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Are There Tournaments In Mutual Funds?

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Abstract

Evidence regarding the tournament hypothesis are mixed. In this thesis, we conduct the tournament analysis once more and find that both monthly and daily data sets provide no proof of tournament behaviour. However, there were tournaments in monthly data using a different time period from the one selected for this work. Further, we found that the presence of autocorrelation in data had no effect on tournament results. We also saw that sorting bias, which is as a result of first-half risk sorting after mid-year performance ranking, produced evidence of tournaments. This is due to mean reversion of the sorted risk levels and the incidence was closely linked to the bear and bull market periods.

Keywords: Mutual fund tournaments, Relative return, Standard deviation ratio, Autocorrelation, Moving average, Four-factor model, Linear regression, Residual risk, Systematic risk, Empirical distribution, Sorting bias.

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1 Introduction

1.1 Background

An economic tournament as opposed to traditional individual investing (where the investor only cares about making some gains irrespective of what others are engaged in) can be described as a competition between economic agents where one or more winners, with prizes greater than that of the losers, emerge. In finance, we often associate tournaments with mutual funds because of the well-documented fund flows effect in which investors flock to the fund with the highest relative performance within a calendar year (Chen *et al.*, 2011). In recent years, the risk-taking behavior of mutual fund managers in response to their relative performance has been explored through extensive research. On the forefront is work by Brown, Harlow and Starks (1996) which documented a hitherto undiscovered game performed by US mutual fund managers and referred to it as mutual fund tournaments. In their work, they consider the research on economics of tournaments as a subset of the literature on agency theoretic contracting where the emphasis is on normative aspects of performance-based compensation schemes. Accordingly, reward structures regarded as tournaments are especially suitable in environments where the effort of an agent is unobservable and the performance of all agents depend on a common economic shock (Brown *et al.*, 1996). To date, existing empirical evidence concerning the notion that various compensation schemes elicit a desirable behavior culminating into mutual fund tournaments is diverse, suggesting that the strength and direction of tournament behavior change over time or that the different empirically derived measures are problematic. These conflicting results leave the important issue unanswered: how and whether previous return performance motivates mutual fund managers to modify their risk-taking behavior (Schwarz, 2011).

Brown *et al.* (1996) views the mutual fund market as a tournament in which all funds having comparable investment objectives compete with one another thereby providing a useful framework for a better understanding of the portfolio management decision-making process. They study whether fund managers engage in risk shifting based on previous fund performance, i.e. how portfolio managers adapt their investment behavior to the economic incentives they are provided. Using a sample of monthly fund returns, they find that high-performers (winners) in the interim assessment period reduce their risk relative to the losers in the interim period. High (low) performance is based on returns above (below) the median or in the upper (lower) quartile. In their work, similarities are drawn between fund in-flows to high-performers (winners) and the payoffs for competitions such as golf and tennis by asserting that the winning categories earn high remunerations. A fact they claim is solidified by the work of Sirri and Tufano (1992) who show that mutual funds earning the highest returns during an interim assessment period receive the largest reward in terms of increased new investments in the fund. These additional contributions provide, in turn, increased compensation to the mutual funds' advisors as their rewards typically are determined as a percentage of the assets under management (Brown *et al,* 1996).

Busse (2001) further explored mutual fund tournaments with both monthly and daily data. The monthly results were not different from those of Brown *et al,* (1996) but the daily results with 20 times as many observations and much more accurate volatility estimates were completely opposite such that, any apparent tendency for poorly performing funds to increase risk relative to better performers disappears. Busse attributes the differences in monthly and daily data to biases in monthly volatility estimates due to autocorrelation patterns in the daily returns with disparate exposure to small capitalisation stocks. The analysis is further tested with unbiased monthly standard deviation estimates as well as the use of statistical characteristics of the actual daily fund returns to simulate a mutual fund environment in which there is no strategic change in risk and the results were found to be consistent with no tournament behaviour (Busse, 2001).

Goriaev *et al.* (2004) revisit the work by Busse (2001), where they analyze both impacts of autocorrelation and cross-correlation on the tournament hypothesis analytically. They estimate bias in volatility attributable to autocorrelation in monthly and daily returns and find that monthly data are more sensitive to changes in autocorrelation of daily data but they argue that test of the tournament hypothesis on monthly data is robust to these changes. They conclude in the paper from their analytical point of view that, the source of spurious evidence found in the past is not so much a neglected temporal correlation in returns, but more a neglected cross-correlation between idiosyncratic fund returns.

Kempf and Ruenzi, (2008) study two kinds of tournaments relevant in the field of mutual funds where they first demonstrate that, aside the position of a fund within its segment, a fund's position within its family also determines its risk taking behavior. They also show that managers act upon mid-year ranking depending on the competitive nature of the environment they are in. They propose that losers from large segments (families) increase risk more than winners, with the opposite holding true in small segments and families. A claim which supports the work of Taylor (2003). Taylor's model is based on the strategic interaction between active fund managers where the winner expects the loser to increase risk (based on tournament hypothesis) and therefore the winner also increases risk to maintain the lead. In his work, outperforming fund managers were likely to increase risk compared to their under-performing counterparts in equilibrium.

Schwarz (2011), finds new evidence of the tournament hypothesis where he attributes the varying results by various authors to sorting bias. He argues that given the dependence of risk and return, return sorting will also likely sort risk levels since managers' first-half return standard deviations are used as the baseline risk levels when measuring risk shifting in the second half of the year. He established high correlation in tournament behavior with level of risk sorting and also demonstrates this bias numerically by assigning risk levels randomly. He corrects the bias by evaluating managers' risk management relative to their own holdings as well as for the ability to control for other security characteristics and use bootstrapping to control for any risk changes due to random trading. He draws similar conclusions to those by Brown et al. (1996) and also finds that tournament behavior is independent of the overall market's first-half performance.

1.2 Research Objective and Structure

In this study, we replicate the works by Brown, Harlow and Starks (1996), Busse (2001) and Schwarz (2011) to analyse mutual fund tournaments. We obtain initial tournament results with data sample consisting of 730 mutual funds spanning the years January 1992 through December 2015. The analysis was conducted using US mutual funds where we compute the relative return (RTN) and its standard deviation ratio (SDR). Results obtained for monthly and daily data sets rejected the tournament hypothesis but when we used data matching the time period (1985-1995) used by Busse in his work, there were indeed tournaments in monthly data which therefore suggested that the time period used most likely influenced the results. There were autocorrelation patterns present in daily returns but the results were not influenced. This fact was consistent with the outcome of a simulated mutual fund environment where any relation between performance and risk is eliminated.

In an attempt to ascertain whether overall market performance had any effect on the risk taking behaviour of managers, we explored the tournament analysis on economic recessions and expansions (dated by the National Bureau of Economic Research) as well as bear and bull market periods (identified by Forbes magazine). We also analysed the existence of sorting bias described by Schwarz (2011) in our data and found that the risk levels of winning and losing funds exhibited mean reversion in most of the years.

The structure of the thesis is as follows. Chapter 2 discusses the theoretical background and methodology of the work and in chapter 3, we present the empirical results replicating Busse's work and the new evidence of sorting bias following Schwarz. Finally, chapter 4 concludes.

2 Theoretical Background

The chapter gives a description of the hypothesis to be tested and the methodology used in the work. We mostly employ the notations in the work by Busse (2001) who uses similar procedures by Brown et. al. (1996) to obtain the initial results.

2.1 Motivation and Testable Hypothesis

Managers who view themselves as being participants in tournaments, would change the risk profile of the fund during the course of the year. However, the relationship between fund inflows and performance is not symmetric: mutual funds that performed worse than the average in the competition do not experience as significant an outflow of invested capital. As a result, those who have performed poorly (loser), will need to generate a higher return with respect to those managers who have high interim returns (winner), to make up their first period 'deficit'. On the other hand, winners who anticipate what those managers ranked below them might do, will increase risk as well as maintain their high rank but they do not need to increase risk to the same extent as do the losers. We represent the above description with standard deviation ratio, which is the ratio corresponding with portfolio risk levels in the first and second subperiods by σ_1 and σ_2 respectively, where the ratio for interim losers will be greater than that for the interim winners. Formally, the tournament hypothesis is given by:

$$(\sigma_{2L}/\sigma_{1L}) > (\sigma_{2W}/\sigma_{1W}) \tag{2.1}$$

where subscripts L and W represent the interim loser and winner strategies.

2.2 Methodology

To test a generalized form of equation (2.1), we develop two variables from the fund return data base. First, we create subgroups of interim winners and losers according to a fund's relative return performance between January and an evaluation month M. Specifically, for each fund p in a given year y, we calculate the cumulative return at the evaluation month as follows:

$$RTN_{py} = \prod_{d=1}^{D}(1 + r_{pd}) - 1 \tag{2.2}$$

where r_{pd} is the daily return in the fund's net asset value plus distributions on day d and there are D daily returns during the year y evaluation period. In our analysis, the end of the evaluation period is allowed to vary between April and August and so RTN is measured over periods ranging from four to eight months. After calculating a separate set of RTN for each sample year, the funds in that tournament are ranked from highest to lowest. Then we calculate whether funds are above or below the median value of RTN, i.e. are they winners or losers.

The second variable we need to test is the hypothesis that winners and losers make different adjustments to their investment, using the standard deviation ratio, SDR. With the interim assessment date at the evaluation month, the fund p SDR for a particular year y is calculated in two ways. First, assuming the daily returns are independent;

$$SDR_{py} = \left[\frac{\frac{1}{(D_y-D)-1}\sum_{d=D+1}^{D_y}\big(r_{pd} - \bar{r}_{p(D+1:D_y)}\big)^2}{\frac{1}{D-1}\sum_{d=1}^{D}\big(r_{pd} - \bar{r}_{p(1:D)}\big)^2}\right]^{\frac{1}{2}} \tag{2.3}$$

with the deviation in the numerator and denominator calculated relative to the mean return over the relevant subperiod denoted by $d = 1$ to D, $d = D + 1$ to D_y refers to the post evaluation period, and there are D_y trading days during the year.

Secondly, we model the returns as a moving average MA(1) process in order to account for positive first-order serial autocorrelation in the returns. The moving average process is estimated twice for each fund year i.e. for both evaluation and post-evaluation periods and the model equations are given by;

$$\begin{aligned} r_{pd} &= \mu_{p1} + \theta_{p1}\varepsilon_{p1,d-1} + \varepsilon_{p1d}, \;\; d\text{=}1 \text{ to } D, \\ r_{pd} &= \mu_{p2} + \theta_{p2}\varepsilon_{p2,d-1} + \varepsilon_{p2d}, \;\; d\text{=}D\text{+}1 \text{ to } D_y \end{aligned} \tag{2.4}$$

The MA(1) conditional standard deviation is given by;

$$SDR_{py} = \frac{\sigma(\varepsilon_{p^2})}{\sigma(\varepsilon_{p^1})} \tag{2.5}$$

For each tournament y, equation (2.5) measures the ratio of the p-th fund's standard deviation after the interim performance assessment relative to its standard deviation before that date. Consequently, the empirical adaptation of the prediction in (2.1) is that this ratio should be significantly larger for funds labeled as losers at the evaluation period than for those designated as winners.

Now, we are able to create a (RTN, SDR) pair for every fund in each of the twenty four annual tournaments. The basic test procedure is to generate a 2×2 contingency table in which each pairing is placed into one of four cells: high RTN (i.e., winner)/high SDR; low RTN (i.e., loser)/high SDR; high RTN/low SDR; low RTN/lowSDR. The null hypothesis in our test is that the percentage of the sample population falling into each of these four cells is equal, i.e. 25 percent, which implies that the two classifications are independent. The alternative hypothesis consistent with equation (2.1) is that the low RTN/high SDR and high RTN/low SDR cells would have measurably larger frequencies than the other two outcomes. The statistical significance of these frequencies is established with a chi-square test having one degree of freedom.

The tournament analysis is repeated for data of monthly frequency where monthly returns of fund p are computed from daily returns using the formula;

$$r_{pm} = \prod_{d=1}^{D_m} (1 + r_{pd}) - 1, \tag{2.6}$$

where there are D_m trading days in month m. Subsequently, the monthly standard deviation ratios are computed by,

$$SDR_{py} = \left[\frac{\frac{1}{(12-M)-1} \sum_{m=M+1}^{12} (r_{pm} - \bar{r}_{p(M+1:12)})^2}{\frac{1}{M-1} \sum_{m=1}^{M} (r_{pm} - \bar{r}_{p(1:M)})^2} \right]^{\frac{1}{2}}, \tag{2.7}$$

where there are M months during the evaluation period and also, RTN is unaffected by the frequency of data. Examining the monthly data this way enables us to directly investigate how the the frequency of data impact the results.

We further analyse mutual fund tournaments by exploring beta and residual risk using single and four factor specifications. According to Busse (2001), fund managers should have more control over beta and residual risk than over total variance, which is affected by the aggregate behavior of all market participants. The equations for the evaluation and post-evaluation periods are,

$$\begin{aligned} R_{pd} &= \alpha_{p1} + \sum_{j=1}^{k} (\beta_{pj1} R_{jd} + L_{pj1} R_{j,d-1}) + \varepsilon_{p1d}, \;\; d{=}1 \textit{ to } D, \\ R_{pd} &= \alpha_{p2} + \sum_{j=1}^{k} (\beta_{pj2} R_{jd} + L_{pj2} R_{j,d-1}) + \varepsilon_{p2d}, \;\; d{=}D{+}1 \textit{ to } D_y \end{aligned} \tag{2.8}$$

with $k = 1$ or 4. R_{pd} is the excess return [1] of fund p on day d; R_{jd} is the return of factor j on day d; $\beta_{pj1}(\beta_{pj1})$ is fund p's regression coefficient on factor j during (after) the evaluation period; L_{pj1} (L_{pj2}) is fund p's one-day lag regression coefficient on factor j during (after) the evaluation period; α_{p1} (α_{p2}) is fund p's abnormal return during (after) the evaluation period; and ε_{pd} is fund p's idiosyncratic return on day d. The first factor of the Fama French daily three factors is taken as the single-factor since it represents the market. The four-factor specification adds factors that capture the differential dynamics of small cap stocks compared to large cap stocks (small minus big, SMB), high book-to-market stocks compared to low book-to-market stocks (HML), and momentum stocks compared to contrarian stocks (MMC) all taken from the Fama French data at a daily frequency. The MMC index is similar to the momentum index used by Carhart (1997), except value-weighted and at a daily frequency. For each year y, fund p's systematic risk ratio for factor j is taken to be

$$SYSR_{pjy} = \frac{\beta_{pj2} + L_{pj2}}{\beta_{pj1} + L_{pj1}}, \tag{2.9}$$

and the residual risk ratio is given by

$$RESR_{py} = \frac{\sigma(\varepsilon_{p2})}{\sigma(\varepsilon_{p1})}. \tag{2.10}$$

[1] Excess return is the difference between the actual return of a security and the risk-free rate.

2.3 Data

The mutual fund sample taken from Morningstar Inc. data base consists of daily returns from January 2, 1992, through December 31, 2015, for 730 active US open-end equity funds. Morningstar's mutual fund sample database is free of survivorship bias and funds are filtered according to the characteristics mentioned by Basak *et al.* (2008) and Chevalier and Ellison (1997) where the investment targets includes growth, aggressive growth and growth and income. Tournaments are held on annual basis and a fund is included in a yearly tournament only if it has return data available for the entire year. Furthermore, the prospectus primary benchmark is the S & P 500 index. In Table 1, we report summary statistics of the sample.

Table 1:

Descriptive Statistics for 730 Mutual Funds, 1992-2015

Year	Number of Funds	Median Return	Median Std. Dev.
1992	220	9.44	8.34
1993	252	11.78	8.20
1994	282	-0.59	4.54
1995	324	33.22	6.78
1996	364	21.00	7.64
1997	416	27.54	7.18
1998	453	20.55	11.88
1999	529	19.72	21.82
2000	581	-2.04	13.77
2001	623	-11.48	11.83
2002	630	-22.07	7.20
2003	633	27.63	11.08
2004	637	10.29	4.93
2005	637	6.07	4.68
2006	626	13.43	4.61
2007	609	6.66	8.09
2008	610	-38.19	6.41
2009	552	28.54	11.34
2010	538	14.25	4.63
2011	492	-1.60	5.50
2012	454	14.61	4.52
2013	425	32.64	5.00
2014	422	10.31	4.78
2015	416	-0.93	5.15

The table reports summary information for the sample 730 mutual funds used. A fund is only included if it has return data for the entire year.

3 Empirical Results

3.1 Initial Tournament Findings

I. Comparison with Busse's data

Table 2:

Frequency Distributions of the 2×2 Contingency Tables for the Median Rank-Ordered Classifications of RTN and SDR: Busse Sample

		Sample Frequency (% of observations)					
		Low RTN (Losers)		High RTN (Winners)			
Assessment Period	Obs	Low SDR	High SDR	Low SDR	High SDR	χ^2	p-value
Panel A. Monthly Returns							
(4,8)	2196(2302)	25.91(24.59)	24.18(25.54)	24.18(25.46)	25.73(24.41)	2.38(0.84)	0.123(0.359)
(5,7)		24.50(23.41)	25.59(26.50)	25.59(26.59)	24.32(23.50)	1.25(8.51)	0.264(0.004)
(6,6)		24.77(23.24)	25.32(26.80)	25.32(26.59)	24.59(23.57)	0.37(10.30)	0.542(0.001)
(7,5)		23.59(22.11)	26.50(27.76)	26.50(27.93)	23.41(22.20)	7.95(29.36)	0.005(0.000)
(8,4)		23.59(23.37)	26.50(26.72)	26.50(26.50)	23.41(23.41)	7.95(9.26)	0.005(0.002)
Panel B. Independent Daily Returns							
(4,8)	2196(2303)	24.50(25.28)	25.59(24.67)	25.59(24.67)	24.32(25.37)	1.25(0.34)	0.264(0.560)
(5,7)		24.86(24.88)	25.23(24.97)	25.23(25.10)	24.68(25.05)	0.20(0.00)	0.657(0.983)
(6,6)		26.14(26.23)	23.95(23.80)	23.95(23.75)	25.96(26.23)	3.87(5.35)	0.049(0.021)
(7,5)		26.00(25.50)	24.09(24.59)	24.09(24.41)	25.82(25.50)	2.92(0.84)	0.087(0.359)
(8,4)		25.96(26.01)	24.13(24.06)	24.13(23.80)	25.77(26.14)	2.64(4.09)	0.104(0.043)
Panel C. MA(1) Daily Returns							
(4,8)	2196(2303)	24.91(25.46)	25.18(24.46)	25.18(24.59)	24.73(25.50)	0.13(0.77)	0.717(0.381)
(5,7)		25.00(24.92)	25.09(25.10)	25.09(25.05)	24.82(24.92)	0.04(0.01)	0.834(0.917)
(6,6)		26.46(26.39)	23.63(23.57)	23.63(23.57)	26.28(26.48)	6.57(7.33)	0.010(0.007)
(7,5)		25.87(25.88)	24.23(24.19)	24.27(24.06)	25.64(25.88)	2.01(2.71)	0.157(0.100)
(8,4)		26.09(26.40)	24.00(23.75)	24.00(23.40)	25.91(26.44)	3.54(7.23)	0.060(0.007)

Results of the 2×2 median classification of rank ordered variables using (i) SDR which is the Standard Deviation ratio and (ii) RTN also the total compound relative return through the first M months of the year for data sample spanning the years used by Busse (year 1985-1995). Interim assessments of fund performance are conducted at five different dates of M=4, 5, 6, 7,and 8. The classifications are performed for surviving funds on yearly basis for all 730 funds using daily returns, monthly returns (compounded from the daily returns) and daily returns modeled as an MA(1) process. Funds are grouped into four classes on yearly basis by determining whether they are (i) above (winner) or below (loser) the median RTN (ii) whether SDR is above or below the median. Panels A, B and C contain the results for monthly, daily and MA(1) daily returns respectively. The assessment period is given by (M, 12-M) where M is the interim assessment month and $12 - M$ represents the rest of the year. The null hypothesis for the χ^2 statistic is that each cell has a frequency of 25%.

We selected data to match the years used by Busse (2001) and in Table 2, the results for the 2×2 contingency tables are recorded using the median classification. Calculations were performed for 5 different interim assessment months i.e. M=4, 5, 6, 7, and 8 which in all amounts to a total of 20 combinations. Panels A, B and C depict results of monthly data (compounded from daily data), daily data and MA(1) daily data respectively of computed RTN and SDR where the percentages are a reflection of 11 individual annual tournaments. For example, we sum up the number of funds classified as Low RTN/High SDR each year and divide by the total number of funds in all four classifications over 11 years. In order for the prediction in (2.1) to hold, we expect the two middle columns of the cells to have frequencies above 0.25. The values in parenthesis are those obtained by Busse (2001).

Results of the monthly returns in panel A are in line with that of Busse where with the exception of the earliest assessment period, the percentage of funds that fall into the Low RTN/High SDR cell is greater than the null expectation of 25%. The results are significant for only the last two evaluation periods which have equal values in all cells and also happen to be the periods with the highest dispersion.

The daily results in panel B assumed to be independent are different but do not give a strong rejection of the tournament hypothesis as in Busse's paper. The first two evaluation periods results are in line with equation (2.1) whereas the last three provide no evidence that mid-year losers increase end of year risk more than winners. The p-values also suggest that apart from the June cut-off, the null hypothesis that each cell has a frequency of 25% cannot be rejected. The interpretation of the results for the MA(1) daily returns in panel C are obviously similar to those described for the daily returns as they have the same trend.

II. Whole Sample Period

Table 3:

Frequency Distributions of the 2×2 Contingency Tables for the Rank-Ordered Classifications of RTN and SDR: Median Ranking

		Sample Frequency (% of observations)					
		Low RTN (Losers)		High RTN (Winners)			
Assessment Period	Obs	Low SDR	High SDR	Low SDR	High SDR	χ^2	p-value
Panel A. Monthly Returns							
(4,8)	11725	25.54	24.50	24.50	25.46	4.64	0.031
(5,7)		26.46	23.57	23.57	26.39	38.19	0.000
(6,6)		25.90	24.14	24.14	25.83	14.00	0.000
(7,5)		26.63	23.41	23.41	26.55	47.35	0.000
(8,4)		26.61	23.43	23.43	26.53	46.34	0.000
Panel B. Independent Daily Returns							
(4,8)	11725	27.15	22.89	22.89	27.07	83.44	0
(5,7)		26.37	23.67	23.67	26.29	33.33	0.000
(6,6)		26.46	23.57	23.57	26.39	38.19	0.000
(7,5)		26.68	23.36	23.36	26.60	50.45	0.000
(8,4)		26.41	23.63	23.63	26.33	35.06	0.000
Panel C. MA(1) Daily Returns							
(4,8)	11725	27.01	23.03	23.03	26.93	72.99	0
(5,7)		26.31	23.73	23.73	26.23	30.41	0.000
(6,6)		26.23	23.80	23.80	26.16	26.86	0.000
(7,5)		26.47	23.57	23.57	26.40	38.64	0.000
(8,4)		26.31	23.73	23.73	26.23	30.41	0.000

Results of the 2×2 median classification of rank ordered variables using (i) SDR which is the Standard Deviation ratio and (ii) RTN also the total compound relative return through the first 5 M months of the year. Interim assessments of fund performance are conducted at five different dates of M= 4, 5, 6, 7,and 8. The classifications are performed for surviving funds on yearly basis for all 730 funds using daily returns, monthly returns (compounded from the daily returns) and daily returns modeled as an MA(1) process. Funds are grouped each year into four classes by determining whether they are (i) above (winner) or below (loser) the median RTN (ii) whether SDR is above or below the median. Panel A and B contain the results for monthly and daily returns respectively whereas in panel C, we have results for the MA(1) daily returns. The assessment period is given by (M, 12-M) where M is the interim assessment month and $12 - M$ represents the rest of the year. The null hypothesis for the χ^2 statistic is that each cell has a frequency of 25%.

Table 3 shows cell frequencies for the median classification of rank ordered variables using the entire sample of data for this presentation. As was done previously for Table 2, separate contingency tables was computed for the evaluation month $M = 4, 5, 6, 7, 8$ of the relative return. It should be noted that a mere rejection of the null hypothesis of equal cell frequencies does not imply an evidence in favour of (2.1) when results are being interpreted. For example, if the two middle columns have frequencies below 25%, then the results indicate the opposite of the tournament hypothesis.

In panels A, B, and C representing the monthly returns, daily returns and MA(1) daily returns respectively, all of the cell frequencies are significantly different from the null of 25% and against the prediction in (2.1) regardless of the evaluation period which means there is no evidence that mid-year losers increase end of year risk more than winners. The April marking date (i.e. M=4) has the highest divergence in cell values in panels B and C whilst the monthly results in panel A attributes the largest dispersion from the null to the July cut-off. The results obtained here for the daily and MA(1) daily returns are in line with results obtained by Busse in his paper but the monthly results clearly contrasts with findings from both Brown *et al.* and Busse where the tournament hypothesis is supported for monthly data. The striking aspect of the results especially with monthly returns is that for a different time period, the hypothesis was supported as evident in Table 2 which implies that results might be a fluke of the time period.

An alternative reasoning is the strategic interaction between active fund managers where the winners are more likely to gamble given a high midyear performance gap or when stocks offer high returns and low volatility (Taylor, 2003). He argues that after the study by Brown *et al.* (1996), winner managers anticipated that the losers might potentially increase risk in the years following their findings and therefore raised their risk accordingly in order to maintain their position as outperformers. This may explain why we find no tournament evidence in our data since managers are well aware for a greater part of the time period (19 out of 24 years) that tournament behaviour exist and consequently, react strategically to cancel the effect.

Table 4:

Frequency Distributions of the 2×2 Contingency Tables for the Rank-Ordered Classifications of RTN and SDR: Quartile Ranking

		Sample Frequency (% of observations)					
		Low RTN (Losers)		High RTN (Winners)			
Assessment Period	Obs	Low SDR	High SDR	Low SDR	High SDR	χ^2	p-value
Panel A. Monthly Returns							
(4,8)	5859	25.90	24.17	24.56	25.37	4.25	0.039
(5,7)		26.32	23.74	23.67	26.27	15.68	0.001
(6,6)		26.78	23.28	23.95	25.99	19.27	0.000
(7,5)		27.45	22.62	21.88	28.05	71.85	0
(8,4)		27.63	22.43	21.97	27.97	74.06	0
Panel B. Independent Daily Returns							
(4,8)	5859	28.80	21.27	21.65	28.29	118.07	0
(5,7)		26.86	23.20	22.73	27.21	39.22	0.000
(6,6)		27.15	22.90	22.72	27.22	44.96	0.000
(7,5)		28.56	21.51	22.81	27.13	80.10	0
(8,4)		27.02	23.04	22.68	27.26	43.06	0.000
Panel C. MA(1) Daily Returns							
(4,8)	5859	28.70	21.37	21.78	28.15	110.35	0
(5,7)		26.88	23.18	22.94	27.00	35.42	0.000
(6,6)		27.10	22.96	22.89	27.05	40.49	0.000
(7,5)		28.20	21.87	23.06	26.87	63.98	0.000
(8,4)		26.95	23.11	22.75	27.19	40.37	0.000

Results of the 2×2 quartile classification of rank ordered variables using (i) SDR which is the Standard Deviation ratio and (ii) RTN also the total compound relative return through the first M months of the year. Interim assessments of fund performance are conducted at five different dates of M=4, 5, 6, 7,and 8. The classifications are performed for surviving funds on yearly basis for all 730 funds using daily returns, monthly returns (compounded from the daily returns) and daily returns modeled as an MA(1) process. Funds are grouped into four classes on yearly basis by determining whether they are (i) RTN is in the upper (winner) or lower (loser) quartile (ii) whether SDR is above or below the median. Panel A and B contain the results for monthly and daily returns respectively whereas in panel C, we have results for the MA(1) daily returns. The assessment period is given by (M, 12-M) where M is the interim assessment month and $12 - M$ represents the rest of the year. The null hypothesis for the χ^2 statistic is that each cell has a frequency of 25%.

The trend in results from Table 4 is not different from the description just given for Table 3. Thus, all the three categories of returns fail to accept the null hypothesis of equal cell frequencies and also do not support the tournament prediction (with significant results) whether we rank relative return (RTN) either by median or quartile.

III. Temporal Dynamics

Although the findings so far do not support the notion that losers increased portfolio risk more than winners over the entire 24-year period, the results cannot be said to be pervasive especially, considering the differences in monthly returns of Tables 2 and Table 3. We therefore examine further the tournament analysis in various sub-periods of data using just the median classification of ranking variables at an interim assessment period of $M = 6$. The results are given in Table 5 where we worked on twelve and six-year periods in addition to reporting previously obtained results of the entire sample to make the comparisons more accessible. With the exception of the 2004-2015 twelve-year period and the 2004-2009 six-year period in panel B of the MA(1) daily returns, the monthly results in panel A and remaining sub-periods of MA(1) daily results suggest that losers reduce risk relative to winners for all periods and the results are significant in most cases. The 2004-2009 and 2004-2015 sub-periods of MA(1) daily returns supports the prediction in (2.1) with statistically significant results.

IV. Beta and Residual Risk Ratios

In Table 6, we repeat the tournament analysis on beta and residual risks (equations (2.9) and (2.10)). Panel A represent results of the residual risk ratio whilst panel B is for the systematic risk ratio. The single factor and four factor models are denoted by SF and FF respectively. We have used the first factor of Fama French four factors, i.e. $Mf - Rf$, as the the SF since it represents the market. In panel B,

Table 5:

Frequency Distributions of the 2×2 Contingency Tables for Temporal Partitions of RTN and SDR Using the Median Values

		Sample Frequency (% of observations)					
		Low RTN (Losers)		High RTN (Winners)			
Assessment Period	Obs	Low SDR	High SDR	Low SDR	High SDR	χ^2	p-value
Panel A. Monthly Returns							
A1. Entire Sample							
1992-2015	11725	25.90	24.14	24.14	25.83	14.00	0.000
A2. Twelve-Year Periods							
1992-2003	5307	26.42	23.63	23.63	26.32	15.97	0.000
2004-2015	6418	25.48	24.56	24.56	25.41	2.03	0.154
A3. Six-Year Periods							
1992-1997	1858	25.83	24.17	24.17	25.83	2.07	0.150
1998-2003	3449	26.73	23.34	23.34	26.59	15.22	0.000
2004-2009	3671	25.20	24.84	24.84	25.12	0.15	0.700
2010-2015	2747	25.85	24.17	24.17	25.81	3.02	0.083
Panel B. Daily MA(1) Returns							
B1. Entire Sample							
1992-2015	11725	26.23	23.80	23.80	26.16	26.86	0.000
B2. Twelve-Year Periods							
1992-2003	5307	28.42	21.63	21.63	28.32	96.34	0
2004-2015	6418	24.43	25.60	25.60	24.37	3.70	0.054
B3. Six-Year Periods							
1992-1997	1858	25.30	24.70	24.70	25.30	0.26	0.610
1998-2003	3449	30.10	19.98	19.98	29.95	139.26	0
2004-2009	3671	23.59	26.45	26.45	23.51	12.36	0.000
2010-2015	2747	25.56	24.46	24.46	25.52	1.26	0.260

The table shows the cell frequencies for a 2×2 classification scheme of the rank-ordered variables: (i)Standard Deviation Ratio (SDR) and (ii)total relative return (RTN) using sub-periods of the sample. Panel A reports the results for monthly returns whereas Panel B reports the results for the daily MA(1) returns. The periods consist of the entire sample in addition to twelve and six years partitions with the interim assessment during the month of June (M=6). Funds have been ranked using only the median classification of assigning winners and losers. The χ^2 statistic is computed based on the null hypothesis that all cells have equal frequencies of 25%.

the second to fourth rows are the various components of the FF model. Apart from the statistically insignificant results of the SF residual risk and MOM component of the FF systematic risk, there is no evidence of a relation between performance and any of the betas or residual risk from daily regressions of the single- or four-factor specifications.

Table 6:

Frequency Distributions of the 2×2 Contingency Tables for Beta and Residual risk ratios

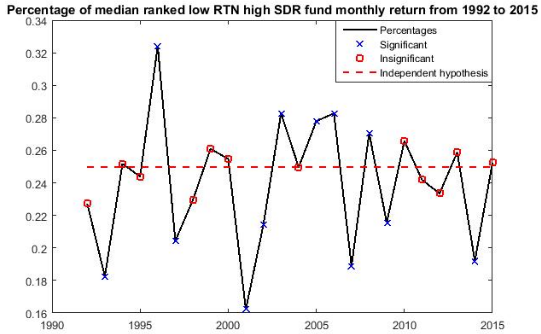
		Sample Frequency (% of observations)					
		Low RTN (Losers)		High RTN (Winners)			
Factor	Obs	Low Risk	High Risk	Low Risk	High Risk	χ^2	p-value
Panel A. Residual Risk Ratio							
SF	11725	25.01	25.03	25.03	24.93	0.03	0.856
FF	11725	25.20	24.84	24.84	25.13	0.52	0.471
Panel B : Systematic Risk Ratio							
SF	11725	25.31	24.72	24.72	25.24	1.43	0.231
Mf-Rf		25.71	24.33	24.33	25.63	8.37	0.004
SMB		25.73	24.31	24.31	25.65	9.02	0.003
HML		25.31	24.72	24.72	25.24	1.43	0.231
MOM		24.60	25.44	25.44	24.52	3.67	0.056

The table shows results of the residual and systematic risk ratios obtained base on equation (2.8). The ratios were obtained for both the single factor (SF) and Fama-French four factor (FF) models given by equations (2.9) and (2.10). Panel A contains the residual (ε) risk whilst Panels B reports the systematic (β) risk. The first row of panel B represents the single factor whereas the second to fifth rows are made up of the various components of the four factor model. The interim assessment period is the month of June (M=6) and funds have been ranked using the median classification of assigning winners and losers. The χ^2 statistic is computed based on the null hypothesis that all cells have equal frequencies of 25%.

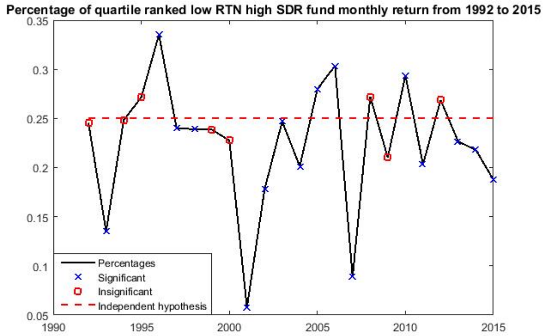
V. Yearly Tournament Analysis

From the temporal dynamics, we observe that for different sub-periods, we have different results, which leads us to have a look at more specific results for each year. The graphs in Figure 1 show the frequency distribution of the percentage of funds allotted to 2×2 contingency tables based on relative return and return standard deviation ratio on yearly basis for monthly, daily and MA(1) daily returns. Funds have been ranked using both the median and quartile classifications.

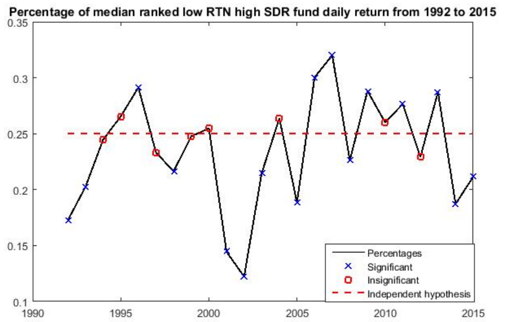
From the figure we could say that the tournament behaviour changes a lot over time, both in strength and direction. For example, the difference of sample frequency between year 1996 and 1997 in Low RTN/High RAR is as high as 12% using monthly return, and a difference of 5.8% using daily return. A distinctive feature of the all graphs is that, percentage frequencies closer to the null of 25% are insignificant and also, most of the yearly observations suggest that losers reduce risk relative to winners in the second-half of the year. Tables 11 and 12 in the appendix correspond to Figures 1a and 1c respectively. Further explanation of these yearly fluctuations is given in section 3.3.



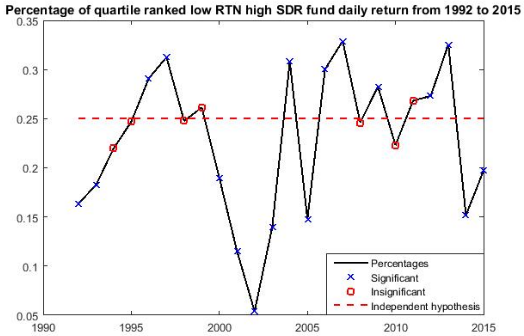
(a) Monthly Median Ranking.



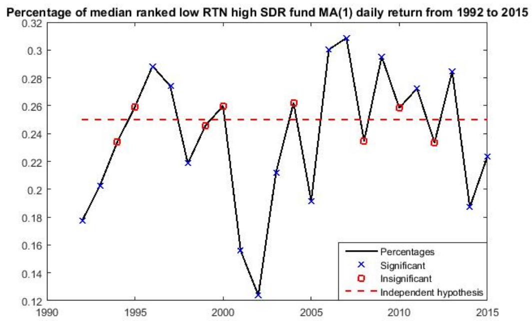
(b) Monthly Quartile Ranking.



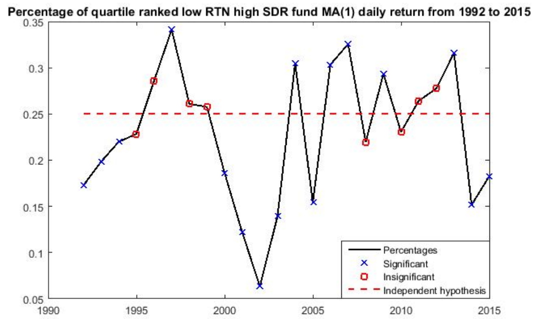
(c) Daily Median Ranking.



(d) Daily Quartile Ranking.



(e) MA(1) Median Ranking



(f) MA(1) quartile Ranking

Figure 1: **Frequency Distribution of Contingency Table for Each Year**:
Diagrams show Monthly, daily and MA(1) daily frequency distributions of the percentage of funds distributed to the cells in 2×2 contingency tables based on relative return (RTN) and return standard deviation ratio (SDR) on yearly tournament basis. The interim assessment period is the month of June (M=6) and funds have been ranked using both the median and quartile classification of assigning winners and losers. The χ^2 statistic is computed based on the null hypothesis that all cells have equal frequencies of 25% and is represented by the dashed line. Circled (crossed) percentages indicate significant (insignificant) results.

3.2 Does Autocorrelation In Data Influence Tournament Results?

According to Busse (2001), daily fund returns are autocorrelated (fund correlated with itself) and cross-correlated (correlations amongst funds) where the former could be due to market frictions, such as non-synchronous trading of the component securities (Kadlec and Patterson (1999) and Chalmers, Edelen, and Kadlec (2000)); time-varying economic premiums (Hameed (1997)); institutional investor trading patterns (Sias and Starks (1997)); or psychological factors (e.g. Jegadeesh and Titman (1993)). Cross-correlation occurs because the prices of the portfolio holdings often respond in the same direction to economic news. Correlations violate the independence assumptions used in deriving the χ^2 tests for equal cell frequencies. Thus, in order to examine the size of the χ^2 tests and to estimate empirical p-values, we simulate tournaments under the null hypothesis of no strategic managerial behaviour but also allowing for dependence. We employ exactly, the procedure used by Busse (2001) and the notations here are also from his paper unless stated otherwise.

Ideally, we want to get rid of any relation between performance and relative volatility in the simulated tournaments. For each fund, each year, we run the daily four-factor model given by;

$$R_{pd} = \alpha_{py} + \sum_{j=1}^{4}(\beta_{pjy}R_{jd} + L_{pjy}R_{j,d-1}) + \varepsilon_{pd}, \; d\text{=}1 \text{ to } D_y. \tag{3.1}$$

We then arrange the four factors and the residuals from the regressions in two matrices for each year of the 12-year sample period (i.e. from Jan. 2, 2004 to Dec. 31, 2015)[2]. The factor matrix is made up of D_y rows and four columns where

[2]Due to the heavy work of simulation for the whole 24 years, we decided to cut it down to 12 years in this part, and the more recently data explains better the current situation.

D_y is the number of daily returns in year y. In the residual matrix, there are D_y rows and 730 columns, where there are 730 funds in the sample. Factors are simulated by randomly selecting a row from the factor matrix and then using the following $D_y - 1$ rows in order, continuing with row one of the factor matrix after row D_y. To simulate residuals, we re-sample randomly with replacement D_y rows from the residual matrix. We then build up the simulated daily returns using the sum betas $(\beta_{pjy} + L_{pjy})$ and intercepts from regression equation (3.1) together with the simulated factors and simulated residuals. In this way, cross-correlation in the factors and residuals and most of the autocorrelation in the factors are preserved. Also, a large amount of randomness in the actual data due to the factors is also captured. We have used non-zero alphas with constant factor loadings throughout the year and re-sampled the residuals to remove any relation between performance and residual risk. Furthermore, re-sampling randomly for the first half of the year, independent of the second half, removes any tournament effects that may be present in the actual data.

We proceed to compute the RTN and SDR for each simulated fund over a January-June, July-December assessment period (i.e. $M = 6$) and allot funds in 2×2 contingency tables using the median classification of assigning winners and losers. The standard deviation estimates assume returns are independent. We repeat the procedure 10,000 times to generate an empirical distribution of the daily 2×2 contingency table allotments under the null hypothesis. Simulated daily returns are further compounded into monthly frequency to construct simulated distributions for monthly returns where we again compute the SDRs and then combine RTNs and SDRs. As with the daily simulations, we construct the simulated monthly distributions at the $M = 6$ assessment period.

Figure 2 shows the monthly and daily distributions of the simulations. The figure is positively skewed with the monthly (daily) distribution centered to the right (left) of the null expectation of 25%. Both also have fatter tails than the χ^2. Based on the two-tailed 5% χ^2 critical values, 39.96% of the monthly simulations would reject the null hypothesis which is an indication that the size of the standard χ^2 is wrong. The daily simulations are similarly prone to spurious rejections of the null. It is therefore important to conduct empirical evaluation of the actual results rather than with the theoretical χ^2 statistic.

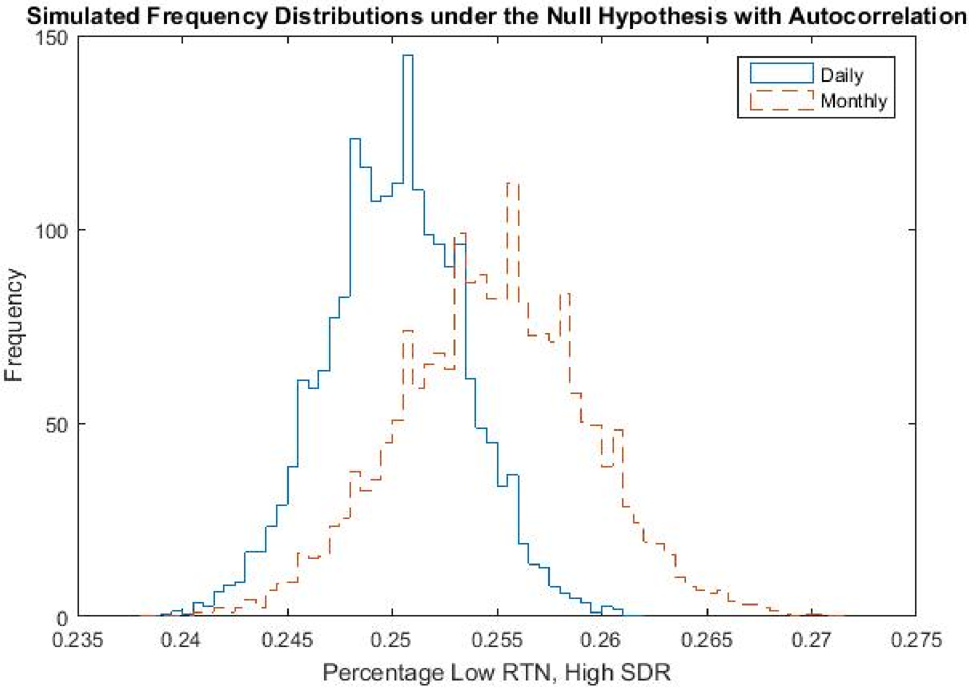


Figure 2: figure shows monthly and daily frequency distributions of the percentage of funds in the low RTN and high SDR cell of a 2×2 contingency table based on total return and return standard deviation ratio after an interim assessment in the month of June ($M = 6$). The distributions are based on 10,000 simulations under the null hypothesis that risk does not change. The simulations incorporate autocorrelation and cross-correlation in the daily returns. Low RTN funds have an RTN below the median and High SDR funds have an SDR above the median. The simulated sample consists of 730 mutual funds. The sample period is from Jan. 2, 2004, to Dec. 31, 2015.

The simulations are repeated as discussed previously, except we remove autocorrelation in the factors. From the actual four-factor and residual matrices, we re-sample randomly with replacement D_y rows from the four factors and, independently, D_y rows from the residuals. The simulated daily returns are built up using the sum betas $(\beta_{pjy} + L_{pjy})$ and intercepts from regression equation (3.1) with these random draws.

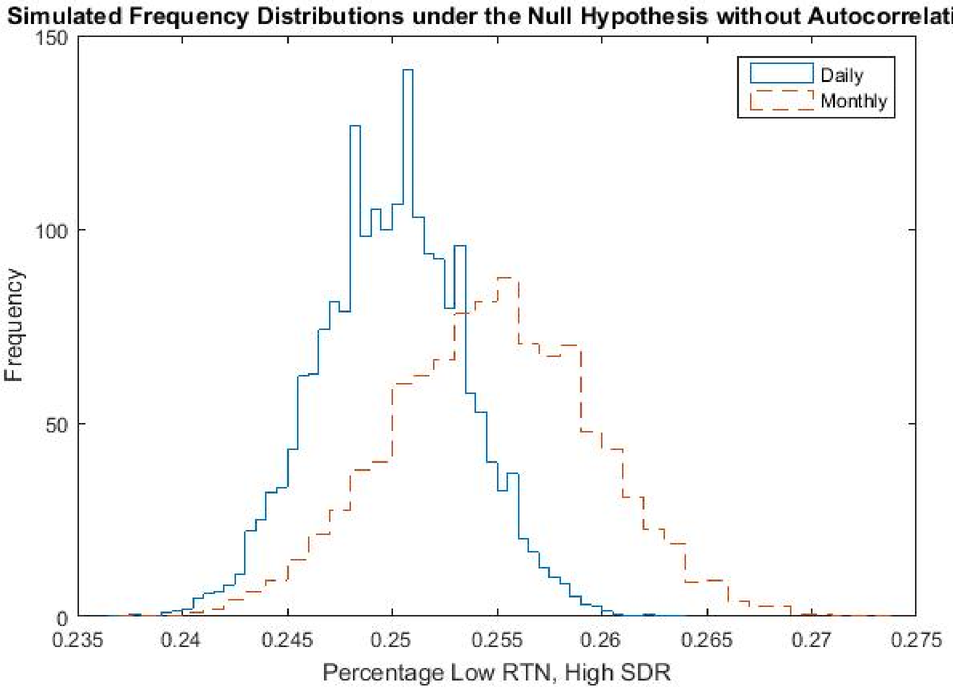


Figure 3: The figure shows monthly and daily frequency distributions of the percentage of funds in the low RTN and high SDR cell of a 2×2 contingency table based on total return and return standard deviation ratio after an interim assessment in the month of June ($M = 6$). The distributions are based on 10,000 simulations under the null hypothesis that risk does not change. The simulations incorporate cross-correlation in the daily returns. Low RTN funds have an RTN below the median and High SDR funds have an SDR above the median. The simulated sample consists of 730 mutual funds. The sample period is from Jan. 2, 2004, to Dec. 31, 2015.

The results are shown in Figure 3 which is not very different from that of Figure 2 despite the slight (very minimal) shift of the centers towards the null expectation of 25%. This suggests that autocorrelation in the daily returns does not affect to a great extent the monthly returns such as to create differences in the results which is possibly why the daily and monthly results produces similar results in Table 3 and

Table 4. Here also, the distributions have fatter tails than the χ^2.

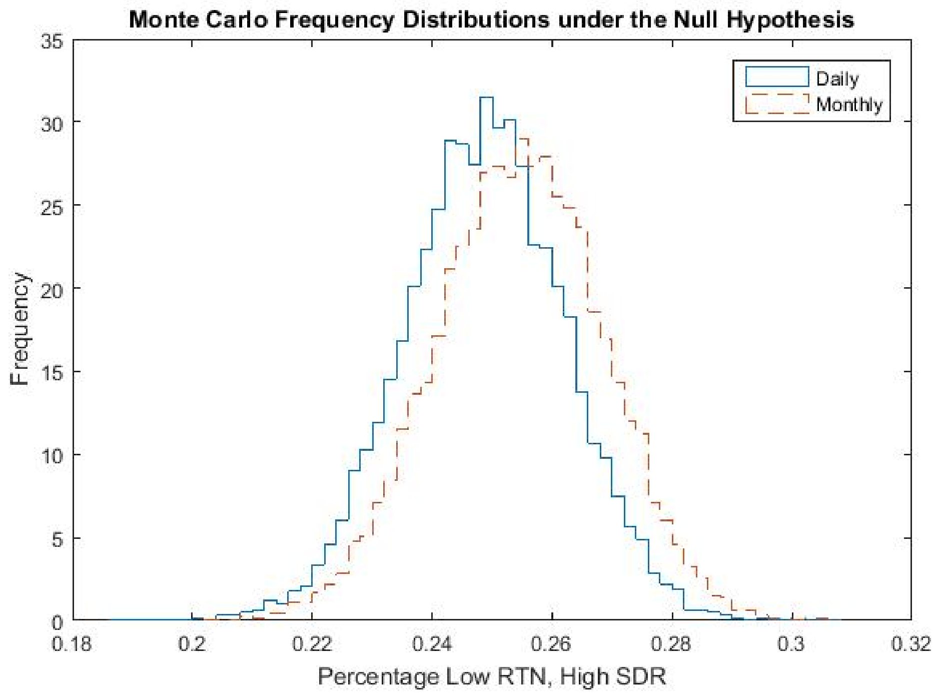


Figure 4: The figure shows monthly and daily frequency distributions of the percentage of funds in the low RTN and high SDR cell of a 2×2 contingency table based on total return and return standard deviation ratio after an interim assessment in the month of June ($M = 6$). The distributions are based on 10,000 Monte Carlo simulations under the null hypothesis that risk does not change. The simulations incorporate cross-correlation in the daily returns. Low RTN funds have an RTN below the median and High SDR funds have an SDR above the median. The simulated sample consists of 730 mutual funds. The sample period is from Jan. 2, 2004, to Dec. 31, 2015.

Our next step is to use the Monte Carlo approach as a check where we have used the normality assumption on which the statistics are based. Four factors are drawn randomly from normal distributions with means and covariance matrix matching those of the actual daily factors. The residuals are also drawn independently from normal distributions with a covariance matrix that matches that of the actual residuals. Using the sum betas $(\beta_{pjy} + L_{pjy})$ and intercepts from regression equation (3.1) with these random draws, the simulated daily returns are built up. We also build the simulated returns with the use of the contemporaneous and lag betas separately instead of combining them into sum betas.

Figure 4 shows the results of the Monte Carlo simulations using the sum betas ($\beta_{pjy} + L_{pjy}$). The distributions are narrower than the previous distributions of the simulations that use the actual return data and much more centered around the null expectation of 25%. The simulations are not materially different when the contemporaneous and lagged betas are used independently rather than combining them into sum betas.

Explaining the Results

The allotment of funds to cells with respect to average returns during the assessment period is invariant to the frequency of data and therefore, it is possible for autocorrelation patterns to have an effect on the monthly and daily results but we cannot also ignore the time period factor in the discussion. Since funds with low returns in the evaluation period tend to have higher autocorrelation in the second half of the year, their relative standard deviations can be biased upward in the second part of the year.

To probe this interpretation for the monthly ratios, we examine the funds that have conflicting monthly and daily SDR classifications. Table 7 panel A shows the number of funds that falls into each of eight categories of intersections of RTN and monthly and daily SDR classifications. About 40% of the SDR classifications differ with monthly and daily data.

In panel B of Table 7, we have the average autocorrelation patterns for the eight categories where for each RTN, daily SDR grouping, funds classified as high monthly SDR have smaller average first half year MA(1) coefficients than their low monthly SDR counterparts. The high monthly SDR funds also have larger average increases in autocorrelation from the beginning to the end of the year. But unlike in Busse,

Table 7:

Daily Autocorrelation and Small Stock Exposure

	Low RTN				High RTN			
	Low Daily SDR		High Daily SDR		Low Daily SDR		High Daily SDR	
	High Monthly SDR	Low Monthly SDR	High Monthly SDR	Low Monthly SDR	High Monthly SDR	Low Monthly SDR	High Monthly SDR	Low Monthly SDR
Panel A. Number								
No.	1209	1894	1621	1143	1128	1636	1900	1194
Panel B. Autocorrelation								
Jan-Jun MA(1)	-0.0039	0.0198	0.0054	0.0227	0.0010	0.0237	0.0138	0.0312
Jul-Dec MA(1)	0.0364	0.0348	0.0383	0.0305	0.0425	0.0417	0.0503	0.0393
MA(1) Change	0.0403	0.0151	0.0328	0.0078	0.0414	0.0180	0.0365	0.0081

The table records the intra-year autocorrelation patterns of the intersection of funds distributed to cells based on: (i) total return during the first six months of the year (RTN); (ii) the ratio of daily return standard deviation during the last six months of the year to daily return standard deviation during the first six months of the year (daily SDR); (iii) the ratio of monthly return standard deviation during the last six months of the year to monthly return standard deviation during the first six months of the year (monthly SDR).

the results do not suggest however that autocorrelation in daily returns drives a monthly tournament pattern since our tournament analysis found no evidence to support (2.1) for both monthly and daily data.

Busse attributed the monthly tournament pattern arising in his work to the fact that there were more low RTN funds classified as low daily SDR, high monthly SDR than as the high daily SDR, low monthly SDR and that across the entire sample of funds, there were large increases in the return autocorrelation from the beginning to the end of the year which ceteris paribus, led to larger average increases in the bias in relative monthly standard deviation for such funds. Even though these factors were apparent in our analysis, there were no clear monthly tournament patterns in our results. This implies that autocorrelation in daily data do not drive monthly tournament patterns as suggested by Busse for the data used in our work. This brings us back to the previous assertion that results might actually be a fluke of the time period used.

Some Time Period Conditions And Their Effect On Tournament Results

Conditions and characteristics with respect to the economy and market exist within specified periods of time which necessarily drive economic actors including fund managers to operate in ways so as to avoid any devastating effect and maintain a level of risk capable of rendering reasonable returns. It is therefore imperative to identify such prevailing conditions to establish their effect on the tournament hypothesis. To achieve this, we identify periods of economic expansions and recessions as well bear and bull markets within the time frame of our sample.

During periods of economic expansions, conditions are said to be sound and positive whilst adverse and negative conditions are attributed to economic recessions. The definitive source of setting official dates for U.S. economic cycles is the National Bureau of Economic Research (NBER)[3]. A bear market is characterised by falling prices of securities and negative market sentiments whereas in a bull market, security prices are rising with accompanying positive expectations of the market. The bear and bull markets used are those identified by Forbes magazine[4].

We proceed to build contingency tables with respect to recessions and expansions as well as bear and bull markets. Tables 8 and 9 show the cell frequencies for different economy and market period classifications with respect to median ranking using monthly and daily return respectively. In Panel A, we classify economy into

[3]NBER recession periods are: Dec 1969 to Nov 1970, Nov 1973 to Mar 1975, Jan to Jul 1980, Jul 1981 to Nov 1982, Jul 1990 to Mar 1991, Mar to Nov 2001, Dec 2007 to June 2009.

[4]Forbes bear market periods are: Feb to Oct 1966, Nov 1968 to Jun 1970, Jan 1973 to Sep 1974, Jan 1977 to Feb 1978, Dec 1980 to Jul 1982, Jul 1983 to Jul 1984, Sep 1987 to Nov 1987, June 1990 to Oct 1990, July 1998 to Oct 1998, Mar 2000 to Oct 2002, Oct 2007 to Feb 2009 (NBER and Forbes' dates obtained from Amundi Working Paper, Factor-Based v. Industry-Based Asset Allocation, June 2015).

recession and expansion periods according to NBER: for Table 8, we reject the null hypothesis of 25% in each cell only in the recession classification of whole period and sub-period of year 2001, and we find no evidence of tournaments; for Table 9, we reject the null hypothesis except for sub-periods 2008-2009 in recession and 2010-2015 in expansion, and we find that there are no tournaments for both entire sample period and listed sub-periods apart from period 2008-2009 which is dated into recession classification.

In Panel B, the bear and bull market periods are identified by Forbes Magazine. From the results, the null hypothesis is rejected for bear market regardless of whether it is the entire or sub-periods for both monthly return and daily return. We find that the Low RTN and High SDR cell is strongly against our tournament hypothesis judging from the very low frequencies in Table 9, whilst in Table 8, we find strong proof of tournament for year 2008 which is the year dated as bear market. For the bull market in Table 8, we fail to reject the null hypothesis of 25% frequency in each cell except for period 2009-2015, whereas in Table 9, we reject the null hypothesis for period 1992-1999, and we find evidence to support the tournament hypothesis that risk in second-half year is higher than that of the first-half year for losers in sub-period 2003-2007 for monthly returns and in sub-periods 2003-2007 and 2009-2015 for daily return. This finding is consistent with the results in Table 5 that for monthly returns, there is no evidence of tournaments but for daily MA(1) returns, we find tournaments in the 2004-2009 six-year period.

Economic conditions (expansions and recessions) do not affect managers' risk taking attitude or Taylor's study comes into play as all evidence are against the tournament hypothesis inferring from the results. On the other hand, market characteristics (bear and bull markets) do affect how managers alter the risk of their funds.

Table 8:

Frequency Distributions of the 2×2 Contingency Tables for Timing Classification of RTN and SDR Using Monthly Return and Median Values

		Sample Frequency (% of observations)					
		Low RTN (Losers)		High RTN (Winners)			
Assessment Period	Obs	Low SDR	High SDR	Low SDR	High SDR	χ^2	p-value
Panel A. Recession & Expansion							
A1. Entire Sample							
Recessions	1785	28.46	21.57	21.57	28.40	33.63	0.000
Expansions	9940	25.44	24.60	24.60	25.36	2.59	0.108
A2. Recession Sub-period							
2001	623	33.87	16.21	16.21	33.71	76.99	0
2008-2009	1162	25.56	24.44	24.44	25.56	0.58	0.446
A3. Expansion Sub-period							
1992-2000	3421	25.52	24.52	24.52	25.43	1.24	0.265
2002-2007	3772	25.08	24.97	24.97	24.97	0.01	0.910
2010-2015	2747	25.85	24.17	24.17	25.81	3.02	0.083
Panel B. Bear & Bull Market							
B1. Entire Sample							
Bear Market	2444	27.58	22.46	22.46	27.50	25.17	0.000
Bull Market	9281	25.46	24.58	24.58	25.39	2.67	0.103
B2. Bear Market Sub-period							
2000-2002	1834	29.12	20.94	20.94	29.01	48.43	0.000
2008	610	22.95	27.05	27.05	22.95	4.10	0.043
B3. Bull Market Sub-period							
1992-1999	2840	25.70	24.33	24.33	25.63	2.04	0.154
2003-2007	3142	24.38	25.68	25.68	24.25	2.36	0.124
2009-2015	3299	26.28	23.73	23.73	26.25	8.45	0.004

The table shows the cell frequencies for a 2×2 classification scheme of the rank-ordered variables: (i)Standard Deviation Ratio (SDR) and (ii) total relative return (RTN) using recession & expansion and bear & bull market classification. Panel A reports the results for recession & expansion economy whereas Panel B reports the results for bear & bull market. The periods consist of the entire sample in addition to sub-periods within different classification with the interim assessment during the month of June (M=6). Funds have been ranked using monthly return and only the median classification of assigning winners and losers. The classification of recession & expansion dated by NBER recession periods and the bear & bull market identified by Forbes Magazine, in case that recession period or bear market begins after July (July included), we take the year into expansion period or bull market since CG. Schwarz hypothesize that each year the existing methodology sorts mangers by their first-half returns. For example, in year 1998 bear market began from July, we put year 1998 into bull market classification. The χ^2 statistic is computed based on the null hypothesis that all cells have equal frequencies of 25%.

Table 9:

Frequency Distributions of the 2×2 Contingency Tables for Timing Classification of RTN and SDR Using Daily Return and Median Values

		Sample Frequency (% of observations)					
		Low RTN (Losers)		High RTN (Winners)			
Assessment Period	Obs	Low SDR	High SDR	Low SDR	High SDR	χ^2	p-value
Panel A. Recession & Expansion							
A1. Entire Sample							
Recessions	1785	28.35	21.68	21.68	28.29	31.47	0.000
Expansions	9940	26.13	23.91	23.91	26.05	18.79	0.000
A2. Recession Sub-period							
2001	623	35.63	14.45	14.45	35.47	111.03	0
2008-2009	1162	24.44	25.56	25.56	24.44	0.58	0.446
A3. Expansion Sub-period							
1992-2000	3421	25.96	24.09	24.09	25.87	4.57	0.033
2002-2007	3772	26.62	23.44	23.44	26.51	14.77	0.000
2010-2015	2747	25.66	24.35	24.35	25.63	1.84	0.175
Panel B. Bear & Bull Market							
B1. Entire Sample							
Bear Market	2444	31.51	18.54	18.54	31.42	163.43	0
Bull Market	9281	25.14	24.90	24.90	25.06	0.16	0.691
B2. Bear Market Sub-period							
2000-2002	1834	32.88	17.18	17.18	32.77	179.65	0
2008	610	27.38	22.62	22.62	27.38	5.51	0.019
B3. Bull Market Sub-period							
1992-1999	2840	26.23	23.80	23.80	26.16	6.52	0.011
2003-2007	3142	24.38	25.68	25.68	24.25	2.36	0.124
2009-2015	3299	24.92	25.10	25.10	24.89	0.05	0.820

The table shows the cell frequencies for a 2×2 classification scheme of the rank-ordered variables: (i)Standard Deviation Ratio (SDR) and (ii) total relative return (RTN) using recession & expansion and bear & bull market classification. Panel A reports the results for recession & expansion economy whereas Panel B reports the results for bear & bull market. The periods consist of the entire sample in addition to sub-periods within different classification with the interim assessment during the month of June (M=6). Funds have been ranked using daily return and only the median classification of assigning winners and losers. The classification of recession & expansion dated by NBER recession periods and the bear & bull market identified by Forbes Magazine, in case that recession period or bear market begins after July (July included), we take the year into expansion period or bull market since CG. Schwarz hypothesize that each year the existing methodology sorts mangers by their first-half returns. For example, in year 1998 bear market began from July, we put year 1998 into bull market classification. The χ^2 statistic is computed based on the null hypothesis that all cells have equal frequencies of 25%.

3.3 New Evidence: Sorting Bias

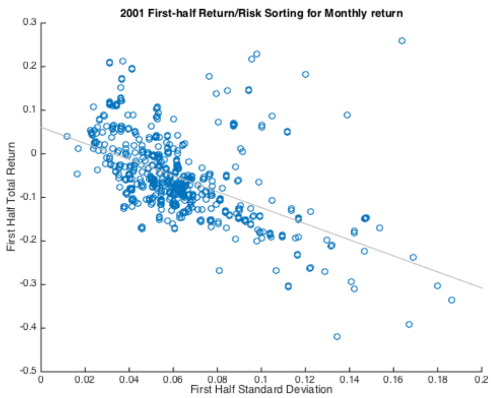
We followed Busse (2001) and found different results for sub-periods 1985-1995 and 1992-2015. We then showed the graphics of yearly tournament (Figure 1), from which we observed that the strength and direction of tournament behaviour changed a lot. We also analysed periods of economic expansions and recessions as well as bull and bear market periods where we found varying results of the tournament hypothesis. These conflicting results leave the important issue unanswered: how and whether previous return performance motivates mutual fund managers to modify their risk-taking behaviour (Schwarz, 2011).

In Schwarz's paper, he found a new evidence called sorting bias. He hypothesized that the varying results are due to a 'sorting bias', which means given the dependence of risk and return, return sorting will also likely sort risk levels (standard deviation) as well: for example, if the market performed well, the funds with lower first-half returns will also tend to have lower first-half risk[5]. According to Schwarz, because of this risk sorting, even if managers do not engage in second-half risk-shifting behaviour, it will appear that risk-increasing tournament behavior occurs as the mean reversion of risk levels over the second half of the year will cause the first-half high-return funds' risk levels to decline relatively more than the first-half low-return funds' risk levels. Thus, sorting bias varies over time depending on the direction and magnitude of first-half risk sorting. From this point, we follow his paper and probe how the market could influence the tournament hypothesis through sorting bias.

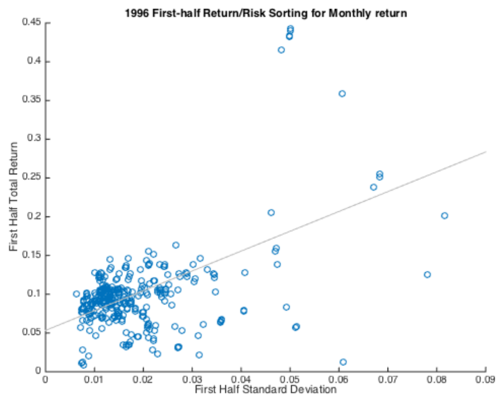
Following Schwarz (2011), we provide a visual demonstration of the sorting bias.

[5] Alternatively, if the market performs poorly over the first half of the year, the funds' risk levels will again be sorted, but in this case funds with lower first-half returns will tend to have higher first-half risk.

Consider two of the strongest tournament behaviour from Figure 1(a) and Figure 1(c): year 1996 and year 2001 for monthly return, year 2002 and year 2007 for daily return. Results from year 2001 and 2002 conclude that under-performing managers are decreasing risk, whereas results of year 1996 and 2007 indicate that under-performing managers are increasing risk. In 2002, stock prices took a sharp downturn. The Standard & Poor's 500-stock index slid 24.48 points, or 2.7 percent, to 881.56, financial and health care stocks contributed about half the loss, the United States stock benchmark has not been that low since Oct. 27, 1997[6]. In 2007, there was a bear market onslaught from 10th October, and before that, the S & P 500 stock index rose for 10.49% from 3 January to 9 October [7].



(a)



(b)

Figure 5: The figure displays the relationship between first-half return and risk for mutual funds in 2001 and 1996 using monthly return. First-half returns, are plotted on y-axis, while first-half monthly standard deviation are plotted on x-axis.

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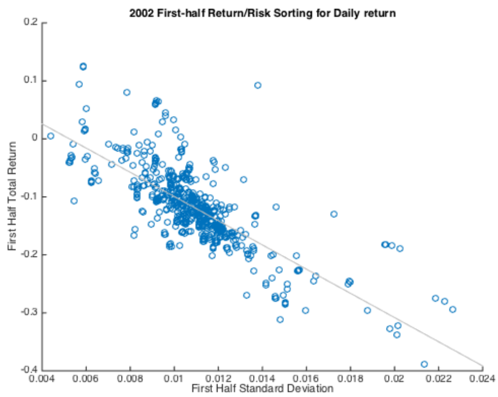
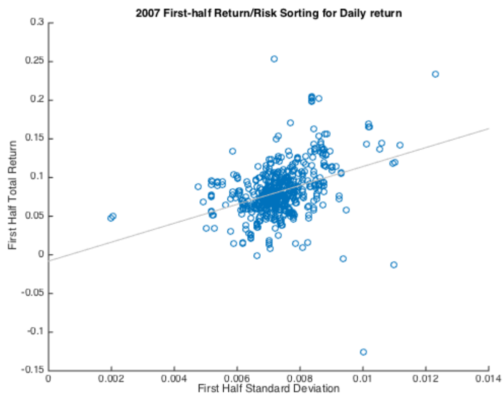
[6] By BLOOMBERG NEWS Published: July 19, 2002

[7] ^GSPC: Historical prices for S&P 500 *http://finance.yahoo.com/q/hp?s=^GSPC*



(a)



(b)

Figure 6: The figure displays the relationship between first-half return and risk for mutual funds in 2002 and 2007 using daily return. First-half returns, are plotted on y-axis, while first-half daily standard deviations are plotted on x-axis.

Figures 5 and 6 show the risk sorting described previously using monthly and daily data respectively. In 2002 (figure 6(a)), there is obviously a negative relationship between return and risk in a bear market. Funds in the low-return group with higher risk levels in the first half of the year, are shown to decrease risk in the second half of the year. The graph of year 2007 (figure 6(b)) shows the opposite result, where there is a positive relationship between first-half return and risk.

Relationship between risk sorting and empirical results

As discussed previously from the work of Schwarz (2011), if risk levels, i.e. standard deviations, are mean reverting and sorting on return also sorts on risk, the standard tournament methodology will suffer from a sorting bias. We therefore follow Schwarz's (2011) paper to examine the level of risk sorting (measured by before ratio) and the amount of tournament behavior (measured by frequency difference) using our data for both monthly and daily returns over the entire sample period.

First, we compute the *Frequency Difference*, which is used as a measure of tournament behavior under the contingency table approach. This value is calculated by finding the difference of the percentages of observations in the High SDR and Low SDR cells for Low RTN funds reported in Tables 11 and 12 in the Appendix. We also calculate the *Before Ratio*, which is the ratio of high-performing funds' median standard deviation divided by the under-performing funds' median standard deviation the first half of the year. If the value of this ratio is greater than one, it indicates that the risk levels of the high-return portfolios are significantly higher in the first half of the year, and if the value is less than one, then it is an indication that the low-return portfolios have significantly higher risk in the first half of the year. Further, besides the contingency tables results, we also compute tournament results with the use of the regression and ranking approach. In this model, the differences between funds' second-half standard deviations and first-half standard deviations are regressed against funds' first-half performance rankings. We rank funds from zero to one, with the highest-performing fund receiving a ranking of one. The results of the relationship between the Before Ratio and tournament behavior in Table 13 and 14 (in Appendix), which are reported for monthly data and daily data respectively. To make the comparison of the results easier, we multiply the rank regression coefficients by minus one so positive values of both the contingency table and rank regression results indicate low-performing funds are increasing risk.

Generally speaking, the results from both Tables 13 and 14 given in the appendix for monthly and daily data respectively are supportive of the risk-sorting hypothesis. In Table 13, the correlations between the level of the first-half risk sorting and tournament behaviour as measured by the contingency table and the rank regression coefficients, are 0.7 and 0.58 respectively. In the years with significant evidence of tournament (1996, 2003, 2005, 2006, 2008), the risk levels for the outperforming funds in the first half of the year are significantly higher than the under-performing funds except in year 2006. Majority of the years in which losers lower their risk levels significantly also comply with the risk sorting hypothesis: they include years 1993, 1997, 2001, 2002, 2007, 2009 and 2014 where with the exception of years 1997 and 2009, first-half year risk levels of under-performing funds were higher than their high-performing counterparts.

The results for daily returns given in Table 14 reports 0.63 and 0.49 as the correlations between the level of the first-half risk sorting and tournament behaviour as measured by the contingency table and the rank regression coefficients respectively. Years with significant tournament results are 1996, 2006, 2007, 2009, 2011, and 2013. Contradictions to sorting bias occurred in 2006 and 2011 whilst in the remaining years, loser funds had lower risk levels in the first-half year compared to high-performing funds. In 1992, 1993, 2001, 2002, 2008, and 2014, we find statistically significant results with opposite direction of tournament hypothesis and the risk levels of first-half low-performing funds are higher than the high-performing funds.

To sum up, the results are in agreement with findings by Schwarz (2011) that loser and winner funds' risk levels display mean reversion in the second half of the year in most of the years. This implies, the relation between return and risk in a specified market condition determines the occurrence of a tournament or not and not the deliberate actions of fund managers. Further, the results from a greater number of the years also corroborate findings from the bear and bull market periods in Tables 8 and 9. There are a few cases where the relationship is contradictory, such as the bull market sub-period of 1992-1999 in Tables 8 and 9. Most of the years within this period exhibited this deviation as shown in the columns for frequency difference in Tables 13 and 14 which in turn, affected the tournament direction. Thus, a positive (negative) slope is not always the case in a bull (bear) market and this puzzle is described in a paper by Ang *et al.* (2009). An example is depicted in Figure 7 for the year 1992 which is dated as bull market.

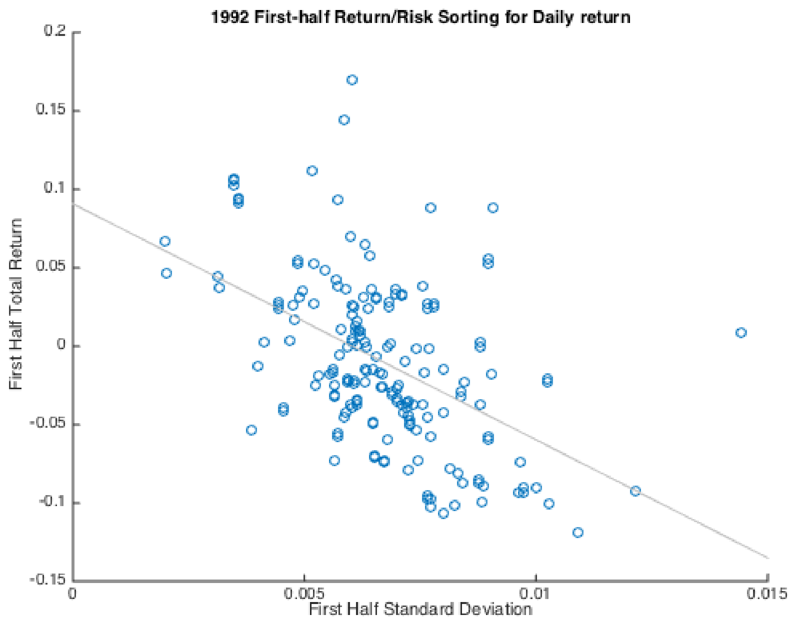


Figure 7: The figure displays the relationship between first-half return and risk for mutual funds in 1992. First-half returns, are plotted on y-axis, while first-half daily standard deviation are plotted on x-axis.

Numeric demonstration of risk-sorting problem

The prior section's results document a significant evidence for sorting bias, in this section, we demonstrate these findings using a numerical simulation following Schwarz (2011). Monthly returns are generated from

$$R_{it} = r_f + \beta_i(R_{mt} - r_f) + \epsilon_{it} \tag{3.2}$$

where the risk free rate r_f is assumed to be 0.005, and the idiosyncratic term ϵ_{it} is assumed to be distributed as normal with mean zero and standard deviation σ_i. Betas, representing the funds' first half year monthly betas, are randomly assigned to the 730 funds. The distribution of the assigned betas is normal with a mean of 0.99 and an average sub-period standard deviation of 0.32. Funds are also assigned an annualized idiosyncratic risk level, which has a mean of 4.7% and standard deviation of 2.8%. The correlation between the randomly assigned idiosyncratic risk levels and betas is 0.29.

Over the course of the year, funds' monthly betas linearly change from the randomly assigned January betas to December betas. A fund's end-of-the-year beta is computed as

$$\beta_{i2} = \beta_{i1} + \alpha(\beta_{mf} - \beta_{i1}) + \epsilon_i, \tag{3.3}$$

where ϵ is distributed normally with mean zero and standard deviation such that the second-half betas also have a standard deviation of 0.32. To calibrate the value of the mean reversion parameter α, we find the median cross-sectional correlation of funds' betas over the first and second halves of the year in our data sample, which is 0.51. Using trial and error, we find that an α of 0.63 arrives at the correlation of the betas. Funds are also assigned an end-of-the-year idiosyncratic risk level. To calibrate the second-half year idiosyncratic risk, we followed the paper of S. Brown *et al.* (1992). Schwarz (2011) also used the numerical simulation similar to this paper. The relationship between non-systematic risk and β is approximated by:

$$\sigma_i^2 = k(1 - \beta_i)^2. \tag{3.4}$$

The value of k chosen in the simulation experiment is 0.0225, which ensures that the end-of-the-year idiosyncratic risk level has the same distributional assumptions and correlation with betas as the initially assigned idiosyncratic risk levels.

Using the generated monthly betas and idiosyncratic risk levels, monthly S&P 500 returns are then employed to generate monthly returns for the 730 funds. With the generated returns, we run the contingency table tournament tests and compute the Before Ratio and Frequency Difference. 10,000 simulations are run for each year and the median outcomes reported.

Table 10 reports the simulated relationship between risk sorting and tournament behaviour. There is a strong correlation between the Before Ratio and tournament behaviour: losers increase risk when they have lower risk in the first-half year, that is when before ratio greater than 1. And we have a similar trend as Schwarz (2011) for year 1992-2006. Even with no tournament behaviour embedded in the simulations, the time series properties of the simulated results closely match the prior findings. But still some individual years' results are not consistent. For example, in 2010 the empirical results find winners increasing risk while the simulations show winners decreasing risk. Even though the beta model is able to explain a large portion of mutual fund returns, there are a variety of reasons that the risk sorting in the first period in the simulations is different from actual data (e.g., Carhart 1997). Thus, although the tournament behaviour for some years is inconsistent, these differences do not invalidate the sorting bias.

Schwarz (2011) corrects for this bias in data by using portfolio holdings to examine the decision of managers. He does this by comparing the risk characteristics of changes in portfolio against the average risk levels of portfolios. This correction is beyond the scope of this study due to inadequate data concerning the stock holdings of the funds used.

Table 10:

Simulated relationship between risk sorting and tournament behavior

Year	Low RTN ("Losers") Low SDR	High SDR	Frequency Difference	1-6 month Std. Dev. Low RTN	High RTN	Before Ratio
1992	25.91	24.09	-1.82	0.0204	0.0197	0.9683
1993	24.60	25.40	0.79	0.0174	0.0180	1.0397
1994	26.60	23.40	-3.19	0.0299	0.0278	0.9304
1995	18.83	31.17	12.35	0.0059	0.0127	2.1612
1996	22.80	27.20	4.40	0.0100	0.0130	1.2999
1997	22.84	27.16	4.33	0.0359	0.0389	1.0827
1998	23.40	26.71	3.31	0.0296	0.0315	1.0647
1999	23.82	26.28	2.46	0.0339	0.0359	1.0579
2000	25.47	24.61	-0.86	0.0435	0.0423	0.9716
2001	27.29	22.79	-4.49	0.0593	0.0516	0.8698
2002	27.30	22.70	-4.60	0.0417	0.0378	0.9054
2003	23.70	26.38	2.69	0.0393	0.0412	1.0482
2004	24.96	25.12	0.16	0.0172	0.0173	1.0066
2005	26.37	23.70	-2.67	0.0239	0.0225	0.9452
2006	25.08	24.92	-0.16	0.0204	0.0202	0.9893
2007	24.47	25.62	1.15	0.0258	0.0263	1.0180
2008	26.23	23.77	-2.46	0.0508	0.0492	0.9671
2009	25.18	24.82	-0.36	0.0826	0.0821	0.9939
2010	26.02	23.98	-2.04	0.0533	0.0522	0.9780
2011	24.59	25.41	0.81	0.0214	0.0217	1.0129
2012	24.01	25.99	1.98	0.0438	0.0450	1.0264
2013	23.06	27.06	4.00	0.0216	0.0229	1.0591
2014	24.64	25.36	0.71	0.0269	0.0273	1.0122
2015	25.24	24.76	-0.48	0.0315	0.0312	0.9922
Correlation of Before Ratio and Freq. Difference						0.85

The table reports the results of the comparison of observed tournament behaviour with risk sorting in the first period using generated returns for year 1992-2015. Frequency Difference is the difference of the percentages of observations in the High SDR and Low SDR cells for Low RTN funds, while Rank Coefficient is the coefficient from a regression with changes in risk levels as dependent variables and funds' performance rankings in the first half of the year as independent variables. The median fund standard deviations are given for the first and second six months of the year for the Low RTN and High RTN groups. Before Ratio is the ratio of the first-half High RTN standard deviation divided by the first-half Low RTN standard deviation. Rank Coefficient results are shown with the opposite sign to present the same conclusions as the Frequency Difference results.

4 Summary and Conclusion

In this presentation, we re-examine the risk-taking behaviour of mutual fund managers with respect to relative risk. The central prediction by Brown *et al.* (1996) that interim first half year underperformers would increase risk more than high-performers over the sample period was not supported by both monthly and daily data sets used. The results were no different after daily data had been modeled as a moving average process to get rid of first-order autocorrelation. The monthly results for the 24-year period were different from findings by both Brown *et al.* (1996) and Busse (2001). That not withstanding, data selected to match the time period used by Busse provided tournaments in the monthly results. This suggests that results might be just a coincidence of the time period used. Another probable explanation is findings in the work by Taylor (2003) where he attributes the absence of tournaments, especially after the year 1996 (awareness of tournaments in mutual funds created by the work released by Brown *et al.* (1996)) to strategic risk taking by winner fund managers to maintain their high-performance. According to him, winners anticipate the gamble that losers might take to increase risk in the second half of the year as suggested by Brown *et al.* As such, they (winners) also increase risk with a certain probability which leads to higher risk for winners than losers in equilibrium.

We proceeded to test the analysis with data devoid of autocorrelation in returns to examine whether autocorrelation in daily data drives monthly tournament results as suggested by Busse (2001). This was achieved by simulating a mutual fund environment with no strategic risk taking and we found both correlated and uncorrelated data results to be consistent with no tournament results which was expected. Busse attributes the differences in results of monthly and daily data to autocorrelation in daily returns which bias monthly standard deviation estimates but clearly, our data was not affected by any autocorrelation present in daily data. We next explored various market and economic conditions likely to drive the direction of tournaments where we worked on periods of economic expansions and recessions as well as bear and bull market periods. The results closely relates to the the evidence of sorting bias.

Schwarz (2011) relates tournament behaviour to the level of concurrent risk sorting occurring when return sorting is conducted in the first half year. Conducting the tournament analysis on yearly basis revealed that lots of changes occur in the strength and direction of results overtime. There was no evidence of sorting bias in the expansion and recession periods and the results for both monthly and daily data indicated that losers in the interim assessment lower their risk levels compared to winners in the second half year. The bear and bull markets strongly displayed mean reversion of winner and loser funds after mid-year evaluation and this effect (sorting bias) strongly dictated the direction of tournaments. In bull markets, losers increased risk in response to their relative performance whilst the opposite occurred in bear markets. As such, the risk/return relationship plays a major role in the risk taking attitude of managers. Their actions are not necessarily deliberate but the market conditions prevailing in a particular time period most likely drive tournament results. We should bear in mind that there can be deviations from this reasoning but the occurrence is minimal.

A numeric demonstration of the risk sorting problem gave evidence of a strong correlation between the Before Ratio and tournament behaviour where we eliminated the existence of tournaments in the simulations but the time series properties of the simulated results matched the prior findings.

In conclusion, we find no tournament behaviour with losers rather reducing risk in monthly as well as daily data for our sample period of 24 years. There was autocorrelation in daily data but this did not affect the monthly results as suggested by Busse. Further, market characteristics such as bear and bull market periods produced tournament results mostly in line with the new evidence of sorting bias. We chose data from the United States to do the analysis in order that, we can easily compare results with previously conducted studies but it will also be interesting to examine the hypothesis on different geographical locations.

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Appendices

Table 11:

Frequency Distributions of the 2×2 Contingency Tables for monthly Median Ranking of Rank-Ordered Classifications of RTN and SDR: Each Year

		Sample Frequency (% of observations)					
		Low RTN (Losers)		High RTN (Winners)			
Year	Obs	Low SDR	High SDR	Low SDR	High SDR	χ^2	p-value
1992	220	27.27	22.73	22.73	27.27	1.82	0.178
1993	252	31.75	18.25	18.25	31.75	18.35	0.000
1994	282	24.82	25.18	25.18	24.82	0.01	0.905
1995	324	25.62	24.38	24.38	25.62	0.20	0.657
1996	364	17.58	32.42	32.42	17.58	32.04	0.000
1997	416	29.57	20.43	20.43	29.57	13.88	0.000
1998	453	27.15	22.96	22.96	26.93	3.03	0.082
1999	529	24.01	26.09	26.09	23.82	1.00	0.316
2000	581	24.61	25.47	25.47	24.44	0.21	0.645
2001	623	33.87	16.21	16.21	33.71	76.99	0
2002	630	28.57	21.43	21.43	28.57	12.86	0.000
2003	633	21.80	28.28	28.28	21.64	10.89	0.001
2004	637	25.12	24.96	24.96	24.96	0.005	0.945
2005	637	22.29	27.79	27.79	22.14	7.92	0.005
2006	626	21.73	28.27	28.27	21.73	10.74	0.001
2007	609	31.20	18.88	18.88	31.03	36.46	0.000
2008	610	22.95	27.05	27.05	22.95	4.10	0.043
2009	552	28.44	21.56	21.56	28.44	10.46	0.001
2010	538	23.42	26.58	26.58	23.42	2.15	0.143
2011	492	25.81	24.19	24.19	25.81	0.52	0.471
2012	454	26.65	23.35	23.35	26.65	1.98	0.159
2013	425	24.24	25.88	25.88	24.00	0.53	0.465
2014	422	30.81	19.19	19.19	30.81	22.76	0.000
2015	416	24.76	25.24	25.24	24.76	0.04	0.845

Results of the 2×2 median classification of rank ordered variables using (i)RTN the total compounded relative return through the first half of the year (ii)SDR which is the Standard Deviation ratio. Interim assessments of fund performance are conducted at June. The classifications are performed for surviving funds on yearly basis for all 730 funds using monthly returns (compounded from the daily returns). Funds are grouped each year into four classes by determining whether they are (i)above (winner) or below (loser) the median RTN (ii)whether SDR is above or below the median. The null hypothesis for the χ^2 statistic is that each cell has a frequency of 25%.

Table 12:

Frequency Distributions of the 2×2 Contingency Tables for daily Median Ranking of Rank-Ordered Classifications of RTN and SDR: Each Year

		Sample Frequency (% of observations)					
		Low RTN (Losers)		High RTN (Winners)			
Year	Obs	Low SDR	High SDR	Low SDR	High SDR	χ^2	p-value
1992	220	32.73	17.27	17.27	32.73	21.02	0.000
1993	252	29.76	20.24	20.24	29.76	9.14	0.003
1994	282	25.53	24.47	24.47	25.53	0.13	0.721
1995	324	23.46	26.54	26.54	23.46	1.23	0.267
1996	364	20.88	29.12	29.12	20.88	9.89	0.002
1997	416	26.68	23.32	23.32	26.68	1.88	0.170
1998	453	28.48	21.63	21.63	28.26	8.21	0.004
1999	529	25.33	24.76	24.76	25.14	0.05	0.821
2000	581	24.61	25.47	25.47	24.44	0.21	0.645
2001	623	35.63	14.45	14.45	35.47	111.03	0
2002	630	37.78	12.22	12.22	37.78	164.58	0
2003	633	28.59	21.48	21.48	28.44	12.52	0.000
2004	637	23.70	26.37	26.37	23.55	1.93	0.165
2005	637	31.24	18.84	18.84	31.08	38.70	0.000
2006	626	19.97	30.03	30.03	19.97	25.36	0.000
2007	609	18.06	32.02	32.02	17.90	48.02	0.000
2008	610	27.38	22.62	22.62	27.38	5.51	0.019
2009	552	21.20	28.80	28.80	21.20	12.78	0.000
2010	538	23.98	26.02	26.02	23.98	0.90	0.343
2011	492	22.36	27.64	27.64	22.36	5.50	0.019
2012	454	27.09	22.91	22.91	27.09	3.18	0.075
2013	425	21.41	28.71	28.71	21.18	9.34	0.002
2014	422	31.28	18.72	18.72	31.28	26.63	0.000
2015	416	28.85	21.15	21.15	28.85	9.85	0.002

Results of the 2×2 median classification of rank ordered variables using (i)RTN the total compounded relative return through the first half of the year (ii)SDR which is the Standard Deviation ratio. Interim assessments of fund performance are conducted at June. The classifications are performed for surviving funds on yearly basis for all 730 funds using daily returns. Funds are grouped each year into four classes by determining whether they are (i)above (winner) or below (loser) the median RTN (ii)whether SDR is above or below the median. The null hypothesis for the χ^2 statistic is that each cell has a frequency of 25%.

Table 13:

Comparison of risk sorting and tournament behaviour using monthly data

			1-6 month Std. Dev.		7-12 month Std. Dev.		
Year	Frequency Difference	Rank Co-efficient	Low RTN	High RTN	Low RTN	High RTN	Before Ratio
1992	-4.55	-0.0026	0.0208	0.0193	0.0238	0.0254	0.9295
1993	-13.49	-0.0152	0.0252	0.0202	0.0220	0.0221	0.8021
1994	0.35	-0.0006	0.0294	0.0282	0.0314	0.0300	0.9576
1995	-1.23	0.0005	0.0123	0.0144	0.0228	0.0255	1.1694
1996	14.84	0.0104	0.0139	0.0166	0.0425	0.0443	1.1922
1997	-9.13	-0.0084	0.0403	0.0410	0.0469	0.0510	1.0160
1998	-4.19	-0.0104	0.0350	0.0364	0.0869	0.0909	1.0414
1999	2.08	-0.0054	0.0377	0.0447	0.0401	0.0497	1.1868
2000	0.86	0.0056	0.0545	0.0571	0.0503	0.0555	1.0492
2001	-17.66	-0.0329	0.0645	0.0503	0.0612	0.0562	0.7807
2002	-7.14	0.0036	0.0439	0.0374	0.0763	0.0692	0.8513
2003	6.48	0.0074	0.0391	0.0442	0.0263	0.0277	1.1301
2004	-0.16	-0.0038	0.0174	0.0190	0.0280	0.0322	1.0933
2005	5.49	0.0037	0.0253	0.0276	0.0246	0.0251	1.0922
2006	6.55	0.0065	0.0231	0.0221	0.0157	0.0143	0.9552
2007	-12.32	-0.0109	0.0262	0.0249	0.0309	0.0335	0.9538
2008	4.10	0.0069	0.0514	0.0526	0.0762	0.0754	1.0231
2009	-6.88	0.0102	0.0788	0.0845	0.0324	0.0363	1.0722
2010	3.16	0.0009	0.0550	0.0544	0.0533	0.0517	0.9888
2011	-1.63	0.0032	0.0224	0.0220	0.0703	0.0682	0.9819
2012	-3.30	-0.0010	0.0448	0.0469	0.0162	0.0173	1.0475
2013	1.65	0.0008	0.0233	0.0248	0.0277	0.0292	1.0651
2014	-11.61	-0.0069	0.0297	0.0280	0.0244	0.0248	0.9418
2015	0.48	-0.0028	0.0328	0.0329	0.0485	0.0489	1.0020
Correlation of Before Ratio and Freq. Difference							0.7013
Correlation of Before Ratio and Rank Coefficient							0.5753

The table reports the results of the comparison of observed tournament behaviour with risk sorting in the first period using the contingency table results from Table 7. Frequency Difference is the difference of the percentages of observations in the High SDR and Low SDR cells for Low RTN funds, while Rank Coefficient is the coefficient from a regression with changes in risk levels as dependent variables and funds' performance rankings in the first half of the year as independent variables. The median fund standard deviations are given for the first and second six months of the year for the Low RTN and High RTN groups. Before Ratio is the ratio of the first-half High RTN standard deviation divided by the first-half Low RTN standard deviation. Rank Coefficient results are shown with the opposite sign to present the same conclusions as the Frequency Difference results.

Table 14:

Comparison of risk sorting and tournament behaviour using daily data

Year	Frequency Difference	Rank Coefficient	1-6 month Std. Dev. Low RTN	1-6 month Std. Dev. High RTN	7-12 month Std. Dev. Low RTN	7-12 month Std. Dev. High RTN	Before Ratio
1992	-15.45	-0.0011	0.0072	0.0062	0.0058	0.0052	0.8560
1993	-9.52	-0.0009	0.0066	0.0062	0.0051	0.0047	0.9464
1994	-1.06	-0.0009	0.0070	0.0062	0.0059	0.0054	0.8910
1995	3.09	-0.0012	0.0045	0.0051	0.0049	0.0057	1.1195
1996	8.24	0.0009	0.0066	0.0071	0.0070	0.0073	1.0737
1997	-3.37	-0.0000	0.0081	0.0089	0.0110	0.0120	1.1056
1998	-6.84	-0.0021	0.0079	0.0085	0.0142	0.0160	1.0835
1999	-0.57	0.0010	0.0109	0.0117	0.0102	0.0107	1.0670
2000	0.86	0.0007	0.0154	0.0160	0.0121	0.0122	1.0382
2001	-21.19	-0.0059	0.0146	0.0122	0.0127	0.0117	0.8331
2002	-25.56	-0.0004	0.0117	0.0099	0.0199	0.0182	0.8497
2003	-7.11	-0.0003	0.0123	0.0129	0.0077	0.0081	1.0480
2004	2.67	0.0003	0.0075	0.0076	0.0068	0.0069	1.0090
2005	-12.40	-0.0003	0.0068	0.0069	0.0063	0.0066	1.0141
2006	10.06	0.0007	0.0075	0.0075	0.0063	0.0059	0.9903
2007	13.96	-0.0001	0.0071	0.0074	0.0121	0.0124	1.0475
2008	-4.75	0.0020	0.0134	0.0130	0.0333	0.0322	0.9690
2009	7.61	0.0037	0.0206	0.0228	0.0105	0.0111	1.1083
2010	2.04	-0.0004	0.0131	0.0130	0.0098	0.0098	0.9905
2011	5.28	0.0004	0.0085	0.0084	0.0197	0.0196	0.9847
2012	-4.19	0.0000	0.0092	0.0091	0.0077	0.0078	0.9921
2013	7.29	0.0003	0.0080	0.0081	0.0063	0.0063	1.0188
2014	-12.56	-0.0012	0.0072	0.0071	0.0079	0.0079	0.9878
2015	-7.69	-0.0001	0.0078	0.0079	0.0114	0.0115	1.0183
Correlation of Before Ratio and Freq. Difference							0.6283
Correlation of Before Ratio and Rank Coefficient							0.4878

The table reports the results of the comparison of observed tournament behaviour with risk sorting in the first period using the contingency table results from Table 8. Frequency Difference is the difference of the percentages of observations in the High SDR and Low SDR cells for Low RTN funds, while Rank Coefficient is the coefficient from a regression with changes in risk levels as dependent variables and funds' performance rankings in the first half of the year as independent variables. The median fund standard deviations are given for the first and second six months of the year for the Low RTN and High RTN groups. Before Ratio is the ratio of the first-half High RTN standard deviation divided by the first-half Low RTN standard deviation. Rank Coefficient results are shown with the opposite sign to present the same conclusions as the Frequency Difference results.