# Tournaments in Mutual Fund Families*

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# Tournaments in Mutual Fund Families

**ABSTRACT**

In this paper we examine intra-firm competition in the mutual fund industry. Our empirical study of the US mutual fund industry shows for the first time that managers within mutual fund families compete against each other. They adjust the risk they take depending on the relative position within their fund family. In particular, we show that the direction of the adjustment crucially hinges on the competitive situation within a family. This behavior is in accordance with predictions derived from theoretical models. Our results have serious implications for investors, fund management companies and regulatory authorities.

Most mutual funds are part of a fund family.[1] Recent papers look at the behavior of these fund families. One stream of this literature focuses on the influence of a star fund in a family on the growth of the other funds in the family (see, e.g., Ivkovic (2003), and Nanda, Wang, and Zheng (2004)). These authors find strong evidence of positive spillover effects. Such effects have consequences for the optimal product policy of fund families. The product policy of fund families is examined in, e.g., Khorana and Servaes (1999) and (2003), Zhao (2001) and (2003), Mamaysky and Spiegel (2002), Massa (2003a) and (2003b), and Siggelkow (2003). All of these papers study top management decisions of a fund family, but they neglect the decisions that managers of an individual fund within the family have to take.[2] They implicitly assume that fund families are coordinated entities.

Our paper is the first to study the behavior of individual fund managers in the context of the organizational setting of their fund family. It is vital to consider fund managers within the wider context of their fund family since the top management of the fund family constructs the incentives for all the fund belonging to the family. In particular, the top management decides which managers to promote and which funds to advertise. If a fund manager gets promoted she will most likely receive a higher salary. Furthermore, if the top management directs marketing efforts towards an individual fund, this will attract higher inflows into that fund (see Jain and Wu (2000), Khorana and Servaes (2003), and Nanda, Wang, and Zheng (2004)). As fund managers get paid depending on their assets under management (see, e.g., Khorana (1996)), this will eventually lead to a higher salary of the respective fund manager, too.[3] Since the overall budget of a fund family for marketing activities is limited and since only a select group of managers will be promoted, fund managers within a family compete against each other for these scarce resources.

Kempf and Ruenzi (2004) provide empirical evidence (i) that fund managers have strong incentives to reach top positions within their family by the end of the year and (ii) that it does not matter whether fund managers who have missed the top positions reach a middle or bottom rank. Therefore, the competition within fund families is similar to a tournament situation: it is important to win the competition, but it is unimportant whether one finishes in the middle or the low ranks in this *family tournament*.[4] In such a tournament fund managers maximize the chance of reaching a top position by adjusting their fund's risk depending on their family rank, i.e. their relative position within their family, during the year (see, e.g., Taylor (2003)).

Our paper addresses two central issues: firstly, we empirically examine the question whether a family tournament does actually exist. We analyze whether fund managers adjust the risk of their portfolios depending on their rank within their family. Knowledge of the existence of a family tournament is highly relevant because tournament behavior of fund managers potentially leads to suboptimal portfolios from the fund investors' point of view and to irrational price formation in asset markets (see James and Isaac (2000)). Therefore, regulatory authorities should also show a definite interest in this issue. Secondly, we take a detailed look at what the risk adjustment strategy of fund managers in the family tournament looks like. Taylor (2003) shows theoretically that the optimal strategy in a tournament depends on whether fund managers interact strategically or not. If there is no strategic interaction, midyear losers (i.e. players with a below-average rank after the first part of the year) should increase risk more than midyear winners (i.e. players with an above-average rank after the first part of the year) do. The reason is that winners thereby can try to lock in their top position, whereas losers try to still reach a top position by the end of the year by taking higher risk. However, if strategic interaction is taken into account, winners should increase risk more than losers do.[5] An intuitive explanation is that winners anticipate the increased risk taking of losers and therefore also increase risk. Whether mutual funds really do behave strategically or not in the family tournament is an open empirical question. The answer to this question sheds light on how individual fund managers react to the incentives they are given. This is of interest for fund investors, but also has implications for the top management of fund families in devising incentive structures.

Our empirical study of the US mutual fund market provides two main results: firstly, a family tournament exists. Mutual funds compete against each other within their family. They adjust risk depending on their family rank. Secondly, we observe strategic behavior in small families and non-strategic behavior in large families. This is consistent with the view that individual managers in large families compete against each other in a situation comparable to atomistic competition. In such an environment, there are too many competitors, so that players do not take the actions of the other fund managers into account and thus do not interact strategically. In contrast, in small families the universe of competitors is manageable so that the situation there is comparable to an oligopoly: funds take the behavior of their competitors into account and act strategically.

Ours is the first paper to analyze the competition of funds within their family. However, our research can still be related to three strands of literature: firstly, we extend the literature on fund families by examining how fund managers behave *within* their family. Secondly, we contribute to the emerging literature on intra-firm competition (see, e.g., Baye, Crocker, and Ju (1996), Corchon and Gonzalez-Maestre (2000), and Ruebeck (2002)) by delivering empirical evidence of intra-firm competition in the mutual fund industry for the first time. Thirdly, we complement the literature on tournaments in mutual fund market segments by showing that funds engage in a family tournament as well as in the well-documented segment tournament.[6]

The schedule of the paper is as follows: Section I describes the data. In Section II we take a first look at the family tournament. Section III focuses more closely on the influence of the competitive situation on the behavior of funds in the family tournament. Section IV concludes.

# I. Data

Our data sample consists of data on US equity funds from the CRSP Survivorship Bias Free US Mutual Fund Database.[7] The database contains data on monthly total returns, the fund management company, the year of origin, and other characteristics of the fund. We use the Strategic Insight Objectives (SI) of funds to define the market segments in which funds operate. This provides us with up to 38 different segments. As the SI classification is available from 1993 on, our data sample starts in 1993. It ends in 2001 leaving us with 9 years of data.

In the observations, we eliminate those years of a fund for which some of the data is missing. All examinations are done for fund families and segments including more than two funds. The CRSP database lists every single share class of a fund as an individual entry. These different share classes of the same fund only differ with respect to their fee structure or their minimum investment requirements, but are backed by the same portfolio of assets. Because they can therefore not be managed independently, we omit all classes of multiple class funds except for the first class of these funds in our dataset in order to preclude double-counting.[8] The first class in the dataset is usually the oldest and largest share-class of the fund. These exclusions reduce our initial number of yearly fund observations from 41.367 to 22.756. To simplify expressions we will term the remaining share class in our sample 'fund'.

We use the return data from our dataset to calculate the rank of a fund $i$ at the end of the first part of year $t$ within its family and within its segment. The *segment rank* of a fund, $R_{it}^{(1)}$, is determined by its total return relative to the total returns of the competing funds in its segment:[9] the rank is calculated by placing the funds of a segment in order according to their total returns and assigning numbers to them in descending order. For example, in a group of five funds the best fund gets rank number 5 and the worst fund rank number 1. These rank numbers are normalized in order to make segments of different size comparable. After this normalization the segment ranks $R_{it}^{(1)}$ are distributed evenly between 0 and 1. A higher $R_{it}^{(1)}$ denotes a better performance within a segment. The superscript (1) is added to express that the respective ranking is based on returns in the first part of the year.

To measure the *family rank* of a fund, $RoR_{it}^{(1)}$, we arrange all funds of a family according to their segment rank, $R_{it}^{(1)}$. Based on this ordering, we then assign a family rank number to each fund. This method ensures that the performance of funds from different segments can be compared. A normalization similar to the one described above is conducted in order to make ranks from families of different size comparable. Thus, the rank of a fund within its family is determined by its *Rank-of-Ranks*, $RoR_{it}^{(1)}$. A higher $RoR_{it}^{(1)}$ denotes a better performance within a family; $RoR_{it}^{(1)}$ is evenly distributed between 0 and 1.

Note that the correlation between $R_{it}^{(1)}$ and $RoR_{it}^{(1)}$ is positive by construction. For the whole sample the correlation coefficient between these two variables is 0.78, indicating that multi-collinearity might be a problem. Even in this case one still gets consistent and unbiased estimators. However, standard errors will be high and it is therefore harder to get significant results.

— Please insert TABLE 1 approximately here —

In Table 1 the rapid growth of the mutual fund industry is documented. The number of mutual funds in our sample increases from 1175 funds in 1993 to 3865 funds in 2001. The emergence of a large number of new funds causes the average fund age to decline from 11 years in 1993 to 8.1 years in 2001. While in 1993 the average fund competes with 156 other funds within its segment, this number rises to over 360 in 2001. Furthermore, the average fund competes with nearly 16 other funds within its family in 1993 and with more than 32 other funds in 2001. The mean number of competitors of each fund in its family in the whole sample is 26. We will use this number later as a an ad-hoc cutoff to define large and small families.

— Please insert TABLE 2 approximately here —

Table 2 presents summary statistics of fund families and fund market segments. It shows that the number of fund families rises from 238 to 383 between 1993 and 2001. The average amount of assets under management in a family increases from about 3 billion USD to more than 8 billion USD. The number of segments in our sample ranges from 34 to 38 in the various years. The average total net asset value (TNA) of a segment rises from 21 billion USD in 1993 to 91 billion USD in 2001.

In the remainder of this paper we concentrate on funds belonging to the three largest segments (Growth, Growth & Income, Small Company Growth), leaving us with 10,321 yearly fund observations.[10] These segments comprise over 100 funds in every year, so we can safely assume that competition within these segments is atomistic and we can expect non-strategic behavior in the segment behavior. Concentration on large segments allows us to examine the effect of the competitive situation within the family in isolation.[11]

# II. Family Tournament

## A. Basic Empirical Model

We argue that fund managers adjust their risk in the course of a year in order to maximize the probability of reaching a top position in their family by the end of the year. We label the first part of a year as *waiting period*. In line with the literature on segment tournaments we choose a length of 7 months as the waiting period (see, e.g., Brown, Harlow, and Starks (1996)). During the following 5 months (adjustment period) portfolio managers are able to adjust the risk of their portfolio. The (7,5)-segmentation is reasonable because a lot of interim rankings are published roughly at the middle of the year and it takes some time for fund managers to adjust their portfolio afterwards.[12] The two subperiods are denoted by superscripts (1) and (2), respectively.

We estimate the risk adjustment strategy using the following pooled regression:

$$\Delta\sigma_{it} = b^F RoR_{it}^{(1)} + b^S R_{it}^{(1)} + b_1 \Delta\sigma_{it}^m + b_2 \sigma_{it}^{(1)} + \sum_{j=T_1}^{T_2} a_j D_j + e_{it}. \quad (1)$$

We follow the estimation approach of Koski and Pontiff (1999) in their study on risk taking in the context of a segment tournament and use the change in standard deviations of fund returns from the waiting period to the adjustment period, $\Delta\sigma_{it} := \sigma_{it}^{(2)} - \sigma_{it}^{(1)}$, as our measure to capture a fund manager's risk changing behavior.[13] $\sigma_{it}^{(1)}$

($\sigma_{it}^{(2)}$) denotes the estimated annualized standard deviation of monthly returns of fund $i$ in the waiting period (adjustment period) of year $t$.

The main explanatory variable is $RoR_{it}^{(1)}$. A significant coefficient $b^F$ is consistent with the existence of a family tournament. A positive (negative) $b^F$ indicates strategic (non-strategic) behavior in the family tournament.

To extract the family-specific influence on fund managers' risk taking behavior, we have to control for other effects that might influence $\Delta\sigma_{it}$. Based on the literature (e.g. Brown, Harlow, and Starks (1996)), we expect an influence of the segment rank of a fund, $R_{it}^{(1)}$, on its risk taking. Therefore, we also add the segment rank $R_{it}^{(1)}$ of fund $i$ as control variable.

Furthermore, mean reversion in funds' volatility is well documented. Daniel and Wermers (2000) argue that funds have a target level of risk. Funds with relatively high risk in the first period will therefore tend to decrease their risk and vice versa. To control for this effect we use $\sigma_{it}^{(1)}$ as an additional explanatory variable in our regression.

An individual fund's risk might also vary due to a change in the market volatility in its segment. We control for this effect by adding the change of the market segment volatility, $\Delta\sigma_{it}^{m}$, into our regression. Since there are no appropriate indices for all market segments available, we use the standard deviation difference of the median volatility fund as our proxy for segment volatility. This proxy is calculated from the median standard deviation in the waiting period, $\sigma_{it}^{m(1)}$, and in the adjustment period, $\sigma_{it}^{m(2)}$, i.e. $\Delta\sigma_{it}^{m} := \sigma_{it}^{m(2)} - \sigma_{it}^{m(1)}$.[14]

To control for year-specific effects, we include a dummy variable $D_j$ for each year of the sample. For example, year-specific effects can be caused by the aggregate liquidity in the market, which is higher in some years than in others because of business cycle patterns (see Rockinger (1995)).

## B. Regression Results

To empirically examine whether a family tournament exists, we test the null-hypothesis ($b^F = 0$) by estimating model (1). Results are presented in Table 3.

— Please insert TABLE 3 approximately here —

Our main focus is on the coefficient of the family tournament, $b^F$. The coefficient is positive and significant at the 5%-level. It indicates that the best funds in a family increase risk by only 0.5 percentage points (in terms of annualized return standard deviation) more than the worst funds. This result is consistent with strategic behavior of fund managers in the family tournament. However, the influence of the family rank appears to be weak.

This weak influence could be due to the fact that managers behave strategically in some families and non-strategically in other families. In this case the effects might cancel out because the optimal behavior of losers and winners, respectively, is of opposite direction in these two cases (see Taylor (2003)). We address this issue in Section III, where we turn to a more detailed examination of the behavior of fund managers in tournament situations and of the impact of the competitive situation they face on their behavior.

In addition to the family tournament, the existence of a segment tournament (coefficient $b^S$) is confirmed as well. The coefficient $b^S$ is different from zero and statistically significant at the 1%-level. However, the sign of the coefficient is surprising: $b^S$ is positive. Winners increase risk more than losers do. This contradicts empirical evidence presented by Brown, Harlow, and Starks (1996), Koski and Pontiff (1999), and Elton, Gruber, and Blake (2003). They all find non-strategic behavior (i.e. $b^S < 0$) in the segment tournament. We take a closer look at this surprising result in a more detailed examination in Section III, too.

The coefficients $b_1$ and $b_2$ of our control variables are of the expected sign. The positive coefficient $b_1$ indicates that the risk changing of a fund depends positively on the change in segment volatility. The highly significant negative coefficient $b_2$ indicates mean reversion in the standard deviation. This confirms the results of earlier studies (see, e.g., Koski and Pontiff (1999)).

# III. Tournament Behavior and Competition

## A. Extended Empirical Model of the Family Tournament

We now turn to a more detailed examination of how a fund's competitive situation influences its tournament behavior. Based on the model of Taylor (2003) we argue that strategic interaction is important in situations where there is only a small number of competitors. In these cases it is possible to take the actions of the other competitors into account - and therefore to act strategically. The number of competitors in the family tournament is small if there are only few funds in the family. We would therefore expect strategic interaction to be important in small families with a situation analogous to oligopolistic competition. In this case, Taylor's (2003) model predicts that winners are more likely to increase risk than losers are ($b^F > 0$).[15]

Accordingly, in large families individual managers compete against each other in a situation comparable to atomistic competition. In such an environment managers do not take the actions of the large number of competitors within their family into account. In this case, losers should increase risk more than winners do, i.e. funds should show non-strategic behavior ($b^F < 0$).

To test our hypotheses we modify (1) by interacting the family rank, $RoR_{i,t}^{(1)}$, with the two possible dummies, $D_l$ and $D_s$, respectively. $D_l$ ($D_s$) equals one if a fund belongs to a large (small) family and zero otherwise.[16] We also interact the segment rank, $R_{i,t}^{(1)}$, with $D_l$ and $D_s$, respectively. Thereby, we allow for different behavior of managers from large and small families in the segment tournament, too. We do not have to distinguish between funds from large and small segments, since we only use observations from large segments (see Section I). Thus, we are able to examine the influence of the family size in isolation by estimating the following model:

$$\Delta\sigma_{it} = b_l^F RoR_{it}^{(1)} \cdot D_l + b_s^F RoR_{it}^{(1)} \cdot D_s \qquad (2)$$

$$+b_l^S R_{it}^{(1)} \cdot D_l + b_s^S R_{it}^{(1)} \cdot D_s$$
$$+b_1 \Delta\sigma_{it}^m + b_2 \sigma_{it}^{(1)} + \sum_{j=T_1}^{T_2} a_j D_j + e_{it}.$$

This model allows us to examine simultaneously whether there is a family tournament and whether the tournament behavior is different for large and small families. We use the mean number of competitors of a fund within its family, i.e. 26, as a cutoff for large families. Our results are stable with respect to a variation of this cutoff (see Section III.C). Using 26 as cutoff, 50,13% of the funds are categorized as belonging to large families.

In the family tournament, we expect to find strategic behavior of funds in small families ($b_s^F > 0$) and non-strategic behavior in large families ($b_l^F < 0$). For the segment tournament we do not expect strategic interaction, because we only examine funds from large segments. Therefore, losers should increase risk more than winners do in the segment tournament, irrespective of the size of their family, i.e. $b_l^S < 0$ and $b_s^S < 0$.

## B. Empirical Evidence of the Influence of the Competitive Situation on Tournament Behavior

The estimation results of model (2) are presented in Table 4.[17]

— Please insert TABLE 4 approximately here —

The estimation results for the control variables remain very similar to those reported above. We still find a positive influence of $\Delta\sigma_{it}^{m}$, i.e. $b_1 > 0$, and a negative influence of $\sigma_{it}^{(1)}$, i.e. $b_2 < 0$.

Our main focus is on the coefficients of the family tournament, $b_l^F$ and $b_s^F$. The null-hypothesis that the family rank has no impact on risk taking can be rejected at the one percent level (F-statistic 9.44): a family tournament does exist. Fund managers change risk depending on their family rank. Furthermore, the results show that the response of fund managers with respect to their family rank depends on the size of their family. This explains why we did not find stronger results in model (1): it was misspecified because of not taking into account differences in the behavior of funds in large and small families.

The coefficient for funds in large families, $b_l^F$, is negative, i.e. loser funds in large families increase risk more than winner funds do. The opposite is true for funds in small families. The respective coefficient for funds from small families, $b_s^F$, is positive, i.e. loser funds in small families increase risk less than winners do. This is evidence for non-strategic behavior in large families and strategic behavior in small families. These findings are in line with our predictions. The effects we found are not only statistically significant (both coefficients are significant at the 1%-level), but also economically meaningful. For example, the estimate for $b_l^F$ is $-0.0183$, i.e. the worst funds from large families increase risk by 1.83 percentage points (in terms of annualized return standard deviation) more than the best funds. This number has to be related to the average annualized return standard deviation of all funds which is 17.7%. One should also bear in mind that fund managers are usually constrained in their risk taking and can only adapt their risk within certain limits, as indicated by the highly significant estimate of $b_2$.

It is also interesting to note that the absolute value of the coefficient for risk adjustment in large families is greater than the absolute value of the respective coefficient in small families in the family tournament, i.e. $|b_l^F| > |b_s^F|$. This is consistent with the notion that fund managers in large families are not as closely monitored as fund managers in small families due to the large number of funds. Therefore, they can adjust risk more freely.

We also find an influence of the rank of a fund within its segment (coefficients $b_l^S$ and $b_s^S$). The F-statistic for the hypothesis that there is no influence of the segment rank on risk taking behavior is 13.61. It can be rejected at the 1%-level. In the segment tournament the absolute value of the coefficient for risk adjustment in large families is again greater than the absolute value of the respective coefficient in small families, i.e. $|b_l^S| > |b_s^S|$. This also indicates that fund managers can adjust risk more freely in large families.

However, the signs of the coefficients $b_l^S$ and $b_s^S$ are surprising again. They are positive and significant, i.e. fund managers show strategic behavior in the segment tournament. This result contradicts the results reported by, e.g., Brown, Harlow, and Starks (1996) who find non-strategic behavior. Possible explanations for the differing results are explored in Section III.D.

## C. Stability of Results Using Different Cutoffs for Large Families

The critical assumption of our study is the definition of the cutoff for large families. We chose the mean number of competitors a fund has within its family, i.e. 26, as cutoff. Estimation results for the coefficients $b_l^F$ and $b_s^F$ from model (2) for different alternative cutoffs are presented in Table 5.

— Please insert TABLE 5 approximately here —

For cutoffs ranging from 15 to 35 funds we always get a negative estimate for $b_l^F$ and a positive estimate for $b_s^F$. All estimates - except of the estimate for $b_l^F$ for a cutoff of 15 funds - are significantly different from zero at the one or five percent level, respectively. The coefficient $b_l^F$ becomes larger (in absolute value) when moving from 15 to 30. This indicates that results for low cutoffs are blurred by small families misclassified as large families. Similarly, $b_s^F$ is decreasing for cutoffs larger than 26, indicating that in these cases results become weaker because some large families are then misclassified as small families. Therefore, the ad-hoc choice of 26 seems to be quite a good proxy for the cutoff for large families. Our main result is stable with respect to a variation of this cutoff.

We do not use time-varying cutoffs, although the size of family members steadily increases during our sample period. The reason of a fixed cutoff is that our argument is based on the importance of strategic interaction. Whether strategic interaction is relevant depends on the number of players. There is no reason to believe that the maximum number of players for which we can still assume strategic interaction to be of relevance is changing over time.

## D. Temporal Stability in the Family Tournament and Temporal Changes in the Segment Tournament

As mentioned above (see Section III.B), we find positive coefficients $b_l^S$ and $b_s^S$, which contradicts earlier studies. A possible explanation for the differing results might be the different sample period these studies use. Whereas Brown, Harlow, and Starks (1996) and other studies mainly examine data from the late 1980s to the early 1990s, our sample also covers the more recent years.

To eliminate the influence of the different sample periods we re-estimate models (1) and (2) for the subsamples 1993-1996 and 1997-2001 separately. We include our (misspecified) model (1) again, because this allows us to directly compare our results to the literature. Model (1) is very similar to the models used in previous papers (e.g. Koski and Pontiff (1999)). Results are presented in Table 6.

— Please insert TABLE 6 approximately here —

Looking at the estimation results from model (1) we now find a significantly negative influence of $b^S$ in 1993-1996. This is consistent with non-strategic behavior in the segment tournament in this period and also with the results of earlier studies. In 1997-2001, $b^S$ is significantly positive. The large number of observations in later years drives the result for the whole sample (see Table 3). The influence of the family rank is positive in both subperiods in Table 6. However, as argued above, the results for the family tournament have to be treated with caution as model (1) is misspecified by mixing up large and small families. All control variables are significant and have the expected sign.

Turning to the estimation results from model (2) in Table 6, we find that the coefficients for the family tournament, $b_l^F$ and $b_s^F$, have the expected signs and are significant at the 1%- and 5%-level, respectively, in 1993-1996 as well as in 1997-2001. The behavior of managers in the family tournament is stable. We observe strategic behavior in small families and non-strategic behavior in large families in both subperiods.

In the segment tournament we now find $b_s^S < 0$ in the 1993-1996 period, which again agrees with earlier studies, whereas the estimate for $b_l^S$ is positive, indicating that funds from large families behave strategically in the segment tournament. However, this latter influence is significant only at the 10%-level.

Comparing the results for 1993-1996 and 1997-2001 shows a change in the behavior of fund managers in the segment tournament. The evidence indicates that fund managers belonging to small families switch from non-strategic to strategic behavior in the segment tournament. Funds from large families behave strategically in the segment tournament before and after 1996.

This difference could be due to the large number of new funds that emerged in the late 1990s (see Table 1). These young funds might have other life-cycle incentives than older funds (see, e.g., Chevalier and Ellison (1999)). Therefore, we re-estimate model (2) for funds founded before and after 1996 separately for the period 1997-2001. Results are presented in Table 7.

— Please insert TABLE 7 approximately here —

The behavior of funds founded before 1996 (old funds) does not substantially differ from the behavior of funds founded after 1996 (young funds). Other possible explanations for the changing behavior in the segment tournament are left for future research.

# IV. Conclusion

In this paper, we study the competition of fund managers among each other within their own family. We present evidence that funds engage in a tournament within their family. In particular, our results indicate that mutual funds adapt their risk in the second part of the year. This change depends on their relative position within the fund family after the first part of the year. With this result we offer a complementary view on mutual fund families: whereas funds have been treated as coordinated entities by the literature so far, our results indicate that there is intense intra-firm competition in the mutual fund industry. Funds compete among each other for the best ranks in their family.

Using the number of funds in a family as a proxy for competition, we also show that the risk taking behavior of funds depends on the competitive situation they face.

Midyear losers from large families increase risk more than winners do. In small families the opposite is true. Midyear winners increase risk more than losers do. This is consistent with the notion of strategic interaction being of importance in situations with a small number of players, whereas strategic interaction is not important in situations with a large number of competitors. Furthermore, the risk adjusting behavior of fund managers is more pronounced in large families than in small families. This suggests less restrictive monitoring of fund managers' risk taking behavior in large families.

Overall, the finding of competition within mutual fund families leads to serious implications for individual investors as well as the management of fund families: in general, the competition of fund managers within their family cannot be expected to be optimal neither from the view of a profit-maximizing fund family nor from the perspective of a fund investor.[18] Due to the uncoordinated behavior of individual funds within their family considerable agency costs might arise. How these costs can be quantified and eventually reduced and how tournament behavior affects capital market equilibrium are interesting questions left open for future research.

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## Notes

[1]A fund family includes all funds managed by the same fund management company (e.g. *Janus* or *Fidelity*). Over 80% of all funds belong to multi-fund families.

[2]Almost all papers on the fund industry (including ours) focus on funds and not on fund managers. Thereby they implicitly assume that each fund is managed by a distinct fund manager. Therefore, there is no need to differentiate between funds and fund managers and we use fund and fund manager synonymously. Papers focusing on fund managers instead of funds are Chevalier and Ellison (1999) and Baks (2003).

[3]Ou-Yang (2003) shows theoretically that the optimal contract for a fund manager should (at least partially) depend on assets under management.

[4]This might not be true for extremely bad performances since this entails the threat of dismissal (see, e.g., Khorana (1996), and Chevalier and Ellison (1999)). For a model where employment risk is the crucial driving force of fund managers risk taking see Hu, Kale, and Subramaniam (2003).

[5]Acker and Duck (2001) derive a similar result. In contrast, Goriaev, Palomino, and Prat (2003) present a model with strategic interaction where it is optimal for losers to increase risk more than winners do. However, their result crucially hinges on the assumption that expected returns start to decrease with risk from a certain point on. They argue that this can be justified by increasing borrowing costs. This implies that one of the two managers in their model borrows heavily. Empirical evidence suggests that mutual funds rarely borrow large amounts of money (see, e.g., Almazan, Brown,

Carlson, and Chapman (forthcoming)). So, in our view the central assumption of the Goriaev, Palomino, and Prat (2003) model does not hold for mutual funds and its results have to be treated with caution in this market.

[6]A segment is defined as the entirety of all funds having comparable investment objectives, e.g. Growth or Health Sector. The risk taking behavior of funds in dependence on their relative position in their segment (segment tournament) has been studied extensively in the literature. The seminal paper is Brown, Harlow, and Starks (1996), who find that midyear-losers increase risk more than midyear winners (i.e. non-strategic behavior in the segment tournament). Similar results are also reported by Orphanides (1996), Koski and Pontiff (1999), Elton, Gruber, and Blake (2003), and Qiu (2003) for mutual funds and by Brown, Goetzmann, and Park (2001) and Agarwal, Daniel, and Naik (2003) for commodity trading advisors and hedge fund managers, respectively.

[7]Source: CRSP™, Center for Research in Security Prices. Graduate School of Business, The University of Chicago. Used with permission. All rights reserved. crsp.uchicago.edu. For a more detailed description of the CRSP database, see Carhart (1997) and Elton, Gruber, and Blake (2001).

[8]We also do all examinations treating each share class as separate observation. Results are very similar.

[9]Patel, Zeckhauser, and Hendricks (1994) show that investors care more about raw returns rather than risk-adjusted measures and more about rankings rather than absolute performance.

[10]However, the family rank of the funds is still calculated using observation from all segments available.

[11]We also do all examinations using only observations from the largest segment (Growth) as well as using only observations from the six largest segments. Results (not reported here) remain very similar. Our results for the family tournament also remain stable if we include all segments, but some coefficients turn out to be less significant.

[12] We also run our regressions taking 6 months instead of 7 months as the waiting period. The general results are unchanged, but the effects show up more clearly in the (7,5) specification than in the (6,6) specification. This is consistent with the literature and an indication that it actually takes some time for fund managers to adapt the risk of their portfolios.

[13]We also use the difference of the risk ratios $(\sigma_{it}^{(2)}/\sigma_{it}^{m(2)})-(\sigma_{it}^{(1)}/\sigma_{it}^{m(1)})$ as dependent variable. The results are very similar to those using $\Delta\sigma_{it}$ as defined above.

[14]We also use the respective mean fund instead of the median to calculate the proxies for the change in segment risk. Our results are not affected by this.

[15]Note, that the Taylor (2003) model is set up as a two-person model. However, the intuition carries over to a multi-person setting.

[16]As a stability test we also run model (1) for different subsamples of small/large families instead of using the dummy approach in (2). Results (not reported here) remain stable.

[17]Our hypothesis are now that the coefficients are either greater than zero (in those cases where we expect strategic behavior) or smaller than zero (when we expect non-strategic behavior) rather than just different from zero. We therefore apply one-sided t-tests to determine the significance-levels.

[18]Baye, Crocker, and Ju (1996) offer a model in which it is optimal for a firm to let different production units for the same good compete with each other. However, they examine competition via quantity setting (Cournot competition). Their setting is not easily transferable to the problem of competition via risk taking.

**Table 1**
**Summary Statistics - Individual Funds**

This table presents summary statistics of our database containing information on US equity mutual funds. Column 2 presents the total number of funds in our sample. Column 3 shows the average age of the funds. Column 4 reports the average number of competitors of a fund within its segment and column 5 shows the average number of competitors of a fund within its family.

| Year | Number of Funds | Mean Age | Competitors in Segment | Competitors in Family |
|---|---|---|---|---|
| 1993 | 1175 | 11.0 | 156.2 | 15.7 |
| 1994 | 1439 | 8.7 | 166.1 | 16.8 |
| 1995 | 1821 | 8.4 | 186.1 | 19.5 |
| 1996 | 2122 | 7.7 | 194.5 | 22.0 |
| 1997 | 2598 | 7.7 | 235.4 | 25.8 |
| 1998 | 2975 | 7.5 | 270.1 | 28.8 |
| 1999 | 3302 | 7.6 | 309.2 | 31.5 |
| 2000 | 3459 | 7.9 | 327.0 | 27.8 |
| 2001 | 3865 | 8.1 | 361.8 | 32.4 |

**Table 2**
**Summary Statistics - Fund Families and Fund Market Segments**

This table presents summary statistics of the families and market segments in the U.S. equity mutual fund industry. Column 2 shows the number of fund families in our sample. Column 3 contains the mean total net asset values (TNA) of all funds in a family. Column 4 reports the number of fund market segments in our sample. Column 5 contains the mean TNA of all funds in a segment. All TNAs are in million USD.

| Year | Families | Mean Family TNA | Segments | Mean Segment TNA |
|---|---|---|---|---|
| 1993 | 238 | 3,049 | 35 | 20.858 |
| 1994 | 260 | 3,267 | 37 | 22.958 |
| 1995 | 270 | 4,487 | 37 | 32.878 |
| 1996 | 278 | 5,856 | 37 | 42.869 |
| 1997 | 297 | 7,429 | 38 | 58.109 |
| 1998 | 319 | 8,620 | 37 | 74.345 |
| 1999 | 336 | 10,844 | 34 | 107.199 |
| 2000 | 381 | 9,178 | 35 | 99.913 |
| 2001 | 383 | 8,271 | 35 | 90.548 |

**Table 3**
**Influence of the Family Rank on Funds' Risk Taking**

This table contains estimates from a pooled regression. Funds from the segments Growth, Growth & Income, and Small Company Growth are examined for the years 1993 to 2001. The dependent variable is the individual fund's change of risk between the first and second part of a year measured as the annualized standard deviation of a fund's monthly returns in the first part of the year less that of the second part of the year. The independent variables are the rank of this fund in its family, $RoR_{i,t}^{(1)}$, and in its segment, $R_{i,t}^{(1)}$, the change in risk in the fund's segment $\Delta\sigma_{it}^{m}$, the risk of the fund in the first part of the year, $\sigma_{it}^{(1)}$, and yearly dummies (estimates not reported). t-values are reported in parentheses. $^{***}$, $^{**}$ and $^{*}$ indicate significance at the one, five and ten percent level (two-tailed tests), respectively. The last two rows contain the number of observations $N$ and the centered $R^2$.

| Independent Variable | Description | 1993-2001 | |
|---|---|---|---|
| $b^F$: $RoR_{it}^{(1)}$ | Family Rank | $0.0059^{**}$ | (2.4011) |
| $b^S$: $R_{it}^{(1)}$ | Segment Rank | $0.0110^{***}$ | (4.0450) |
| $b_1$: $\Delta\sigma_{it}^{m}$ | Std-Change in the Segment | $0.8359^{***}$ | (30.0342) |
| $b_2$: $\sigma_{it}^{(1)}$ | Fund's std in the first part of year | $-1.1837^{***}$ | (-55.4950) |
| $N$ | | 10,321 | |
| $R^2$ | | 72.17% | |

**Table 4**
**Influence of the Competitive Situation on Strategic Risk Taking**

This table contains estimates from a pooled regression. Funds from the segments Growth, Growth & Income, and Small Company Growth are examined for the years 1993 to 2001. The dependent variable is the individual fund's change of risk between the first and second part of a year measured as the annualized standard deviation of a fund's monthly returns in the first part of the year less that of the second part of the year. The independent variables are the rank of this fund in its family, $RoR_{i,t}^{(1)}$, and in its segment, $R_{i,t}^{(1)}$, the change in risk in the fund's segment $\Delta\sigma_{it}^{m}$, the risk of the fund in the first part of the year, $\sigma_{it}^{(1)}$, and yearly dummies (estimates not reported). $RoR_{i,t}^{(1)}$ and $R_{i,t}^{(1)}$ are multiplied with either $D_l$ or $D_s$, respectively. $D_l$ ($D_s$) equals one if a fund belongs to a large (small) family, and zero otherwise. t-values are reported in parentheses. $^{***}$, $^{**}$ and $^{*}$ indicate significance at the one, five and ten percent level (one-tailed tests), respectively. The last two rows contain the number of observations $N$ and the centered $R^2$.

| Independent Variable | Family | 1993-2001 | |
|---|---|---|---|
| $b_l^F$: $RoR_{it}^{(1)} \cdot D_l$ | large | $-0.0183^{***}$ | (-2.5512) |
| $b_s^F$: $RoR_{it}^{(1)} \cdot D_s$ | small | $0.0092^{***}$ | (3.5422) |
| $b_l^S$: $R_{it}^{(1)} \cdot D_l$ | large | $0.0332^{***}$ | (4.3561) |
| $b_s^S$: $R_{it}^{(1)} \cdot D_s$ | small | $0.0089^{***}$ | (3.1337) |
| $b_1$: $\Delta\sigma_{it}^{m}$ | | $0.8363^{***}$ | (30.0690) |
| $b_2$: $\sigma_{it}^{(1)}$ | | $-1.1837^{***}$ | (-55.5036) |
| $N$ | | 10,321 | |
| $R^2$ | | 72.22% | |

**Table 5**
**Estimation Results Using Different Cutoffs for Large Families**

This table contains estimates of $b_l^F$ and $b_s^F$ from model (2) for different cutoffs for large families. Funds from the segments Growth, Growth & Income, and Small Company Growth are examined for the years 1993 to 2001. The dependent variable is the individual fund's change of risk between the first and second part of a year measured as the annualized standard deviation of a fund's monthly returns in the first part of the year less that of the second part of the year. The independent variables are the rank of this fund in its family, $RoR_{i,t}^{(1)}$, and in its segment, $R_{i,t}^{(1)}$, the change in risk in the fund's segment $\Delta\sigma_{it}^m$, the risk of the fund in the first part of the year, $\sigma_{it}^{(1)}$, and yearly dummies (estimates not reported). $RoR_{i,t}^{(1)}$ and $R_{i,t}^{(1)}$ are multiplied with either $D_l$ or $D_s$, respectively. $D_l$ ($D_s$) equals one if a fund belongs to a large (small) family, and zero otherwise. t-values are reported in parentheses. ***, ** and * indicate significance at the one, five and ten percent level (one-tailed tests), respectively. The last two rows contain the number of observations $N$ and the centered $R^2$.

| Cutoff | 15 | 20 | 25 | 30 | 35 |
|---|---|---|---|---|---|
| $b_l^F$ | $-0.0001$ | $-0.0123^{**}$ | $-0.0170^{***}$ | $-0.0238^{***}$ | $-0.0186^{**}$ |
| | $(-0.0286)$ | $(-1.9687)$ | $(-2.3757)$ | $(-2.8486)$ | $(-2.0064)$ |
| $b_s^F$ | $0.0074^{***}$ | $0.0090^{***}$ | $0.0089^{***}$ | $0.0088^{***}$ | $0.0079^{***}$ |
| | $(2.6804)$ | $(3.3957)$ | $(3.4311)$ | $(3.4412)$ | $(3.1098)$ |
| $N$ | 10.321 | 10.321 | 10.321 | 10.321 | 10.321 |
| $R^2$ | 72.18% | 72.20% | 72.21% | 72.22% | 72.20% |

**Table 6**
**Influence of the Family and Segment Tournament in 1993-1996 and 1997-2001**

This table contains estimates from pooled regressions for the subsamples 1993-1996 and 1997-2001. Funds from the segments Growth, Growth & Income, and Small Company Growth are examined. The dependent variable in all regressions is the individual fund's change of risk between the first and second part of a year measured as the annualized standard deviation of a fund's monthly returns in the first part of the year less that of the second part of the year. The independent variables are the same as in Table 3 (for Model (1)) and in Table 4 (for Model (2)), respectively. t-values are reported in parentheses. ***, ** and * indicate significance at the one, five and ten percent level (one-tailed tests), respectively. The last two rows contain the number of observations $N$ and the centered $R^2$.

| | 1993-1996 | | 1997-2001 | |
|---|---|---|---|---|
| Independent Variable | Model (1) | Model (2) | Model (1) | Model (2) |
| $b^F$: $RoR_{it}^{(1)}$ | 0.0060*** | | 0.0068** | |
| | (2.5931) | | (1.9959) | |
| $b^S$: $R_{it}^{(1)}$ | −0.0104** | | 0.0199*** | |
| | (-3.9300) | | (5.2369) | |
| $b_l^F$: $RoR_{it}^{(1)} \cdot D_l$ | | −0.0256** | | −0.0162** |
| | | (-2.0494) | | (-1.8569) |
| $b_s^F$: $RoR_{it}^{(1)} \cdot D_s$ | | 0.0072*** | | 0.0101*** |
| | | (3.0437) | | (2.6868) |
| $b_l^S$: $R_{it}^{(1)} \cdot D_l$ | | 0.0195* | | 0.0371*** |
| | | (1.5487) | | (4.0368) |
| $b_s^S$: $R_{it}^{(1)} \cdot D_s$ | | −0.0108*** | | 0.0137*** |
| | | (-4.0030) | | (3.3534) |
| $b_1$: $\Delta\sigma_{it}^m$ | 0.3407*** | 0.3430*** | 1.1255*** | 1.1256*** |
| | (12.6444) | (12.7316) | (25.1671) | (25.1111) |
| $b_2$: $\sigma_{it}^{(1)}$ | −1.8556*** | −1.8520*** | −1.1496*** | −1.1559*** |
| | (-40.6470) | (-40.5690) | (-45.5991) | (-45.6305) |
| $N$ | 3,086 | 3,086 | 7,235 | 7,235 |
| $R^2$ | 57.25% | 57.36% | 72.37% | 72.37% |

**Table 7**
**Behavior of funds founded before/after 1996 in 1997-2001**

This table contains estimates from the same pooled regression as in Table 4. The sample period is 1997-2001. The left (right) schedule presents results using a subsample of funds founded before and in (after) 1996. t-values are reported in parentheses. $^{***}$, $^{**}$ and $^{*}$ indicate significance at the one, five and ten percent level (one-tailed tests), respectively. The last two rows contain the number of observations $N$ and the centered $R^2$.

| Independent Variable | Founded before 1996 | | Founded after 1996 | |
|---|---|---|---|---|
| $b_l^F$: $RoR_{it}^{(1)} \cdot D_l$ | $-0.0063$ | (-0.6087) | $-0.0311^{**}$ | (-1.9584) |
| $b_s^F$: $RoR_{it}^{(1)} \cdot D_s$ | $0.0132^{***}$ | (3.0831) | 0.0068 | (0.9046) |
| $b_l^S$: $R_{it}^{(1)} \cdot D_l$ | $0.0362^{***}$ | (3.3277) | $0.0418^{**}$ | (2.4582) |
| $b_s^S$: $R_{it}^{(1)} \cdot D_s$ | $0.0177^{***}$ | (3.8080) | $0.0142^{**}$ | (1.7374) |
| $b_1$: $\Delta\sigma_{it}^m$ | $1.0796^{***}$ | (20.2023) | $1.2342^{***}$ | (15.1180) |
| $b_2$: $\sigma_{it}^{(1)}$ | $-1.0817^{***}$ | (-34.3577) | $-1.2741^{***}$ | (-29.7935) |
| | | | | |
| N | 5,203 | | 2,032 | |
| $R^2$ | 75.02% | | 63.51% | |