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Mutual Fund Performance and Number of Fund Managers: A Swedish Perspective

Abstract
In light of the immense increase of investments in mutual funds during the last decades, we study whether mutual fund performance, risk-taking behavior and characteristics are related to the number of fund managers that actively take investment decisions within equity mutual funds. In particular, we study the relative, rather than absolute, impact of having a certain number of fund managers. The results suggest that teams of two and three managers outperform single-managed funds, while funds with teams of four managers or more underperform relative to all other, on a risk-adjusted alpha basis. This suggests a reversed U-shaped team-size–performance pattern where teams outperform up to a certain level, from which point performance deteriorates when adding additional managers. We conclude that previous research may have had difficulties to find a team-size–performance relationship because outperformance by two and three managers might be concealed by the underperformance of teams with more than three managers – on an aggregated level. Additionally, evidence is found that teams of three managers take on significantly more risk than other manager compositions and that idiosyncratic risk is taken mainly by two and three managers. Finally, we show that management fee decreases with the number of fund managers, while teams tend to run larger and younger funds.

Key words: Fund Performance, Risk Taking, Management Structure, Team Size, Number of Fund Managers

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All inaccuracies and flaws that remain are fully the authors' responsibility.

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I. Introduction

Two prominent developments within the private savings and mutual fund universe, during the recent decades, have been the immense increase of investments in mutual funds and the rising presence of mutual funds managed by teams rather than by single managers. Only in Sweden, total assets under management by mutual funds have increased from SEK 64.6 billion in 1986 to SEK 1,726 billion in the first half of 2010.[1,2] Similarly, based on our raw sample of funds investable for a Swedish investor, team-managed funds have increased from 18 to 40 percent during the same period.[3] However, research on team-managed mutual funds has thus far been modest in quantity and shallow in analysis. This study seeks to examine team-managed equity mutual funds more in depth than has been previously done, trying to find whether a certain number of managers in a team can explain mutual funds' performance, risk-taking behavior and characteristics. More specifically, we look at the relative impact of funds with one, two, three, or four-or-more fund managers – analyzed from the perspective of a Swedish investor.[4]

So far, the main approaches for explaining differences in mutual funds' performance have been to look at expenses, investment strategies, inflows, size, and previous performance.[5] One of the most recent additions to the fund performance literature is the approach to examine whether fund manager characteristics to some extent explain fund performance and risk. Golec (1996) initiated this approach and his research was expanded upon by Chevalier & Ellison (1999b). Using the manager characteristics age, education and tenure; Chevalier & Ellison find that fund managers from high SAT-average schools outperform those from low SAT-average schools and that younger managers outperform older managers, on a risk-adjusted basis.

However, only little research has been directed towards the question of which impact team management has on a fund's performance and risk profile and this research has just scratched the surface of what probably is a very complex phenomenon. Golec (2006), for example, finds no significant impact on funds' alpha when using a continuous management team size variable. The studies from Prather & Middleton (2002), and Chen, Hong, Huang & Kubik (2004), follow the similar basic methodology: A set of mutual funds are categorized as "singled managed" or "team managed" and thereafter compared along regular return and risk measures. Using this methodology Prather & Middleton find no significant differences between single- and team-managed mutual funds. Chen et al. (2004), however, discover that sole managers exhibit better stock-picking ability than teams, when investing in local markets.

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[1] One USD was worth approximately 7 SEK averaged over the sample period 2007-2010 according to the Riksbank.
[2] Figures on total assets under management are collected from the Swedish Investment Fund Association.
[3] This is based on all funds available for Swedish investors on Morningstar.se as of December 2010.
[4] See, for example (Essayyad & Wu, 1988), for an approach with a U.S. investor's perspective on performance of U.S. international mutual funds.
[5] That for example a fund's fee structure is a key determinant of after-fee performance is supported by much empirical research, which has helped to spur the growing popularity of low-cost, passively managed mutual funds. Whether or not active mutual funds can engage in particular investment strategies in order to outperform passive funds is less obvious and contradicting research exists. Studies by Jensen (1968), Malkiel (1995), Gruber (1996) and Carhart (1997) shows that actively managed funds underperform relative to passive index funds, in many cases even before taking the expenses into account. These authors generally question the very notion of persistent fund performance due to a superior investment strategy. On the other hand, studies by Grinblatt & Titman (1989, 1993), Daniel, Grinblatt, Titman, & Wermers (1997), Wermers (2000), Elton, Gruber, & Blake (1996) and Otten & Bams (2002) find evidence that active manages exhibit stock-picking talent and can outperform passive indexes with similar characteristics.

Even so, we do not believe that the work of human interaction within a team can be fully interpreted by an analysis of "single management versus team management". One particular team may not be comparable to just any other team. On an informal, common-sense note this is apparent by just contemplating the large amount of attention and resources devoted to in-depth analysis of teams in other fields such as management, sociology and sports – all trying to understand how successful and innovative teams are created and maintained. Fortunately, one need not be content in relying on common sense as academic research in this field is plentiful – with the noted exception of empirical finance.

The literature on group behavior and performance within e.g. psychology, sociology and management is subtle and diverse, and many contradictory conclusions exist. Hill (1982) reach the conclusion that teams have the ability to integrate members' different pieces of knowledge and information into an aggregated sum, resulting in a decision-making process superior to that of individuals. Applied on mutual funds, this would indicate that more fund managers lead to wiser investment decisions and subsequently to higher performance. Conversely, Janis (1982) asserts that teams, with time, tend to develop high levels of group cohesion which often inhibits learning and rational decision making. Rather than integrating members' ideas into an aggregated sum, there might be a few dominating ideas within the team, and any new ideas are met with scorn and pushed away without rational evaluation. In addition, the team may tend to ignore uncomfortable facts and regard itself as infallible, which frequently leads to excessive risk taking. If this holds true within the mutual fund universe, it would indicate that funds managed by teams with a high level of cohesiveness will take on more risk and be less quick to adjust when market environments change. Stein (2002) finds, when examining commercial banks and their investment-project lending practices, that the optimal size of a management team depends on what type of information the bank predominantly deals with: "soft" or "hard" information. For soft information, which is difficult to quantify and transmit, small organizations and few managers are most effective. Handling of hard information such as credit ratings and financial key ratios, on the other hand, is suitable for division of labor and thus for large organizations with many managers. If this theory holds true also for investment management, it would imply that more fund managers are better at handling the analysis of investment opportunities and therefore have a greater chance to outperform single-managed funds. However, if one believes that profitable trading information exists and can be obtained through "soft" channels such as personal networks, this theory would support an outperformance by smaller fund management teams.

The diversity, subtleties and contradictions of the literature on group behavior illustrate the complexity of how teams function, and lead into our thesis' primary purpose: *To examine the effects of management team size on fund performance, risk and characteristics.* Our dataset enables us to redefine "teams" into "number of managers" for actively managed mutual funds during the period 2007 to 2010. We use daily data series for these funds and their respective category-specific benchmarks, as well as information on fund size, age and fees on a quarterly basis, to analyze how a fund's number of managers impacts fund characteristics.[6] More specifically, we first estimate the performance and risk of the sample funds by various measures

[6] We recalculate the daily data to quarterly returns, net of fees, over the sample period 2007 through 2010, where all dividends and income are assumed to be reinvested in the fund.

such as Jensen's alpha, Sharpe ratio and standard deviation. The estimated measures are then used as dependent variables in a set of cross-sectional analyses to examine if they can be explained by whether it is one, two, three, or four-or-more, managers that actively manage the fund, as well as other fund characteristics such as fund size, age, risk and fee structure.

We enter into this study with one main *ex ante* hypothesis: "The number of fund managers *does impact* funds' performance and risk-taking behavior." This hypothesis is crafted in light of the research on group behavior – summarized above – whose disparity of angles and conclusions indicates that any team of human beings is an intricate beast likely to produce a variety of unpredictably consequences. This complexity is also precisely the reason why we abstain from speculating about any direction or magnitude of our hypothesis. That is, we expect that mutual funds *are* affected by the number of managers managing them – but we do not have an expectation on *how*.

This research area is of practical interest for both investors and fund companies. Investors are clearly interested in evaluating their portfolios and thus appreciate new information about determinants of mutual funds performance. Also, since level of risk aversion and investment horizon vary significantly between investors, information about differences in funds' risk-taking behavior is valuable. As mentioned above, savings in mutual funds are growing and presumably thereby also the importance of information regarding this type of investment. This is especially true for Sweden, and Swedish investors, where a new national pension system was introduced in 1994, which requires that 2.5 percent of the salary is deducted and added into the premium pension system until one reaches retirement age. Each individual is offered to freely invest this capital among approximately 800 Swedish and international funds.[7] Including these savings, 98 percent of the Swedish population (aged 18–74) currently holds savings in funds, and funds represented 27 percent of the total households' financial assets in 2008.[8] Hence, we think that finding explanatory variables for fund performance and risk measures, analyzed through a Swedish investor's perspective offers valuable contributions to fund investors – we see no reason, however, why our results should not be valuable for academics and investors worldwide.

Fund companies should be interested in understanding how the organization of their fund managers may be related to fund performance, especially since previous research show that good performance may lead to an increase in the customer base and therefore also an increase in revenues for the company. Additionally, a natural assumption would be that employing more managers entails higher salary costs. Thus, fund companies could benefit from information on whether adding an additional manager to a management team will result in a performance improvement commensurate to the additional cost. Fund companies should also be interested in whether the level of risk in their funds changes when adding or removing managers.

From the results in Section IV, a number of interesting findings lend support to our hypothesis. Our most interesting finding is that teams of two and three managers outperform single-managed funds, while funds with teams of four managers or more underperform relative to all others – when analyzing the

[7] As of May 2011. Source: Pensionsmyndigheten (Swedish Pension Agency).
[8] Source: The Swedish Investment Fund Association.

funds' alphas. This *reversed U-shaped team-size–performance pattern* supports some social psychology research, which asserts that small-sized teams outperform individuals but that performance starts to erode as teams become larger – see e.g. Laughlin et al. (2006). These results are not present in the cross-sectional regressions of the funds' Sharpe ratios, which to some extent can be explained by the higher (lower) unsystematic risk taken by two and three (four-or-more) managers. We also conclude that one possible explanation for why some previous research has not been able to find significant performance differences between single-managed and team-managed funds may be that the performance differences are averaged out. Or more specifically, that the relative outperformance of two and three managers is concealed by the underperformance of funds managed by four managers or more – on an aggregated level. Moreover, we find evidence that small-sized management teams tend to take on more risk. Finally, we show that fund size increases with the number of managers, while management fees are decreasing with the number of managers, and that teams of four-plus managers run significantly younger funds.

The remainder of the paper is organized as follows. Section II describes our data, data screening process and potential data biases. Section III describes the methodology and regressions used to perform our analysis. Section IV presents the results of the number-of-managers effects on fund characteristics, performance and risk-taking behaviors. Section V examines whether survivorship or selection biases are present in our dataset and performs robustness checks to control for such biases. Section VI concludes.

II. Data

A. Data description

The bulk of our fund data is collected from Morningstar Sweden and consists of daily Net Asset ue[9] (NAV) series for equity mutual funds available on Morningstar's official homepage and in general available for Swedish investors.[10] We also obtain data on total fund size[11], inception date, investment strategy description, management and performance fees, and fund manager(s) of each fund from Morningstar. The NAV-data is available in "total return" (SEK), which assumes any income or distributions to be reinvested within the fund and that the fund's base currency is converted to SEK (using the SEK currency exchange rate). This is appropriate for our study, since this would be the actual "price" that a Swedish investor would have to buy and sell the fund for. It also eliminates any inconsistencies when comparing funds of different fund classes, such as accumulative and distributing funds, as well as funds denominated in different base currencies. Similarly to much of the previous literature, the mutual fund prices might be subject to survivorship bias, since non-academic customers of Morningstar have little interest in funds that no longer are in business. We will discuss this further in Section V, and conclude that this issue should not have an important impact on our results.

Quarterly data on fund size have been obtained in SEK from 2007 and forward, which is why we have restricted our sample to include the years 2007 through 2010. This period is interesting for several reasons, most of all due to the dramatic volatility that occurred during the financial crisis of 2008. Management and performance fees represent a snapshot figure as of December 2010, and we have thus assumed the funds' respective fees to be time constant during the sample period.[12]

For each fund, data on the name(s) of the fund manager(s), the manager's start date and, if any, end date, are used to calculate the number of active managers in each month of the sample period. In some cases Morningstar reports funds to be "team managed" rather than providing the names of the managers. Since we cannot distinguish the number of managers in these cases, we will not use this data when analyzing the relative performance of funds with different number of fund managers.

This dataset is merged with proprietary data from Söderberg & Partners[13] which attach a fund subcategory to each fund. More specifically, the funds are categorized into 38 subcategories, all listed in the appendix (A). This merged, new, dataset includes categorization of funds which are currently – or have recently been – available to mutual fund investors in Sweden through financial brokers such as Nordnet, SEB etc.[14]

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[9] Net Asset Value of a fund represents its total assets minus liabilities. NAV is usually reported per share, which basically is the NAV divided by the total number of outstanding shares. The NAV figures are net of fees.
[10] Morningstar Sweden's official homepage: http://www.morningstar.se
[11] The terms "Total Fund Value", "Total Assets Under Management" and "Fund Size" are used to represent the same figure in this study.
[12] This assumption is not very strong. We robustness check this by looking at a snapshot of the management fees in December 2009. On average only 0.2% of the sample funds had changed their management fee during that year. Grinblatt & Titman (1994) use a similar approach and also assume the fee to be constant over the entire sample period.
[13] Söderberg & Partners is the leading independent advisor and accommodator of insurances and financial products in Sweden. Website: http://soderbergpartners.se.
[14] This also includes all equity funds available through the Swedish Premium Pension system. http://www.pensionsmyndigheten.se

In order to estimate Jensen's alpha and beta for the funds we need to assign a market proxy or a benchmark index to each fund. There are several approaches to select benchmark indexes in a performance analysis. One way is to assign a single benchmark to act as the market proxy for all funds in the sample. Another approach would be to regress each fund's return series on a set of different benchmarks and select the benchmark with the highest R-squared. A third way would be to use the benchmark suggested by the fund company itself. Finally, an additional approach is to select a benchmark manually by comparing the investment strategy description, style and distribution of the fund and the benchmark indexes. In our dataset a combination of the second and last approach is used. A benchmark index is assigned to each subcategory that matches the criteria mentioned above.[15] Obviously, each one of these four approached might lead to selection biases in one way or another, and we will discuss this further in Section V. However, our approach is favorable in the sense that we are not obliged to eliminate funds with different risk exposures due to investments in foreign markets, which Dahlquist, Engström, & Söderlind (2000) have to do in their study.[16] A similar argument is presented in Adler & Horesh (1974), which states that security returns of mutual funds that invest in international countries are best characterized by domestic indexes – since no proxy for an international market portfolio held by all investors exists.

In this study we use the OMRX Treasury Bill Index as a proxy for the risk-free rate, which represents the "risk-free" return a Swedish investor would get when investing in treasury bills issued by the Swedish National Debt Office. Daily price information of the risk-free rate and the benchmark indexes of the 38 subcategories are gathered from Bloomberg Inc. In order to correctly compare this data with the NAV-data of the funds, total return (SEK) prices are used.

The combined datasets of the three sources mentioned above will represent our raw dataset and comprises 1,476 equity mutual funds.

B. Data screening and cleaning

During a careful screening-and-adjustment process our starting sample is reduced from 1,476 to 824 funds, and we will summarize this process in the following. If funds exist multiple times in the dataset in the form of different fund classes, such as different base currencies or distributing rules, these redundant observations are eliminated – following previous research. These funds have the exact same asset composition and management structure and we thus remove duplicate funds to avoid multiple counting.[17] This elimination process should not affect results since all NAV-figures are reported in total return (SEK).

[15] This matching process is performed by Söderberg & Partners Asset Management and is based on two steps. The first step is to find and compare benchmark indexes with similar characteristics as the funds in each subcategory, for example with similar asset and geographical compositions. In the second step an index is chosen for each subcategory with regards on how difficult it is to outperform relative to the other similar indexes, by a comparison of performance. The index which proves to be more difficult to outperform is chosen.

[16] They conclude that: "We exclude funds that invest in foreign markets since they have different risk exposures that would require additional benchmarks to span the investment opportunity set."

[17] The elimination process follows the rule to keep funds classes in the following priority: a) minimum inception date, b) fund targeted at retail clients, c) unhedged, d) first introduced on Swedish market. 182 duplicate funds are eliminated in this process.

Funds without observations during the analyzed sample period are excluded, as well as a single fund with obvious errors in its NAV-data.[18] We also eliminate fund-quarters with less than 57 observations (equals 228 observations per year on average) since estimation on fewer observations than this might bias that quarter's estimation results.[19]

For a few funds, gaps in the data on fund size (total fund value) are present. If this gap is shorter than one calendar year, we assign estimated values for each quarter, calculated linearly between each gap's two adjacent values. We deem this to be a reasonable approach since fund size will be analyzed in log-form which is less sensitive than level form, and since we believe that missing fund-size values are occurring randomly with regard to management team size. However, during the financial crisis, some large, non-linear swings in size did occur. We thus eliminate any full fund-calendar-year without any fund value information.[20]

As described in the introduction we will not use data on fund's that are "team managed", i.e. do not offer details on how many managers that take active investment decisions within the team in our main analysis, we thus drop these funds.[21]

In order to estimate alpha and beta measures using the market model we use the benchmark index assigned to each fund as its market proxy. To ensure that the chosen benchmarks are suitable, we eliminate all funds with lower correlation than 0.5 with its benchmark calculated on daily returns. If correlation is lower than this, it most likely indicates that a) the assigned benchmark is erroneous, or b) the comparison of risk-adjusted measures will be unfair.[22]

Index tracking or passively managed funds are eliminated by an automatic search for "index" in the fund name and a manual search – of information that reveals the fund to be passively managed – in the investment strategy description (provided by the fund company).[23] This is necessary since the study naturally focuses on the relative performance of the number of managers in actively managed funds only.

These 824 actively managed funds available for Swedish investors, and in total 11,690 fund-quarters, will represent our dataset. Summary statistics for these funds are presented in Table I.

C. Data issues

This study analyzes *relative*, not *absolute*, performance and risk-taking behavior. Therefore – following the reasoning of Chevalier & Ellison (1999b) – biases which occur non-randomly in some dimensions, but randomly with regard to the management team size, should not distort our relative measures. For exam-

[18] 22 funds are eliminated due to not having any observations during the years 2007-2010 and the NAV-series of the single dropped fund includes a NAV-change of over 100 percent over one day, which is why we decided to drop it.
[19] We expect the fund to have 252 trading days per year on average, which equals 63 trading days per quarter. 2.35% of the sample is eliminated due to this restriction.
[20] 13 funds-years were dropped due to this restriction.
[21] This data will only be used in the appendix when we show aggregated results on single-managed funds compared to team-managed funds. 65 "team-managed" funds are eliminated due to this fact.
[22] 24.5 percent of our observations are dropped due to this restriction. The threshold level (0.5) is arbitrarily chosen but aims at excluding, for example, funds with negative correlation to its benchmark, which obviously indicates that an erroneous benchmark is used. Söderberg & Partners Asset Management uses a similar method and threshold in their fund analysis. Basically, we want to make sure that the fund is moving in the same direction as its comparison index to ensure that a fair index is chosen. To robustness test our results, we rerun our main regressions without this correlation restriction and find that some results become insignificant, but that the fit and magnitudes of the results remain.
[23] 60 passively managed funds are dropped in this screening. The manual screening should make sure that no index tracking funds are still in the sample. However, to robustness check this we perform two separate tests where we rerun our main results by i) eliminating funds with a beta between 0.95 and 1.05 and ii) eliminating funds with a correlation larger than 0.95. None of these tests changes the economic inference of our main results.

ple, we eliminate some funds-years without any fund size data (mentioned above). If insufficient data on fund size is more prevalent for low performing funds, i.e. occurs non-randomly, this would cause our performance measures, e.g. Sharpe ratio and Jensen's alpha, to be upwardly biased. But if insufficient data reporting occurs randomly with regard to the management team size, all team sizes should on average be equally affected by this bias, and the relative relationship between different team sizes should not be affected. Thus if two managers were to outperform three managers by two percent in our analysis, this would indicate that two managers should outperform three managers by two percent in reality as well – but these two percent would take on a higher absolute value in our analysis than in reality (which is not the interest of this study). An implication of this is that we will be rigorous in trying to prevent bias from distorting our relative measures; but we may be slightly less rigorous – in order to preserve our sample size – if we believe that only absolute, but not relative, measures are threatened.

As previously noted our raw NAV-data is denoted in total return (SEK) and adjusted for dividends (reinvested) and fees (subtracted). This enables comparison of cumulative funds and dividend-paying funds; as well as after-fee analysis, which is what is relevant for investors. A concern with this approach may be that a fund's base-currency return may differ from its return converted to SEK. Initially we note that this study principally takes on a Swedish perspective and an investors' cash flow would thus correspond to the returns analyzed here. More importantly, even if this would affect our absolute measures we do not find any clear reason to believe that our relative measures would be affected to any significant degree.[24]

More on data issues, such as selection and survivorship bias as well as a discussion on the trade-off between noise and frequency, will be presented in Section V.

[24] To robustness test this, we rerun the regressions and control for the funds' base currencies with a set of base currency dummies that take the value of one if the fund is denominated in a certain currency, and zero otherwise. The point estimates from these results and their direction does not change compared to our original results However some significance levels are slightly raised, but not to such an extent that the economic inference of the results are affected.

TABLE I
Quarterly Summary Statistics

The table reports summary statistics for all variables used in the analysis. Sharpe is the Sharpe ratio calculated on quarterly excess return divided by the standard deviation of the quarterly excess return. Alpha is Jensen's alpha presented quarterly in percentage and is obtained through a market model estimation. Standard deviation represents total risk and is the quarterly standard deviation of returns in percentage. Beta is the coefficient of the fund's assigned benchmark index in a regression on benchmark excess return and fund excess return. Unsystematic risk is measured by the standard deviation of the residuals from the same regression and is presented in quarterly percentage. Size is the total assets under management in million SEK and Log of Size is the natural logarithm of that figure. ManFee is the annual management fee and PerfFee is the performance fee, both presented in percentage. Age is the age of the fund in years from the fund's minimum of either inception or first available NAV-date. The management team size variables includes a set of dummy variables that takes the value of one if the variable name corresponds to the number of fund managers in the fund, and zero otherwise. *1 manager* represents a single-manager, *2 managers* and *3 managers* represents two- and three managers respectively and *4+ manager*s represents a team where the number of managers is four-or-more. The observations are fund-quarters.

Measure	*Mean*	*Median*	*Stdev*
Sharpe	0.198	0.140	1.004
Alpha	0.0059	0.0079	0.0873
Standard Deviation	11.430	9.736	5.917
Beta	0.811	0.831	0.202
Unsystematic Risk	0.800	0.673	0.477
Size (MSEK)	4022	1389	8044
Log of Size	20.99	21.05	1.60
Age	10.91	10.25	6.84
ManFee	1.56	1.50	0.37
PerfFee	1.15	0	4.15
1 manager	0.665	1	0.472
2 managers	0.246	0	0.431
3 managers	0.064	0	0.245
4+ managers	0.024	0	0.154
Number of Observations	11,690	11,690	11,690

III. Methodology

After the data screening above we are left with a time-series dataset of NAVs and prices for funds, their benchmarks, and the proxy of the risk-free rate. From this dataset of daily frequencies we calculate and estimate a variety of risk and performance measures for each quarter in our sample period. Together with the non-daily-frequency fund characteristics described in Section II this data creates an unbalanced panel dataset. Using this panel dataset, we run several cross-sectional OLS regressions to analyze how the number of managers managing a fund impacts performance, risk and fund characteristics. In the remainder of this section we will explain the technicalities of this methodology.

A. Calculation of daily and quarterly returns

We begin by calculating the daily log returns from our raw dataset using the following standard formulas for (1) funds, (2) benchmark indexes and (3) the risk-free rate proxy, respectively:

$$lrNav_{i,d} = \log\left(\frac{NAV_{i,d}}{NAV_{i,d-1}}\right) \quad (1)$$

$$lrInd_{i,d} = \log\left(\frac{Price_{i,d}}{Price_{i,d-1}}\right) \quad (2)$$

$$lrRf_{d} = \log\left(\frac{Price_{d}}{Price_{d-1}}\right) \quad (3)$$

where $lrNav_{i,d}$ is the daily log return of fund *i* in day *d*, and $NAV_{i,d}$ is the net asset value per share measured total return (SEK) of fund *i* in day *d*, $lrInd_{i,d}$ is the daily log return of benchmark index *i* in day *d* and $Price_{i,d}$ is the price in SEK of the benchmark index *i* at day *d*, $lrRf_d$ is the daily log return of the risk-free rate proxy OMRX Treasury Bill Index in day *d* and $Price_d$ is the price of the risk-free rate on day *d*.

The log returns are then recalculated to arithmetic daily returns as well as collapsed by the sum of each quarter's log returns and recalculated to quarterly arithmetic returns by the following formulas:

$$rNav_{i,d} = e^{(lrNav_{i,d})} - 1 \quad (4)$$

$$rNav_{i,d} = e^{(lrInd_{i,d})} - 1 \quad (5)$$

$$rRf_{d} = e^{(lrRf_{d})} - 1 \quad (6)$$

$$rNav_{i,q} = e^{(\sum_{t=1}^{n} lrNav_{i,d})} - 1 \quad (7)$$

$$rInd_{i,q} = e^{(\sum_{t=1}^{n} lrInd_{i,d})} - 1 \quad (8)$$

$$rRf_{q} = e^{(\sum_{t=1}^{n} lrRf_{d})} - 1 \quad (9)$$

where "*d*"("*q*") represents daily (quarterly) figures. These returns will be used over the years 2007 through 2010 as the basis for our analysis going forward.

B. Capital Asset Pricing Model

We employ a market-model estimation using the Capital Asset Pricing Model (CAPM) introduced in Sharpe (1964) and follow the procedure in Jensen (1968) to estimate some of the measures used in our analysis. Jensen showed that the theoretical SML equation can be used as a simple linear equation, which can be empirically tested using an ordinary least squares regression (OLS). This empirical version of the CAPM is formulated as: $R_{i,t} - R_f = \alpha_i + \beta_i(R_{m,t} - R_f) + \varepsilon_i$, where $R_{i,t} - R_f$ is the excess return of security *i* over the risk-free rate, α is the excess risk-adjusted return, β is the security's beta (systematic risk), $R_{m,t} - R_f$ is the market risk premium and ε_i is a generic error term.

We follow this approach and estimate each fund's alpha (α) and beta (β) over a quarterly (3-month) horizon from daily returns using:

$$\left(rNav_{i,d} - rRf_d\right) = \alpha_i + \beta_i\left(rInd_{i,d} - rRf_d\right) + \varepsilon_i \qquad (10)$$

where $\left(rNav_{i,d} - rRf_d\right)$ is the excess return of fund *i* over the risk-free rate, $\left(rInd_{i,d} - rRf_d\right)$ is the excess return of the benchmark assigned to fund *i*, and ε_i is the error term for fund *i* from the OLS regression.

C. Performance and risk measures

This section will provide the calculations and details of the performance and risk measures that are used in the main analysis.

a) Sharpe ratio

The Sharpe ratio, or reward-to-variability as first mentioned in Sharpe (1966), will be used in the analysis as one of two risk-adjusted performance measures. We use the revised version, by Sharpe in 1994, which acknowledges that the risk-free rate changes over time. The Sharpe ratio is calculated using:

$$S_{i,q} = \frac{(rNav_{i,q} - \mathrm{rRf_q})}{\sigma_{i,q}} \qquad (11)$$

where $S_{i,q}$ is the quarterly Sharpe ratio for fund *i* in quarter *q* and $\sigma_{i,q} = \sqrt{var\left(rNav_{i,q} - rRf_q\right)}$. The Sharpe measure does not distinguish systematic risk from idiosyncratic risk; it measures the total risk-adjusted excess return.

b) Jensen's alpha

The second risk-adjusted performance ratio is Jensen's alpha, which is estimated on daily returns over a 3-month horizon as shown by *equation (10)*. The main difference compared to the Sharpe measure is that Jensen's alpha is adjusted only for systematic risk, and is thus considered to measure the fund manager(s)' skill(s). This indicates that the fund management has to deviate from a fully diversified constant-beta portfolio to realize an alpha different from zero.

c) Standard deviation

Standard deviation will be used as a risk measure of the fund's total risk, including both systematic and idiosyncratic risk, and is calculated using:

$$Stdev_{i,q} = \sqrt{\frac{1}{N}\sum_{d=1}^{N}\left(rNav_{i,d} - \mu_{i,q}\right)^2} \times \sqrt{N} \qquad (12)$$

where $Stdev_{i,q}$ is the quarterly standard deviation of fund *i* in quarter *q*, N is the number of observations in each quarter and is assumed to be 63 on average for all funds (based on 252 trading days per year) and $\mu_{i,q} = \frac{1}{N}\sum_{d=1}^{N} rNav_{i,d}$ is the mean return of fund *i* in quarter *q*.

d) Systematic risk

Systematic risk measures the part of the fund's variance that cannot be eliminated by diversification, and is measured by beta. Similarly to alpha, beta is estimated using *equation (10)* on daily returns over a 3-month horizon. This horizon might be considered to be relatively short, but we try to avoid longer horizon since a fund's riskiness may change over time, especially during periods of economic crisis such as the 2007-2010 sample period. One might also consider estimations performed on daily frequencies to be rather noisy, and we will thus discuss and robustness check for this in Section V.

e) Unsystematic risk

Unsystematic risk, or idiosyncratic risk, represents the fund's risk that is company or industry specific and uncorrelated with the aggregated market or benchmark return. We follow the approach in Chevalier & Ellison (1999b) and calculate unsystematic risk as the quarterly standard deviation of the residuals from the CAPM regression – *equation (10)* – for each fund.

D. Main analysis: Cross-sectional regressions on different number of managers

In order to analyze how a fund's number of managers is related to its performance, risk taking and fund characteristics we regress the measures above, as dependent variables, on the funds' number of managers. The basic concept will be the following.

Since we are interested in the relative performance of different management sizes we group funds with one ("1"), two ("2"), three ("3") and four-or-more ("4(+)") managers into four distinct group of funds. In order to obtain the point estimate and significance level of the relative impact of these groups we run each cross-sectional regression three times, where one group with a certain number of managers is omitted and thus represents the benchmark number of managers. In empirical terms this means that each group will represent the constant using the following procedure:

$$Measure_{i,q} = \beta_0 + \beta_1 dMan\mathbf{2}_{i,q} + \beta_2 dMan\mathbf{3}_{i,q} + \beta_3 dMan\mathbf{4}(+)_{i,q} + X + \varepsilon_i \quad (13)$$

$$Measure_{i,q} = \beta_0 + \beta_1 dMan\mathbf{1}_{i,q} + \beta_2 dMan\mathbf{3}_{i,q} + \beta_3 dMan\mathbf{4}(+)_{i,q} + X + \varepsilon_i \quad (14)$$

$$Measure_{i,q} = \beta_0 + \beta_1 dMan\mathbf{1}_{i,q} + \beta_2 dMan\mathbf{2}_{i,q} + \beta_3 dMan\mathbf{4}(+)_{i,q} + X + \varepsilon_i \quad (15)$$

where $Measure_{i,q}$ is the dependent variable for fund *i* in quarter *q*, *dMan**1*** is a dummy variable that takes the value of one if fund *i* is managed by a single manager in the first day of quarter *q* and zero otherwise, *dMan**2*** is a dummy variable that takes the value of one if fund *i* is managed jointly by two managers on the first day of quarter *q*, *dMan**3*** is a dummy variable that takes the value of one if fund *i* is managed jointly by three managers on the first day of quarter *q*, *dMan**4(+)*** is a dummy variable that takes the value of one if fund *i* is managed by four managers or more on the first day of quarter *q*, *X* represents control and fund characteristics variables which will be presented below and ε_i is the the uncorrelated error term. In equation (13), (14), (15), funds with one, two and three managers will represent the constant or benchmark

number of managers, respectively.[25] Quarterly statistics of the number of managers in the sample is presented in Table II.

The approach of omitting one group of funds with a certain number of managers is used since it is desirable to look at the statistical significance of the differences between the numbers of managers rather than running one regression and using the statistical significance as a criterion for separating the point estimates different impacts – see e.g. Gelman & Stern (2006).

TABLE II
Quarterly Observation Statistics of Number of Managers

The table reports the number of observations for fund-quarters where the funds are managed by one, two, three, or four-or-more, managers respectively. *1 manager* represents a single-managed fund, *2 managers* and *3 managers* represents that two and three managers manage the fund respectively and *4+ managers* represents a team-managed fund where the number of managers is four or more. Observations are fund-quarters.

1 manager	*2 managers*	*3 managers*	*4+ managers*	Total
7,771	2,881	753	285	11,690

The fund characteristics, stated as X in regression 13–15, that will be used are:

1. Fund $Size_{i,q}$, the natural logarithm of the average total fund value (in MSEK) during quarter *q*.
2. Fund $Age_{i,q}$, the average age in years during quarter *q* for fund *i*, and is calculated from the fund's inception date or first available NAV-data – where the oldest date is chosen as the fund's birth.
3. Management Fee_i, is the annual percentage of invested assets that the fund company collects as management fees, from the investor, in order to manage the fund.
4. Performance Fee_i, is a fee collected by some funds if the fund outperforms its benchmark index, normally between 10–20 percent annually. This leads to higher total costs for the investor, but could lead to more incentives to perform well or take higher risk for the fund manager(s). Only a few funds in the sample are associated with performance fees.
5. $Beta_{i,q}$, is the systematic risk of fund *i* in quarter *q*. See above for estimation details.
6. Unsystematic $Risk_{i,q}$, is the unsystematic risk of fund *i* in quarter *q*. See above for estimation details.

We do not assign the performance of a fund to a certain number of managers until the end of quarter *q*, in order to avoid look-ahead biases. To robustness test our results, however, we follow the approach in Chevalier & Ellison (1999b) and rerun all regressions by eliminating all quarters during which there was a change in the number of managers (and where we cannot truly ascribe the full performance to a specific

[25] Elaboration: In the first regression (13) we omit the dummy variable for one manager whereby β_1 becomes the relative impact of two managers compared to one manager, β_2 becomes the relative impact of three managers compared to one manager and β_3 becomes the relative impact of four-or-more managers compared to one manager. In the second regression (14) we omit the dummy variable for two managers whereby β_1 becomes the relative impact of one manager compared to two managers, β_2 becomes the relative impact of three managers compared to two manager and β_3 becomes the relative impact of four managers compared to two manager. The third regression (15) follows the same logic and the dummy variable for three managers is omitted.

number of fund managers).[26] Results show that fit, significance and economic inference do not change compared to all our main results in Section IV.

For all performance measures we apply heteroskedasticity-robust standard errors to calculate the significance level of the point estimates. For risk and fund characteristics measures, however, we cannot use statistical significance inferred from the t-statistics, since we expect these to be biased due to serial correlation in the residuals for a single fund over different quarters. Hence, we use Newey-West standard errors for these measures to control for serial correlation.[27] For risk measures such as beta and standard deviation we use a lag order of one quarter, whereas a lag order of 3 quarters is used when calculating significance for the fund characteristics measures. The rationale behind this is simply that we expect longer serial correlation in errors terms (up to one year) for the fund characteristics, and shorter serial correlation for the risk measures as the sample period represents one of the most volatile periods in financial history.

When running alpha performance regressions we follow the approach in Golec (1996) and include our risk measures as control variables. Friend & Blume (1970) showed that there is a negative correlation between alpha and beta, and claim that measures of portfolio performance can be improved by adjusting for the portfolio risk. Black (1986) discuss the impact that noise trading versus information trading has and concludes that noise trading will deviate the security prices from its true value, whereas information trading works in the opposite direction. From this, one might think that noise by fund managers have a negative relation to performance, which in that case indicates that unsystematic risk may be negatively related to alpha. In order to avoid any risk of omitted variable biases we include beta and unsystematic risk in the alpha regression, and similarly we include beta in the unsystematic risk regression and vice versa to control for aggressive managers that may try to obtain high returns by raising both the systematic and the idiosyncratic risk.

Our results are presented in the next section.

[26] 3.9% of the fund-quarters were excluded, due to a change of management size during that quarter, in this robustness test.
[27] See Newey & West (1987).

IV. Results

In Section I we stated our *ex ante* hypothesis, crafted in light of the contradictory social-psychology research on group behavior: "The number of managers *does impact* funds' characteristics, performance and risk-taking behavior." In this section we examine this hypothesis by presenting and discussing whether funds managed by a certain number of managers can predict cross-sectional distributions of fund characteristics, performance and risk-taking behavior. The regression results are presented in Table III, Table IV and Table V.

Let us clarify and restate a few important issues about the presentation and analysis of our results. First, remember that we look at *relative*, not absolute, results. Thus, if we state that x outperforms y, bear in mind that both x and y may actually underperform (or outperform) their benchmark indexes. Second, as we have no *ex ante* expectations about directions of our hypotheses we appropriately use the more conservative two-tailed test. Our standard significance levels are five percent and ten percent but we state higher significance levels a few times to illustrate weak patterns. Third, for brevity and clarity we sometimes exclude words such as "managers" and "funds".

A. Fund characteristics

A few interesting observations can be made from the relation between management fee and fund size, in Table III. Fund size tends to increase when the numbers of managers are increased from one, to two, to three. The standard deviation of fund size (log form) is 1.60, which means that fund size increases by 0.212 divided by 1.60, or 13 percent of a standard deviation going from one to two managers. Similarly, going from two to three managers increases fund size by an additional 25 percent of a standard deviation. A negative significant relationship between three and four-plus managers is breaking this pattern, but being a fund managed by four-plus managers increases fund size with 15 percent of a standard deviation, compared to single-managed funds (only significant at 13.5 percent).

Conversely, the management fee estimates decrease with the number of managers. A standard deviation of 0.37 for management fees indicates that going from a single-managed fund to a fund managed by three managers and four-plus managers, on average decreases the management fee with 22 percent and 66 percent of a standard deviation respectively. This inverse indirect relationship between management fee and fund size could perhaps partly be explained by economies of scale. If fund size is increased to such an extent that economies of scale are achieved, the fund might in turn be enabled to charge lower management fees.

A direct negative relation between size and management fees are, however, not significant in our data, but Golec (1996) find a significant negative relationship in data on US equity funds.

Four-plus management teams manage significantly younger funds than funds with less fund managers. On average their funds are estimated to be 1.6, 1.1 and 1.7 years younger than funds managed by one, two and three managers, respectively. This lower fund age could be an indication of persistent underperformance, since research has shown that poorly performing funds are more likely to be closed – see e.g. Brown et al. (1992). It could also imply that new funds are more willing to employ several managers,

TABLE III

Quarterly Relative Fund Characteristics Between Number of Managers

The table reports results from fund characteristics regressions where the dependent variables Fund Size (log), Fund Age and Management Fee are regressed on a set of dummy variables that takes the value of one if the fund is managed by the number of managers that corresponds to the variable name, and zero otherwise. The point estimates for these dummy variables represent the relative impact against the benchmark number of managers' impact on fund characteristics. The benchmark number of managers is reported in italic in the first column and range from 1 manager (single manager) to 3 managers (three active managers). The constant and standard errors have been omitted for brevity, but are available upon request. For each regression we control for some of the fund characteristics: Size (the natural logarithm of total assets under management in MSEK), Age (fund age in years from inception or first available NAV-date), Manfee (annual management fee), Perffee (performance fee). The control variables are only presented once for every dependent variable since the point estimates and significance are exactly equal no matter which management team size dummy that is used as the constant. Significance is calculated with Newey-West standard errors to control for serial correlation (3 lag order), where (*) represent a significance level of at least 5 % and (^) represents a significance level of at least 10 % using a two-tailed ted. The observations are 11,690 fund-quarters.

Fund Size (log)

	Impact on dependent variable for different number of managers relative to the benchmark number of managers			*Fund Characteristics*					
Benchmark (Constant)	2 managers	3 managers	4+ managers	Size	Age	Manfee	Perffee	Beta	Unsys
1 manager	0.212*	0.617*	0.238						
2 managers		0.405*	0.026	-	0.058*	-0.031	-0.040*	-	-
3 managers			-0.380*						

*Note: *(^) Significant at least at the 5(10) percent level using a two-tailed test.*

Management Fee

	Impact on dependent variable for different number of managers relative to the benchmark number of managers			*Fund Characteristics*					
Benchmark (Constant)	2 managers	3 managers	4+ managers	Size	Age	Manfee	Perffee	Beta	Unsys
1 manager	-0.015	-0.083*	-0.243*						
2 managers		-0.068*	-0.228*	-0.002	-0.008*	-	-0.008*	-	-
3 managers			-0.160*						

*Note: *(^) Significant at least at the 5(10) percent level using a two-tailed test.*

Fund Age

	Impact on dependent variable for different number of managers relative to the benchmark number of managers			*Fund Characteristics*					
Benchmark (Constant)	2 managers	3 managers	4+ managers	Size	Age	Manfee	Perffee	Beta	Unsys
1 manager	-0.535*	0.060	-1.643*						
2 managers		0.595	-1.108^	1.056*	-	-2.679*	-0.145*	-	-
3 managers			-1.703*						

*Note: *(^) Significant at least at the 5(10) percent level using a two-tailed test.*

which could be a consequence of the increased presence of team managed funds in general or due to a higher workload during the first years after the fund's inception. Also, we find weak evidence that single managers run older funds, which could be explained by the argument that some single managers are considered to be "star" managers who are recruited to run older and more well-established funds. This could also help to explain the higher management fees for single-managed funds – simply because "star" managers might require a higher compensation for their work.[28]

B. Performance and risk

In this section the results from the regressions of the risk-adjusted measures Jensen's alpha and the Sharpe ratio, as well as the risk measures standard deviation (representing total risk), beta (systematic risk) and the standard deviation of the residuals (unsystematic risk) will be presented. These measures are calculated using the method explained in Section III and results are presented in Table IV and Table V.

For the alpha measure we notice an interesting pattern in that four-plus managers significantly underperform all else. There is, however, no linear-like negative relationship between team size and performance. Instead two and three managers actually outperform a single manager, while no significant difference is found between two and three managers. In other words, a "reversed U-shaped team-size–performance pattern" is present, suggesting that performance initially increases as team size grows, but at some point "too many cooks spoil the broth" and performance starts to decline.

Perhaps the aggregate ability of management teams of four-plus managers is lower than that of individuals or smaller sized teams. As we alluded to in the introduction, there is social psychology research available for building such a case. According to Janis (1982) a team is more likely to develop "groupthink" the longer they work together, which tends to inhibit learning and rational decision making. Jewell & Reitz (1981) find that as teams grow in size, members feel less involved in the decision making and their motivation is reduced, which could result in lower performance. Other research emphasizes that larger sized teams are more likely to fraction into conflicts which hamper the decision-making process and decreases performance – see e.g. O'Reilly, Caldwell, & Barnett (1989).

The research in the previous paragraph can also be used to analyze the intriguing fact that two and three equity managers outperform single managers, but that four-plus managers underperform all else. The research above does not propose that the negative effects emerge all at once when going from an individual to a team, but rather that they start to emerge as team size increases (excluding Janis). A conflict, for example, gradually becomes more likely as teams grow in size. But two and three managers do not just avoid underperforming a single manager, they actually outperform him. There may thus be some merit to the research which suggests that groups can aggregate their members' knowledge into an aggregated sum and correct each other's mistakes, see e.g. Hill (1982), but perhaps only up to a certain size. This is indeed found by Laughlin et al. (2006) when analyzing the effects of varying team sizes for solving intellectual problems. They find that small-sized teams of three to five members outperform individuals,

[28] The concept of "star" managers was presented in Chevalier & Ellison (1999a), who argue that small finds might employ a "star" manager with a high salary in order to attract new money into the fund.

but that there is no important benefit of increasing team size beyond three individuals. Small-sized teams' members tend to correct each other's mistakes, combine abilities and resources, and therefore perform better.

In addition, the reversed U-shaped team-size–performance pattern lends support to our suspicion, noted in section I, that an analysis along "single-managed versus team-managed funds" may not pick up the nuances of group behavior. Perhaps the reason for why Prather & Middleton (2002) and Golec (2006) find no significance difference between single- and team-managed funds is because the differences between different team sizes are averaged out.

TABLE IV

Quarterly Relative Performance Between Number of Managers

The table reports results from performance regressions where the dependent variables Jensen's alpha and the Sharpe ratio are regressed on a set of dummy variables that takes the value of one if the fund is managed by the number of managers that corresponds to the variable name, and zero otherwise. The point estimates for these dummy variables represent the relative performance against the benchmark number of managers' performance. All point estimates are presented in quarterly percentage figures. The benchmark number of managers is reported in itallic in the first column and range from 1 manager (single manager) to 3 managers (three active managers). The constant and standard errors have been omitted for brevity, but is available upon request. For each regresion we control for some of the fund characteristics: Size (the natural logarithm of total assets under management in MSEK), Age (fund age in years from inception or first available NAV-date), Manfee (annual management fee), Perffee (performance fee), Beta (systematic risk as estimated in a market model CAPM estimation) and Unsys (unsystematic risk is the quarterly standard deviation of the residuals in the same estimation). The control variables are only presented once for every dependent variable since the point estimates and significance are exactly equal no matter which management team size dummy that is used as the constant. Significance is calculated with heteroskedasticity-robust standard errors, where (*) represent a significance level of at least 5 % and (^) represents a significance level of at least 10 % using a two-tailed ted. The observations are 11,690 fund-quarters.

Jensen's Alpha

Benchmark (Constant)	*Impact on dependent variable for different number of managers relative to the benchmark number of managers*			*Fund Characteristics*					
	2 managers	3 managers	4+ managers	Size	Age	Manfee	Perffee	Beta	Unsys
1 manager	0.0042*	0.0069*	-0.0093*						
2 managers		0.0026	-0.0136*	0.0012*	-0.0002^	0.0080*	0.0003^	-0.0088	-0.0050*
3 managers			-0.0162*						

*Note: *(^) Significant at least at the 5(10) percent level using a two-tailed test.*

Sharp Ratio

Benchmark (Constant)	*Impact on dependent variable for different number of managers relative to the benchmark number of managers*			*Fund Characteristics*					
	2 managers	3 managers	4+ managers	Size	Age	Manfee	Perffee	Beta	Unsys
1 manager	0.050*	-0.037	0.011						
2 managers		-0.087*	-0.039	0.011^	0.002	0.065*	0.004^	-	-
3 managers			0.048						

*Note: *(^) Significant at least at the 5(10) percent level using a two-tailed tes.*

To control this, we rerun the regressions and use single-managed funds versus two-plus team managed funds (all funds managed by more than one manager) and find no significant difference in alpha performance.[29] This indicates that two and three managers' outperformance is concealed by the underperformance of four-plus managers, on an aggregated level.

We also find that performance seems to be positively related to fund size and management fee. The latter relation might appear unintuitive since much empirical work show that *total* fees (which includes management fee) are negatively related to performance. Golec (2006) finds similar results to ours and argues that higher management fees may be charged by managers with superior investment skills.

While the reversed U-shaped team-size–performance pattern is present in the alpha regressions, the same does not apply in the cross-sectional regressions of the Sharpe ratio. This difference may appear contradictory. However, the Sharpe ratio is calculated using total risk and can thus be considered to "punish" any unsystematic risk taken by the fund manager.[30] It could in many cases be unjust to punish managers of e.g. focused funds, such as small cap or sector funds, for carrying unsystematic risk since they cannot, or are not, intended to diversify away such risk.[31] And in Table V we note a weak pattern that four-plus managers indeed do take on less unsystematic risk, while funds with three managers take on significantly more unsystematic risk than all other. Going from a single-managed fund to a fund managed by two (three) managers, increases unsystematic risk by 48 (127) percent of a standard deviation respectively. However, going from a fund managed by two (three) managers to a fund managed by four-plus managers decreases the unsystematic risk by 68 (147) percent of a standard deviation respectively.[32] This may be one of the reasons why the alpha underperformance by four-plus managers and the outperformance by three managers are not detected by the Sharpe ratio. On the other hand, the outperformance by two managers holds, even when considering the Sharpe ratio.[33]

The relation above begs the question *why* two and three managers take on more unsystematic risk, while four-plus managers take on less unsystematic risk. Golec (2006) suggests that one might expect unsystematic risk to fall as the number of managers grows, since each individual in the team may want to include his or her favorite stocks in the fund. This could explain the lower unsystematic risk taken by four-plus managers. The relatively high unsystematic risk taken by two and three managers is more puzzling. A possible explanation could be that fund managers in small-sized teams in fact may wish to include their favorite investments to such a large extent that the fund allocation to these investments rise well beyond the intended diversification level – and thus increases the fund's unsystematic risk.

Table V illustrates that fund teams of three managers are estimated to take on the most total risk, systematic risk and unsystematic risk. They take on significantly more total risk and systematic risk than

[29] Full table results for single-managed funds versus team-managed funds are available in the appendix (B).
[30] See Bodie, Kane, & Marcus (2009, ss. 828–832), where they lay out the reasoning for why the sharpe ratio should be used for evaluating *total* portfolios, while alpha is more appropriate for evaluating e.g. single mutual funds.
[31] They are not supposed to be completely diversified since they offer other benefits to investors. An investor can diversify unsystematic risk taken by funds, by investing in several funds in order to combine an altogether diversified portfolio.
[32] The figure for four-plus managers compared to two managers is however only significant at the 20.5 percent level.
[33] We also run a regression on the Treynor ratio which is a risk-adjusted measure based on systematic risk. Unsurprisingly, results rank the number of managers similarly to the alpha regression – indicating a reversed U-shaped team-size-performance pattern.

one and two managers, and significantly more unsystematic risk than all else. Three managers also outperform all else according to alpha (although insignificantly relative to two managers) as Table III illustrates

TABLE V

Quarterly Relative Risk Between Number of Mangers

The table reports results from risk measure regressions where the dependent variables Standard Deviation, Beta and Unsystematic risk are regressed on a set of dummy variables that takes the value of one if the fund is managed by the number of managers that corresponds to the variable name, and zero otherwise. The point estimates for these dummy variables represent the relative risk taking against the benchmark number of managers' risk taking. The benchmark number of managers is reported in italic in the first column and range from 1 manager (single manager) to 3 managers (three active managers). The constant and standard errors have been omitted for brevity, but are available upon request. For each regression we control for some of the fund characteristics: Size (the natural logarithm of total assets under management in MSEK), Age (fund age in years from inception or first available NAV-date), Manfee (annual management fee), Perffee (performance fee). The control variables are only presented once for every dependent variable since the point estimates and significance are exactly equal no matter which management team size dummy that is used as the constant. Significance is calculated with Newey-West standard errors to control for serial correlation (1 lag order), where (*) represent a significance level of at least 5 % and (^) represents a significance level of at least 10 % using a two-tailed ted. The observations are 11,690 fund-quarters.

Standard Deviation

Benchmark (Constant)	*Impact on dependent variable for different number of managers relative to the benchmark number of managers*			*Fund Characteristics*					
	2 managers	3 managers	4+ managers	Size	Age	Manfee	Perffee	Beta	Unsys
1 manager	0.134	0.752*	0.143						
2 managers		0.618*	0.009	-0.157*	0.000	1.140*	0.022		
3 managers			-0.609						

*Note: *(^) Significant at least at the 5(10) percent level using a two-tailed test.*

Beta

Benchmark (Constant)	*Impact on dependent variable for different number of managers relative to the benchmark number of managers*			*Fund Characteristics*					
	2 managers	3 managers	4+ managers	Size	Age	Manfee	Perffee	Beta	Unsys
1 manager	-0.017*	0.026*	0.017						
2 managers		0.043*	0.034*	0.010*	0.001*	-0.002	0.000	-	-0.013*
3 managers			-0.009						

*Note: *(^) Significant at least at the 5(10) percent level using a two-tailed test.*

Unsystematic Risk

Benchmark (Constant)	*Impact on dependent variable for different number of managers relative to the benchmark number of managers*			*Fund Characteristics*					
	2 managers	3 managers	4+ managers	Size	Age	Manfee	Perffee	Beta	Unsys
1 manager	0.229*	0.605*	-0.097						
2 managers		0.376^	-0.326	-0.122*	-0.003	1.026*	-0.011	-4.483*	-
3 managers			-0.701*						

*Note: *(^) Significant at least at the 5(10) percent level using a two-tailed test.*

and previously noted. This may lead to the conclusion that the high relative performance of three managers may be explained by their higher risk taking. That conclusion is, however, contradictory to the fact that alpha is negatively correlated with systematic risk (11%) and unsystematic risk (>1%) in Table III.[34] The higher risk taking of three managers therefore does not seem to explain their high relative alpha performance (which itself is risk-adjusted). Instead, this further supports our reasoning above that there may be social psychological reasons for why small-sized teams exhibit superior performance. What the source of three manager's relatively high risk taking is does not appear obvious, but some explanations may come from Janis's (1982) on group behavior, as elaborated on in the next paragraph.

While two and three managers take on significantly more total risk than one manager, this is not the case for teams of four-plus managers. This lends support to Janis' (1982) research which indicates that risk taking tend to increase in groups with strong cohesiveness. Cohesiveness should logically be higher in smaller groups than in larger groups, and this is also shown by Shaw (1981).

Finally, we conclude that there are ample results which support our hypothesis from Section I, that the number of managers *does impact* funds' performance and risk-taking behavior. For some results we find plausible explanations from social psychological research, while other findings, such as the high relative risk-taking behavior of teams of three managers, are more difficult to interpret. Nonetheless, the number of managers managing a fund seems to be a possible predictor of the cross-sectional distributions of fund characteristics, performance and risk-taking behavior.

[34] The 11% and <1% significances on the control variables systematic and unsystematic risk in the alpha regression confirms the conclusion of Friend & Blume (1970) that there is a negative correlation between alpha and beta, and claim that measures of portfolio performance can be improved by adjusting for the portfolio risk.

V. Robustness Checks

A. Selection biases – a benchmark issue

This study has been more numerous than some previous studies with regards to the indexes used when measuring alpha and beta. We have grouped the equity funds into 38 different subcategories and assigned a specific benchmark index to each fund based on the characteristics of each subcategory. Additionally, we dropped fund observations that had a lower correlation than 0.5 with its assigned index, since a lower correlation than that could indicate that an inappropriate index was used.[35]

Previous literature, mainly analyzing US equity funds, often uses a single-index measurement, such as the S&P 500, when performing the CAPM-estimation, e.g. Ippolito (1989) and Golec (1996). The latter also claims this to be a drawback of his study. The implications of using single- or multi-index measures have been widely discussed and contradictory studies – on whether using either one of them will affect the funds' performance ranking – exist. For example, Hendricks, Patel, & Zeckhauser (1993) try several single-index and multi-index models but find little effect on the rankings of funds. Grinblatt & Titman (1994), on the other hand, show that single-index and multi-index benchmarks produce significantly different performance rankings. They claim that the overall performance of the mutual fund industry is strongly influenced by the choice of the benchmarks, and that results are likely to be erroneous if the benchmark index easily can be gamed by the fund managers through exploitation of CAPM. This conclusion is in line with Roll (1978), which show that an index can be found for every asset to produce a beta of any desired magnitude, both large and small. Thus, any fund can be estimated to show a certain performance against the security market line, depending on the choice of the index that represents the market portfolio. This will lead to selection biases since the true market portfolio not necessarily is observable – a critique first discussed in Roll (1977). However, since our study is based on a cross-sectional analysis on the relative performance between the number of fund managers, we can expect the average performance differences to be less important for our results.

To control for these factors we would, in a best-case scenario, have access to a multi-index time-series which control for size, value and momentum biases for each of our subcategories and calculated from a Swedish investor's perspective. Even so, our results should provide fairly non-spurious results since we have benchmarks for each type of funds in order to span that particular fund's investment opportunity set.

B. Survivorship and look-ahead biases

The structure of our dataset makes it vulnerable to both survivorship bias and a type of look-ahead bias that might occur due to "new" funds that join the sample during our analyzed period. The former is widely discussed in previous literature, but the latter, also defined as "omission" bias in Prather & Middleton (2002), is not as common in performance studies. We will discuss both these biases in the following.

[35] As mentioned in Section II, we run robustness test without this restriction and find that some results become insignificant, but that the fit and magnitude of the point estimates remain.

Empirical evidence shows that poorly performing funds are more likely to be closed or merge with other funds than high performing funds, which causes the average performance measures of mutual funds to be biased upwards in much of the fund performance literature.[36] Our dataset do not include funds that were liquidated before December 2010, which implies that our performance measures, in absolute terms, would be biased upward. Hence, the raw data used in this study might not be ideal for absolute-performance analysis, but as previously explained we are analyzing cross-sectional patterns in the relative performance and risk-taking behavior of funds with different management team sizes. Thus, our relative measures should not be distorted if the survivorship bias occurs randomly with regard to the number of fund managers of each fund. However, Elton, Gruber, & Blake (1996) find some evidence of survivorship-bias differentials between different fund characteristics and one might fear that this could affect our relative measures. Unfortunately, our dataset does not allow us to test the impact of possible survivorship biases, but if one could access information on all active funds (provided by Morningstar) during the beginning of our sample period a robustness test similar to the one presented in Chevalier & Ellison (1999b) could be performed. In conclusion, due to the nature of this study – whether a group of actively managed funds outperform another group of actively managed funds – we think that the effect of this bias is unclear and have no *a priori* reason to consider it to have a large impact on our results. Additionally, we think that any possible survivorship effect may be relatively small due to the short sample period.

Our dataset includes data on all active funds by the end of 2010, which means that new funds may have been launched during the sample period. This might cause an "omission" bias since, for example, Arteaga, Ciccotello, & Grant (1998) show that a one-year return bias potentially is created through the process of mutual fund inceptions. The study finds that fund companies may create multiple funds simultaneously, with different investment objectives, and when the initial outcomes are known – liquidate the poorly performing funds and focus on the "winning" funds by increasing marketing efforts. In the traditional "active versus passive managed fund"-literature, this bias would affect the performance measures upward for the actively managed funds relative to the index funds. However, if this effect holds true for our sample, "new" funds would bias our relative results upward only if "new" funds affect performance for a specific group of funds.

To test the robustness of our results, we rerun the performance and risk measures on two subsamples of fund-quarters where i) all first year's observations of each fund are excluded ii) all funds launched during the sample period are completely eliminated, following the approach of Prather & Middleton (2002). For i) and ii), 3.33 percent and 9.75 percent of the funds-quarters are eliminated, respectively. The new results with the reduced omission bias sample are presented in Table VI. In general results stay consistent with our main results, but a few of the p-values from the regression are raised. We illustrate results for the robustness test for alpha and unsystematic risk, since the Sharpe ratio, beta and standard deviation are not considerably affected by the reduced sample.

[36] See, for example, Brown, Goetzmann, Ibbotson, & Ross (1992) and Elton, Gruber, & Blake (1996).

For alpha and unsystematic risk the estimates are roughly the same in our first omission biased free sample (Table IV i), and all significance levels for the relative performance between different team sizes remain. For the second omission bias free sample, illustrated in Table VI ii), most significant differences between differently sized management teams remain compared to our main regression presented in Table IV, but some differences are nevertheless present. In this subsample, four-plus managers still underperforms one manager, but not significantly as in our main regression. However, they still underperform two and three at the same significance levels. In our main regression three managers take on more unsystematic risk than two managers but in Table VI ii) we notice that this difference becomes insignificant. In general, these finding suggest that our main results are robust against any potential "omission" biases.

TABLE VI
Robustness Checks

The table reports results from performance and risk regressions where the dependent variables are Jensen's alpha and unsystematic risk, as shown on the left-hand side of the table. The methodology follows the same principle as in Tables III - V with the difference being that new underlying datasets are used. These are: i) a sub-sample of funds where the first fund-year after the funds' inception are eliminated, ii) a sub-sample of funds where all funds that were launched during the sample period (2007-2010) are eliminated, iii) a sample of funds similar to the original sample but where the CAPM estimation is based on weekly frequencies instead of daily frequency and iv) a sample of funds similar to the original sample but where all fund-years with less than 12 monthly observations are eliminated and where the CAPM estimation is based on monthly frequencies over a one-year period. These datasets are created to robustness tests our results. Interpretation is simplest by comparing results from table i), ii), iii) and iv) to the corresponding results in Table III - V. The measures: Sharpe ratio, beta (systematic risk) and standard deviation (total risk) have been left out for brevity since these results were not considerably affected. All data not presented in these tables, such as the standard errors, are available upon request.

i) Reduced Omission Bias Free Sample: Excluding first-year observations

	Benchmark (Constant)	*Relative impact of different number of managers versus the benchmark number of managers*			*Fund Characteristics Controls*					
		2 managers	3 managers	4+ managers	Size	Age	Manfee	Perffee	Beta	Unsys
Alpha	*1 manager*	0.0039*	0.0070*	-0.0085*						
	2 managers		0.0032	-0.0123*	0.0011*	-0.0002^	0.0093*	0.0005*	-0.0103^	-0.0048*
	3 managers			-0.0155*						
Unsys	*1 manager*	0.240*	0.612*	-0.085						
	2 managers		0.372^	-0.325	-0.118*	-0.004	1.025*	-0.020^	-4.536*	-
	3 managers			-0.697*						

*Note: *(^) Significant at least at the 5(10) percent level using a two-tailed test. Number of observations: 11,301.*

ii) Reduced Omission Bias Free Sample: Excluding new funds during sample period

	Benchmark (Constant)	*Relative impact of different number of managers versus the benchmark number of managers*			*Fund Characteristics Controls*					
		2 managers	3 managers	4+ managers	Size	Age	Manfee	Perffee	Beta	Unsys
Alpha	*1 manager*	0.0054*	0.0058^	-0.0064						
	2 managers		0.0004	-0.0118*	0.0014*	-0.0000	0.0092*	-0.0000	-0.0093^	-0.0051*
	3 managers			-0.0122*						
Unsys	*1 manager*	0.258*	0.540*	-0.090						
	2 managers		0.282	-0.348	-0.107*	0.002	0.955*	-0.027*	-4.833*	-
	3 managers			-0.630*						

*Note: *(^) Significant at least at the 5(10) percent level using a two-tailed test. Number of observations: 10,621.*

iii) Quarterly Period Sample: Estimation on weekly returns

	Benchmark (Constant)	*Relative impact of different number of managers versus the benchmark number of managers*			*Fund Characteristics Controls*					
		2 managers	3 managers	4+ managers	Size	Age	Manfee	Perffee	Beta	Unsys
Alpha	*1 manager*	0.0180*	0.0071	-0.0615*						
	2 managers		-0.0109	-0.0795*	0.0053*	-0.0017*	0.0163	0.0017*	0.0947*	-0.0610*
	3 managers			-0.0686*						
Unsys	*1 manager*	0.070*	0.029	-0.110*						
	2 managers		-0.040	-0.180*	-0.042*	-0.005*	0.318*	0.003	-0.204*	-
	3 managers			-0.140*						

*Note: *(^) Significant at least at the 5(10) percent level using a two-tailed test. Number of observations: 11,690.*

iv) Yearly Period Sample: Estimation on monthly returns

	Benchmark (Constant)	*Relative impact of different number of managers versus the benchmark number of managers*			*Fund Characteristics Controls*					
		2 managers	3 managers	4+ managers	Size	Age	Manfee	Perffee	Beta	Unsys
Alpha	*1 manager*	0.0114	-0.0372	-0.2470*						
	2 managers		-0.0486	-0.2584*	0.0321*	-0.0027	-0.0295	0.0042	-0.0752	0.0653*
	3 managers			-0.2098*						
Unsys	*1 manager*	0.183*	0.013	-0.234*						
	2 managers		-0.170^	-0.417*	-0.073*	-0.013*	0.730*	0.010*	0.750*	-
	3 managers			-0.246*						

*Note: *(^) Significant at least at the 5(10) percent level using a two-tailed test. Number of observations: 2,756.*

C. Frequency and noise biases

In general, it is widely considered that the more observations one includes in an empirical estimation the better. This suggests that a long time period is desirable when for example estimating the CAPM. However, long estimation periods may bias the results for beta since it is likely that the true beta (systematic risk) will change over time. To control for this fact, one could use shorter time periods but increase the frequency in order to keep the number of observations high. This is what we have done, so far, in this study by using daily frequency over a 3-month time period. On the other hand, some claim that using daily returns will increase the noise in the data, which might reduce the efficiency of the estimates. For example, Grinblatt & Titman (1994) suggests that the noisiness in portfolio returns might make it difficult to detect abnormal performance.

For those reasons we rerun our estimations in two separate ways, by: recalculating our dataset returns to weekly (monthly) frequencies and estimate our CAPM regression on the weekly (monthly) excess returns of the funds and their benchmark indexes for each quarter (year). Obviously, for the quarterly (yearly) estimation on weekly (monthly) returns, this reduces the frequency to merely 13 (12) observations which according to Chevalier & Ellison (1999b) is fewer data points for the estimation than one might want to have. These two new dataset should provide results without any potential biases from noisy return data.

Similarly to the results from the omission bias free samples, the Sharpe ratio, beta and standard deviations results are almost identical to our main results, except for the systematic risk taken by three manag-

ers which in these samples becomes insignificant. Hence, Table VI iii) and iv) will only present results for alpha and unsystematic risk using weekly and monthly frequency, respectively.

Table VI iii) show results based on weekly frequency, which should provide results with less noise, but still over the same time period (a quarter) as in our main analysis. The main difference here is that outperformance by three managers over single-managed funds becomes insignificant. In terms of unsystematic risk, these results show that three managers no longer take on significantly higher risk. On the other hand, four-plus managers show a negative and significant relation compared to all other manager compositions.

In Table VI iv) results based on monthly frequencies over a full-year time period are presented. This estimation might itself be biased since we have to assume that variables stay constant over a full-year. The main differences with regards to unsystematic risk are that four-plus managers now show significantly lower risk-taking than all other management compositions and that two managers seem to take on significantly more unsystematic risk than all other, even more than three managers. Regarding Jensen's alpha, only results for four-plus managers are now significant, which strengthens the validity of the inference that four-plus managers underperform relative to all other compositions of teams or single managers. The outperformance by two and three managers does, however, become insignificant. In general, this indicates that the reversed U-shaped team-size–performance pattern might be slightly affected by noise in returns. More significantly, it suggests that our most robust finding in this study is the underperformance by four-plus managers.

D. Subjective biases

The data on number of managers is collected from Morningstar, who in turn has gathered the information either through the funds' fact sheets or from information reported from the fund companies. This information might be at risk to have a subjective bias – for example if Morningstar employees misinterpret the number of managers that actually take active investment decision in the fund, when scanning the fact sheets. We do believe, however, that this risk is small since the number of managers ought to be fairly unambiguous information. To confirm this belief, we perform a robustness check of the information by choosing a random sample of funds and contact the fund companies of these funds, either by e-mail or telephone, to confirm that the information we have is accurate. Obviously, this robustness test itself could induce a response bias – if funds with a certain number of managers do not respond – but we appreciate this risk to be small. We contacted five percent of the sample funds, which corresponds to ~50 funds, out of which 33 responded and 31 were confirmed to be accurate. However, among the inaccurate funds it was most commonly the start or end dates of the manager(s) that was inaccurate, which in terms of fund-quarter equaled to an error margin of only 1.8 percent. We consider this to be acceptable for this study.

VI. Conclusion

The purpose of this study has been to analyze team management of equity mutual funds more in depth than what has previously been done, with the hypothesis that the number of managers managing a fund has an impact the fund's characteristics, performance and risk taking. We find several results that lend support to our hypothesis.

Our most interesting finding is that teams of two and three managers outperform single managers, while teams with four managers or more underperform relative to all others. This finding suggests a reversed U-shaped team-size–performance relationship – when looking at the risk-adjusted Jensen's alpha measure. In particular, we find social psychological research on group behavior to be helpful in trying to explain this pattern. For example, Laughlin et al. (2006) show that the members of small-sized teams tend to correct each other's mistakes, combine abilities and resources, and as a consequence perform better. Additionally, O'Reilly, Caldwell, & Barnett (1989) show that when teams grow in size they are more likely to fraction into conflicts which potentially may decrease the team's performance. In other words, an interpretation of social psycological research applied on investment management could indicate that small-sized teams should outperform both individuals and larger-sized teams, which is what our reversed U-shaped team-size–performance result supports. This alpha pattern is not present for the Sharpe-ratio results, which to some extent can be explained by differences in the unsystematic risk taken by fund managers, since the Sharpe ratio by definition "punishes" idiosyncratic risk while Jensen's alpha does not.

We also rerun our alpha regression on single-managed funds versus team-managed funds and find no significant relationship, which indicates that the outperformance by two- and three-managed funds may be councealed by the underperformance of teams with four managers or more. Thus, the approach of Golec (1996) and Prather & Middleton (2002) of analysing either teams versus single managers or having team size as a continuous variable, may have missed interesting differences within team-managed funds.

An additional finding is that equity funds run by teams of two and three managers take on more unsystematic risk than other-sized teams which is congruent with Janis' (1982) research indicating that teams with high levels of cohesion tend to increase their risk-taking behavior.

Three managers charge lower management fees than one and two managers; and four-plus managers charge lower management fee than all others. An explanation for this could be the weak pattern we find of fund size increasing with team size, enabling economies of scale to offset the (presumed) increased salary to some extent. Another explanation could be that "star" managers are recruited to manage single-managed funds with a higher requirement of compensation.

The robustness checks in Section V both reinforce and problematize some of our empirical results, but in general the overall economic inference from the results in Section IV remain, especially the underperformance by four-plus managers.

After having run these robustness tests we feel confident in concluding that a significant amount of our results confirm our hypothesis that the number of managers has relevance for performance and risk taking. This insight has several practical implications for academia, fund companies and investors. We

hope that our study has highlighted the sparse amount of financial research available on team management of mutual funds, and that there actually is valuable information to obtain. Fund companies can incorporate, into their fund management strategies, the suggestion that that small-sized teams outperform, and take on more risk, than sole managers and teams of four-plus managers. If performance is paramount, small-sized teams may be the most advisable management structure, but awareness should be kept that the risk level also tends to increase for this management structure. Likewise, investors who primarily are concerned with performance (risk) should consider (not consider) to place their investments in funds managed by teams of two or three managers.

Regardless of the circumstances under which these results are used, we hope that our main conclusion; that the number of managers managing a fund, in fact, is a possible predictor of the cross-sectional distributions of fund characteristics, performance and risk-taking behavior, will be a factor to include in future research.

VII. Further Research

As we noted in the opening paragraphs of this thesis, in-depth research on team management of mutual funds is noticeably sparse, so practically *any* new research in this field would be valuable. One difficulty may be to find sufficiently detailed data on mutual funds' management teams. We can think of much data – unavailable to us – which could be used in this area for original analysis. Hence, anyone who possesses unique information about fund teams can almost certainly also use it for unique research.

We would like to conclude by making a rather concrete suggestion for further research. An interesting approach would be to apply Goodstein, Gautam and Boeker's (1994) research on board composition (in business settings) on fund management teams. Goodstein, Gautam and Boeker compare the performance of "homogenous" and "heterogeneous" boards with regard to strategic changes, in particular in times of turbulence. They find, among other things, that homogenous boards are more effective in initiating strategic change in a timely fashion than heterogeneous boards, as there are various difficulties in reaching an agreement on new strategy for the latter.

We sought to analyze differences between homogeneous and heterogeneous fund management teams ourselves but recognized that we did not have adequate data for creating an appropriate proxy for team's homogeneity or heterogeneity. To create this kind of proxy one would at least need each team members' age, sex, nationality, tenure and education; and if possible also their SAT score or IQ. If these hard data could be supplemented by soft data such as team members' varying attitudes, thoughts on popular investment strategies, risk appetite, and work ethics; the study would be deepened even further. A study like this would thus require the gathering of new, qualitative data by survey; and preferably also the cooperation with researchers from other academic disciplines with experience in group-behavior studies. This would be a difficult task, but if overcome we believe that many fascinating, new insights into mutual fund team management could be acquired. Primarily insights on the relative performance and risk-taking behavior of homogeneous versus heterogeneous teams, in various contexts, but additional insights may also be obtained.

VIII. References

Adler, M., & Horesh, R. (1974). The Relationship Among Equity Markets: Comment. *The Journal of Finance , 29* (4), 1311-1317.

Arteaga, K. R., Ciccotello, C. S., & Grant, T. C. (1998). New Equity Funds: Marketing and Performance. *Financial Analysts Journal , 54* (6), 43-49.

Berger, A. N., Miller, N. H., Petersen, M. A., Rajan, R. G., & Stein, J. C. (2005). Does Function Follow Organizational Form? Evidence From the Lending Practices of Large and Small Banks. *Journal of Financial Economics. , 76* (2), 237-269.

Black, F. (1986). Noise. *The Journal of Finance , 41* (3), 529-543.

Bodie, Kane, & Marcus. (2009). *Investments* (Vol. 8). McGraw-Hill International.

Brown, S. J., Goetzmann, W., Ibbotson, R. G., & Ross, S. A. (1992). Survivorship Bias in Performance Studies. *The Review of Financial Studies , 5* (4), 553-580.

Carhart, M. M. (1997). On Persistence in Mutual Fund Performance. *The Journal of Finance , 52* (1), 57-82.

Chen, J., Hong, H., Huang, M., & Kubik, J. D. (2004). Does Fund Size Erode Mutual Fund Performance? The Role of Liquidity and Organization. *The American Economic Review , 94* (5), 1276-1302.

Chevalier, J., & Ellison, G. (1999b). Are Some Mutual Fund Managers Better than Others? Cross-Sectional Patterns in Behavior and Performance. *The Journal of Finance , 54* (3), 875-899.

Chevalier, J., & Ellison, G. (1999a). Career Concerns of Mutual Fund Managers. *The Quarterly Journal of Economics , 114* (2), 389-432.

Dahlquist, M., Engström, S., & Söderlind, P. (2000). Performance and Characteristics of Swedish Mutual Funds. *The Journal of Financial and Quantitative Analysis , 35* (3), 409-423.

Daniel, K., Grinblatt, M., Titman, S., & Wermers, R. (1997). Measuring Mutual Fund Performance with Characteristic-Based Benchmarks. *The Journal of Finance , 52* (3), 1035-1058.

Elton, E. J., Gruber, M. J., & Blake, C. R. (1996). Survivorship Bias and Mutual Fund Performance. *The Review of Financial Studies , 9* (4), 1097-1120.

Essayyad, M., & Wu, H. K. (1988). The Performance of U.S. International Mutual Funds. *Quarterly Journal of Business and Economics , 27* (4), 32-46.

Friend, I., & Blume, M. (1970). Measurement of Portfolio Performance Under Uncertainty. *The American Economic Review , 60* (4), 561-575.

Gelman, A., & Stern, H. (2006). The Difference Between "Significant" and "Not Significant" is not Itself Statistically Significant. *The American Statistician , 60* (4), 328-331.

Gelman, A., & Stern, H. (2006). The Difference Between "Significant" and "Not Significant" is not Itself Statistically Significant. *The American Statistician , 60* (4), 328-331.

Golec, J. H. (1996). The Effects of Mutual Fund Manager's Characteristics on Their Portfolio Performance, Risk and Fees. *Financial Services Review , 5* (2), 133-148.

Grinblatt, M., & Titman, S. (1994). A Study of Monthly Mutual Fund Returns and Performance Evaluation Techniques. *The Journal of Financial and Quantitative Analysis , 29* (3), 419-444.

Grinblatt, M., & Titman, S. (1989). Mutual Fund Performance: An Analysis of Quarterly Portfolio Holdings. *The Journal of Business , 62* (3), 393-416.

Grinblatt, M., & Titman, S. (1993). Performance Measurement without Benchmarks: An Examination of Mutual Fund Returns. *The Journal of Business , 66* (1), 47-68.

Gruber, M. J. (1996). Another Puzzle: The Growth in Actively Managed Mutual Funds. *The Journal of Finance , 51* (3), 783-810.

Hendricks, D., Patel, J., & Zeckhauser, R. (1993). Hot Hands in Mutual Funds: Short-Run Persistence of Relative Performance, 1974-1988. *The Journal of Finance , 48* (1), 93-130.

Hill, G. W. (1982). Group Versus Individual Performance: Are N + 1 Heads Better Than One? *Psychological Bulletin , 91* (3), 517-539.

Ippolito, R. A. (1989). Efficiency With Costly Information: A Study of Mutual Fund Performance, 1965-1984. *The Quarterly Journal of Economics , 104* (1), 1-23.

Janis, I. (1982). *Groupthink: Psychological Studies of Policy Decisions and Fiascoes* (2 ed.). Boston: Houghton Mifflin.

Jensen, M. C. (1968). The Performance of Mutual Funds in the Period 1945-1964. *The Journal of Finance , 23* (2), 389-416.

Jewell, L. N., & Reitz, J. H. (1981). *Group effectiveness in organizations.* Scott, Foresman (Glenview, Ill.).

Laughlin, P. R., Hatch, E. C., Silver, J. S., & Boh, L. (2006). Groups Perform Better Than the Best Individuals on Letters-to-Numbers Problems: Effects of Group Size. *Journal of Personality and Social Psychology , 90* (4), 644-651.

Malkiel, B. G. (1995). Returns from Investing in Equity Mutual Funds 1971 to 1991. *The Journal of Finance , 50* (2), 549-572.

Newey, W. K., & West, K. D. (1987). A Simple, Positive Semi-Definite, Heteroskedasticity and Autocorrelation Consistent Covariance Matrix. *Econometrica , 55* (3), 703-708.

O'Reilly, C. A., Caldwell, D. F., & Barnett, W. P. (1989). Work Group Demography, Social Integration, and Turnover. *Administrative Science Quarterly , 34* (1), 21-37.

Otten, R., & Bams, D. (2002). European Mutual Fund Performance. *European Financial Management Journal , 8* (1), 75-101.

Prather, L. J., & Middleton, K. L. (2002). Are N + 1 heads better than one? The case of mutual fund managers. *Journal of Economic Behavior & Organization , 47*, 103-120.

Roll, R. (1977). A Critique of the Asset Pricing Theory's Tests. *Journal of Financial Economics , 4* (2), 129-176.

Roll, R. (1978). Ambiguity when Performance is Measured by the Securities Market Line. *The Journal of Finance , 33* (4), 1051-1069.

Sharpe, W. F. (1964). Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk. *The Journal of Finance , 19* (3), 425-442.

Sharpe, W. F. (1966). Mutual Fund Performance. *The Journal of Business , 39* (1), 119-138.

Shaw, M. E. (1981). *Group Dynamics: The Psychology of Small Group Behavior*. New York: McGraw-Hill.

Stein, J. C. (2002). Information Production and Capital Allocation: Decentralized versus Hierarchical Firms. *The Journal of Finance , 57* (5), 1891-1922.

Wermers, R. (2000). Mutual Fund Performance: An Empirical Decomposition into Stock-Picking Talent, Style, Transactions Costs, and Expenses. *The Journal of Finance , 55* (4), 1655-1695.

IX. Appendix

A. Subcategories and their assigned benchmark indexes

Appendix A
Equity Subcategories and Assigned Benchmark Indexes

Subcategory	Assigned Benchmark Index
Africa and Middle-East	S&P Mid-East and Africa BMI TR USD Index
Asia	MSCI AC Asia Pacific Index
Asia ex Japan	MSCI AC Asia Pacific Ex Japan Index
Asia, single countries	MSCI AC Asia Pacific Index
Biotechnology	MSCI World Net Biotechnology Index
Brazil	MSCI Brazil 10/40 Index
China	MSCI Golden Dragon Index
Commodities	MSCI World/Material Index
Communication	MSCI World/Tel Svc Index
Consumer Goods	MSCI World Index
Eastern Europe	MSCI Emerging Markets Eastern Europe Index
Eastern Europe Ex Russia	Nomura Central Eastern Index CE Ex Russia Index
Emerging Markets	MSCI Daily Net Emerging Markets Index
Energy	MSCI World/Energy Index
Environment	MSCI World Index
Euro-country	MSCI EMU Index
Europe	MSCI Europe Index
Europe, single countries	MSCI Europe Index
Europe, small and mid cap	MSCI Europe Small Cap Index
Finance	MSCI World/Finance Index
Global	MSCI World Index
Global och Sweden	50% SIX Portfolio Return Index; 50% MSCI World Index
Global, small and mid cap	MSCI World Small Cap Index
Health Care	MSCI World/Health Care Index
India	MSCI India Index
Industry funds, other	MSCI World Index
Information Technology	MSCI World/Inf Tech Index
Japan	TPX - TOPIX (Tokyo) Index
Japan, small and mid cap	TSE2 TOPIX 2nd Index
Latin America	MSCI EM Latin America Index
Nordics	Carnegie Nordic Cap Index
North America	S&P 500 Index
North America, small and mid cap	Russell 2000 Index
Precious Metals	FTSE Gold Mines Series All Mines Index
Real Estate	MSCI World Real Estate Index
Russia	Russian RTS Index
Sweden	SIX Portfolio Return Index
Sweden, small and mid cap	Sweden Carnegie Small Cap Index

B. Quarterly relative impact for team-managed versus single-managed funds

Appendix B

Quarterly Relative Impact of Team Managed Funds

The table reports results from regressions where several dependent variables are regressed on a dummy variable that takes the value of one if the fund is managed by more than a single manager, and zero otherwise. The point estimates for performance and risk measures are presented in quarterly percentage figures. The point estimates presents the relative impact of going from a single-managed fund to a team-managed fund. The constant has been omitted for brevity, but is available upon request. The dependent variables includes the Sharpe ratio calculated on quarterly excess return divided by the standard deviation of the quarterly excess return, the alpha as estimated by the market model, the standard deviation of quarterly returns, the beta coefficient derived from a CAPM-estimation with a category-specific benchmark for each fund, the unsystematic risk calculated as the standard deviation of the residuals from the same estimation. Additionally, log of fund size is the natural logarithm of total assets under management in MSEK, manfee is the annual management fee, perffee is the performance fee and fund age is the age of the fund in years from inception or first available NAV-date. For performance measures heteroskedasticity-robust standard errors are in parenthesis, and for other measures Newey-West standard errors are in parenthesis. The point estimates significance are indicated by *(^), which indicates that the result is significant at least at the 5(10) percent level using a two-tailed test. The observations are fund-quarters.

Dependent variable	Point Estimate	St Error	St Errors
Sharpe	0.028	(0.019)	Robust
Alpha	0.002	(0.002)	Robust
Standard Deviation	0.180	(0.131)	Newey(1)
Beta	-0.008^	(0.005)	Newey(1)
Unsystematic Risk	0.184*	(0.086)	Newey(1)
Log of Fundvalue	0.268*	(0.051)	Newey(3)
Management Fee	0.016	(0.013)	Newey(3)
Performance Fee	-0.788*	(0.116)	Newey(3)
Fund Age	-0.576*	(0.218)	Newey(3)
Nr of Obs.	12,678		-

*Note: *(^) Significant at least at the 5(10) percent level using a two-tailed test.*