on the ranking. The funds are characterized as a winner if they have a higher return at the assessment date than the median RTN value. The funds are characterized as a loser if they have a lower return than the median RTN value. If a fund is the median in a specific annual tournament, we delete the fund from that specific tournament. The classification is also done using the upper quartile in the ranking for winners and the lower quartile in the rankings for losers. Using the median has the advantage of allowing more funds,

and thus observations, in the analysis, but the winner loser distinction becomes weak close to the median. The quartile based ranking identifies "extreme" winners and losers better but only uses half of the available data.

The second variable used to test the hypothesis that winners and losers make different adjustments to the risk in their portfolio is the risk adjustment ratio (*RAR*). This is a ratio of the volatility after the interim assessment date (January - M) divided by the volatility before the interim assessment date (M + 1 – December).

$$RAR_{jy} = \sqrt{\frac{\sum_{m=M+1}^{12}(r_{jmy} - \bar{r}_{j(12-M)y})^2}{(12-M)-1}} \Bigg/ \sqrt{\frac{\sum_{m=1}^{M}(r_{jmy} - \bar{r}_{jMy})^2}{M-1}} \qquad (2)$$

If the *RAR* > 1 it indicates that the volatility of the funds' returns increased after the interim assessment date in that specific tournament. If the *RAR* < 1 it indicates that the volatility of the funds' returns decreased after the interim assessment date in that specific tournament. Similarly to *RTN*, the funds are grouped into two groups for each sub tournament. If RAR_{jMy} is higher than the median RAR_{My} the fund is denoted as having a "high risk adjustment ratio" in that sub tournament. If RAR_{jMy} is lower than the median RAR_{My} the fund is denoted as having a "low risk adjustment ratio" in that sub tournament.

The funds are now denoted as a winner/loser and high/low risk adjustment ratio for each of the annual tournaments. Following Brown, Harlow and Starks (1996) we form a 2x2 contingency table for all funds and each assessment date. If the null-hypothesis holds true the percentage of the sample population in each cell is equal at 25%. The prediction of the tournament hypothesis is that the low RTN/high RAR and the high RTN/low RAR cells have larger frequencies than the other two outcomes. If the high RTN/high RAR and the low RTN/low RAR cells have higher frequencies this indicates anti-tournament behavior. The null-hypothesis is tested with a chi-square test comparing the predicted table with the actual cell frequency table to observe if they have a significantly different distribution.

5. Empirical results

In order to make the analysis of our empirical findings easy to follow, we split them up into two chapters: 5.1 shows and discusses our finding when we rank investment grade funds and high yield funds together, and 5.2 shows and discusses our finding when we analyze the sub-tournaments where high yield funds and investment grade funds are ranked separately.

5.1. Whole sample, investment grade and high yield funds together

5.1.1. Risk adjustment behavior in the whole sample period

For the purpose of investigating if corporate bond fund managers engage in tournament behavior, we start by looking at the whole sample of funds, i.e. both investment grade funds and high yield funds together. The result is illustrated in Table 5.1.1. Separate contingency tables are calculated for all 12 combinations of performance assessment month M=4, 5, 6, 7, 8 and 9 with median and quartile rankings for of the RTN variable. The null hypothesis of the test is that the frequency is equal in each cell (i.e. 25% of the sample in each cell). When interpreting the results, it should be kept in mind that rejecting the null hypothesis of equal frequency among four cells does not necessarily imply tournament behavior. If the high RTN and high RAR have higher fractions than high RTN and low RAR, this would indicate anti-tournament behavior. Panel A of Table 5.1.1 lists results for winners and losers categorized by median value for the *RTN* variable. Panel B reports the results for winners and losers categorized by the quartile for the *RTN* values. Thereby, Panel B includes only the "extreme winners" and "extreme losers" while Panel A makes use of all available data.

Panel A illustrates that every interim assessment month from June through September exhibits tournament behavior at test statistics that are significant at the 99% confidence level. The month of August as the assessment period exhibits the strongest tournament behavior with a χ^2 statistica of 160, followed by July with χ^2 statistica of 112. The findings suggest that fund managers revise their short term investment strategies the months surrounding the release of the second quarter performance rankings. The result is consistent with the notion that fund managers adjust their investment strategy during the month following the second quarter, as the half year performance is usually reported by financial press and information services.

Panel B shows a less consistent result. Similar as for Panel A, we observe a risk-shifting behavior for July, August and September. However, the result for April is puzzling, showing an anti-tournament behavior with a χ^2 statistica of 48.925. Extreme winners appears to risk-shift

more than extreme losers during an early stage of the year. We believe a plausible explanation is that the early year extreme winners might want to catch the opportunity to become one of the best performing funds for the year by making high risk bets. As one of the leading funds, the managers don't need to worry about employment, resulting in a small downside if the return decreases. As the end of the year gets closer, the realistic chance to gain better ranking decreases, leading to smaller incentives to gamble for the winners.

Table 5.1.1: Frequency Distributions of a 2 x 2 Classification of the Risk Adjustment Ratio (RAR) and Winner/loser Variables

Measured on all funds for the time period 1999-2014 with assessment period M=4, 5, 6, 7, 8, 9. Assessment period is defined as number of month of the assessment period and number of months that is left of the year, e.g. (4.8) is the assessment period January to April, and rest of the year is May to December. RTN is defined as the gross return of the assessment period, where winners have RTN above the median, and losers have RTN below the median. RAR is defined as the ratio of standard deviation of the rest of the year over the standard deviation of assessment period for each fund, where High "RAR" is funds with RAR above the median and Low "RAR" is fund with RAR below the median. When ranked by quartile, high RTN is the top quartile of gross returns for assessment period, and low RTN is the bottom quartile of gross returns for assessment period. RAR is divided by median for the funds in the top and bottom quartile. The χ^2 statistics is based on the null hypothesis that the distribution is equal.

Sample frequency as percent of observations

		Low RTN ("Losers")		High RTN ("Winners")			
Assessment Period	Observations	Low "RAR"	High "RAR"	Low "RAR"	High "RAR"	χ^2	p-value
Panel A: Winners/Losers ranked by median							
		All Funds					
(4.8)	2738	25.46%	24.54%	24.54%	25.46%	0.913	0.339
(5.7)		24.80%	25.20%	25.20%	24.80%	0.177	0.674
(6.6)		24.76%	25.24%	25.24%	24.76%	0.247	0.619
(7.5)		19.94%	30.06%	30.06%	19.94%	112.095	0.000
(8.4)		18.96%	31.04%	31.04%	18.96%	160.060	0.000
(9.3)		20.60%	29.40%	29.40%	20.0%	84.852	0.000
Panel B: Winners/Losers ranked by quartile							
		All Funds					
(4.8)	1362	32.31%	17.69%	17.39%	32.31%	48.925	0.000
(5.7)	1362	25.62%	24.38%	24.38%	25.62%	0.849	0.357
(6.6)	1344	24.55%	25.45%	25.45%	24.55%	0.429	0.513
(7.5)	1344	17.34%	32.66%	32.66%	17.34%	126.976	0.000
(8.4)	1344	16.74%	33.26%	33.26%	16.74%	146.976	0.000
(9.3)	1362	18.80%	31.20%	31.20%	18.80%	83.880	0.000

5.1.2. Temporal dynamics of risk adjustment behavior

The findings in the previous section provide support for the tournament hypothesis among corporate bond funds. Losers increase portfolio risk to a greater extent than winners around the release of the second quarter results.

The results were especially strong with the month of August as the assessment date. Although the results are significant, they are not necessarily pervasive. In table 5.1.2 we conduct an experimental design where we use *RTN* winners and losers defined by median and August as the assessment month. The experiment is similar as for the one illustrated in 5.1.1. However, the result is split into two eight-year sub periods (1999-2006, 2007-2014) and four four-year sub-periods (1999-2002, 2003-2006, 2007-2010, 2011-2014). As illustrated in table 5.1.2, risk-shifting behavior is consistent for all sub-periods except for 1999-2002. We believe this might be explained by the burst of the dot-com bubble during 2001. The bear markets during that period increased the employment incentive relative to compensation incentive. However, a similar result is not observed during the financial crisis. We believe this might be due to that the crisis of 2001 was an equity crisis, while the crisis of 2008 was a credit crisis. The volatility of 2008 was because of a sharp increase in credit risk, meaning that most volatility experienced by corporate bond funds was systematic.

Table 5.1.2: Frequency Distributions of a 2 x 2 Classification of the Risk Adjustment Ratio (RAR) and Winner/loser Variables, divided into sub-periods

Measured on all funds for the time period 1999-2014, 1999-2006, 2007-2014, 1999-2002, 2003-2006, 2007-2010 and 2011-2014 with assessment period M=8. Assessment period is defined as number of month of the assessment period starting in January and number of months that is left of the year, e.g. (4.8) is the assessment period January to April, and rest of the year is May to December. RTN is defined as the gross return of the assessment period, where winners have RTN above the median, and losers have RTN below the median. RAR is defined as the ratio of standard deviation of the rest of the year over the standard deviation of assessment period for each fund, where High "RAR" is funds with RAR above the median and Low "RAR" is fund with RAR below the median. The χ^2 statistics is based on the null hypothesis that the distribution is equal.

Sample frequency as percent of observations (M=8)

		Low RTN ("Losers")		High RTN ("Winners")			
Sample Period	Observations	Low "RAR"	High "RAR"	Low "RAR"	High "RAR"	χ^2	p-value
Panel A: Time Period 1999-2014							
99-14	2,738	18.96	31.04	31.04	18.96	160.06	0.000
Panel B: Split into non-overlapping 8-year periods							
99-06	1,600	19.94	30.06	30.06	19.94	65.61	0.000
07-14	1,138	17.57	32.42	32.43	17.57	100.39	0.000
Panel C: Split into non-overlapping 4-year periods							
99-02	778	24.16	25.84	25.84	24.16	0.87	0.3051
03-06	822	15.94	34.06	34.06	15.94	108.03	0.000
07-10	624	18.27	31.73	31.73	18.27	45.23	0.000
11-14	514	16.73	33.27	33.27	16.73	56.23	0.000

5.1.3 Fund size and risk adjustment behavior

Another hypothesis that we test is whether managers in smaller funds have more incentives to change volatility than larger funds. They could also be less constrained by market forces from taking action to change their portfolio volatility. This is tested by segmenting the 232 corporate bond funds into large and small funds using the median of total net assets. Following Brown, Harlow and Starks (1996), the results are divided into two eight-year sub-periods to analyze the temporal dynamics. We find significant signs of risk-shifting behavior for large as well as small funds. Table 5.1.3 can be found in the appendix.

5.1.4 The influence of cumulative performance

The analysis has up to this point assumed that investors make decisions solely based on last year performance. However, previous research indicates that this is a too simplistic view. As discussed in the literature review both year-to-date performance as well as performance in previous years adds explanation-value new for risk shifting behavior. Brown, Harlow and Starks extend this research to the tournament hypothesis. It is possible that a manager's performance in previous years affects the tendency to adjust volatility at the interim date of a current tournament. Brown, Harlow and Starks (1996) found that cumulative performance as well as interim performance had a positive impact on risk-shifting behavior. We start by defining cumulative return performance for the j-th fund at the interim assessment date in year y as:

$$CUMRTN_{jy} = \prod_{t=y-q}^{y-n} \left[\left[\prod_{m=1}^{12} (1 + r_{jmt}) \right] \right] \quad (3)$$

Subscript t represents the number of years prior to the current tournament that are being used in the ranking. In the industry the standard historical performance measures are the 3- and 5- year relative performance. Consistent with this practice, we calculate the cumulative return for both two years and four years before the current tournament. Cumulative return is ranked and translated into binary variables, where a winner (cumulative return for 2 or 4 years is above median) are denoted 1 and losers are denoted 0. The statistics are then subsequently used in

logistic regressions that predicts the probability that a fund will adjust its risk following an interim assessment date. We specify a dependent binary variable with the value of 1 if fund j's volatility ratio is below the median level and 0 if it is above the median level. The results of the logistic regressions are summarized in table 5.1.4

Table 5.1.4 should be interpreted as follows. The estimated odds ratio (relative increase in probability of a fund not increasing its volatility ratio due to being an interim winner) can be recovered from the logit procedure with the function $p = e^z - 1$, where z represents the independent variables. Looking at the first logistic regression the probability of an interim loser not increasing risk is 168% higher than for an interim loser. This is a strong evidence against our null-hypothesis. The probability of a 2-year winner not increasing its risk is 20% lower than for an interim loser. Finally, the probability of a 4-year loser increasing its risk is 30% lower than for an interim loser.

The results indicate that both interim return rankings and historical return rankings influence the risk-shifting with high significance. The results are quite puzzling however. Specifically the predicted direction was that high historical return performance would decrease the probability of a fund increasing its volatility mid-year. What we are seeing in the results is that high historical return performance increases the probability of a fund increasing its volatility. The effect is especially strong for the 4 year performance ranking, it is significant at a confidence level of 99%. The effect for the 2 year performance ranking is significant at a 95% confidence level. Our hypothesis is that high yield funds consistently are ranked as winners in the RTN ranking. At the same time they might be more prone to shift risk as investors require higher returns. This would explain why high historical performance would lead more risk shifting behavior as high yield funds consistently have high RAR and high RTN rankings. It is important to note that this indicates that our tests are not robust. High yield and investment grade funds are not likely to compete against each other. Therefore, we now split up the analysis between investment grade funds and high yield funds to see if they compete internally.

Table 5.1.4: Logistic regression of 2 and 4 year cumulative performance, interim performance and risk shifting behavior for all funds

DVOLRAT = f(Interim Annual Return, 2-year Cumulative Return, 4-year Cumulative Return)

DVOLRAT is defined as a binary variable assuming the value of 1 if a fund's volatility ratio is below the median in annual tournament, 0 otherwise. Cumulative 2 year performance measure is defined as the cumulative return for the two previous years expressed as a dummy variable where 1 is a winner, i.e. the cumulative performance is above the median, 0 otherwise. Cumulative 4 year performance is measured similarly but for the cumulative performance of the previous 4 years. The Coefficients should be interpreted as if the other variables remain fixed, the chance of a fund will increase risk is equal to exp(coefficient) - 1. The χ^2 statistics is based on the null hypothesis that the distribution is equal.

Logistic Regression for all funds (M=8)					
No. of Obs.	Intercept	Interim Perform. Measure	Cum. 2-yr Perform. Measure	Cum. 4-yr Perform. Measure	χ^2
Binary Variables					
2738	-0.493 (0.000)	0.987 (0.000)			161.66
2505	-0.362 (0.000)	0.948 (0.000)	-0.204 (0.013)		139.33
2045	-0.358 (0.000)	1.057 (0.000)		-0.357 (0.000)	156.67

**p-values for the coefficients are illustrated in brackets*

5.2 Sub-samples, investment grade and high yield fund separately

5.2.1 Risk adjustment behavior in the whole sample period

Up until this point, all corporate bond funds have been analyzed together. In this part of the analysis the dataset is segmented into two separate subgroups so that investment grade and high yield funds can be analyzed separately. In order to save space, the test for investment grade and high yield funds are presented in the same table. However, we want to emphasize that the tests are conducted separately. The *RTN* and *RAR* rankings are recalculated independently in the subgroups. This step of the analysis examines if investment grade and high yield funds differ in their risk shifting behavior. It is plausible that the behavior in the subgroups is different as investors in high yield funds have other expectations on volatility and returns than for investors in investment grade funds. An A rated corporate bond fund is unlikely to increase risk to catch up to high yield funds in a tournament, and it is interesting to examine if investment grade funds and high yield funds compete internally in their own subgroup.

Separate contingency tables are calculated for high yield funds and investment grade funds. 24 combinations of contingency tables are formed in total for performance assessment month M=4, 5, 6, 7, 8 and 9; median and quartile rankings for the RTN variable and for investment grade and high yield funds separately. Again, it should be kept in mind that

rejecting the null hypothesis does not necessarily imply tournament behavior but can imply anti-tournament behavior. If the high RTN/high RAR and the low RTN/low RAR cells have higher frequencies this indicates anti-tournament behavior. Panel A and B illustrate the results for investment grade funds. Panel C and D illustrate the results for high yield funds. For panel A and C winners and losers are categorized using the median value of RTN. For panel B and D winners and losers are categorized using the top and bottom quartile values of RTN.

First, we look at the results for investment grade funds in Panel A, where we identify tournament behavior in June, July and August at a 99% confidence level. Investment grade funds also exhibit tournament behavior in May at a confidence level of 95%. The findings suggest that investment grade funds, viewed separately, compete against each other in annual tournaments and adjust their risk around the release of the second quarter performance rankings. Panel B exhibits similar results for the months of July and August, with tournament behavior being present at a confidence interval of 95%. However, there is no significant tournament behavior in the month of June when using quartile rankings of RTN.

Table 5.2.1: Frequency Distributions of a 2 x 2 Classification of the Risk Adjustment Ratio (RAR) and Winner/loser Variables tested on investment grade funds and high yield funds separately
Measured on investment grade and high yield funds separately of each other for the time period 1999-2014 with assessment period M=4, 5, 6, 7, 8. Assessment period is defined as number of month of the assessment period starting in January and number of months that is left of the year, e.g. (4.8) is the assessment period January to April, and rest of the year is May to December. RTN is defined as the gross return of the assessment period, where winners have RTN above the median, and losers have RTN below the median. RAR is defined as the ratio of standard deviation of the rest of the year over the standard deviation of assessment period for each fund, where High RAR is funds with RAR above the median and Low RAR is fund with RAR below the median. When ranked by quartile, high RTN is the top quartile of gross returns for assessment period, and low RTN is the bottom quartile of gross returns for assessment period. RAR is divided by median for the funds in the top and bottom quartile of gross return. The χ^2 statistics is based on the null hypothesis that the distribution is equal.

Sample frequency as percent of observations for investment grade funds

		Low RTN ("Losers")		High RTN ("Winners")			
Assessment Period	Observations	Low "RAR"	High "RAR"	Low "RAR"	High "RAR"	χ^2	p-value
Panel A: Winners/Losers ranked by median							
		Investment Grade Funds					
(4.8)	1778	25.93	24.07	24.07	25.93%	2.4550	0.118
(5.7)		23.73	26.27	26.27	23.73%	4.556	0.033
(6.6)		23.45	26.55	26.55	23.45%	6.805	0.009
(7.5)		23.23	26.77	26.77	23.23%	8.929	0.003
(8.4)		23.12	26.88	26.88	23.12%	10.099	0.001
Panel B: Winners/Losers ranked by quartile							
		Investment Grade Funds					
(4.8)	880	25.57	24.43	24.43	25.57	0.455	0.500
(5.7)		25.34	24.66	24.66	25.34	0.164	0.686
(6.6)		23.86	26.14	26.14	23.86	0.818	0.178
(7.5)		23.07	26.93	26.93	23.07	5.255	0.022
(8.4)		22.95	26.05	27.05	11.95	5.8909	0.015

Sample Frequencies as percent of observations for high yield funds

Assessment Period	Observations	Low "RAR"	High "RAR"	Low "RAR"	High "RAR"	χ^2	p-value
Panel C: Winners/Losers ranked by median							
		High Yield Fund					
(4.8)	960	23.44	26.56	26.56%	23.44	3.750	0.053
(5.7)		23.33	26.67	26.67%	23.33	4.267	0.039
(6.6)		21.56	28.44	28.55%	21.56	18.150	0.000
(7.5)		24.90	25.10	25.10%	24.90	0.017	0.897
(8.4)		26.25	23.75	23.75%	26.25	2.400	0.121
Panel D: Winners/Losers ranked by quartile							
		High Yield Fund					
(4.8)	470	23.38	26.17	26.17	23.38	1.030	0.310
(5.7)		23.19	26.81	26.81	23.19	2.758	0.097
(6.6)		21.06	28.94	28.94	21.06	11.651	0.001
(7.5)		23.62	26.38	26.38	23.62	1.438	0.230
(8.4)		25.53	24.47	24.47	25.53	0.213	0.645

Looking at the results for high yield funds in Panel C we see tournament behavior in the month of June at a 99% confidence level and in the month of May at a 95% confidence level. Interestingly, high yield funds exhibit no sign of tournament behavior in July and August. In July the results are insignificant with a p-value of 0.897 and in the month of August the results indicate anti-tournament behavior. However the results in August are insignificant with a p-value of 0.121. Panel D still exhibits strong tournament behavior in the month of June at a 99% confidence interval. The results for the month of May are insignificant.

The results indicate that both high yield and investment grade funds exhibit tournament behavior when analyzed in sub tournaments. However, they seem to exhibit different tournament behavior. Investment grade funds exhibit the most significant tournament behavior around the month of August while high yield funds exhibit the strongest tournament behavior around the month of June. This implies that high yield funds start to increase volatility to catch up to their competition earlier in the year than investment grade funds. This is in line with the notion that high yield funds are a more volatile asset class. Investors are likely to care more about relative performance when investing in high yield funds, thereby mutual fund managers adjust their volatility earlier in the year.

5.2.2 Temporal Dynamics of risk adjustment behavior

Like the case for all funds, we want to analyze the temporal dynamics of tournament behavior for investment grade and high yield funds separately. Although the results show significant tournament behavior for both investment grade and high yield funds the results are not necessarily pervasive in all time periods. For investment grade funds August exhibited the most significant tournament behavior and for high yield funds June exhibited to most significant tournament behavior, so these months are used as assessment date when analyzing the temporal dynamics. Table 5.2.2 Panel A exhibits the experimental results for investment grade funds where we use RTN classified by median and the month August as the assessment month. Panel B shows the results for high yield funds were we use RTN classified by median and the month of June as the assessment month. Notice that the assessment month differs in the two tests as we saw in the previous analysis that investment grade and high yield funds exhibit the most significant tournament behavior in different times at the year. Cell frequencies are listed in Table 5.2.2 for several temporal sample partitions.

Table 5.2.2: Frequency Distributions of a 2 x 2 Classification of the Risk Adjustment Ratio (RAR) and Winner/loser Variables, 1999-2014 for investment grade funds and high yield funds ranked independently, divided into time sub-periods

Measured on investment grade and high yield funds separately for the time period 1999-2014 and sub-periods 1999-2006, 2007-2014, 1999-2003, 2004-2006, 2007-2010 and 2011-2014 with assessment period M=8 for investment-grade funds and M=6 for high yield funds. Assessment period is defined as number of month of the assessment period starting in January and number of months that is left of the year, e.g. (4.8) is the assessment period January to April, and rest of the year is May to December. RTN is defined as the gross return of the assessment period, where winners have RTN above the median, and losers have RTN below the median. RAR is defined as the ratio of standard deviation of the rest of the year over the standard deviation of assessment period for each fund, where High "RAR" is funds with RAR above the median and Low "RAR" is fund with RAR below the median. The χ^2 statistics is based on the null hypothesis that the distribution is equal.

Sample frequency as percent of observations for investment grade funds (M=8)

		Low RTN ("Losers")		High RTN ("Winners")			
Sample Period	Observations	Low "RAR"	High "RAR"	Low "RAR"	High "RAR"	χ^2	p-value
Panel A: Whole Sample							
99-14	1778	23.12	26.88%	26.88%	23.12%	10.099	0.001
Panel B: Eight-Year Period							
99-06	1080	22.96	27.04%	27.04%	22.96%	7.14	0.007
07-14	698	23.35	26.65%	26.65%	23.35%	3.0315	0.082
Panel B: Four-Year Period							
99-02	538	24.16	25.84%	25.84%	24.16%	0.60	0.438
03-06	542	21.77	28.23%	28.23%	21.77%	9.04	0.003
07-10	390	20.26	29.74%	29.74%	20.26%	14.041	0.000
11-14	308	27.27	22.73%	22.73%	27.27%	2.545	0.111

Sample frequency as percent of observations for high yield funds (M=6)

Sample Period	Observations	Low "RAR"	High "RAR"	Low "RAR"	High "RAR"	χ^2	p-value
Panel D: Whole Sample							
99-14	960	21.56	28.44	28.55	21.56	18.150	0.000
Panel E: Eight-Year Period							
99-06	520	24.81	25.19	25.19	24.81	0.03	0.861
07-14	440	17.73	32.27	32.27	17.73	37.24	0.000
Panel F: Four-Year Period							
99-02	240	32.08	17.92	17.92	32.08	19.27	0.000
03-06	280	18.57	31.43	31.43	18.57	18.51	0.000
07-10	234	17.95	32.05	32.05	17.95	18.61	0.000
11-14	206	17.48	32.52	32.52	17.48	18.66	0.000

First, we look at investment grade funds where we can establish that the result are not pervasive for all time periods. While tournament behavior is significant over the full sample time period, it is insignificant when split into the sub-periods 1999-2002, 2007-2014 and 2011-2014. For high yield funds, different results are observed. Similar as to investment grade funds,

tournament behavior is significant over the full sample time period. However, during the period 1999-2002, a very significant anti-tournament behavior is observed.

The behavior for high yield funds in 1999- 2002 is in line with the employment incentive introduced by Kempf and Ruenzi, where losers have incentives to decrease risk in order to protect employment due to the bear markets arising from the burst of the dot-com bubble. Since high yield funds have higher volatility, it's intuitive to assume that risk adjustment behavior is stronger for high yield funds than for investment grade funds. This is indicated by our findings as high yield funds have higher χ^2 in all four-year time periods. Furthermore, notice that no risk shifting behavior is observed for 1999-2006. This is due to the anti-tournament behavior of 1999-2002 and tournament behavior of 2003-2006 cancelling each other out.

Comparing investment grade and high yield funds the latter exhibit stronger and more consistent risk adjustment behavior, in spite of the deviation during the 1999 - 2002 sample time period. We find it likely that high yield funds have higher expectations on performance than investment grade funds as they are considered a more volatile investment that should yield higher returns. Both the employment incentive and the compensation incentive are thereby likely stronger for high yield funds than for investment grade funds. This would result in more extreme risk adjustment behavior for high yield funds, which is exactly what we observe in our results. When split into four- year periods risk adjustment behavior is significant for high yield funds at a p-value of 0.000 for all sub-time periods. For investment grade funds the results are less consistent and the p-value is only 0.000 for one sub-time period. These results suggest that high yield funds have stronger incentives to adjust risk than investment grade funds.

5.2.3 Fund size and risk adjustment behavior

Several authors have found that large funds are less likely to engage in risk-shifting behavior than small funds.[3] We didn't find any significantly differing behavior between large and small funds when we analyzed all funds together. However, there might be a size effect when we analyze investment grade and high yield funds ranked separately. We conduct the same tests again to analyze weather managers in smaller funds have more incentives to change volatility than managers in larger funds. They could either have more incentives or they could be less constrained by market forces from taking action to change their portfolio volatility. This is tested by segmenting the funds into large and small funds using the median of total net assets.

[3] Chevalier & Ellison: Brown, Harlow and Starks among others

The sample is split into large and small funds and into two sub-periods, 1999-2006 and 2007-2014, to check if the result is persistent. The analysis is done separately for investment grade and high yield funds. Notice that the line denoted as "Total" is not a test, but rather to show that the *RTN* and *RAR* variables are ranked for large and small together. Thereby resulting in symmetric frequencies for the "total"-line. They do not equate to the corresponding tests in table 5.1.2 as the median sized fund has been excluded.

Looking at Table 5.2.3 in Panel A we see that small investment grade funds exhibit tournament behavior at a confidence level of 99%. However, for large funds we cannot reject the null hypothesis they do not adjust their risk following the August assessment period. Splitting the time period into two eight-year periods we see similar results. In both panel B and C we see small funds exhibiting significant tournament behavior at a 95% confidence level. Large funds exhibit neither significant tournament nor anti-tournament behavior in any of the sub-periods. As previously mentioned the results can be either because smaller funds have stronger incentives to grow their assets under management or it is simply easier for them to adjust their portfolios due to their smaller size. Nevertheless, the results are interesting and they show that small investment grade funds have a significant propensity to engage in tournament behavior.

High yield funds on the other hand seem to exhibit a different behavior. For each sub-period, the risk-shifting behavior for large funds is more significant than for small funds. When looking at the 1999-2006 sample time-period we observe no significant risk adjustment behavior. This is aligned with the results in table 5.2.2 where we observe significant anti-tournament behavior in 1999-2002 and significant tournament behavior in 2003 - 2006 which cancel each other out in the 1999 – 2006 sample time period. However, when looking at the 2007 – 2014 sample time period we observe significant tournament behavior for high yield funds, both large and small. High yield funds are not limited by size and they have incentives to engage in tournament behavior regardless of their size. This is not surprising as high yield funds are a more volatile asset class. However, we find it odd that large high yield funds seem to exhibit more significant tournament behavior than small funds. We are not sure about the reasons for this behavior, and it would be an interesting area to research further.

Table 5.2.3: Frequency Distributions of a 2 x 2 Classification of the Risk Adjustment Ratio (RAR) and Winner/loser Variables for investment grade funds and high yield funds ranked separately, divided by large and small size

Measured for investment grade funds and high yield funds separately and independently for the time period 1999-2014, 1999-2006, 2007-2014 with assessment period M=6 for investment grade funds and M=8 for high yield funds. Assessment period is defined as number of month of the assessment period and number of months that is left of the year, e.g. (4.8) is the assessment period January to April, and rest of the year is May to December. RTN is defined as the gross return of the assessment period, where winners have RTN above the median, and losers have RTN below the median. RAR is defined as the ratio of standard deviation of the rest of the year over the standard deviation of assessment period for each fund, where High "RAR" is funds with RAR above the median and Low "RAR" is fund with RAR below the median. Size is split by median in Total Net Assets (TNA), where Large are firms larger than median and small are firms smaller than median. The χ^2 statistics is based on the null hypothesis that the distribution is equal.

Sample frequency as percent of observation for investment grade funds (M=8)

			Low RTN ("Losers")		High RTN ("Winners")			
Sample Period	Size	Observations	Low "RAR"	High "RAR"	Low "RAR"	High "RAR"	χ^2	p-value
Panel A: Whole Sample								
99-14	Large	886	22.57	24.04	28.10	25.28	1.568	0.210
99-14	Small	886	23.59	29.80	25.73	20.88	10.712	0.001
99-14	Total		23.58	26.92	26.92	23.58		
Panel B: Limited time period, 99-06								
99-06	Large	537	21.42	23.84	29.61	25.14	2.430	0.119
99-06	Small	537	24.39	30.35	24.58	20.67	5.075	0.024
99-06	Total		22.91	27.09	27.09	22.91		
Panel C: Limited time period, 07-14								
07-14	Large	349	24.36	24.36	25.79	25.50	0.003	0.958
07-14	Small	349	22.35	28.94	27.51	21.20	5.800	0.016
07-14	Total		23.35	26.65	26.65	23.35		

Sample frequency as percent of observation for high yield funds (M=6)

			Low RTN ("Losers")		High RTN ("Winners")			
Sample Period	Size	Observations	Low "RAR"	High "RAR"	Low "RAR"	High "RAR"	χ^2	p-value
Panel D: Whole Sample								
99-14	Large	476	16.60	27.73	32.35	23.32	20.089	0.000
99-14	Small	476	26.05	29.62	25.00	19.33	4.337	0.037
99-14	Total		21.32	28.68	28.68	21.32		
Panel E: Limited time period, 99-06								
99-06	Large	256	18.36	23.44	30.86	27.34	2.061	0.151
99-06	Small	256	30.47	27.73	20.31	21.48	0.351	0.554
99-06	Total		24.41	25.59	25.59	24.41		
Panel F: Limited time period, 07-14								
07-14	Large	220	14.55	32.73	34.09	18.64	25.205	0.000
07-14	Small	220	20.91	31.82	30.45	16.82	13.466	0.000
07-14	Total		17.73	32.27	32.27	17.73		

5.2.4 The influence of cumulative performance

As with all funds, we evaluate if historical performance together with year-to-date performance effect risk adjustment behavior. The logistic regression from chapter 5.1.4 is conducted for investment grade funds and high yield funds separately. Subsequently, table 5.2.4 should be interpreted as table 5.1.4. The estimated odds ratio (relative increase in probability of a fund not increasing its volatility ratio due to being an interim winner) can be recovered from the logit procedure with the function $p = e^z - 1$, where z represents the independent variables. Looking at the logistic regression for investment grade funds; an interim "loser" has a 53% probability to increase risk while an interim winner has a 46% probability to increase risk. This is strong evidence against the null hypothesis and goes in line with our prediction that "losers" tend to increase volatility to a larger extent than "winners". Historical performance seems to influence the tendency to increase risk in a way contradictory to our prediction. A 2-year winner is 20% more likely to increase risk than a two-year loser. Four-year winners are 36% more likely to increase risk than four-year losers. The results are significant at a 99% confidence level, however it should be taken into account that the effect of interim performance is still much stronger than for the historical performance coefficients. Separate logistic regression for small and large investment grade funds did not provide additional explanatory value. They can thereby be found in the appendix. We argue that the unintuitive effect of historical performance is because all investment grade funds don't compete against each other. Rather investment grade funds could compete in separate volatility sub tournaments. To better understand tournament behavior among investment grade we suggest future researchers segment the market further.

Looking at the logistic regression for high yield funds, an interim "loser" has a 57% probability to increase risk while an interim winner has a 43% probability to increase risk. This is strong evidence against the null hypothesis and goes in line with our prediction that "losers" tend to increase volatility to a larger extent than "winners". While the two and four year results seem to indicate that historic performance has an inverse relation with risk adjustment behavior the findings are not significant with respective p-values of 0.364 and 0.664. We cannot conclude that historic performance has an effect on risk adjustment behavior in an interim period for high yield funds. The results suggest that investors in high yield funds are more concerned with short term than long term performance, leading managers to only shift risk as a response to recent performance.

Table 5.2.4: Logistic regression of 2 and 4 year cumulative performance, interim performance and risk shifting behavior for investment grade funds and high yield funds ranked separately

DVOLRAT = f(Interim Annual Return, 2-year Cumulative Return, 4-year Cumulative Return) DVOLRAT is defined as a binary variable assuming the value of 1 if a fund's volatility ratio is below the median in annual tournament, 0 otherwise. Cumulative 2 year performance measure is defined as the cumulative return for the two previous years expressed as a dummy variable where 1 is a winner, i.e. the cumulative performance is above the median, 0 otherwise. Cumulative 4 year performance is measured similarly but for the cumulative performance of the previous 4 years. The Coefficients should be interpreted as if the other variables remain fixed, the chance of a fund will increase risk is equal to exp(coefficient)-1. The χ^2 statistics is based on the null hypothesis that the distribution is equal.

Logistic Regression for Investment Grade Funds (M=8)

No. of Obs.	Intercept	Interim Perform. Measure	Cum. 2-yr Perform. Measure	Cum. 4-yr Perform. Measure	χ^2
			Binary Variables		
1772	-0.154 (0.022)	0.302 (0.001)			10,45
1527	0.027 (0.756)	0.404 (0.000)	-0.461 (0.000)		31,28
1237	-0.011 (0.912)	0.416 (0.000)		-0.398 (0.000)	23,05

Logistic Regression for High Yield Funds (M=6)

			Binary Variables		
960	-0.277 (0.003)	0.554 (0.000)			18.21
805	-0.317 (0.009)	0.776 (0.000)	-0.134 (0.364)		30.09
651	-0.583 (0.000)	1.188 (0.000)		-0.071 (0.664)	54.68

6. Conclusion

The behavior of mutual fund managers as a response to economic incentives has been of interest in the academic and professional community for a long time. Studies in the area have specifically focused on the adverse incentives of managers in equity funds. However, other mutual fund categories have recently experienced high growth in assets under management. Corporate bond funds have grown from managing $50 billion in 1990 to managing $1.9 trillion in 2013[4]. Despite the growing impact of bond funds on investor wealth, there is little academic research on the adverse incentives of bond fund managers. This thesis starts

This analysis centers on the tournament hypothesis proposed by Brown Harlow and Starks (1996). The central prediction is that interim "losers" increase portfolio volatility in order to catch up to interim "winners", and subsequently have higher inflow of investments into the fund. Using monthly returns of 232 corporate bond funds, where 151 are investment grade funds and 81 are high yield funds, we find significant tournament behavior. However, we observe no size effect and the influence of historical performance on risk adjustment behavior is

[4] "Chapter Two, Recent Mutual Fund Trends," **Investment Company Institute,** accessed April 11, 2016, http://www.icifactbook.org/fb_ch2.html.

contradictory to our prediction. It is likely that high yield funds have both higher propensity to engage in tournament behavior and have consistently higher returns which skews our results.

In order to increase our understanding of the risk adjustment behavior we separate investment grade and high yield funds to analyze the sub-samples individually. The separate analysis produces more consistent results and provides strong evidence of tournament behavior among corporate bond funds. Specifically, small investment grade funds exhibit tournament behavior while large investment grade funds exhibit no tournament behavior. This is either because smaller investment grade funds have more incentives to adjust risk or it is easier for them to adjust their portfolio. High yield funds exhibit significant tournament behavior independent of size.

The influence of historical performance remains puzzling and high historic performance seem to increase the probability of engaging in risk adjustment behavior for investment grade funds. This is likely due to different volatility sub-samples among investment grade funds having different risk adjustment behavior. We conclude that to understand the competitive behavior among investment grade funds the sample needs to be segmented further. All investment grade funds don't seem to compete against each other. For high yield funds historical performance does not significantly affect risk adjustment behavior. We argue this might be because investors in high yield funds are more concerned with short term performance than with long-term performance. We leave a more detailed analysis of the influence of historical performance on risk adjustment behavior of corporate bond funds to future research.

The most important implication of our research is that we provide evidence that managers in corporate bond funds are effected by the adverse incentives stemming from the competitive structure in the mutual fund industry. Interestingly, the behavior is complex and there is more to learn. Specifically it would be interesting to see a more detailed analysis of the influence of historical performance on risk shifting behavior for high yield funds and a more detailed analysis of sub-samples for investment grade funds to understand which funds compete against each other.

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Tables, Graphs and figures

Table 3.1: Descriptive statistics, fund characteristics

This table shows the descriptive statistics of fund characteristics for the full sample from 1999 to 2014. TNA is total Net Assets, Age is time since fund inception, Expense ratio is total expenses over TNA, Turnover Ratio is how large fraction of the holdings that have been replaced over a given year.

	Total		High Yield		Investment Grade	
	Mean	Median	Mean	Median	Mean	Median
TNA ($mn)	687	244	842	324	605	211
Age (months)	202	167	170	153	219	176
Expense ratio	1.03%	0.92%	1.17%	1.03%	0.96%	0.86%
Turnover Ratio	135%	80%	74%	65%	171%	113%

Table 3.2: Descriptive Statistics, data set

Descriptive statistics of the data set year by year. TNA is the aggregated Total Net Assets for all funds during each year. IG is Investment Grade funds, HY is High Yield funds, Total is the sum of high yield and investment grade funds.

		Number of Funds			Median Return (%)		
Year	TNA ($bn)	Total	IG	HY	Total	IG	HY
1999	88.9	163	117	46	-1.04	-1.82	5.15
2000	86.6	184	128	56	7.98	9.75	-6.68
2001	96.9	205	142	63	7.02	7.51	1.63
2002	104.7	228	152	76	6.66	8.29	-1.15
2003	121.5	227	151	76	6.99	4.90	23.78
2004	122.0	219	147	72	4.80	4.25	9.73
2005	108.1	199	129	70	2.06	1.94	2.37
2006	110.9	181	118	63	4.61	4.04	9.75
2007	111.9	173	112	61	4.01	4.98	2.03
2008	81.4	157	99	58	-12.00	-7.15	-24.31
2009	116.5	151	93	58	22.86	12.66	43.92
2010	134.0	146	88	58	10.76	8.07	13.79
2011	146.6	137	82	55	5.13	6.05	3.35
2012	170.1	131	79	52	10.73	8.63	14.48
2013	151.0	124	74	50	0.407	-0.55	6.39
2014	153.0	124	74	50	4.94	5.80	1.97

Table 5.1.1: Frequency Distributions of a 2 x 2 Classification of the Risk Adjustment Ratio (RAR) and Winner/loser Variables

Measured on all funds for the time period 1999-2014 with assessment period M=4, 5, 6, 7, 8, 9. Assessment period is defined as number of month of the assessment period and number of months that is left of the year, e.g. (4.8) is the assessment period January to April, and rest of the year is May to December. RTN is defined as the gross return of the assessment period, where winners have RTN above the median, and losers have RTN below the median. RAR is defined as the ratio of standard deviation of the rest of the year over the standard deviation of assessment period for each fund, where High "RAR" is funds with RAR above the median and Low "RAR" is fund with RAR below the median. When ranked by quartile, high RTN is the top quartile of gross returns for assessment period, and low RTN is the bottom quartile of gross returns for assessment period. RAR is divided by median for the funds in the top and bottom quartile. The χ^2 statistics is based on the null hypothesis that the distribution is equal.

Sample frequency as percent of observations

		Low RTN ("Losers")		High RTN ("Winners")			
Assessment Period	Observations	Low "RAR"	High "RAR"	Low "RAR"	High "RAR"	χ^2	p-value
Panel A: Winners/Losers ranked by median							
			All Funds				
(4.8)	2738	25.46%	24.54%	24.54%	25.46%	0.913	0.339
(5.7)		24.80%	25.20%	25.20%	24.80%	0.177	0.674
(6.6)		24.76%	25.24%	25.24%	24.76%	0.247	0.619
(7.5)		19.94%	30.06%	30.06%	19.94%	112.095	0.000
(8.4)		18.96%	31.04%	31.04%	18.96%	160.060	0.000
(9.3)		20.60%	29.40%	29.40%	20.0%	84.852	0.000
Panel B: Winners/Losers ranked by quartile							
			All Funds				
(4.8)	1362	32.31%	17.69%	17.39%	32.31%	48.925	0.000
(5.7)	1362	25.62%	24.38%	24.38%	25.62%	0.849	0.357
(6.6)	1344	24.55%	25.45%	25.45%	24.55%	0.429	0.513
(7.5)	1344	17.34%	32.66%	32.66%	17.34%	126.976	0.000
(8.4)	1344	16.74%	33.26%	33.26%	16.74%	146.976	0.000
(9.3)	1362	18.80%	31.20%	31.20%	18.80%	83.880	0.000

Table 5.1.2: Frequency Distributions of a 2 x 2 Classification of the Risk Adjustment Ratio (RAR) and Winner/loser Variables, divided into sub-periods

Measured on all funds for the time period 1999-2014, 1999-2006, 2007-2014, 1999-2002, 2003-2006, 2007-2010 and 2011-2014 with assessment period M=8. Assessment period is defined as number of month of the assessment period starting in January and number of months that is left of the year, e.g. (4.8) is the assessment period January to April, and rest of the year is May to December. RTN is defined as the gross return of the assessment period, where winners have RTN above the median, and losers have RTN below the median. RAR is defined as the ratio of standard deviation of the rest of the year over the standard deviation of assessment period for each fund, where High "RAR" is funds with RAR above the median and Low "RAR" is fund with RAR below the median. The χ^2 statistics is based on the null hypothesis that the distribution is equal.

Sample frequency as percent of observations (M=8)

		Low RTN ("Losers")		High RTN ("Winners")			
Sample Period	Observations	Low "RAR"	High "RAR"	Low "RAR"	High "RAR"	χ^2	p-value
Panel A: Time Period 1999-2014							
99-14	2,738	18.96	31.04	31.04	18.96	160.06	0.000
Panel B: Split into non-overlapping 8-year periods							
99-06	1,600	19.94	30.06	30.06	19.94	65.61	0.000
07-14	1,138	17.57	32.42	32.43	17.57	100.39	0.000
Panel C: Split into non-overlapping 4-year periods							
99-02	778	24.16	25.84	25.84	24.16	0.87	0.3051
03-06	822	15.94	34.06	34.06	15.94	108.03	0.000
07-10	624	18.27	31.73	31.73	18.27	45.23	0.000
11-14	514	16.73	33.27	33.27	16.73	56.23	0.000

Table 5.1.3: Frequency Distributions of a 2 x 2 Classification of the Risk Adjustment Ratio (RAR) and Winner/loser Variables for All Funds, split by large and small size

Measured for all funds for the time period 1999-2014, 1999-2006, 2007-2014 with assessment period M=8. Assessment period is defined as number of month of the assessment period starting in January and number of months that is left of the year, e.g. (4.8) is the assessment period January to April, and rest of the year is May to December. RTN is defined as the gross return of the assessment period, where winners have RTN above the median, and losers have RTN below the median. RAR is defined as the ratio of standard deviation of the rest of the year over the standard deviation of assessment period for each fund, where High RAR is funds with RAR above the median and Low RAR is fund with RAR below the median. M Size is split by median in Total Net Assets. The χ^2 statistics is based on the null hypothesis that the distribution is equal.

Sample frequency as percent of observation for all funds (M=8)

			Low RTN ("Losers")		High RTN ("Winners")			
Sample Period	Size	Observations	Low "RAR"	High "RAR"	Low "RAR"	High "RAR"	χ^2	p-value
Panel A: Time period, 99-14								
99-14	Large	1365	17.07	29.89	32.82	20.22	88.633	0.000
99-14	Small	1365	20.81	32.23	29.30	17.66	73.047	0.000
	Total	2700	18.94	31.06	31.06	18.94		
Panel B: Time period, 99-06								
99-06	Large	796	17.21	28.89	32.54	21.36	42.012	0.000
99-06	Small	796	22.61	31.28	27.64	18.47	25.599	0.000
	Total	1592	19.91	30.09	30.09	19.91		
Panel C: Time period, 07-14								
07-14	Large	569	16.87	31.28	33.22	18.63	47.891	0.000
07-14	Small	569	18.28	33.57	31.63	16.52	52.649	0.000
	Total	1138	17.57	32.43	32.43	17.57		

Table 5.1.4: Logistic regression of 2 and 4 year cumulative performance, interim performance and risk shifting behavior for all funds

DVOLRAT = f(Interim Annual Return, 2-year Cumulative Return, 4-year Cumulative Return)

DVOLRAT is defined as a binary variable assuming the value of 1 if a fund's volatility ratio is below the median in annual tournament, 0 otherwise. Cumulative 2 year performance measure is defined as the cumulative return for the two previous years expressed as a dummy variable where 1 is a winner, i.e. the cumulative performance is above the median, 0 otherwise. Cumulative 4 year performance is measured similarly but for the cumulative performance of the previous 4 years. The Coefficients should be interpreted as if the other variables remain fixed, the chance of a fund will increase risk is equal to exp(coefficient)-1.

Logistic Regression for all funds (M=8)					
No. of Obs.	Intercept	Interim Perform. Measure	Cum. 2-yr Perform. Measure	Cum. 4-yr Perform. Measure	χ^2
Binary Variables					
2738	-0.493 (0.000)	0.987 (0.000)			161.66
2505	-0.362 (0.000)	0.948 (0.000)	-0.204 (0.013)		139.33
2045	-0.358 (0.000)	1.057 (0.000)		-0.357 (0.000)	156.67

**p-values for the coefficients are illustrated in brackets*

Table 5.2.1: Frequency Distributions of a 2 x 2 Classification of the Risk Adjustment Ratio (RAR) and Winner/loser Variables tested on investment grade funds and high yield funds ranked separately

Measured on investment grade and high yield funds separately of each other for the time period 1999-2014 with assessment period M=4, 5, 6, 7, 8. Assessment period is defined as number of month of the assessment period starting in January and number of months that is left of the year, e.g. (4.8) is the assessment period January to April, and rest of the year is May to December. RTN is defined as the gross return of the assessment period, where winners have RTN above the median, and losers have RTN below the median. RAR is defined as the ratio of standard deviation of the rest of the year over the standard deviation of assessment period for each fund, where High RAR is funds with RAR above the median and Low RAR is fund with RAR below the median. When ranked by quartile, high RTN is the top quartile of gross returns for assessment period, and low RTN is the bottom quartile of gross returns for assessment period. RAR is divided by median for the funds in the top and bottom quartile. The χ^2 statistics is based on the null hypothesis that the distribution is equal.

Sample frequency as percent of observations for investment grade funds

		Low RTN ("Losers")		High RTN ("Winners")			
Assessment Period	Observations	Low "RAR"	High "RAR"	Low "RAR"	High "RAR"	χ^2	p-value
Panel A: Winners/Losers ranked by median							
		Investment Grade Funds					
(4.8)	1778	25.93	24.07	24.07	25.93%	2.4550	0.118
(5.7)		23.73	26.27	26.27	23.73%	4.556	0.033
(6.6)		23.45	26.55	26.55	23.45%	6.805	0.009
(7.5)		23.23	26.77	26.77	23.23%	8.929	0.003
(8.4)		23.12	26.88	26.88	23.12%	10.099	0.001
Panel B: Winners/Losers ranked by quartile							
		Investment Grade Funds					
(4.8)	880	25.57	24.43	24.43	25.57	0.455	0.500
(5.7)		25.34	24.66	24.66	25.34	0.164	0.686
(6.6)		23.86	26.14	26.14	23.86	0.818	0.178
(7.5)		23.07	26.93	26.93	23.07	5.255	0.022
(8.4)		22.95	26.05	27.05	11.95	5.8909	0.015

Sample Frequencies as percent of observations for high yield funds

Assessment Period	Observations	Low "RAR"	High "RAR"	Low "RAR"	High "RAR"	χ^2	p-value
Panel C: Winners/Losers ranked by median							
		High Yield Fund					
(4.8)	960	23.44	26.56	26.56%	23.44	3.750	0.053
(5.7)		23.33	26.67	26.67%	23.33	4.267	0.039
(6.6)		21.56	28.44	28.55%	21.56	18.150	0.000
(7.5)		24.90	25.10	25.10%	24.90	0.017	0.897
(8.4)		26.25	23.75	23.75%	26.25	2.400	0.121
Panel D: Winners/Losers ranked by quartile							
		High Yield Fund					
(4.8)	470	23.38	26.17	26.17	23.38	1.030	0.310
(5.7)		23.19	26.81	26.81	23.19	2.758	0.097
(6.6)		21.06	28.94	28.94	21.06	11.651	0.001
(7.5)		23.62	26.38	26.38	23.62	1.438	0.230
(8.4)		25.53	24.47	24.47	25.53	0.213	0.645

Table 5.2.2: Frequency Distributions of a 2 x 2 Classification of the Risk Adjustment Ratio (RAR) and Winner/loser Variables, 1999-2014 for investment grade funds and high yield funds ranked independently, divided into time sub-periods

Measured on investment grade and high yield funds separately for the time period 1999-2014 and sub-periods 1999-2006, 2007-2014, 1999-2003, 2004-2006, 2007-2010 and 2011-2014 with assessment period M=8 for investment-grade funds and M=6 for high yield funds. Assessment period is defined as number of month of the assessment period starting in January and number of months that is left of the year, e.g. (4.8) is the assessment period January to April, and rest of the year is May to December. RTN is defined as the gross return of the assessment period, where winners have RTN above the median, and losers have RTN below the median. RAR is defined as the ratio of standard deviation of the rest of the year over the standard deviation of assessment period for each fund, where High "RAR" is funds with RAR above the median and Low "RAR" is fund with RAR below the median. The χ^2 statistics is based on the null hypothesis that the distribution is equal.

Sample frequency as percent of observations for investment grade funds (M=8)

		Low RTN ("Losers")		High RTN ("Winners")			
Sample Period	Observations	Low "RAR"	High "RAR"	Low "RAR"	High "RAR"	χ^2	p-value
Panel A: Whole Sample							
99-14	1778	23.12	26.88%	26.88%	23.12%	10.099	0.001
Panel B: Eight-Year Period							
99-06	1080	22.96	27.04%	27.04%	22.96%	7.14	0.007
07-14	698	23.35	26.65%	26.65%	23.35%	3.0315	0.082
Panel B: Four-Year Period							
99-02	538	24.16	25.84%	25.84%	24.16%	0.60	0.438
03-06	542	21.77	28.23%	28.23%	21.77%	9.04	0.003
07-10	390	20.26	29.74%	29.74%	20.26%	14.041	0.000
11-14	308	27.27	22.73%	22.73%	27.27%	2.545	0.111

Sample frequency as percent of observations for high yield funds (M=6)

Sample Period	Observations	Low "RAR"	High "RAR"	Low "RAR"	High "RAR"	χ^2	p-value
Panel D: Whole Sample							
99-14	960	21.56	28.44	28.55	21.56	18.150	0.000
Panel E: Eight-Year Period							
99-06	520	24.81	25.19	25.19	24.81	0.03	0.861
07-14	440	17.73	32.27	32.27	17.73	37.24	0.000
Panel F: Four-Year Period							
99-02	240	32.08	17.92	17.92	32.08	19.27	0.000
03-06	280	18.57	31.43	31.43	18.57	18.51	0.000
07-10	234	17.95	32.05	32.05	17.95	18.61	0.000
11-14	206	17.48	32.52	32.52	17.48	18.66	0.000

Table 5.2.3: Frequency Distributions of a 2 x 2 Classification of the Risk Adjustment Ratio (RAR) and Winner/loser Variables for investment grade funds and high yield funds ranked separately, divided by large and small size

Measured for investment grade funds and high yield funds separately and independently for the time period 1999-2014, 1999-2006, 2007-2014 with assessment period M=6 for investment grade funds and M=8 for high yield funds. Assessment period is defined as number of month of the assessment period and number of months that is left of the year, e.g. (4.8) is the assessment period January to April, and rest of the year is May to December. RTN is defined as the gross return of the assessment period, where winners have RTN above the median, and losers have RTN below the median. RAR is defined as the ratio of standard deviation of the rest of the year over the standard deviation of assessment period for each fund, where High "RAR" is funds with RAR above the median and Low "RAR" is fund with RAR below the median. Size is split by median in Total Net Assets (TNA), where Large are firms larger than median and small are firms smaller than median. The χ^2 statistics is based on the null hypothesis that the distribution is equal.

Sample frequency as percent of observation for investment grade funds (M=8)

			Low RTN ("Losers")		High RTN ("Winners")			
Sample Period	Size	Observations	Low "RAR"	High "RAR"	Low "RAR"	High "RAR"	χ^2	p-value
Panel A: Whole Sample								
99-14	Large	886	22.57	24.04	28.10	25.28	1.568	0.210
99-14	Small	886	23.59	29.80	25.73	20.88	10.712	0.001
99-14	Total		17.57	32.43	32.43	17.57		
Panel B: Limited time period, 99-06								
99-06	Large	537	21.42	23.84	29.61	25.14	2.430	0.119
99-06	Small	537	24.39	30.35	24.58	20.67	5.075	0.024
99-06	Total		22.91	27.09	27.09	22.91		
Panel C: Limited time period, 07-14								
07-14	Large	349	24.36	24.36	25.79	25.50	0.003	0.958
07-14	Small	349	22.35	28.94	27.51	21.20	5.800	0.016
07-14	Total		23.35	26.65	26.65	23.35		

Sample frequency as percent of observation for high yield funds (M=6)

			Low RTN ("Losers")		High RTN ("Winners")			
Sample Period	Size	Observations	Low "RAR"	High "RAR"	Low "RAR"	High "RAR"	χ^2	p-value
Panel D: Whole Sample								
99-14	Large	476	16.60	27.73	32.35	23.32	20.089	0.000
99-14	Small	476	26.05	29.62	25.00	19.33	4.337	0.037
99-14	Total		21.32	28.68	28.68	21.32		
Panel E: Limited time period, 99-06								
99-06	Large	256	18.36	23.44	30.86	27.34	2.061	0.151
99-06	Small	256	30.47	27.73	20.31	21.48	0.351	0.554
99-06	Total		24.41	25.59	25.59	24.41		
Panel F: Limited time period, 07-14								
07-14	Large	220	14.55	32.73	34.09	18.64	25.205	0.000
07-14	Small	220	20.91	31.82	30.45	16.82	13.466	0.000
07-14	Total		17.73	32.27	32.27	17.73		

Table 5.2.4: Logistic regression of 2 and 4 year cumulative performance, interim performance and risk shifting behavior for investment grade funds and high yield funds separately

DVOLRAT = f(Interim Annual Return, 2-year Cumulative Return, 4-year Cumulative Return) DVOLRAT is defined as a binary variable assuming the value of 1 if a fund's volatility ratio is below the median in annual tournament, 0 otherwise. Cumulative 2 year performance measure is defined as the cumulative return for the two previous years expressed as a dummy variable where 1 is a winner, i.e. the cumulative performance is above the median, 0 otherwise. Cumulative 4 year performance is measured similarly but for the cumulative performance of the previous 4 years. The Coefficients should be interpreted as if the other variables remain fixed, the chance of a fund will increase risk is equal to exp(coefficient)-1.

Logistic Regression for Investment Grade Funds (M=8)

No. of Obs.	Intercept	Interim Perform. Measure	Cum. 2-yr Perform. Measure	Cum. 4-yr Perform. Measure	χ^2
			Binary Variables		
1778	-0.151 (0.025)	0.302 (0.001)			10.11
2505	-0.362 (0.000)	0.949 (0.000)	-0.204 (0.013)		139.33
2045	-0.358 (0.000)	1.057 (0.000)		-0.357 (0.000)	156.67

Logistic Regression for High Yield Funds (M=6)

			Binary Variables		
960	-0.277 (0.003)	0.554 (0.000)			18.21
805	-0.317 (0.009)	0.776 (0.000)	-0.134 (0.364)		30.09
651	-0.583 (0.000)	1.188 (0.000)		-0.071 (0.664)	54.68

Table 5.2.5: Logistic regression of 2 and 4 year cumulative performance, interim performance and risk shifting behavior for investment grade funds, result split up by large and small funds

DVOLRAT = f(Interim Annual Return, 2-year Cumulative Return, 4-year Cumulative Return) DVOLRAT is defined as a binary variable assuming the value of 1 if a fund's volatility ratio is below the median in annual tournament, 0 otherwise. Cumulative 2 year performance measure is defined as the cumulative return for the two previous years expressed as a dummy variable where 1 is a winner, i.e. the cumulative performance is above the median, 0 otherwise. Cumulative 4 year performance is measured similarly but for the cumulative performance of the previous 4 years. The Coefficients should be interpreted as if the other variables remain fixed, the chance of a fund will increase risk is equal to exp(coefficient)-1.

Logistic Regression for Investment Grade Funds (M=8), small

No. of Obs.	Intercept	Interim Perform. Measure	Cum. 2-yr Perform. Measure	Cum. 4-yr Perform. Measure	χ^2
			Binary Variables		
886	-0.234 (0.012)	0.443 (0.001)			10.73
763	-0.102 (0.387)	0.546 (0.000)	-0.333 (0.024)		17.51
618	-0.142 (0.268)	0.510 (0.002)		-0.208 (0.205)	10.54

Logistic Regression for Investment Grade Funds (M=8), big

			Binary Variables		
886	-0.063	0.169 (0.211)			1.57
764	0.169	0.266 (0.072)	-0.585 (0.000)		17.48
619	0.158	0.305 (0.062		-0.596 (0.000)	16.41

**p-values for the coefficients are illustrated in brackets*