Chapter 1

Introduction

1.1 Motivation

Mutual funds have become one of the largest financial intermediaries in the leading world economies, currently controlling about 7 trillion dollars in assets in the US and over 3 trillion Euros in assets in Europe (see Investment Company Institute, 2002). Currently, investors can choose from thousands of funds offering a wide range of investment profiles, from relatively safe short-term debt instruments to relatively risky stocks and derivatives.

Similarly to investing in the stock market directly, holding mutual fund shares involves financial risks, as the fund's portfolio may rise or fall in value. Mutual funds claim to provide a number of benefits to their shareholders, compared to investing in other financial intermediaries or directly in the financial markets (see, e.g., Pozen, 1998):

1. *Low transaction costs.* Mutual funds allow investors including those with limited wealth to hold a diversified portfolio of financial securities at low cost. Mutual fund shares are easy to buy through an intermediary or directly, via telephone or Internet.

2. *Customer services.* Shareholders can transfer money between funds within the same family at low cost. In addition, they do not run liquidity risk, since they can sell their shares at net asset value at any time.

3. *Professional management.* The investment strategy of a mutual fund is developed by financial professionals, who are able to select the right stocks at the right time.

Thus, mutual funds claim to be especially attractive for small investors who do not have sufficient resources to follow a sound investment strategy at low cost.

Given the tremendous size of the mutual fund industry, it is crucial for the regulatory agencies to ensure that the funds efficiently invest money of their shareholders, since even a basis point difference in fund returns implies almost a billion dollar gain or loss for investors. The role of the academic research is to check the validity of the claims referred to above. It has been demonstrated that investing in mutual funds may not necessarily be optimal for consumers. It has been shown that active funds, on average, do not earn positive performance adjusted for risk and expenses (see, e.g., Gruber, 1996). Even though some funds seem to have superior risk-adjusted performance, there are many funds that consistently underperform their benchmarks (see, e.g., Carhart, 1997, and Kosowski et al., 2000). However, most shareholders of funds with consistently poor performance do not punish them by withdrawing their money, which may be due to various institutional and psychological factors (see, e.g., Gruber, 1996, and Sirri and Tufano, 1998). On the other hand, the concentration of money flows among a few top performers may provide adverse incentives to fund managers to take excessive risk in order to maximize the probability of becoming the top (see, e.g., Hvide, 1999, and Carpenter, 2000).

The aim of this thesis is to investigate empirically and theoretically the behavior of mutual fund investors and managers. These two problems are linked to each other, since in practice a manager's compensation is typically based on a proportion of the fund's assets (see, e.g., Khorana, 1996). In this thesis, we concentrate on those aspects of the allocation rules used by investors, which may provide adverse incentives to fund managers. On the other hand, we investigate strategies used by fund managers in response to these incentives.

1.2 The organization and structure of the mutual fund industry

In this section, we describe the organization and structure of the mutual fund industry, which is crucial for understanding the incentives and actual behavior of fund investors and managers. According to the basic definition, a mutual fund is an investment com-

pany that pools money from shareholders and invests in a diversified portfolio of securities (see, e.g., Investment Company Institute, 2002). In the US, the most important laws regulating mutual funds and ensuring investor protection are the Investment Company Act (ICA) and the Investment Advisers Act (IAA) of 1940. Mutual funds are typically organized as corporations and have a board of directors or trustees, which is elected by the shareholders. In contrast to most business corporations, mutual funds have very limited internal resources and rely on the provision of the specific services by affiliated organizations and independent contractors. In particular, the board of directors hires a separate entity - the investment advisor / management company - to provide all management and advisory services to a fund for a fee, which is usually based on a percentage of the fund's average net assets. In practice, however, the usual procedure is for the management organization to create mutual funds. To mitigate a potential conflict of interest, the ICA requires that an investment advisor must serve under a written contract approved initially by a vote of the shareholders and thereafter approved annually by the board of directors. Transactions between a fund and its manager are prohibited and at least 40% of a fund's directors must be independent from the fund's management company or principal underwriter. The IAA imposes recordkeeping, reporting, disclosure, and other requirements on investment advisors and contains several antifraud provisions. An investment advisor has a general fudiciary duty with respect to the compensation for its services, which bars an advisor from inadequate increase of its fees. Besides management company, mutual funds also employ principal underwriters who are responsible for the distribution of fund shares, custodians holding securities from fund portfolio, transfer agents conducting recordkeeping, and administrators overseeing the other agents providing services for a fund.

Mutual funds are considered "open-end" companies, since they are obliged to sell or redeem their shares at the net asset value (NAV), which is equal to fund's total net assets (total assets minus total liabilities) divided by the outstanding number of shares. The NAV must reflect the current market value of the securities in the fund portfolio and is usually calculated daily on the basis of the closing prices.

Mutual funds can be *active* pursuing their own portfolio management strategy or *passive* tracking the return of some benchmark index. In addition, mutual funds differ with respect to the share distribution method used. *Load* funds distribute their shares through broker-dealers who charge investors a commission proportional to the amount

of the investment. Load fees may be front-end (charged at the time of the purchase) or back-end (charged at the time of the redemption). For the US funds, the front-end load is on average between 4% and 5%, while the back-end load usually declines the longer a shareholder holds the fund shares, e.g., from 5% after one year to 4% after 2 years, etc. (see, e.g., Pozen, 1998). In addition, brokers often receive annual distribution fees, called 12b-1 fees, typically ranging from 25 to 75 basis points of assets per year. *No-load* funds use direct distribution channels such as mail and phone and charge no front- or back-end loads and limited (up to 25 basis points per year) 12b-1 fees. Many funds have multiple share classes of the same fund corresponding to different combinations of load and 12b-1 fees. For example, class A shares are usually sold with a front-end load, while class B shares - with a back-end load. Besides the 12b-1 fees, the annual fund operating expenses paid by the shareholders also include the management fee, the recordkeeping fee, etc.

There are four basic types of mutual funds: equity, bond, hybrid, and money market (see Investment Company Institute, 2002). Equity and bond funds concentrate their investments in stocks and bonds, respectively. Hybrid funds typically invest in a combination of stocks, bonds, and other securities. These three types of funds are known as long-term funds, whereas money market funds are referred to as short-term funds, since they invest in securities maturing in less than one year. Morningstar, one of the leading mutual fund data providers, divides all long-term funds into four classes: domestic stock, international stock, taxable bond, and municipal bond.

Chapter 2

A survey of the literature

2.1 Introduction

Mutual funds represent one of the organizational forms of delegated portfolio management, in which fund shareholders delegate the task of allocating their money to the fund manager. Since the manager's objectives are not necessarily identical to those of the fund's shareholders, a potential agency problem arises: the agent (fund manager) may not pursue investment policies optimal for the principals (fund shareholders). Numerous studies have examined the incentives and the actual behavior of mutual fund managers and investors. Among the main topics investigated in this literature are mutual fund performance evaluation, determinants of mutual fund flows, and strategic behavior of fund managers.

The measurement of mutual fund performance is crucial for evaluating fund managers. As discussed in Section 2.4.1, past performance of a mutual fund influences both the managerial compensation and the decision to retain, promote, or fire the manager. The central question in the studies of mutual fund performance is: "Does active fund management add value?" For a mean-variance investor, this question can be reformulated as: "Does the addition of active mutual funds to the portfolio of available assets lead to a shift in the mean-variance frontier?" If the answer is negative, consumers may be better off investing in low-cost index funds and avoiding expensively managed active funds. Two approaches have been used in the literature to measure risk-adjusted performance of mutual funds: return-based (see, e.g., Gruber, 1996) and portfolio-based (see, e.g., Daniel et al., 1997). The former approach employs fund returns, while the latter uses fund portfolio composition in order to construct a passive benchmark replicating

the risk characteristics of the fund's portfolio. The difference between the fund's return and the benchmark return indicates whether the manager has superior knowledge or skills that allow him to outperform the benchmark (see Section 2.2.1). The existing empirical evidence suggests that mutual funds, on average, have a negative or, at best, neutral risk-adjusted performance (see Section 2.2.2). However, this does not necessarily imply that investors should not invest in mutual funds at all. Several studies examine whether there are consistent differences between performance of various mutual funds that can be forecasted (see Section 2.2.3). It has been found that there is a significant year-to-year persistence in raw returns, i.e., funds with the highest (lowest) raw returns over the last year are likely to be winners (losers) next year as well (see, e.g., Brown and Goetzmann, 1995). However, most of this persistence appears to be due to the differences in fund fees and exposures to the common risk factors (see, e.g., Carhart, 1997). Several studies nevertheless demonstrate that it is possible to identify funds with inferior as well as funds with superior risk-adjusted performance (see Kosowski et al., 2000) and that even investors with skeptical priors about the managerial skill may include the latter funds in their optimal portfolios (see, e.g., Baks, Metrick, and Wachter, 2001).

According to standard portfolio theory, an investor should base his allocation decision on the expected return and risk of mutual funds and alternative assets. Since in practice investors incur costs to collect and, maybe even more importantly, to process relevant information, they may limit their attention to a subset of the actual investment opportunity set, which does not necessarily include all mutual funds present in the market. Investors are more likely to consider more visible funds, for which the information or search costs are lower. Other factors related to the transaction costs, such as the fee structure (e.g., front load vs annual 12b1 fee), size of the fund family, and tax considerations, may also play a role for mutual fund investors. A number of studies investigates the relationship between performance and flows to mutual funds (see Section 2.3.2). Consistent with theoretical predictions, it has been demonstrated that better performing funds attract larger flows (see, e.g., Gruber, 1996). The flow-performance relationship appears to be convex, being stronger (weaker) for the best (worst) performers (see, e.g., Sirri and Tufano, 1998). The empirical evidence on other determinants of mutual fund flows is discussed in Section 2.3.3. Mutual fund flows are found to depend on a number of fund-specific factors, such as fund size, age, and fees (see, e.g., Sirri and

Tufano, 1998, and Chevalier and Ellison, 1997), as well as fund family characteristics, such as size and age of the fund's family and performance of other funds in the family (see, e.g., Nanda, Wang, and Zheng, 2000).

Numerous studies conduct a game-theoretic as well as empirical analysis of the strategic behavior of mutual fund managers (see Sections 2.4.2 and 2.4.3, respectively). There are two major factors that influence the expected payoff and, consequently, strategy of a mutual fund manager: the compensation structure and the retention policy. Several studies model the behavior of fund managers in response to the exogenously given compensation contracts observed in the mutual fund industry. They demonstrate that contracts linear or convex in the fund's benchmark-adjusted performance are not optimal for the incentive alignment between managers and investors (see, e.g., Admati and Pfleiderer, 1996). In equilibrium, fund managers typically choose lower effort and excessive risk taking (see, e.g., Hvide, 1999). In addition, the fund manager's risk policy may vary over time depending on the current performance relative to the benchmark (see, e.g., Carpenter, 2000). Some studies use a different approach allowing the compensation structure to be a part of the equilibrium, i.e., being endogenously determined in the model. They show that various types of fees used in the mutual fund industry may arise in equilibrium, including the incentive fee rewarding good performance (see, e.g., Das and Sundaram, 2002) and fraction-of-funds fee based on the fund's assets (see, e.g., Heinkel and Stoughton, 1994). The existing empirical evidence suggests that fund choice of risk may be related to its past performance (see, e.g., Brown, Harlow, and Starks, 1996, and Chevalier and Ellison, 1997). However, most of these results should be taken with caution, since they are based on statistical tests that do not take the auto-correlation and cross-correlation in fund returns into account (see Busse, 2001). Several studies find the evidence of the gaming behavior, such as window-dressing and marking-up of fund performance, by fund managers around the year-ends (see, e.g., Musto, 1999, and Carhart, et al., 2002).

2.2 Mutual fund performance evaluation

2.2.1 Definition of performance measures

In this section, we discuss the empirical evidence on mutual fund performance. We start by describing typical performance measures used in the literature. The most basic measure of mutual fund performance is a fund's raw return over a certain period of time. While being the simplest and most appealing to investors, this measure does not allow us to discriminate among managers who have superior skill, those who are lucky, and those who merely earn expected risk premiums on their high-risk investments. There are three factors driving mutual funds' expected raw returns: (i) the performance of the market and other risk factors, (ii) the fund's exposure to these risk factors, and (iii) the stockpicking skill of the portfolio manager. Various risk-adjusted performance measures have been constructed to single out the third factor, which plays an important role for investors choosing among funds and fund management companies devising managerial compensation. Most studies use absolute performance measures defined as a difference between the fund return and the return on a passive portfolio with a similar risk profile. The passive portfolio is formed using a return-based approach or a portfolio-based approach, which are explained below.

According to the return-based approach, fund performance is defined as the intercept in the time series regression of the excess fund return[1] on the excess returns of passive benchmark portfolios (factor-mimicking portfolios, in context of the arbitrage pricing theory):

$$R_{i,t} - R_t^f = \alpha_i + \sum_{k=1}^{K} \beta_i^k F_t^k + \varepsilon_{i,t}, \tag{2.1}$$

where $R_{i,t}$ is fund i's return, R_t^f is a risk-free rate, and F_t^k is the excess return on k-th benchmark portfolio in period t. This measure is often referred to as Jensen's alpha, since it was introduced in Jensen (1969), who used the excess market return as a single benchmark. Intuitively, Jensen's alpha can be interpreted as the difference between the fund's return and the return of the passive portfolio consisting of β_i^k units of the k-th benchmark ($k = 1, ..., K$) and $1 - \sum_{k=1}^{K} \beta_i^k$ units of the risk-free asset. A positive Jensen's alpha implies that mean-variance investors who used to restrict attention to the K benchmark assets and a riskless asset only, are able to extend their efficient set by

[1] Henceforth, the excess return denotes the rate of return in excess of the riskless interest rate.

taking a long position in the given fund, neglecting other effects such as the transaction costs and taxes.

Currently, most studies use multi-factor models to estimate Jensen's alpha. One of the most frequently used specifications is a three-factor model of Fama and French (1993). Besides an overall market factor, they use two additional stock market factors related to firm size (stock price times the number of shares) and book-to-market equity (the ratio of the book value of the firm's common stock to its market value). The corresponding factor returns are calculated as the difference between the returns on small- and big-stock portfolios and the returns on portfolios with high and low book-to-market equity, respectively. The four-factor model of Carhart (1997) adds one more factor related to one-year momentum in stock returns. The excess return on the corresponding factor-mimicking portfolio is computed as the difference between returns on stocks with high and low returns over the previous year. Thus, the Fama-French three-factor alpha measures fund performance taking into account exposure to size and growth factors, while the Carhart four-factor alpha in addition adjusts for the momentum effect.

In the portfolio-based approach, fund performance is measured as the difference between fund return and return on a passive portfolio with characteristics matching the portfolio of a fund under consideration. For example, Daniel et al. (1997) construct a synthetic portfolio of stocks matching fund holdings along the dimensions of size, book-to-market ratio, and one-year momentum. A zero performance measure indicates that the fund's performance could have been replicated by buying stocks with the same characteristics as those held by the fund, while a positive measure suggests that a manager has additional selection ability. In practice, funds are often assigned a stylized stock index as a benchmark, e.g., a small-cap index for funds investing in stocks of small companies. The simplicity of measuring fund performance as an index-adjusted return makes it appealing to investors. However, one should keep in mind that indexes based on relatively large market segments can provide only a rough approximation of the risk profile of a non-index fund. We will see that benchmarking by a certain index may change the investment strategy of the fund manager in a way detrimental for investors (see Section 2.4).

So far, we considered absolute performance measures calculated as the difference between the excess fund return and the return on the passive portfolio. Another type of absolute performance measure is the fund average excess return earned per unit of risk

exposure. The most popular measure of this type is the Sharpe ratio, which is calculated as the average excess return of a fund divided by the standard deviation of the fund's returns:

$$Sharpe_i = \frac{\bar{R}_i - R^f}{\sigma_i}. \tag{2.2}$$

If the slope of the capital market line is larger than the fund's Sharpe ratio (the slope of the line connecting the position of the fund with the point of the risk-free rate), this is taken as evidence that the fund underperformed the market. Note that in contrast to Jensen's alpha, which takes the covariance of the fund return with benchmark returns into account, the Sharpe ratio is only based on the characteristics of a given fund. Therefore, the Sharpe ratio does not show whether an investor should add a given fund to his current portfolio, but helps to compare different mutual funds with each other. Specifically, a mean-variance investor restricted to invest either in fund A and a riskless asset or in fund B and a riskless asset will choose the one with the highest Sharpe ratio.

Absolute measures discussed above adjust fund performance for exposure to given passive benchmarks or risk factors. Another way to obtain a risk-adjusted performance measure is to evaluate fund performance relative to its peers, funds with a similar investment approach (i.e., funds with similar exposures to common risk factors). A typical relative cardinal measure of fund performance is the fund return in excess of the median or mean return in the fund's category. Note that this measure may not be appropriate if a fund's investment style differs significantly from those of other funds in the category. One should also keep in mind a potential effect of the survivorship bias, if the peer group contains only survived funds (as reported, e.g., by Brown and Goetzmann, 1995, disappearing funds tend to have poor performance). As shown in Section 2.4, the use of category-specific returns as a benchmark, similarly to benchmarking by stock indices, may lead to undesirable changes in fund strategies.

Most of the existing academic studies of mutual funds use cardinal performance measures as described above. However, the financial media as well as fund advertisements pay at least as much attention to ordinal performance measures based on the underlying cardinal measures. A typical ordinal measure is defined as a performance rank of a given fund within its category, which groups funds with a similar investment approach. The main difference between cardinal and ordinal performance measures is that the latter do not take into account by how much one fund outperforms the other. As discussed in Chapter 6, this can induce adverse risk-taking incentives to fund managers competing

for the top performance ranks rather than maximizing risk-adjusted returns. Besides, ordinal performance measures are susceptible to the same criticisms as their underlying cardinal measures.

In Section 2.2.2, we describe the results of studies measuring the average performance of mutual funds, i.e., performance of the mutual fund universe taken as a whole. In Section 2.2.3, we discuss studies investigating whether there are consistent differences between performance of various mutual funds that can be forecast using various fund-specific and manager-specific characteristics.

2.2.2 Average performance of mutual funds

The existing empirical evidence based on both return-based and portfolio-based approaches suggests that an average active mutual fund has negative or neutral risk-adjusted performance net of expenses. This is demonstrated, for example, by Gruber (1996) whose main measure of performance is Jensen's alpha from a four-factor model with the market, size, growth, and bond factors. His sample consists of 270 US common stock funds during the period from 1985 to 1994 (almost all funds of this type that existed in 1984) and is free from survivorship bias. He finds that US stock funds underperformed an appropriately weighted average of the four benchmark indices by approximately 65 basis points per year. Since the average expense ratio in the sample is about 113 basis points per year, this implies that an average mutual fund earns positive risk-adjusted returns, but charges the investors more than the value added.

Similar conclusions are reached by Daniel et al. (1997) who measure performance of equity holdings of over 2500 US equity funds in 1975-1994 using a portfolio-based approach. They use as a benchmark the return on a portfolio of stocks that is matched to the fund's equity holdings each quarter on the basis of size, book-to-market, and one-year momentum characteristics. The authors find that US equity funds have some stock selection ability (i.e., buying those growth stocks that have higher expected returns than other growth stocks), but hardly any ability to time the different stock characteristics (i.e., buying growth stocks when they have unusually high returns). Overall, the performance earned by managers of active funds is not significantly greater than the difference between their expenses and expenses of passive index funds. Using the same sample of funds, Wermers (2000) extends this analysis by considering not only gross returns on

funds' equity holdings, but also their net returns to investors. He finds that funds' stock portfolios outperformed the CRSP value-weighted market index by 1.3% per year, with 70 basis points being due to fund managers' stockpicking skills and the rest being due to the stocks' risk premiums. However, funds underpeformed the market index by 1% per year on a net return basis. The 2.3% difference between gross and net returns is due to the relatively low returns on fund nonstock holdings (0.7%), the expense ratios (0.8%), and the transaction costs (0.8%). Thus, a positive abnormal return earned by active mutual funds is more than offset by their expenses and transaction costs.

Ferson and Schadt (1996) criticize the standard approach to measure performance, which relies on unconditional expected returns. They argue that if expected returns and risks vary over time, then traditional performance measures may be upward- or downward-biased due to the common time variation in risks and risk premiums. They propose to use as a benchmark a managed portfolio strategy that can be replicated using publicly available information. Such conditional performance evaluation approach is consistent with the semi-strong form of market efficiency. In their model, Jensen's alpha is based on a factor model with time-varying conditional betas that are linear functions of the lagged public information variables including the short-term interest rate, dividend yield, term spread, and default spread. Using a sample of 67 US open funds from 1968 to 1990, they find that the distribution of the conditional Jensen's alphas is consistent with the neutral performance of mutual funds, whereas the unconditional Jensen's alphas indicate average underperformance.

Edelen (1999) argues that previously found negative performance of mutual funds may be explained by costs of providing liquidity to fund investors (open-end funds are obliged to buy and sell their shares at the net asset value). In his sample of 166 randomly selected open-end funds in 1985-1990, approximately one-half of the average fund's assets are redeemed in the course of the year and over two-thirds of the average fund's assets arrived as new inflow in the previous year. The author estimates that a unit of liquidity-motivated trading induced by investor flows, defined as an annual rate of trading equal to 100% of fund assets, is associated with 1.5-2% decline in risk-adjusted returns. Controlling for this liquidity cost changes the average Jensen's alpha from a statistically significant -1.6% per year to a statistically insignificant -0.2% per year.

2.2.3 Differential performance of mutual funds

In the previous section, it was demonstrated that mutual funds as a group have negative or neutral estimated performance adjusted for risk and expenses. However, this does not imply that consumers should avoid all mutual funds. If there exists a subset of funds that are able to consistently earn superior risk-adjusted returns, then investors would like to identify such funds and invest in them. In this section, we discuss the results of studies trying to identify consistent performance differences across funds and forecast fund performance.

Numerous studies examine whether past fund performance is indicative of future fund performance, i.e., whether there are differences in fund performance that persist over time. For instance, Brown and Goetzmann (1995) explore persistence in performance of US equity funds in 1976-1988 using both relative and absolute benchmarks. They find a significant year-to-year persistence in raw and risk-adjusted returns (the latter based on a three-factor model with the market, size, and bond factors) relative to the median return of all funds in the sample (relative benchmark) and S&P500 return (absolute benchmark). However, persistence seems to be mostly due to the underperforming funds. In other words, a fund underperforming other funds this year is likely to continue underperforming them next year. The authors note that the persistence pattern depends on the time period and that there was a significant reversal of relative winners and losers in a few years. They conclude that the observed pattern in relative performance could be due to the common component in fund strategies not captured by the standard risk-adjustment procedures.

This conclusion is supported by Carhart (1997) who demonstrates that most of performance persistence found in the previous studies can be attributed to the one-year momentum effect. His database covers US diversified equity funds in 1962-1993 and is free of survivor bias. When he sorts funds on the basis of lagged one-year raw return, his four-factor model with the market, size, book-to-market, and one-year momentum factors explains almost all of the cross-sectional variation in expected returns. In accordance with the previous evidence, funds with better last-year performance have higher return and one-factor Jensen's alpha than funds that underperformed last year. However, this difference is mostly due to the size and especially momentum factors, as last-year winners tend to hold more small stocks and momentum stocks than last-year losers. The only significant persistence unexplained by the Carhart's model is

consistent underperformance by the worst-performing funds, which have significantly negative four-factor alphas. Investigating the factors explaining the differences in fund risk-adjusted performance, Carhart finds a significantly negative relationship between fund four-factor alphas and expense ratios, turnover, and load fees. A 1% increase in expense ratio, turnover, and maximum load fee is associated with 1.54%, 0.95%, and 0.11% decline in annual risk-adjusted return, respectively. Testing the consistency in funds' annual return rankings, Carhart finds that year-to-year rankings of most funds are largely random. Only funds in the top and bottom performance deciles in the last year are likely to remain in these deciles next year. As a result, one-year performance persistence is short-lived, being mostly eliminated after one year. Carhart finds slight evidence of persistence in risk-adjusted performance, as funds with high four-factor alphas tend to have above-average alphas in subsequent periods. However, this result should be taken with caution, since using the same model to sort and estimate performance may pick up the model bias that appears between ranking and formation periods.

Teo and Woo (2001) examine persistence in style-adjusted fund returns (fund returns in excess of the returns of the average fund in their Morningstar style category). They argue that most funds with high raw returns are clustered into well-performing styles and that a large year-to-year variation in style returns may preclude finding persistence in raw returns. Sorting funds on the basis of lagged three-year style-adjusted returns, they find significant spreads between Carhart's four-factor Jensen's alphas of funds from top and bottom deciles. These spreads are larger than those based on raw returns and persist for up to six years. This evidence suggests that some managers do have better abilities than the others.

Several studies investigate other factors that can explain mutual fund performance. Using a sample of US stock and bond funds in 1990-1999, Elton, Gruber, and Blake (2002) examine performance differences between funds using incentive fees (fees dependent on the fund's benchmark-adjusted return) and other funds using solely fraction-of-funds fees (fees proportional to the fund's assets). They find that funds with incentive fees earn, on average, an (insignificantly) positive multi-factor alpha of 58 basis points per year, which is higher than average alpha of other funds. Note, however, that this difference appears to be almost entirely due to differential expenses of these two classes of funds. Funds using incentive fees have an average expense ratio of 56 basis points per year lower than expense ratios of similar funds with no incentive fees. Among funds

with incentive fees, the risk-adjusted performance seems to be higher when managers are hired internally by the fund family.

Chevalier and Ellison (1999a) study the relationship between fund performance and characteristics of fund managers that may indicate ability, knowledge, or effort. Their sample consists of 492 managers of growth and growth-and-income funds in 1988-1994. They find significant differences between raw returns of fund managers with different characteristics including the manager's age, the average SAT score at the manager's undergraduate institution, and whether the manager has an MBA. However, most of these return differences are attributed to the differences in managers' investment styles and to the selection biases. After adjusting for these, the authors find that managers who attended higher-SAT undergraduate institutions have higher risk-adjusted performance.

The beliefs of investors manifested in money flows to mutual funds also seem to contain some information about future fund performance. Gruber (1996) finds that US stock funds receiving more money subsequently perform significantly better than funds losing money. Using a sample of US equity funds in 1970-1993, Zheng (1999) shows that this "smart money" effect is short-lived and is largely but not completely explained by investors chasing past winners. She demonstrates that the smart money effect is not due to macroeconomic information or style effect, which suggests that investors use fund-specific information when choosing between funds. The smart money effect is mostly pronounced in the subset of small funds, whose lagged flows may be used to form the strategy beating the market.

Several studies use a Bayesian approach for performance evaluation, which combines prior investors' beliefs about the fund performance with the information in the data and produces posterior distribution of fund alphas. Baks, Metrick, and Wachter (2001) show that even some extremely skeptical priors about the skill of fund managers lead to economically significant allocations to some active diversified equity funds, based on posterior expectation of the Fama-French (1993) three-factor alpha. Pastor and Stambaugh (2002) develop a framework in which investors' prior beliefs can distinguish managerial skill from inaccuracy of the pricing model (CAPM, three-factor model of Fama-French, 1993, and four-factor model of Carhart, 1997). Using a sample of US domestic equity funds, they demonstrate that optimal portfolios of mutual funds are influenced substantially by both types of prior beliefs. Portfolios with the highest Sharpe ratios are constructed when prior beliefs have some confidence in a pricing model. However, in-

vesting in equity funds may be optimal even for skeptical investors who rule out the accuracy of pricing models as well as managerial skill.

Even if a small group of "star" fund managers earned superior risk-adjusted performance in the past, this may be due to luck. It is natural to expect that some funds out of thousands in the mutual fund universe outperform market indexes simply by chance. Using a sample of US equity funds in 1975-1994, Kosowski et al. (2000) apply a bootstrap technique to simulate the distribution of the extreme (maximum and minimum) performance measures across funds. Using various unconditional and conditional multi-factor models to measure performance, they demonstrate that the performance of the best and worst funds is not a result of sampling variability. To illustrate this point, 41 funds had a risk-adjusted return of at least 1% in 1995, while only 15 funds were expected to achieve this level by chance. This finding provides strong evidence of differential stockpicking skills among fund managers and supports the value of the active mutual fund management.

2.3 Behavior of mutual fund investors

2.3.1 Modelling mutual fund flows

In this section, we review studies conducting an empirical analysis of the determinants of mutual fund flows, focusing on the impact of past performance. In a typical regression model, the dependent variable is the fund's net relative or absolute flow. Traditionally (see, e.g., Gruber, 1996), net absolute flows are defined as the change in fund assets net of reinvested dividends:

$$F_{i,t} = TNA_{i,t} - TNA_{i,t-1}(1 + R_{i,t}), \tag{2.3}$$

where $TNA_{i,t}$ denotes fund i's total net assets at the end of period t and $R_{i,t}$ is return of fund i in period t. Similarly, net relative flows are defined as a net percentage growth of fund assets:

$$f_{i,t} = \frac{TNA_{i,t} - (1 + R_{i,t})TNA_{i,t-1}}{TNA_{i,t-1}} = \frac{F_{i,t}}{TNA_{i,t-1}}. \tag{2.4}$$

Both definitions are based on an assumption that all investor earnings are automatically reinvested in the fund and flows occur at the end of period t. A typical model in the

literature specifies flows (in this case, net relative flows) as a linear function of past performance and a set of control variables:

$$f_{i,t} = a + b_1 r_{i,t-1} + ... + b_K r_{i,t-K} + x'_{i,t-1} c + u_{i,t}, \tag{2.5}$$

where $r_{i,t}$ is some measure of fund i's performance (e.g., raw return, Jensen's alpha, or corresponding ranking) in period t and $x_{i,t-1}$ includes such variables as fund size, age, fees, a measure of riskiness, and performance of other funds in the family. To control for unobserved individual effects (e.g., marketing effort, general reputation, etc.), $x_{i,t-1}$ sometimes includes lagged flow $f_{i,t-1}$.

The empirical evidence on the impact of past performance and other attributes of mutual funds on their flows is described in Sections 2.3.2 and 2.3.3, respectively.

2.3.2 Impact of past performance on mutual fund flows

The existing evidence demonstrates a strong positive relationship between mutual fund flows and various measures of their past performance measured over the one-year, three-year,and five-year horizons, including Jensen's alpha and raw return (see, e.g., Gruber, 1996) and category return rankings (see, e.g., Sirri and Tufano, 1998). When taken together, both raw and risk-adjusted performance measures have significantly positive impact on flows, although the impact of the latter appears to be stronger (see, e.g., Gruber, 1996). This suggests that some investors are style timers choosing funds with high loadings of factors that performed well recently. Note, however, that these effects may be partially offset by the negative impact of fund total risk on flows (see, e.g., Barber, Odean, and Zheng, 2001). The sensitivity of flows to performance seems to decline with time, i.e., fund last-year performance is more important for investors than fund performance two or three years ago (see Sirri and Tufano, 1998).

The flow-performance relationship appears to be asymmetric, as flows to top performers are more sensitive to their performance than flows to poorly performing funds. Using a piecewise linear model in a sample of US growth funds in 1971-1990, Sirri and Tufano (1998) show that flows to funds in the top performance quintile in their objective category are strongly related to their last-year return rankings, whereas for other funds the relationship between flows and performance is weak. For an average fund, moving five percentiles among the top performing funds in the category is associated

with 8.4% increase in annual relative flow, while a similar move in rankings among funds with bad or intermediate performance results in 0 to 1.4% increase in flows. Chevalier and Ellison (1997) use a semiparametric model to estimate the shape of the relationship between fund flows and last-year market-adjusted returns (fund returns in excess of the market return) in a sample of growth and growth-and-income funds in 1982-1992. They demonstrate that this shape differs considerably in the subsets of young and old funds (funds with age of up to 5 years and over 5 years, respectively). For young funds, the shape of the flow-performance relationship is quite steep and close to linear. A 1% rise in the market-adjusted return of an average young fund is associated with about 4% increase in the fund's annual relative flow. In contrast, the expected flows to old funds are less sensitive to their last-year performance and the flow-performance sensitivity has a generally convex shape. Old funds outperforming the market are expected to attract about 2.8% extra annual flows due to 1% rise in the market-adjusted return.

Since performance persistence is more pronounced among poor performers than among good performers (see, e.g., Carhart, 1997), one may expect that consumers respond stronger to low than high performance. The divergence between these expectations and the observed convexity of the flow-performance relationship can be explained by a number of institutional and psychological factors, which prevent large outflows from funds with bad past performance. Market frictions such as the presence of search costs, back-end load charges, tax considerations, and restrictions of the investment retirement plans increase the transaction costs of withdrawing money from the poorly performing funds, while status-quo bias (see Zeckhauser, Patel, and Hendricks, 1991) and cognitive dissonance bias (see Goetzmann and Peles, 1997) make investors ignore information about bad fund performance.

Capon, Fitzsimons, and Prince (1996) use a different approach to examine the allocation rules used by mutual fund investors. They conducted a survey of 3000 consumers investing in US mutual funds who were asked to rate on a five-point scale the importance of given information sources and selection criteria and describe their investment approach and demographic characteristics. The results of the survey demonstrate that investors consider performance-related variables as the most important information source (published performance rankings) and selection criterion (performance track record). At the same time, fund characteristics other than return and risk, such as advertising (as an information source) and fund manager reputation, fund family scope, and management

fees (as selection criteria), are also important for consumers. The authors also find that mutual fund clientele consists of several groups considerably differing from each other in terms of demographic characteristics and investment behavior. These groups range from the well-informed investors to the naive ones who are ignorant of their fund investment style and load structure. Further discussion of the non-performance factors driving mutual fund flows is carried on in the next section .

2.3.3 Impact of other factors on mutual fund flows

When the information about mutual fund performance is costly, consumers incur search costs to make an allocation decision. Many investors, especially small ones, may choose to save on these costs and make a choice based on the available (incomplete) information. In this case, more visible funds, i.e., the ones which are heavily advertised and have an established reputation, are expected to attract larger money flows, irrespective of their performance. In addition, flows to these funds may be more sensitive to their performance, since the impact of advertising and established reputation should be even stronger when combined with good performance. Fund flows may be also affected by factors related to other types of transaction costs, such as the fee structure (e.g., front load vs annual 12b1 fee), tax considerations, and the size of the fund family.

One proxy for fund visibility is its size. Apparently, large funds spend more on advertising and are more likely to receive media attention. Indeed, money flows to mutual funds are recognized to be roughly proportional to fund size (see, e.g., Gruber, 1996). This is the reason why most studies use the fund's relative flow as a dependent variable in the regressions. However, the magnitude of relative flows declines with fund size, i.e., large funds tend to attract significantly smaller relative flows than small funds (see, e.g., Sirri and Tufano, 1998). Therefore, size effect must be taken into account both in regressions of absolute and relative flows.

The level of media coverage, which helps to lower search costs, is found to be positively related to fund flows. Sirri and Tufano (1998) show that growth funds whose names are referred to in the major newspapers and periodicals attract larger flows during the same year, while Jain and Wu (2000) find that flows are significantly larger for those equity funds that are advertised in the financial magazines.

Fund age may also serve as a proxy for investor awareness about the fund. In contrast

to young funds, old funds have an established reputation, which may be good or bad depending on their performance realized in the past. Therefore, recent performance should be more informative for young funds that do not have such reputation. Indeed, as discussed in Section 2.3.2, Chevalier and Ellison (1997) find that flows to young funds are more sensitive to their last-year performance than flows to old funds.

The effect of fund fees on flows can be twofold. On the one hand, higher fees may lead to lower flows, as investors would like to maximize net-of-fee earnings. In addition, load funds and funds with higher expense ratios have worse performance than funds charging lower fees (see Carhart, 1997). On the other hand, higher 12b1 fee, which is a part of the expense ratio, is associated with larger marketing expenditures and may increase fund flows. The existing evidence is consistent with the presence of both effects. Using a sample of US diversified equity funds in 1970-1999, Barber, Odean, and Zheng (2001) find that a negative relationship between fund flows and total fees (composed from load fees and expense ratios) is due to the strong negative impact of load fees. However, they find no significant relation between fund flows and expense ratios and even a positive relation in a subset of large funds. These results also suggest that investors pay more attention to salient fees, like loads and commissions, than expense ratio. The effect of advertising on fund investors may also explain higher flow-performance sensitivity of high-fee funds found by Sirri and Tufano (1998).

Bergstresser and Poterba (2002) study the impact of personal taxation on the investment decisions of consumers who hold mutual fund shares in conventional taxable accounts (not in tax-deferred retirement saving plans). Their sample includes US domestic equity funds in 1993-1999. They find that funds delivering more heavily taxed returns (i.e., returns including more dividends or realized capital gains) attract lower flows than funds with similar pretax returns and lower tax burdens. The flows also appear to be lower for funds with larger stocks of unrealized capital gains (new shareholders of such funds may be taxed on future distributions of these capital gains).

The magnitude of the transaction costs incurred by a mutual fund investor is also related to the characteristics of the fund's family. Since investors are more likely to be aware about the brand name of large and old fund families, funds from these families are more visible. In addition, families offering a large number of funds with a wide range of investment styles decrease the transaction costs for investors who often switch between different types of funds (e.g., stock funds and money market funds). Therefore, funds

from large, old, and diverse families are expected to attract higher flows. Indeed, Ivkovic (2000) finds in a sample of US stock and bond funds in 1991-1999 that funds belonging to larger families attract higher flows. Using a sample of all US open-end funds in 1979-1998, Khorana and Servaes (2001) demonstrate that families achieve larger market share when they have more prior experience, offer funds in a wider range of objectives, and use more distribution channels. Nanda, Wang, and Zheng (2000) explore the performance spillover effects within the family, using a sample of US diversified equity funds in 1992-1998. They find that the presence of a star performer (fund with the return within top 5% in its category) in the family helps to boost flows to the other funds in the family.

2.4 Strategic behavior of mutual fund managers

2.4.1 The objectives of fund managers

Similarly to other industries, there is a potential divergence of interests between shareholders and managers of mutual funds. The manager's strategy consists of two major choices: *effort*, which allows him to extend the investment opportunities set, and *risk*, i.e., a point at this set. If the principal (fund shareholders) could contract directly on actions (effort and risk), it would be possible to achieve a first-best outcome with properly structured agent's (fund manager's) incentives. Since in practice the manager's effort is not contractible (i.e., not verifiable by a third party such as a court), the moral hazard problem cannot be eliminated.

In a typical mutual fund, two factors influence the manager's expected payoff: the compensation structure and the retention policy. Currently, two types of compensation schemes are used by mutual funds: base or fraction-of-funds fee and incentive fee (the latter always used in combination with the base fee). The base fee is linked to the fund's size and is charged as a percentage of the average net assets during the year (see, e.g., Khorana, 1996). Deli (2002) reports that in US marginal asset-based fee rates are greater for small funds, funds from small families, equity funds (compared to debt funds), and international funds (compared to domestic funds). These differences are interpreted as being due to the economies of scale and the difficulty of monitoring the performance.

The incentive fee depends on the fund's performance relative to a certain benchmark.

The 1970 amendment to the Investment Company Act of 1940 requires the incentive fees of US mutual funds be of a "fulcrum" type. This means that the fee must be symmetric around the benchmark, i.e., the reward for outperformance must be the same as penalty for underperformance. Probably, this restriction is the reason why only a few US mutual funds use incentive fees. According to Elton, Gruber, and Blake (2002), these are mostly large funds accounting for less than 2% of the total number of funds in the industry, but controlling more than 10% of the total assets under management. The incentive fees can be of the linear or bonus type, being the linear or discrete step functions of the benchmark-adjusted fund return, respectively. In most cases, funds use linear incentive fees with a limit (both upper and lower) on the size of the incentive fee, so that the sum of the base and incentive fees cannot be negative. As a result, the incentive fee is usually a piecewise linear function of benchmark-adjusted performance (flat below the lower limit and above the upper limit and increasing between them), which is convex up to the upper fee limit. As was discussed in Section 2.3.2, the sensitivity of flows to performance is higher for well-performing funds than for poor performers (see, e.g., Sirri and Tufano, 1998). This implies that the base fee is a convex function of the fund's past performance. Thus, fund performance influences the manager's expected payoff in a convex manner directly, through the incentive fee (over some range), and indirectly, through the base fee and the observed flow-performance relationship.

Another factor which influences manager's strategy is the impact of his actions on the probability of terminating the contract. Several studies demonstrate that fund performance plays a crucial role for the decision to dismiss, retain, or promote the fund's manager. Khorana (1996) estimates that managers in the lowest performance decile are four times more likely to be replaced than managers in the top performance decile. Chevalier and Ellison (1999b) find that the termination of the contract is more performance-sensitive for young managers, who do not have an established reputation, than for old managers. For young managers, the probability of termination is a convex function of past performance (over most of the range), decreasing steeply with performance in case of negative excess returns and being rather insensitive to the differences in performance at positive excess return levels. The authors also find that considerable deviations of the fund's sector weightings and the level of the unsystematic risk from the mean values in the objective category increases the probability of manager's termination in case of poor performance, while increasing, although to a smaller extent, the

probability of his promotion in case of good performance. Thus, the convexity of the manager's expected payoff with respect to the fund's past performance may be weakened due to the strong impact of the manager's poor performance on termination decision.

There is vast literature providing extensive game-theoretic analysis of the managerial behavior in response to different payoff structures (see Section 2.4.2). A number of empirical studies test the predictions concerning the managers' risk-taking behavior based on these models as well as other hypotheses (see Section 2.4.3).

2.4.2 Managers' strategies: game-theoretic analysis

In this section, we discuss the studies modelling the strategic behavior of mutual fund managers. The models of the delegated portfolio management in the mutual fund industry, in which the agent (fund manager) receives money from the principal (fund shareholder) to invest in financial markets, have their own specifics. Since there are much more investors than funds, fund managers have most of the bargaining power. As a consequence, fund managers and not investors are typically proposing the compensation contracts. Therefore, most models of mutual funds examine pooling equilibria in which all managers have one type of contract and signal their quality with performance or separating equilibria in which managers signal the differences in their abilities by offering different types of contracts.

One strand of this literature adopts a behavioral approach and examines the equilibrium behavior of fund managers in response to exogenously given compensation structures observed in the mutual fund industry. Another strand of the literature models both the actions of fund managers and the investment strategies used by fund investors. In this case, the compensation scheme is determined endogenously within the model. In all these studies, the manager's compensation is some (linear or convex) function of the fund's performance with respect to some benchmark, which can be absolute (e.g., the return on a market index such as S&P500) or relative (e.g., the best return among other funds). In the former case, the benchmark is exogenous and cannot be influenced by players' actions. In the latter case, the benchmark is determined endogenously in the equilibrium.

We start with the first strand of the literature and exogenous benchmarks. Grinblatt and Titman (1989) use option pricing theory to analyze the impact of convex option-like

compensation schemes on risk-taking behavior of fund managers. They show that such schemes induce excessive risk taking from both informed and uninformed fund managers. Moreover, managers with superior information may select the same portfolio as the uninformed managers, if the performance fee can be hedged in the manager's personal portfolio. Carpenter (2000) models the dynamic investment problem of a risk-averse manager who is compensated with a call option on the managed assets with an exercise price equal to a benchmark return and who cannot hedge this position. She demonstrates that option-like compensation does not always lead to greater risk taking. The manager dynamically adjusts volatility in response to changes in the benchmark-adjusted return and may actually decrease risk if the option is in the money or if the evaluation date is far away. Chen and Pennacchi (1999) analyze in a continuous setting the impact of the fund's prior performance on the portfolio choice of a fund manager with convex benchmark-adjusted compensation. They show that funds with poor performance have an incentive to increase the tracking error with respect to the benchmark, which is however not equivalent to an increase in volatility. Admati and Pfleiderer (1996) show that even compensation contracts that are linear in benchmark-adjusted performance are not optimal with respect to efficient risk sharing and incentive alignment between managers and investors. In their model, an optimal outcome is achieved when compensation is only based on the total unadjusted return of the manager's portfolio.

Similar conclusions are reached by studies in which managers are rewarded on the basis of relative performance, i.e., when the benchmark is endogenous. Hvide (1999) models the one-period game between fund managers with the tournament reward structure, where only the top performer receives the bonus (resulting, e.g., from the money flows). In his model, managers choose not only effort, which determines the expected return, but also the riskiness of the portfolio. In the extreme case, when there are no limits to possible risk taking, the tournament breaks down, as managers choose zero effort and infinite risk in equilibrium. When risk-taking is limited, the tournament rewards induce excessive risk taking and lack of effort from fund managers. The author shows that the scheme with higher reward for modest rather than excellent performance may lead to less risky strategies. Palomino (2002) analyzes a different reward structure, in which the manager's payoff depends linearly on the difference between his return and some function of the returns of other funds (e.g., the mean return in the fund's category). He shows that even in case of linear relative performance objectives, managers

choose overly risky strategies to outperform their competitors. Furthermore, there is an underacquisition of information in equilibrium.

Thus, neither linear, nor convex compensation contracts can optimally (in the first-best sense) align interests of managers and investors of mutual funds. What happens if we allow the compensation structure to be determined in the equilibrium? Heinkel and Stoughton (1994) consider the multiperiod relationship between risk-neutral investor and a pool of risk-neutral fund managers with different, but ex ante unknown abilities. They show that in the first period the investor induces most managers to sign the standard ("boilerplate") contract with little performance-based component (only few managers with exceptional ability choose a different contract with high performance-based component). The investor provides proper effort-exerting incentives to fund managers by a credible threat of dismissal following a performance evaluation. The manager is only retained, if the return on his portfolio exceeds the benchmark by an appropriate amount (too high return indicates luck rather than skill). These results may provide theoretical justification for the limited use of performance fees in the mutual fund industry.

Huddart (1999) examines a similar two-period model with two risk-averse managers of different abilities. In this model, investors also infer about managers' abilities on the basis of their relative performance over the first period. In the second period, investors reallocate their wealth to the fund with the highest first-period return, which is most likely to be informed in equilibrium. However, this allocation rule, which maximizes investor perceptions of managerial ability, does not provide proper risk taking incentives to fund managers. When managers receive a fraction-of-funds fee, they choose overly risky strategies to maximize the chance of becoming the top after the first period. The uninformed manager does it to appear informed, while the informed manager does it to increase the cost of mimicking him. The author shows that the adoption of a performance fee with respect to an exogenous benchmark helps to mitigate these effects.

Das and Sundaram (2002) consider the setting in which fund managers choose fee structures to signal their abilities to investors and compare the equilibria with asymmetric incentive fees with the equilibria with (unlimited) fulcrum fees. Consistent with the previous studies, they show that asymmetric incentive fees encourage the adoption of more risky portfolios than fulcrum fees. However, when the entry costs for the uninformed managers are low, the incentive fees may be preferable for investors' welfare than fulcrum fees.

Palomino and Uhlig (2002) model a game in which risk-neutral investors choose between an index fund and an active fund. The manager of an active fund may be good or bad (a bad manager is uninformed, while a good manager may be informed with some probability) and is compensated with a fraction-of-funds fee. Investors can only observe realized returns, from which they infer about the unknown quality of the active fund's manager. Under the condition that investing in an active fund is not optimal ex ante (i.e., before observing returns), the model has an equilibrium, in which investing in the active fund is optimal ex post, if its return falls within some interval (i.e., is neither too low or too high). In this equilibrium, an informed manager picks a portfolio with minimal riskiness, and an uninformed manager chooses higher risk, gambling on a lucky outcome. When the fee structure is endogenous, both types of the active fund's manager choose the same fraction-of-funds fee structure.

2.4.3 Managers' strategies: empirical evidence

In this section, we review empirical evidence on strategic behavior of mutual fund managers. We start with the studies testing predictions of the theoretical models discussed in the previous section. Since the calendar year is often used as the performance evaluation period for mutual fund managers[2], they are interested in maximizing their calendar-year performance. The convexity of the manager's payoff in fund performance (see Section 2.4.1) suggests that mutual funds participate in the annual tournaments competing for the top year-end rankings. Based on the theoretical models of Carpenter (2000)and Chen and Pennacchi (1999), one can formulate the hypothesis that funds with bad performance after the first part of the year have an incentive to increase risk in the second part of the year, trying to catch up with interim winners at the end of the year. Several studies test this tournament hypothesis examining within-year changes in risk measured on the basis of monthly return data. Applying a contingency table methodology to the sample of US growth funds in 1976-1991, Brown, Harlow, and Starks (1996) find

[2]In general, two types of the evaluation horizon are used: rolling horizon or fixed calendar-year horizon. Mutual fund performance based on the rolling one-year horizon (e.g., fund raw return during the last 12 months) as well as year-to-date performance (e.g., fund raw return from January to the current month) are often published in the financial newspapers. The calendar-year performance is reported in funds' prospectuses as well as fund listings published on an annual basis by many periodicals and data providers.

that interim losers (defined as funds below the median category return over the first part of the year) increase risk towards the end of the year relative to interim winners. Using a sample of US domestic equity funds in 1992-1994, Koski and Pontiff (1999) apply regression methodology and find a negative relationship between fund return over the first semester and the change in total, systematic, and unsystematic risk between the first and second semesters. Chevalier and Ellison (1997) use a different approach, measuring fund risk on the basis of the fund's portfolio holdings. They also find a negative relationship between fund return over the first nine months of the year and the change in fund risk between September and December, using a sample of growth and growth-and-income funds in 1982-1992. However, Busse (2001) finds no such evidence, applying either the contingency table or the regression methodology to daily returns of 230 US domestic equity funds in 1985-1995 (new entrants after 1984 are not included). He explains this divergence in the results by the presence of the auto-correlation and cross-correlation in fund returns, which was not accounted for in the standard statistical tests used in the previous studies.

A related literature examines strategic changes in fund styles measured as factor loadings from a multi-factor model. Chan, Chen, and Lakonishok (2002) find in a sample of US domestic equity funds in 1976-1997 that fund styles measured on the basis of Fama-French (1993) three-factor model tend to cluster around a broad market benchmark. When deviating, funds are more likely to favor growth stocks with good recent performance. There is some consistency in styles, although funds with poor past performance are more likely to change styles. Using daily returns of US domestic equity funds in 1985-1995, Lynch and Musto (2000) find that the changes in the factor loadings from Carhart (1997) four-factor model are larger for funds in the bottom performance quartile than for the other funds. Poorly performing funds tend to increase investments in growth stocks, while good performers are likely to decrease their momentum loadings. The change in strategy as well as managerial replacement among the poor performers seem to lead to the performance improvement. Note, however, that the results of these studies should be taken with caution, since they are also a subject to the critique of Busse (2001) that statistical tests should account for the auto-correlation and cross-correlation in fund returns.

Several studies investigate the gaming behavior by mutual fund managers around the year-ends. Using the database with daily returns of US diversified equity funds

in 1985-1997, Carhart et al. (2002) find strong evidence that some fund managers mark up their holdings at the last trading day of the year to improve a calendar-year performance (similar although weaker effects are also found at the quarter-ends). By trading aggressively at the end of the trading day, a manager pumps up the closing prices of his portfolio holdings, which determine the fund's net asset value and daily return. The authors show that funds with the greatest ability and the most incentive to improve their performance rankings are more active in marking up. Musto (1999) presents evidence of window dressing by managers of money market funds in 1987-1997. He demonstrates that funds allocating between government and private issues tend to increase their government holdings around the disclosure dates (at the fiscal year-end and six months later).

Since fund performance is reported on the net-of-fee basis, a manager can improve the fund's relative performance by waiving a part of his contracted fee. Christoffersen (2001) documents that over half of US money market funds waived fees in 1990-1995. This effect is economically significant: institutional funds waive almost half of their contracted advisory fees (19 basis points per year), while retail funds waive about two-thirds of their contracted fees (33 basis points per year). Fee waivers allow managers to flexibly react throughout the year to changes in relative performance, which affect fund flows. The link between fund performance and fee waivers appears to be especially strong and statistically significant among poorly performing funds, for which lower performance is associated with larger amounts of waived fees. A convex flow-performance relationship seems to encourage well-performing retail funds to increase waivers as a function of their performance. However, the fee waivers remain largely flat among well-performing institutional funds. This is interpreted as evidence of greater price competition among institutional funds than among retail funds.

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