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# Trading efficiency of Fund Families: Impact on Fund Performance and Investment Behavior

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**Trading Efficiency of Fund Families:**
**Impact on Fund Performance and Investment Behavior**

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## ABSTRACT

This study examines how the efficiency of trading desks operated by mutual fund families affects the performance and trading of affiliated funds. We estimate the trading efficiency of a fund family's trading desk as the difference between the gross return of the family's index fund, which incorporates trading costs, and the return of the underlying index, which does not incorporate trading costs, around index adjustment dates. By operating more efficient trading desks that help reduce trading costs, fund families improve the performance of their funds significantly and also enable their funds to trade more and hold less liquid portfolios.

JEL *classification:* D23; G23; G24

*Keywords*: Mutual funds; fund families; trading efficiency; fund performance; investment behavior

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## 1. Introduction

Most mutual funds operate as part of larger business entities, commonly referred to as mutual fund families. Fund families make strategic decisions with far-reaching consequences for the operations and performance of their member funds. Academic research has documented some of these decisions and their impact on fund performance.[1] However, one of the most direct ways in which fund families can affect the performance of their member funds, which is through the operation of a trading desk, has been overlooked.[2] Our study fills this gap in the literature.

We hypothesize that a trading desk operating within a mutual fund family can affect the family's member funds in two ways. First, it can directly affect fund performance through its impact on the funds' trading costs.[3] Particularly, we would expect funds that belong to families with more efficient trading desks to incur lower trading costs and therefore generate better performance, everything else held equal. Second, the trading desk can influence the trading strategies of its member funds by helping funds avoid constraints related to trading costs. Specifically, a more efficient trading desk, through its ability to control trading costs, presumably enables funds to exploit more opportunities not only in their broad investable universe but also among illiquid assets. Thus, we would expect funds from families with more efficient trading desks to be able to trade more and hold less liquid portfolios.

Despite the appealing economic rationale underlying our hypotheses, empirical evidence on this topic is lacking. This has probably been caused by there being no easy way to meaningfully compare mutual fund families based on the efficiency of their trading desks. Besides severe data limitations on the trades of fund families'

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1 See, e.g., Gaspar et al. (2006), Kacperczyk and Seru (2012), and Chen et al. (2013).

2 See Anand et al. (2012) for an excellent detailed discussion of how trading desks support their portfolio managers. There they point out that trading desks directly shape the execution of trades placed by portfolio managers by making important choices, such as deciding which trading venues to use, which brokers to use and to what extent to use them, whether and how to split the orders, and what time frame to use for execution, among others.

3 Academic researchers agree that trading costs are an important determinant of fund performance. On average, they reduce fund performance by about one percentage point per year (see, e.g., Bollen and Busse 2006, Chalmers et al. 1999, Chalmers et al. 2001, Wermers 2000, Edelen et al. 2013, and Busse et al. 2015) and, thus, are comparable in magnitude to the typical expense ratio charged by mutual funds (see Investment Company Institute 2014). However, trading costs differ widely among otherwise comparable funds and can be even more burdensome for some funds. For example, Wermers (2000) estimates mutual fund trading costs to range from 0.28% and 2.65% based on turnover-sorted fund quintiles.

trading desks, a key challenge is that different fund families have different investable stock universes that are subject to different trading costs.[4] Thus, realistic comparisons of trading efficiency based on traditional trading cost measures across different families are not feasible. To circumvent this limitation, we exploit instances when fund families engage in informationless trading of the same securities to accomplish a similar task. Focusing on S&P 500 index funds, which represent the most widely used index product, we estimate the trading efficiency of a given fund family as the difference between the return of its index fund gross of expenses and the return of the S&P 500 index (henceforth, return difference) around index adjustment dates.[5] The rationale is that trading costs are reflected in the gross return of an index fund but not in the return of the underlying index, making the return difference a reasonable measure of trading costs associated with trades of index funds in response to changes in the composition of the underlying index. In line with this rationale, we interpret the ability of an index fund from family A to generate a higher return difference than another index fund from family B as an indication that the trading desk of family A is better at trade execution than that of family B.

Using a broad sample of US equity funds for the period 2000 to 2013, we find strong support for our first main hypothesis that trading efficiency of mutual fund families has a positive impact on the performance of their member mutual funds. Specifically, actively managed funds belonging to families with the most efficient trading desks deliver a significantly higher performance than their counterparts from families with the least efficient trading desks. This result is also economically significant, with the performance differences between these two fund groups being more than 71 basis points per year.

We take multiple steps to rule out alternative explanations or alleviate endogeneity concerns. First, we include fund fixed effects in additional regression specifications to control for unobservable fund characteristics. Second, we employ two placebo tests. The first one is based on a bootstrap procedure, which randomly assigns the efficiency measure of a family's trading desk to fund-year observations and estimates the relation between fund performance and trading efficiency. We repeat this procedure 10,000 times and the results rule out that the effect

[4] A fund family investing primarily in small cap stocks is going to have higher trading costs than a fund family that invests primarily in large cap stocks simply because small cap stocks have higher trading costs. However, this does not necessarily mean that the first fund family has a less efficient trading desk.

[5] Blume and Edelen (2004) study the performance and tracking errors of index funds that track the S&P 500 index and document large differences in these variables across these funds.

of trading efficiency on performance is spurious. The second placebo test constructs an alternative measure of trading efficiency based on index funds that are outsourced by the fund family. This efficiency measure should not be related to the trading efficiency of the outsourcing family and the performance of its in-house funds because the trading desk of the outsourcing family is not responsible for the execution of trades of the outsourced index funds. This responsibility lies with the external advisors who manage the outsourced index funds. Supporting our argument, we find no positive and significant relation of this alternative trading efficiency measure with the performance of funds managed in-house. Finally, we explore how the well-documented negative relation between fund performance and turnover interacts with our trading efficiency measure. Presumably funds that trade more incur higher trading costs, which act as a drag on fund performance.[6] In line with this argument, if our measure reflects trading desk efficiency, its interaction with fund turnover ought to show that efficient trading desks have a moderating effect on the negative impact of turnover on fund performance. In support of this argument, we document that the negative effect of turnover on fund performance is significantly weaker for funds from more efficient families than for funds from less efficient families.

We also find strong support for our second group of hypotheses that more efficient trading desks afford affiliated funds the opportunity to trade more and hold less liquid portfolios. The idea is that efficient trading desks help funds get around investment restrictions related to trading costs. We document that funds belonging to families with more efficient trading desks trade more. The average portfolio turnover of funds from the most efficient families is up to about 14 percentage points higher than that of funds from the least efficient families. They also hold less liquid portfolios. A similar comparison suggests that funds from the most efficient families hold cash positions that are one third smaller and also hold stocks that are significantly less liquid. These findings are consistent with theoretical arguments that trading costs influence the investment decisions of investors (see, e.g., Demsetz 1968) such that investors reduce the amount of trading (see, e.g., Constantinides 1986) and hold more liquid securities (see, e.g., Amihud and Mendelson 1986) when facing higher trading costs.

Our paper makes a contribution to the literature that examines the trading costs of institutional investors. Some of these papers investigate and document heterogeneity in transaction costs among specific types of institutions

[6] See, e.g., Carhart (1997), Barras et al. (2010), Kacperczyk and Seru (2012), and Jiang and Verardo (2013).

(see, e.g., Keim and Madhavan 1997). Others focus more specifically on the trading costs of mutual funds and analyze their impact on fund performance (see, e.g., Perold 1988, Alexander et al. 2007, Bollen and Busse 2006, Christoffersen et al. 2008, Edelen et al. 2013, and Busse et al. 2015). Trading costs, although "invisible" to investors, can be quite significant. For example, recent evidence from Busse et al. (2015) on a subset of funds that provided trade execution details to Ancerno suggests that trading costs of mutual funds are typically comparable in magnitude to the funds' expense ratios.

Anand et al. (2012) also use Ancerno trade data for a subset of reporting institutions – but not necessarily mutual fund families – and find that institutional trading desks exhibit persistent skills with respect to quality of trade execution, which is also related to future performance of their portfolios. A difference between our study and Anand et al. (2012) is how the quality of the trading desk is assessed. They use the cost of actual trades, which is driven not only by the quality of the trading desk but also by information. For example, managers might want to act quickly on a piece of short-lived information and thus be willing to accept higher trading costs. By comparison, our approach rules out the confounding effect of information-based trading by exploiting information-free trading by index funds. This enables us to construct a more direct measure of the efficiency of trading desks, which allows for comparisons across families. Besides this methodological contribution, a key contribution to this literature is that this is the first article to study the relation between the efficiency of fund families' trading desks and the performance and the investment behavior of the individual mutual funds that they support.

Our paper is also related to a second literature that studies the importance of trading costs as a determinant of investment decisions (see, e.g., Demsetz 1968). In particular, two major mechanisms are established for the relationship between trading costs and investment behavior. First, trading stocks entails economically significant costs (see, e.g., Holthausen et al. 1990 and Keim and Madhavan 1997) and, thus, investors accommodate trading costs by reducing the frequency and volume of their trades (see, e.g., Constantinides 1986). Second, since less liquid stocks are associated with higher average returns (see, e.g., Amihud and Mendelson 1986, Brennan et al. 1998, Brennan and Subrahmanyam 1996, and Amihud 2002) investors with lower trading costs hold less liquid assets (see, e.g., Amihud and Mendelson 1986). We contribute to this literature by showing that mutual funds do indeed respond to lower trading costs resulting from affiliation with more efficient trading desks in a way that is consistent with the theoretical predictions of this literature.

In addition, our paper makes a contribution to a growing literature that looks at how strategies employed by mutual fund families affect the performance outcomes and investment behavior of its member funds. For instance, Guedj and Papastaikoudi (2004) and Gaspar et al. (2006) show fund families subsidize the performance of their top-performing funds. Kacperczyk and Seru (2012) analyze whether a family strategy to centralize decision making affects fund performance. Chen et al. (2013), Kostovetsky and Warner (2012), Moreno et al. (2013), Debaere and Evans (2014), and Sorhage (2015) analyze the decision of mutual fund families to outsource part of their duties and how this decision affects fund performance. Finally, Kempf and Ruenzi (2008) and Simutin (2013) show that intra-family competitive dynamics can affect certain investment decisions of the member funds. Our paper contributes to this literature by investigating how an understudied strategic decision made by mutual fund families to shape the efficiency of their trading desks affects the performance of corresponding member funds.

More generally, our paper adds to a group of studies that document how fund family characteristics affect fund performance. For instance, previous studies show that funds from larger families (see, e.g., Chen et al. 2004) and funds from families that focus on particular styles (see, e.g., Siggelkow 2003) outperform. One can argue that organizing into families rather than operating as standalone entities allows mutual funds to exploit economies of scope by spreading their operational costs across different funds. For example, one such cost is incurred by running a trading desk, which mainly involves employing traders who help execute the trades of all portfolio managers.[7] Our results suggest that not all mutual funds families are created equal and some are likely better at exploiting the above-mentioned economies of scope. Thus, our study makes a contribution by documenting a new family characteristic, namely the efficiency of the family's trading desk, which is important for the performance of the family's mutual funds and needs to be accounted for in cross-sectional fund performance comparisons.

[7] In addition, by offering a large menu of funds fund families are able to reach a larger base of investors, who value the larger number of options and the convenience of being able to switch freely among the funds offered by the family (see, e.g., Massa 2003 and Elton et al. 2007).

The remainder of this paper is organized as follows. In section 2, we discuss our data, the methodology we employ to measure trading desk efficiency, sample summary statistics, and information on our efficiency measure. Section 3 examines the impact of trading desk efficiency on mutual fund performance and rules out alternative explanations for our findings. We analyze how the efficiency of the trading desk affects the trading behavior of mutual funds in Section 4. Section 5 concludes.

## 2. Data and methodology

### 2.1. Data sources

We obtain data from multiple sources: (1) CRSP Survivor-Bias-Free US Mutual Fund (CRSP MF) database, (2) Thomson-Reuters Mutual Fund Holdings database, (3) CRSP US Stock database, (4) Morningstar Direct database, (5) Active Share database of Cremers and Petajisto (2009) and Petajisto (2013), (6) N-CSR SEC Filings, and (7) CRSP Indices database.

The CRSP MF database provides information about fund characteristics such as fund return, total net assets under management (TNA), expenses, age, and investment objective.[8] Furthermore, the database includes an identifier that allows us to assign each fund to a specific fund family. We focus on US equity funds and eliminate global, international, balanced, and fixed-income funds. We aggregate data reported at the share class level using MFLINKS to group together share classes that belong to the same fund and weight the variables of interest by the assets of the share classes.

From the Thomson Mutual Fund Holdings database we obtain the portfolio holdings of each fund as well as the names of the fund`s investment advisors and match this information via MFLINKS to our CRSP sample. We supplement the holdings information with daily stock data from the CRSP US Stock database.

We use the Morningstar Direct database, the Active Share database, the N-CSR SEC Filings, and the CRSP Indices database to identify S&P 500 index funds. From the CRSP Indices database we also obtain information on the S&P 500 returns and the index constituents at each point of time.

[8] We determine a fund's investment objective like in Pástor and Stambaugh (2002) based on the CRSP fund objective codes.

## 2.2. Measuring trading desk efficiency

Our measure of the trading efficiency of a fund family's trading desk is based on the premise that trading desks that are better at trade execution would make it possible for a family's index fund to adjust its portfolio at lower transaction costs in response to index reconstitutions. The lower transaction costs would then lead to a higher return difference between the index fund and the index around index adjustment dates. Thus, in essence we exploit instances when trading desks engage in informationless trading of the same securities over the same period to accomplish the similar task of tracking the same index. We follow four steps to estimate the efficiency of a fund family`s trading desk.

Step 1: We identify S&P 500 index funds following a similar approach as in Berk and Binsbergen (2013). We focus on S&P 500 index funds because index funds that track the S&P 500 represent the largest category of index funds offered across a larger number of families as compared to other types of index funds that track different indices.[9] We first identify all index funds that are classified as such in the CRSP MF database. We then use information about the benchmarks of these funds from Morningstar Direct and from the Active Share database to extract index funds that follow the S&P 500.[10] From these funds, we eliminate all funds that do not closely follow the index by imposing the following criteria simultaneously: The number of portfolio stock positions is between 400 and 520; the fund beta with respect to the S&P 500 index is between 0.98 and 1.02; and the $R^2$ of the corresponding regression is higher than 0.98.[11] Finally, we manually check the N-CSR reports filed with the SEC to make sure that the remaining funds do not use leverage and fully replicate S&P 500 index funds.

[9] We explored the possibility of constructing alternative trading efficiency measures based on index funds that follow other indices, such as Russell 1000 Value, Russell 1000 Growth, Russell 2000, Russell 3000, and NASDAQ 100. However, the number of families that offer index funds that track these indices is rather small. In fact, Russell 2000, which is the second most popular index among fund families, is tracked by index funds offered by only 11 sample families. Nonetheless, it was reassuring to observe that the efficiency measures constructed from S&P 500 funds and Russell 2000 funds were highly correlated, with a correlation coefficient of 0.44 (p-value=0.0001) when using family-year observations and 0.71 (p-value=0.0142) when using family observations.

[10] Details on the construction of the Active Share data are provided in Cremers and Petajisto (2009) and Petajisto (2013).The Active Share database was downloaded from Antti Petajisto's website: http://www.petajisto.net/data.html.

[11] This approach is similar to the one used in Boldin and Cici (2010).

Step 2: We calculate the return difference between each index fund and the S&P 500 index over all trading days that are within a week before and after an index reconstitution.[12] Our choice of this particular window to compute the return difference was shaped by evidence from Green and Jame (2011), who show that index funds do not restrict their portfolio rebalancing to the effective index reconstitution date but trade around that date in an attempt to mitigate transaction costs. In particular, they find that the lion`s share of index funds trade within a one week window around index adjustment days. The return difference is then averaged for each index fund across all non-overlapping index adjustment periods in a specific year to come up with an annual measure of the trading efficiency of each index fund.

Step 3: We employ this measure of the trading efficiency of an index fund as our proxy for the efficiency of the trading desk of the corresponding fund family if the index fund is in-house managed. Thus, we exclude all outsourced index funds for which a sub-advisor is responsible since only the sub-advising company and its trading desk are responsible for their trade execution.[13] This leaves us with 83 fund families, for which we can measure the efficiency of their trading desk.[14]

Step 4: We assign the trading desk`s efficiency measure of a specific fund family to all actively managed US domestic equity funds that belong to that family. Our sample of actively managed funds consists of 1,106 US equity funds and 7,053 fund-year observations over the 2000 to 2013 period.[15]

## 2.3. Sample characteristics

Table 1 presents summary statistics on family and fund characteristics, respectively in Panels A and B, for our sample and the remaining actively managed US equity funds in CRSP.

- Insert Table 1 approximately here -

[12] To calculate the return difference, we use the gross-of-expenses return of the index fund. This ensures that the return difference is not influenced by the total expense ratio of the index fund.

[13] To identify sub-advised index funds, we follow Chen et al. (2013) and compare the name of the fund family provided by CRSP to the name of the investment advisory firm provided by Thomson. If their names differ and they do not belong to the same ownership structure, we classify the index fund as sub-advised.

[14] In the very rare cases that a fund family has two S&P index funds, we calculate the trading desk efficiency of the family based on the index fund with longer history.

[15] The starting date is determined by the availability of the CRSP fund family identifier.

Panel A of Table 1 suggests that funds in our sample come from larger, older, and more diversified families than the remaining funds. The sample families cover about 30% of the funds and about 47% of the assets controlled by all actively managed US equity funds. Panel B shows that the average fund in our sample is more than twice as large as the average fund in the peer group, holds less cash, and differs to varying degrees with respect to age, turnover, flow, flow volatility, and expense ratio.

### 2.4. Characteristics of the efficiency measure

In Table 2 we report information on the characteristics of our efficiency measure.[16] Panel A reports summary statistics on the distribution. The mean and median value of our efficiency measure is negative. This is not surprising given that index funds generate transaction costs that undoubtedly cause them to underperform the index. The underperformance is 39 basis points for the median index fund in our sample. There appears to be a small group of funds, however, that generate positive values for their efficiency measure. These funds are beating the index, possibly by gaming the index reconstitutions or by engaging in security lending.

- Insert Table 2 approximately here -

Panel A of Table 2 also suggests that the efficiency of the trading desks of our sample families has been increasing through time. This is consistent with the view that trading desks have become better at controlling trading costs, most likely due to them having access to increasingly better technology and trading platforms, but is also consistent with a declining trend in commissions charged in the markets.

Panel B reports serial correlations for our measure over different lags. The serial correlation coefficients suggest that the trading desk efficiency measure exhibits persistence over several years. This result is consistent

[16] In unreported results we examined whether our trading efficiency measure is related to brokerage commissions. Like Edelen et al. (2013), we collected commission data for our index funds from N-SAR reports. One limiting factor is that fund commission amounts are not reported at the fund level but aggregated at the series level, which is a group of funds (some of which are actively-managed) that file under the same N-SAR report. The correlation between our trading efficiency measure and commissions normalized by fund assets is 0.22 but statistically insignificant. The lack of significance is perhaps explained by the fact that the aggregation in N-SAR reports introduces measurement error in the commission measure of index funds.

with Anand et al. (2012) who find that institutional trading desks exhibit persistent skills with respect to quality of trade execution.

### 2.5. Efficiency measure and fund, fund family, and fund portfolio characteristics

To understand the characteristics of families and funds that are associated with more efficient trading desks, in Table 3 we examine the characteristics of family or fund groupings that are stratified by the level of the efficiency measure. Specifically, we rank and sort families or funds into quintiles based on the efficiency measure in year *t-1* and compute average characteristics measured in year *t* for the different efficiency groups. In addition, we report simple correlations between our efficiency measure in year *t-1* and each of the family or fund characteristics in *t*.

Panel A focuses on family characteristics. Comparisons of the different efficiency groups reveal no clear relation between most of the family characteristics and our efficiency measure. This is also corroborated by the lack of significant correlations between our efficiency measure and the various characteristics. The only exception to this is the relation between the efficiency measure and its lagged value, which suggests (consistent with Panel B of Table 2) that the efficiency of trading desks affiliated with our sample families is persistent.

- Insert Table 3 approximately here -

In Panel B, we perform similar comparisons but with the focus on fund characteristics. Funds from families with the most efficient trading desks appear to be larger, experience higher and less volatile flows, have lower expense ratios, and hold smaller cash balances than funds from families with the least efficient trading desks.

In Panel C we report characteristics related to the liquidity of the fund's stockholdings. The liquidity-related characteristics are stock characteristics that are value-weighted at the portfolio level, with weights determined by the market value of each stock position. They include: market capitalization, dollar volume of shares traded, relative spread, measured as the difference between the logarithm of the best offer price and the logarithm of the best bid price, Amihud (2002) illiquidity measure, measured as the stock`s absolute return divided by its dollar volume, and liquidity beta, measured as the sensitivity (beta loading) on the liquidity factor as in Pástor and Stambaugh (2003). Funds from families with the most efficient trading desks appear to hold less liquid stocks.

Specifically, funds in the top efficiency group tend to hold stocks that have a lower market cap, lower dollar trading volume, higher relative spread, and higher Amihud illiquidity measure. These are important distinctions that will be addressed in greater detail in Section 4.

In Panel D we provide performance statistics for the different efficiency groups. Although, these univariate comparisons do not properly control for important fund characteristics, we observe that the performance measures increase with the efficiency measure. All correlations are positive and significant at the 1%-level.

With respect to risk characteristics, Panel E shows some evidence that funds in the top efficiency group hold stocks with higher market betas, although the beta difference is economically small. Consistent with evidence from Panel C, a comparison of loadings on the size factor suggests that funds in the high efficiency group hold smaller cap stocks.

## 3. Trading efficiency and performance

In this section we explore the relation between our efficiency measure of a fund family's trading desk and the performance of the funds belonging to the family. In Section 3.1 we test our hypothesis that funds belonging to families with more efficient trading desks generate better performance than funds from families with less efficient trading desks. In Section 3.2 we provide evidence supporting the validity of our key variable as a measure of the efficiency of a family's trading desk.

### 3.1. Does trading desk efficiency have an impact on fund performance?

Our hypothesis postulates that actively managed funds belonging to families with more efficient trading desks deliver a better performance than funds from families with less efficient trading desks.[17] We test this hypothesis using multiple testing approaches.

Our first approach employs a matched sample analysis whereby we perform performance comparisons of funds from families with high trading efficiency with funds from families with low trading efficiency that share similar characteristics. An attractive feature of this approach is that it can control reasonably well for fund or

[17] In the entire analysis, we focus only on actively managed funds that are in-house managed. The reason is that the trading desk of a given fund family is responsible for the execution of trades of in-house funds but not for the execution of trades of outsourced funds, which are managed by an external advisor.

family characteristics that might affect performance in a non-linear fashion. Each year we sort our sample funds into quintiles based on the trading desk`s efficiency of the corresponding fund family in the previous year *t-1*. Performance is measured in the subsequent year *t*. We sort based on the lagged value of the efficiency measure to avoid spurious correlation between trading efficiency and fund performance. The top group consists of all funds belonging to families that are in the top quintile with respect to their trading desk efficiency, while the bottom group consists of funds belonging to families in the quintile with the lowest trading efficiency. After we stratify funds by their trading efficiency, we match each fund from the top group with an equally weighted portfolio of all funds from the bottom group that share the same investment style and similar characteristics (meaning that they belong to the same quintile with respect to the characteristic in the respective year).

We believe that the second most important characteristic to match on after matching on investment style is family size. This is because larger families are likely to have access to more resources and get better trade execution terms due to their higher trading volume. In addition to investment style and family size, we match on some other fund characteristics. Our choice of these other characteristics is motivated by previous research that has studied the relation between fund performance and fund characteristics. These additional characteristics include fund size, fund age, fund turnover, past fund performance, and fund flow volatility, respectively.[18] For each fund in the top group we calculate the difference between its performance and that of the matching portfolio consisting of funds from the bottom efficiency group.

We use three different measures of performance: (1) Jensen (1968) alpha, (2) Fama and French (1993) 3-factor alpha, and (3) Carhart (1997) 4-factor alpha. We estimate these measures based on net-of-fee returns. Annual fund alphas are constructed as the difference of the realized and expected excess fund returns in a given year (each compounded over the 12 monthly observations). We compute a fund's expected net return in a given month

[18] Previous research has analyzed the relation between fund performance and fund size (see, e.g., Chen et al. 2004 and Berk and Green 2004), fund age (see, e.g., Ferreira et al. 2013), portfolio turnover (see, e.g. Carhart 1997), past performance (see, e.g., Hendricks et al. 1993), and fund flow volatility (see, e.g., Rakowski 2010).

using factor loadings estimated over the previous 12 months and factor returns in that month.[19] The performance differences for the various matching criteria and performance measures are provided in Table 4.

- Insert Table 4 approximately here -

Table 4 clearly shows that funds belonging to families with most efficient trading desks deliver a significantly higher performance than funds from families with the least efficient trading desks that share similar characteristics. The estimated outperformance of the most efficient funds relative to the matched least efficient funds is statistically significant in 14 out of 15 cases. This outperformance is also economically significant, ranging from 1.2 to 2.4 percentage points per year.

Our second approach compares the performance of the most efficient and least efficient funds using multivariate regressions. The key independent variables are the dummy variables *TopEff* (*MedEff*), which equal one if the fund belongs to the top efficiency quintile (middle three quintiles) and zero otherwise. The bottom quintile is our base group. Using these dummy variables we run a pooled regression model, which is specified as follows:

$$\begin{aligned} Perf_{i,t} = \alpha &+ \beta_1 TopEff_{i,t-1} + \beta_2 MedEff_{i,t-1} + \gamma_1 FamSize_{i,t-1} + \gamma_2 FamFocus_{i,t-1} \\ &+ \gamma_3 FundSize_{i,t-1} + \gamma_4 FundAge_{i,t-1} + \gamma_5 FundTO_{i,t-1} + \gamma_6 Perf_{i,t-1} \\ &+ \gamma_7 FundFlow_{i,t-1} + \gamma_8 FundFlowVola_{i,t-1} + \gamma_9 FundTER_{i,t-1} + \varepsilon_{i,t} \end{aligned} \tag{1}$$

To control for possible effects of fund and family characteristics on performance, we include the logarithm of the fund family's net assets under management reported in millions (*FamSize*), the investment concentration of the fund family across investment styles (*FamFocus*) as in Siggelkow (2003), the logarithm of the fund's total net assets under management reported in millions (*FundSize*), the logarithm of the fund's age in years (*FundAge*), the fund's yearly turnover ratio (*FundTO*), the lagged fund performance (*Perf*), the fund flows (*FundFlow*) as defined in Sirri and Tufano (1998), the fund flow volatility (*FundFlowVola*), measured as the standard deviation of the fund`s monthly net-flows during the year, and the fund's total expense ratio (*FundTER*). Like in Table 4, because

[19] Results remain qualitatively similar when we estimate factor loadings over the previous 24 or 36 months or when we estimate factor loadings over the previous 12 months based on returns of daily frequency.

we want to rule out the impact of investment style on performance in each year, we include style-by-year fixed effects in the regression. In addition, we introduce an alternative specification, which employs fund and time fixed effects to control for unobservable fund characteristics and time effects. Standard errors are clustered at the family level.

- Insert Table 5 approximately here -

Results reported in Table 5 lead to the same conclusion as Table 4: Funds belonging to families with the most efficient trading desks deliver significantly higher performance than the funds in base group once we control for the various characteristics. The estimated outperformance of the most efficient funds relative to the least efficient funds is both statistically and economically significant, ranging from 71 to 190 basis points per year. Funds from families in the middle efficiency group also outperform funds in the base group but the difference is statistically significant only in two cases.

Our third approach for assessing the impact of trading efficiency on performance employs multivariate regressions similar to the second approach, with the only difference being that we replace the trading efficiency dummies with the continuous version of our trading efficiency measure. More specifically, the pooled regression model is specified as follows:

$$\begin{aligned} Perf_{i,t} &= \alpha + \beta Efficiency_{i,t-1} + \gamma_1 FamSize_{i,t-1} + \gamma_2 FamFocus_{i,t-1} \\ &\quad + \gamma_3 FundSize_{i,t-1} + \gamma_4 FundAge_{i,t-1} + \gamma_5 FundTO_{i,t-1} + \gamma_6 Perf_{i,t-1} \\ &\quad + \gamma_7 FundFlow_{i,t-1} + \gamma_8 FundFlowVola_{i,t-1} + \gamma_9 FundTER_{i,t-1} + \varepsilon_{i,t} \end{aligned} \tag{2}$$

The key independent variable is the measure of trading desk efficiency (*Efficiency*) as defined in Section 2.2. Thus, model (2) uses the continuous version of the efficiency measure, while model (1) uses a discretized version. The included controls and fixed effects are as in model (1). We again cluster standard errors at the family level.

- Insert Table 6 approximately here -

Table 6 again provides evidence that the trading desk efficiency of a fund family is positively related to the performance of the families' funds. This holds for both specifications that use different fixed effects structures, suggesting that a higher trading efficiency measure is associated with better performance relative to other funds with lower trading efficiency but also relative to a fund's own performance in previous periods characterized by lower trading efficiency. The economic effect is again significant. A one-standard-deviation increase of the efficiency measure leads to an increase in performance of up to 24 (44) basis points when we use style-by-year (fund and year) fixed effects in the regression.[20]

In unreported results, we also explored whether higher trading efficiency is more beneficial during times of worsening market-wide liquidity or when the liquidity situation of a fund deteriorates due the fund experiencing large outflows. This is exactly what we found, suggesting that more efficient trading desk come to the help of their affiliated funds when their help is needed the most.

Overall, the results from Tables 4 through 6 strongly support our first main hypothesis that funds belonging to families with efficient trading desks outperform funds from inefficient families. This is consistent with the view that fund families can provide a performance-enhancing service to their funds by reducing their trading costs through the operation of an efficient trading desk.

### 3.2. Does our measure actually capture trading desk efficiency?

In this section we conduct tests to check the validity of our measure. We start with two placebo tests and conclude with a test that examines whether efficiency of the trading desk moderates a possible negative impact of turnover on fund performance.

#### 3.2.1 Placebo test: Bootstrap

Our first robustness test employs a bootstrap procedure, which imposes the null of the efficiency of the trading desk having no effect on fund performance. This is done by randomly assigning the efficiency measure of fund families' trading desks to fund-year observations, creating in effect counterfactuals where we expect efficiency to have no effect on performance. This randomization of fund-years with respect to their trading desk efficiency

[20] One could argue that since our trading efficiency measure is constructed from S&P 500 index funds, it captures only trading efficiency with respect to trading of large stocks. This is not corroborated by unreported tests that compare the impact of trading efficiency on performance for funds that invest in large stocks versus funds that invest in small stocks. This additional evidence is consistent with the view that our efficiency measure based on S&P 500 index funds is a good proxy of the trading efficiency of a family's trading desk across all different types of stocks.

measures keeps all other fund or family characteristics unchanged. For each random assignment, we estimate regression models (1) and (2), and we repeat this procedure 10,000 times.

- Insert Figure 1 approximately here -

In Figure 1 we show the distribution of the coefficients estimated for all the iterations of the bootstrap. We report results only when performance is measured as the Carhart alpha, but results are similar for all the other performance measures and are therefore not reported here in the interest of brevity. In Figure 1 we observe that the actual estimates from Table 5 and 6 are positioned at the outermost right-hand tail of the bootstrap distribution. Specifically, in Panel A the actual estimate for *TopEff* from model (1) with fund and time fixed effects is about three standard deviations above the mean of the bootstrap estimates, with only 0.17% of the bootstrap values above the actual estimate. Thus, the actual estimate is significantly different from the mean of the empirical distribution resulting under the null of no performance effect due to trading desk efficiency. In Panel B, a similar pattern is observed with the actual estimate from model (2). In sum, the evidence from the bootstrap strongly rejects the null in favor of our hypothesis that the efficiency of the trading desk positively affects fund performance.

### 3.2.2. Placebo test: Efficiency measure based on outsourced index funds

The presence of both outsourced and in-house managed index funds provides us with an opportunity to run another placebo test. If our efficiency measure indeed captures the efficiency of the family's trading desk, then we should observe a performance effect only when the efficiency measure is constructed based on index funds that are in-house managed. The rationale is that the trading desk of a given fund family is responsible for the execution of trades of in-house index funds but not for the execution of trades of outsourced index funds, which are managed by an external advisor. Thus, a version of the efficiency measure based on outsourced index funds represents an attractive placebo treatment that is expected to have no effect on the performance of the active funds that are in-house managed.

The results presented so far are all based on the efficiency measure calculated from in-house managed index funds. To test whether the placebo efficiency measure based on outsourced index funds has an impact on the performance of the actively managed funds of the outsourcing family, we repeat the analysis of Tables 5 and 6 but now calculate the efficiency measure based on outsourced index funds only.[21]

- Insert Table 7 approximately here -

Table 7 shows that the coefficient of the placebo efficiency measure calculated from outsourced index funds is insignificant, suggesting that the placebo efficiency treatment, as expected, has no performance impact on the performance of actively managed funds of the outsourcing family. This second falsification exercise further supports the notion that the efficiency measure based on in-house index funds captures the quality of a family's trading desk.

### 3.2.3. Impact of fund turnover on performance

For our final validity test we analyze the impact of turnover on fund performance. Turnover can have a two-sided effect. High turnover might result from investors adjusting their portfolios to new ideas and thus generating performance. However, turnover also generates trading costs, which hurt performance. If our efficiency measure indeed captures the quality of the trading desk, we expect trading to be less costly, which would make the second effect weaker when a fund is affiliated with a more efficient trading desk.

To test this hypothesis, we estimate the impact of turnover on performance for three groups of funds that differ with respect to the trading desk efficiency of the corresponding fund families. We interact fund turnover with the dummies characterizing the efficiency of the trading desk. The top group consists of funds belonging to families which are in the top quintile with respect to their trading desk efficiency. The bottom group consists of the funds belonging to families in the bottom quintile and the remaining funds form the medium group. The dummy variable *TopEff* (*MedEff*, *BotEff*) equals one if the fund belongs to the top (medium, bottom) group and zero

[21] We cannot repeat the matched sample due to the low number of observations, which does not allow us to form appropriate matching groups.

otherwise. Table 8 provides regression estimates and results from testing whether the impact of turnover on performance is different between funds in the top efficiency group and funds in the bottom group.

- Insert Table 8 approximately here -

The key takeaway from Table 8 is that the impact of fund turnover on performance differs significantly between funds in the top efficiency group and funds in the bottom group. This is consistent with the higher efficiency of certain trading desks moderating the negative impact of turnover-induced trading costs on fund performance.

## 4. Trading efficiency and trading strategy

In this section we examine whether trading desk efficiency affects the trading strategies pursued by mutual funds. Theoretical literature provides two main hypotheses: First, investors accommodate trading costs by reducing the frequency and volume of their trades (see, e.g., Constantinides 1986). Second, investors with lower trading costs hold less liquid assets to earn the liquidity premium (see, e.g., Amihud and Mendelson 1986). We test these hypotheses in this section. More specifically, in Section 4.1 we test whether funds that belong to families with efficient trading desks trade more, and in Section 4.2 we explore whether trading desk efficiency impacts funds` portfolio liquidity.

### 4.1. Trading efficiency and turnover

In this section we test the hypothesis that funds that belong to families with efficient trading desks exhibit a higher turnover. As in Section 3.1, we use three testing approaches, which we report in Table 9: the matched sample approach (Panel A), the multivariate regression approach with the *TopEff* and *MedEff* dummy variables (Panel B), and the multivariate regression approach with *Efficiency* as the key independent variable (Panel C).

We utilize various turnover measures. The first measure, *FundTO*, is the fund's yearly turnover ratio, defined as the minimum of security purchases and sales divided by the average total net assets under management during the calendar year. The second group of measures, *BuyTO* and *SellTO*, are two variables derived from fund turnover that represent the separate effects of buy and sell trading by adding (subtracting) the percentage change in fund`s total net assets under management, as in Carhart (1997). The final measure, *PositionTO*, represents the position-adjusted turnover ratio as suggested by Edelen et al. (2013). To come up with this measure, we first estimate the average position size for a fund by dividing the fund`s total net assets under management by its total number of holdings. Then, we calculate the percentile rank of this position size relative to all other funds of the same investment objective in a given year. Finally, we multiply *FundTO* with this percentile to obtain the position-adjusted turnover ratio.

- Insert Table 9 approximately here -

Results from the matched approach reported in Panel A of Table 9 provide strong evidence that the trading desk efficiency of a fund family is positively related to the turnover of the families' funds. Funds belonging to families with the most efficient trading desks exhibit significantly higher turnover than funds in the base group. In particular, the observed difference in turnover amounts to up to 14 percentage points.

Results from the regressions that use the dummy or the continuous variable approach, reported in Panels B and C, tell a similar story. Funds from families with more efficient trading desks exhibit higher turnover, as evidenced by the significance of the coefficients of the *TopEff* and *Efficiency* variables. Thus, our findings are consistent with the view that funds from families with more efficient trading desks exploit this trading efficiency to pursue more investment opportunities, while funds from less efficient families are more constrained to do so.

### 4.2. Trading efficiency and liquidity

It is well documented that less liquid assets are associated with higher trading costs but also with higher average returns (see, e.g., Amihud and Mendelson 1986, Brennan et al. 1998, Brennan and Subrahmanyam 1996, and Amihud 2002). Hence, funds need to balance the benefit of holding less liquid assets with the cost of trading them. Since funds of families with efficient trading desks are able to trade at lower costs, financial theory suggests that these funds should hold less liquid portfolios, which can be accomplished by holding less cash (the most liquid asset) or by holding less liquid stocks.

First, we test whether funds from more efficient families hold less cash. The basic idea is that funds from more efficient families can sell stocks in a less costly way than funds from inefficient families when they need to cover unexpected liquidity needs. Therefore, funds from more efficient families would need to hold less cash.

To examine whether cash holdings of mutual funds are affected by the trading efficiency of their respective families, again we employ the matched sample approach and the two regression approaches used in the previous section. Our measure of a fund`s *cash holding* position is the reported portfolio weight in cash in the CRSP MF database.

- Insert Table 10 approximately here -

The results of Table 10 show that for all three approaches and all implemented model specifications, trading desk efficiency relates negatively to the fraction of assets held in cash. The cash holding of funds from the most efficient families is up to one percentage point smaller than the cash holding of funds from the least efficient families as shown in the matched sample results of Panel A. The dummy approach of Panel B shows results of similar order of magnitude, that is, the cash holding is up to three quarters of a percentage point smaller for funds from the most efficient group relative to funds from the least efficient group. This is an economically significant difference given that funds from the most efficient group hold on average less than three percent of their assets in cash during our sample period.

Second, we investigate whether efficient funds also hold less liquid stocks in their portfolios. We estimate portfolio liquidity following Massa and Phalippou (2005) as the value-weighted average of the liquidity measure of all stocks in a fund`s portfolio. We use various proxies for stock liquidity that are documented in the literature. *MarketCap* captures the stock`s market capitalization and *DollarVol* is the stock turnover times the stock price (see, e.g., Brennan et al. 1998). The higher each measure is, the more liquid a stock or portfolio is. In contrast, *Relative Spread* (see, e.g., Holden et al. 2014), the difference between the logarithm of the best offer price and the logarithm of the best bid price, *Amihud* (see Amihud 2002), the stock`s absolute return divided by its dollar volume, and *LiqBeta*, the sensitivity (beta loading) to the liquidity factor as in the Pástor and Stambaugh (2003) 5-factor model, define the level of a stock`s illiquidity.

- Insert Table 11 approximately here -

To examine whether portfolio liquidity of mutual funds is affected by the trading efficiency of their respective families, again we use the matched sample approach and the two regression approaches. Results from the matched sample approach, reported in Panel A of Table 11, suggest that efficient funds hold less liquid assets. For *MarketCap* and *DollarVol* we find a negative and highly significant difference between funds in the top and the bottom efficiency group, i.e. funds in the top group holds smaller and less traded stocks. Not surprisingly, these stocks are characterized by a higher relative bid-ask spread and a higher price impact of a trade as documented by the positive and highly significant values of *Relative spread* and *Amihud*. They also carry a higher liquidity risk as suggested by the positive *LiqBeta* (significant in 4 out of 5 cases). These differences are also highly economically significant. For example, the market cap difference between the two groups, which is as high as 6.4 billion dollars, suggests that the average market cap of stocks held by funds from the most efficient group is up to 24 percent lower than the average market cap of stocks held by the least efficient group. Similarly, the relative spread difference of 0.0006 suggests that the average relative spread of stocks held by funds from the most efficient group is up to 26 percent lower than the average relative spread for the least efficient group. These findings are consistent with the view that the trading cost reduction benefit provided by more efficient trading desks allows mutual funds to exploit more opportunities among illiquid stocks, trading of which incurs higher trading costs but also potentially higher returns.

As an alternative way of assessing the economic significance of these results, in unreported tests we compared the impact of trading efficiency on the Carhart alpha versus its impact on the five factor alpha, estimated by augmenting the Carhart model to include the Pastor-Stambaugh liquidity factor. This comparison suggests that the performance difference between high and low efficiency fund groups gets smaller when we move from the Carhart alpha to the five factor alpha. The drop in the performance difference is about 50 basis points and thus economically significant. We interpret it as the gain that accrues to high efficiency funds from their ability to capture the liquidity premium.

Interestingly, the regression approaches in Panels B and C do not allow us to draw the same conclusion as the approach employed in Panel A because the coefficients of the *TopEff* and *Efficiency* variables are not significant at conventional levels. A possible explanation is that the matched sample approach can control better for non-linear effects related to size characteristics, which Busse et al. (2015) document to have a strong impact on portfolio liquidity.[22]

## 5. Conclusion

In this paper we study an important but overlooked mechanism through which mutual fund families can affect the performance of their mutual funds. Mutual fund families decide the type and amount of resources that they devote to the operations of their trading desks. This decision dictates the efficiency of the trading desk, which in turn can have a direct impact on the trading costs and performance of a family's member funds.

Introducing a measure of trading efficiency that allows for meaningful comparisons across fund families with different investable universes, we document that operating an efficient trading desk is important. Funds from the most efficient families outperform those from the least efficient ones by more than 71 basis points per year, which supports the idea that more efficient families help mutual funds to reduce transaction costs and thus boost performance. This finding is robust and is further corroborated by additional tests that rule out alternative explanations and alleviate endogeneity concerns.

Besides a performance impact due to reduced trading costs, the level of trading efficiency also appears to affect the trading strategies of the member mutual funds. In particular, the presence of an efficient trading desk within a mutual fund family is associated with the member funds trading more and holding less liquid portfolios (enabling them earn the illiquidity premium). This suggests that funds that belong to more efficient families internalize the trading efficiency of their families in their decision-making to avoid or minimize the impact of constraints on their trading activities that are associated with trading costs.

[22] In addition, Table 3 suggests that the various efficiency groups are unbalanced by certain family and fund characteristics. For example, there is an overrepresentation of larger funds in the highest trading efficiency group relative to the lowest efficiency group. Larger funds are known to hold more liquid portfolios simply because of their size (see, e.g., Busse et al. 2013). This would make it harder to find a difference in portfolio liquidity in the direction suggested by our hypothesis. Therefore, a matched sample approach can help balance our data to allow for meaningful comparisons that can better mitigate the confounding effect of other fund characteristics.

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**Table 1 – Sample characteristics**

This table reports descriptive statistics for the fund families (Panel A) and funds (Panel B) of our sample compared to non-sample funds in the CRSP universe. Family size is the average total net assets under management of a fund family in millions of dollars. Number of funds in family is the average number of different funds that belong to the same fund family. Family focus represents the average concentration of a fund family across investment objectives, defined as in Siggelkow (2003). Family age represents the average fund age in years of the oldest fund in a family. Fund size represents the average total net assets under management of the fund in millions of dollars. Fund age represents the average fund age in years. Fund turnover is defined as the average of the minimum of security purchases and sales divided by the average total net assets under management during the calendar year. Fund flow represents the average of a fund`s percentage growth rate adjusted for internal growth of the fund, as defined in Sirri and Tufano (1998). Fund flow volatility is the average standard deviation of a fund`s monthly net-inflows during the year. Fund expense ratio represents average funds' fees charged for total services. Fund cash holdings is the average cash position reported by a mutual fund to CRSP in its quarterly statements, relative to the size of the fund. The last column of the table reports the difference in fund family and fund statistics between our sample and the non-sample CRSP universe. ***, **, * denote statistical significance for the difference in means between both groups at the 1%, 5%, and 10% significance level, respectively.

| | Sample period: 2000-2013 | | |
|---|---|---|---|
| | Sample | Non-sample CRSP universe | Difference |
| **Panel A: Family characteristics** | | | |
| Number of families | 83 | 792 | |
| Family size (in million USD) | 24,884.77 | 2,954.09 | 21,930.68 *** |
| Number of funds in family | 13.16 | 3.17 | 9.99 *** |
| Family focus (in %) | 49.36 | 78.32 | -28.96 *** |
| Family age (in years) | 20.88 | 12.03 | 8.85 *** |
| **Panel B: Fund characteristics** | | | |
| Number of funds | 1,106 | 3,149 | |
| Fund size (in million USD) | 1,642.64 | 712.78 | 929.86 *** |
| Fund age (in years) | 11.10 | 9.49 | 1.61 *** |
| Fund turnover (in %) | 92.18 | 86.57 | 5.61 *** |
| Fund flow (in %) | 11.14 | 13.96 | -2.82 ** |
| Fund flow volatility (in %) | 15.44 | 16.83 | -1.40 *** |
| Fund expense ratio (in %) | 1.11 | 1.35 | -0.24 *** |
| Fund cash holdings (in %) | 2.33 | 3.71 | -1.39 *** |

**Table 2 – Characteristics of the efficiency measure**

This table reports summary statistics of the trading desk efficiency measure over the period 2000 to 2013. The efficiency measure is estimated as the annualized average return difference between a family`s S&P500 index fund and the index around index adjustment dates within a year. In Panel A, we report summary statistics on the distribution of the trading desk efficiency measure for different sub-periods and the total sample. We report the average efficiency measure, its standard deviation and the $5^{th}$, $25^{th}$, $50^{th}$, $75^{th}$, and $95^{th}$ percentile, respectively. Panel B shows serial correlations of the efficiency measure at various lags.

**Panel A: Efficiency measure (in %) per sub-period**

| | Efficiency (in %) | | | | | | |
|---|---|---|---|---|---|---|---|
| Year | Mean | Std. | Percentiles | | | | |
| | | | 5% | 25% | 50% | 75% | 95% |
| 2000-2004 | -0.91 | 0.95 | -2.77 | -1.41 | -0.71 | -0.34 | 0.21 |
| 2005-2009 | -0.18 | 0.78 | -1.24 | -0.64 | -0.22 | 0.20 | 1.18 |
| 2010-2013 | -0.19 | 0.70 | -1.85 | -0.41 | -0.05 | 0.21 | 0.63 |
| 2000-2013 | -0.49 | 0.91 | -2.07 | -0.79 | -0.39 | 0.01 | 0.87 |

**Panel B: Serial correlation**

| Efficiency measure in | t | t-1 | t-2 | t-3 | t-4 | t-5 | t-6 |
|---|---|---|---|---|---|---|---|
| t | 1 | | | | | | |
| t-1 | 0.1511 *** | 1 | | | | | |
| t-2 | 0.2313 *** | 0.1647 *** | 1 | | | | |
| t-3 | 0.1412 *** | 0.2115 *** | 0.1289 *** | 1 | | | |
| t-4 | 0.1183 *** | 0.1261 *** | 0.1973 *** | 0.1237 *** | 1 | | |
| t-5 | 0.0810 *** | 0.1323 *** | 0.1056 *** | 0.1867 *** | 0.1441 *** | 1 | |
| t-6 | 0.1043 *** | 0.1200 *** | 0.1047 *** | 0.1312 *** | 0.1611 *** | 0.1090 *** | 1 |

**Table 3 – Efficiency measure and fund, fund family, and fund portfolio characteristics**

This table reports information on family characteristics (Panel A), fund characteristics (Panel B), the liquidity of portfolio stockholdings (Panel C), fund performance (Panel D), and risk factors (Panel E) for sample families and sample funds stratified by the efficiency of their corresponding trading desks. In year *t-1*, fund families are sorted into quintiles according to their efficiency measure, which is described in Table 2. *Q1* (*Q5*) includes families or funds affiliated with trading desks with the lowest (highest) efficiency measures. In each panel, we report the average values for year *t* together with the difference between *Q5* and *Q1*. In the last column, we estimate the correlation coefficient between the efficiency measure in year *t-1* and the respective variable in year *t*. In Panel A, we report family characteristics. Family size, number of funds in family, family focus, and family age are defined as in Table 1. Efficiency measure is defined as in Table 2. Size of S&P 500 index fund represents the total net assets under management of the fund family`s S&P500 index fund in millions of dollars. Age of S&P 500 index fund is the family`s S&P500 index fund age in years. Tracking Error of S&P 500 index fund is defined as the annualized average of the standard deviation of the return difference between a family`s S&P500 index fund and the S&P500 index during the year. In Panel B, we report fund characteristics. They are defined as in Table 1. In Panel C, we report fund portfolio characteristics that capture the (il)liquidity of the stockholdings. Market capitalization is the value-weighted average of the market capitalization of all stocks held by a fund. Dollar volume measures the value-weighted average of the dollar volume of shares traded of all stocks held by a fund. Relative spread is the value-weighted relative spread of the individual stocks held, which is measured for each stock held as the difference between the logarithm of the best offer price and the logarithm of the best bid price. Amihud measure is the value-weighted average of the Amihud measures of individual stocks held, which is based on the illiquidity measure of Amihud (2002). Liquidity beta is the sensitivity (beta loading) to the liquidity factor as in the Pástor and Stambaugh (2003) 5-factor model. In Panel D, we report the funds net-of-fee performance. We use: Fund return, Jensen (1968) alpha (Jensen alpha), Fama and French (1993) 3-Factor alpha (Fama-French alpha) and Carhart (1997) 4-Factor alpha (Carhart alpha). In Panel E, we report risk factors, defined as the sensitivity (beta loadings) of the fund return to the market factor (Market beta), value factor (Value beta), size factor (Size beta) as well as momentum factor (Momentum beta) as in the Carhart (1997) 4-factor model. ***, **, * denote statistical significance at the 1%, 5%, and 10% significance level, respectively.

| | *Q1 (Bottom)* | *Q2/Q3/Q4 (Medium)* | *Q5 (Top)* | *Q5-Q1* | *Correlation* |
|---|---|---|---|---|---|
| **Panel A: Family characteristics** | | | | | |
| Family size (in million USD) | 10,056.77 | 35,492.22 | 21,299.30 | 11,242.53 * | 0.0499 |
| Number of funds in family | 9.54 | 16.04 | 11.46 | 1.91 | 0.0319 |
| Family focus (in %) | 56.30 | 44.31 | 49.15 | -7.14 * | -0.0002 |
| Family age (in years) | 19.22 | 23.68 | 22.35 | 3.13 | -0.0393 |
| Efficiency measure (in %) | -0.63 | -0.23 | -0.21 | 0.42 *** | 0.1511 *** |
| Size of S&P 500 index fund (in million USD) | 954.40 | 6,196.81 | 7,193.00 | 6,238.59 ** | 0.0211 |
| Age of S&P 500 index fund (in years) | 8.17 | 11.50 | 9.80 | 1.63 ** | 0.0253 |
| Tracking Error of S&P 500 index fund | 11.57 | 8.84 | 11.46 | -0.11 | 0.0802 |

**Table 3 – Efficiency measure and fund, fund family, and fund portfolio characteristics (continued)**

| | *Q1 (Bottom)* | *Q2/Q3/Q4 (Medium)* | *Q5 (Top)* | *Q5-Q1* | *Correlation* |
|---|---|---|---|---|---|
| **Panel B: Fund characteristics** | | | | | |
| Fund size (in million USD) | 1,057.39 | 2,007.54 | 1,794.97 | 737.58 *** | 0.0736 *** |
| Fund age (in years) | 10.77 | 11.40 | 10.60 | -0.17 | 0.0666 *** |
| Fund turnover (in %) | 93.96 | 84.49 | 89.63 | -4.33 | -0.0347 |
| Fund flow (in %) | 3.94 | 10.01 | 12.49 | 8.55 *** | 0.0507 ** |
| Fund flow volatility (in %) | 20.42 | 13.83 | 15.54 | -4.88 *** | -0.0855 *** |
| Fund expense ratio (in %) | 1.23 | 1.09 | 1.00 | -0.23 *** | -0.2157 *** |
| Fund cash holdings (in %) | 2.73 | 2.32 | 2.07 | -0.66 *** | -0.0975 *** |
| **Panel C: (Il)liquidity measures of funds` stockholdings** | | | | | |
| Market capitalization (in million USD) | 27,200.00 | 25,800.00 | 24,000.00 | -3,200.00 *** | -0.0445 * |
| Dollar volume (in million USD) | 34.60 | 32.70 | 31.60 | -3.00 ** | 0.0547 ** |
| Relative spread | 0.0023 | 0.0027 | 0.0027 | 0.0004 ** | -0.1062 *** |
| Amihud measure | 0.1808 | 0.4120 | 0.6534 | 0.4726 *** | 0.1121 *** |
| Liquidity beta | -0.0006 | -0.0014 | 0.0022 | 0.0028 | -0.0014 |
| **Panel D: Performance measures** | | | | | |
| Fund return (in %) | 6.44 | 7.77 | 9.51 | 3.07 *** | 0.2327 *** |
| Jensen alpha (in %) | -0.06 | 0.32 | 0.42 | 0.48 | 0.1301 *** |
| Fama-French alpha (in %) | -0.59 | -0.13 | -0.30 | 0.29 | 0.119 *** |
| Carhart alpha (in %) | -0.01 | 0.37 | 0.21 | 0.22 | 0.1538 *** |
| **Panel E: Risk factors** | | | | | |
| Market beta | 0.9939 | 1.0043 | 1.0181 | 0.0241 ** | 0.0333 |
| Value beta | -0.0402 | -0.0172 | -0.0163 | 0.0239 | -0.0589 ** |
| Size beta | 0.1665 | 0.1763 | 0.2015 | 0.0350 * | 0.0634 *** |
| Momentum beta | 0.0344 | 0.0245 | 0.0406 | 0.0062 | -0.0146 |

**Table 4 – Mutual fund performance – Matched sample analysis**

This table reports results from a matched sample analysis where each fund from families with the most efficient trading desks (Top Efficiency) is matched with an equally weighted portfolio of funds affiliated with families with the least efficient trading desks (Bottom Efficiency) using the following matching criteria: Year, Style, Family size, Fund size, Fund age, Fund turnover, Fund performance, and Fund flow volatility. Fund performance represents the fund`s net-off-fee performance measure of the previous year and the remaining variables are defined as in Table 1. One-year-lagged values of these attributes are used to rank funds into quintiles independent of the categorization of funds into top efficient and bottom efficient groups. To categorize funds by their trading efficiency, in year *t-1* fund families are sorted into quintiles according to their efficiency measure. Top Efficiency (Bottom Efficiency) group includes funds from families with the highest (lowest) efficiency measures. Funds from the Top Efficiency group are matched to funds from the Bottom Efficiency group that belong to the same investment style and the same Family size quintile in a certain year. In rows one through five we use the quintile ranking based on Fund size, Fund age, Fund turnover, Fund performance, and Fund flow volatility as an additional matching criterion, respectively. Performance differences between top efficient funds and the corresponding bottom efficient matched portfolio are computed for the following performance measures based on net-of-fee returns: Jensen (1968) alpha (Jensen), Fama and French (1993) 3-Factor alpha (Fama French) and Carhart (1997) 4-Factor alpha (Carhart). P-values reported in parentheses. ***, **, * denote statistical significance at the 1%, 5%, and 10% significance level, respectively.

| Matching characteristics | Observations | Dependent variable: | | |
|---|---|---|---|---|
| | | Jensen | Fama French | Carhart |
| Year, Style, Family size, and Fund size | 438 | 0.0177 *** | 0.0207 *** | 0.0179 ** |
| | | (0.0002) | (<.0001) | (0.0133) |
| Year, Style, Family size, and Fund age | 406 | 0.0121 *** | 0.0166 *** | 0.0120 |
| | | (0.0074) | (0.0003) | (0.1067) |
| Year, Style, Family size, and Fund turnover | 369 | 0.0219 *** | 0.0172 *** | 0.0205 ** |
| | | (<.0001) | (0.0024) | (0.0146) |
| Year, Style, Family size, and Fund performance | 419 | 0.0125 *** | 0.0170 *** | 0.0142 * |
| | | (0.0054) | (0.0007) | (0.0673) |
| Year, Style, Family size, and Fund flow volatility | 383 | 0.0184 *** | 0.0224 *** | 0.0235 *** |
| | | (0.0001) | (<.0001) | (0.0004) |

**Table 5 – Mutual fund performance – Regression analysis I**

This table reports results from pooled OLS regressions that analyze the impact of trading desk efficiency on mutual fund performance using three different net-of-fee performance measures: Jensen (1968) alpha (Jensen), Fama and French (1993) 3-Factor alpha (Fama French) and Carhart (1997) 4-Factor alpha (Carhart). The key independent variables are two binary variables *TopEff* and *MedEff*, that equal one if the fund family`s trading desk, respectively, belongs to the top or to one of the middle three efficiency quintiles and zero otherwise. All independent variables are lagged by one year and additional independent controls include family size, family focus, fund size, fund age, fund turnover, fund performance, fund flow, fund flow volatility and fund expense ratio. Family size (*FamSize*) is the logarithm of the fund family's assets under management. Family focus (*FamFocus*) represents the concentration of a fund family across investment objectives, defined as in Siggelkow (2003). Fund size (*Fund Size*) represents the logarithm of the fund's total net assets under management. Fund age (*FundAge*) is the logarithm of the fund's age in years. Fund turnover (*FundTO*) is the fund's yearly turnover ratio, defined as the minimum of security purchases and sales divided by the average total net assets under management during the calendar year. Fund performance (*Perf*) represents the fund`s respective net-of-fee performance measure of the previous year. Fund flow (*FundFlow*) represents the fund`s percentage growth rate adjusted for internal growth of the fund, as defined in Sirri and Tufano (1998). Fund flow volatility (*FundFlowVola*) is the standard deviation of the fund`s monthly net-inflows during the year. Fund expense ratio (*FundTER*) represents funds' fees charged for total services. Two regressions specifications are estimated for each performance measure, one with style-by-year fixed effects and the other with fund fixed effects and year fixed effects. P-values reported in parentheses are based on robust standard errors clustered at the family level. ***, **, * denote statistical significance at the 1%, 5%, and 10% significance level, respectively.

| Dependent variable: | Jensen | | | | Fama French | | | | Carhart | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *TopEff* | 0.0071 | * | 0.0126 | ** | 0.0078 | * | 0.0163 | *** | 0.0098 | ** | 0.0190 | *** |
| | (0.0746) | | (0.0441) | | (0.0585) | | (0.0027) | | (0.0326) | | (0.0036) | |
| *MedEff* | 0.0042 | | 0.0046 | | 0.0057 | | 0.0106 | ** | 0.0056 | | 0.0109 | * |
| | (0.2786) | | (0.4962) | | (0.1178) | | (0.0478) | | (0.1343) | | (0.0531) | |
| *FamSize* | 0.0021 | *** | -0.0068 | * | 0.0016 | ** | -0.0020 | | 0.0035 | *** | 0.0000 | |
| | (0.0038) | | (0.0663) | | (0.0410) | | (0.5823) | | (0.0000) | | (0.9985) | |
| *FamFocus* | -0.0117 | | -0.0218 | | -0.0187 | | -0.0021 | | -0.0235 | ** | -0.0358 | |
| | (0.2372) | | (0.3216) | | (0.1027) | | (0.9404) | | (0.0384) | | (0.2010) | |
| *FundSize* | -0.0047 | *** | -0.0300 | *** | -0.0029 | *** | -0.0243 | *** | -0.0035 | *** | -0.0264 | *** |
| | (0.0000) | | (0.0000) | | (0.0029) | | (0.0001) | | (0.0005) | | (0.0000) | |
| *FundAge* | 0.0086 | *** | 0.0120 | | 0.0065 | *** | 0.0219 | ** | 0.0066 | *** | 0.0183 | ** |
| | (0.0000) | | (0.1310) | | (0.0037) | | (0.0264) | | (0.0099) | | (0.0342) | |
| *FundTO* | -0.0031 | * | 0.0056 | * | -0.0036 | | 0.0029 | | -0.0025 | | -0.0012 | |
| | (0.0878) | | (0.0533) | | (0.1535) | | (0.4089) | | (0.3122) | | (0.7590) | |
| *Perf* | 0.0437 | *** | -0.0528 | *** | -0.0286 | | -0.0979 | *** | 0.0029 | | -0.0689 | *** |
| | (0.0005) | | (0.0020) | | (0.2211) | | (0.0084) | | (0.8862) | | (0.0075) | |
| *FundFlow* | -0.0002 | | 0.0000 | | -0.0001 | | 0.0000 | | -0.0006 | | -0.0006 | |
| | (0.4232) | | (0.9173) | | (0.7965) | | (0.9841) | | (0.1633) | | (0.3542) | |
| *FundFlowVola* | 0.0000 | | 0.0002 | | -0.0002 | ** | -0.0001 | | -0.0001 | | 0.0001 | |
| | (0.8009) | | (0.2987) | | (0.0112) | | (0.1347) | | (0.4041) | | (0.7521) | |
| *FundTER* | -1.1470 | *** | -0.4761 | | -0.6553 | ** | 2.8915 | | -0.2974 | | 4.4900 | |
| | (0.0000) | | (0.6841) | | (0.0106) | | (0.1457) | | (0.3730) | | (0.2748) | |
| Style × Year FE | Yes | | No | | Yes | | No | | Yes | | No | |
| Fund FE | No | | Yes | | No | | Yes | | No | | Yes | |
| Year FE | No | | Yes | | No | | Yes | | No | | Yes | |
| Observations | 5,792 | | 5,792 | | 5,792 | | 5,792 | | 5,792 | | 5,792 | |
| Adj. $R^2$ | 0.2568 | | 0.2073 | | 0.1710 | | 0.0982 | | 0.1941 | | 0.1030 | |

**Table 6 – Mutual fund performance – Regression analysis II**

This table presents results from pooled OLS regressions that analyze the impact of trading desk efficiency on mutual fund performance using three different net-of-fee performance measures: Jensen (1968) alpha (Jensen), Fama and French (1993) 3-Factor alpha (Fama French) and Carhart (1997) 4-Factor alpha (Carhart). The main independent variable is *Efficiency*, estimated as the annualized average return difference between a family`s S&P500 index fund and the index around index adjustment dates within a year. Other independent variables and fixed effects are defined as in Table 5 and all independent variables are lagged by one year. P-values reported in parentheses are based on robust standard errors clustered at the family level. ***, **, * denote statistical significance at the 1%, 5%, and 10% significance level, respectively.

| Dependent variable: | Jensen | | Fama French | | Carhart | |
|---|---|---|---|---|---|---|
| *Efficiency* | 77.2174 * | 145.1477 * | 109.0789 ** | 167.6101 *** | 118.2680 * | 189.8075 ** |
| | (0.0773) | (0.0511) | (0.0319) | (0.0026) | (0.0521) | (0.0292) |
| *FamSize* | 0.0020 *** | -0.0067 * | 0.0015 * | -0.0018 | 0.0033 *** | 0.0002 |
| | (0.0035) | (0.0662) | (0.0651) | (0.6211) | (0.0000) | (0.9532) |
| *FamFocus* | -0.0116 | -0.0212 | -0.0185 | -0.0014 | -0.0234 ** | -0.0350 |
| | (0.2391) | (0.3266) | (0.1078) | (0.9611) | (0.0415) | (0.2116) |
| *FundSize* | -0.0047 *** | -0.0300 *** | -0.0028 *** | -0.0244 *** | -0.0035 *** | -0.0265 *** |
| | (0.0000) | (0.0000) | (0.0029) | (0.0001) | (0.0007) | (0.0000) |
| *FundAge* | 0.0085 *** | 0.0119 | 0.0065 *** | 0.0216 ** | 0.0065 ** | 0.0179 ** |
| | (0.0000) | (0.1343) | (0.0036) | (0.0291) | (0.0117) | (0.0365) |
| *FundTO* | -0.0029 | 0.0058 ** | -0.0033 | 0.0031 | -0.0022 | -0.0010 |
| | (0.1237) | (0.0400) | (0.1943) | (0.3716) | (0.3839) | (0.8044) |
| *Perf* | 0.0438 *** | -0.0532 *** | -0.0287 | -0.0978 *** | 0.0027 | -0.0690 *** |
| | (0.0004) | (0.0017) | (0.2206) | (0.0080) | (0.8961) | (0.0076) |
| *FundFlow* | -0.0002 | 0.0000 | -0.0001 | 0.0000 | -0.0006 | -0.0007 |
| | (0.4048) | (0.9027) | (0.7880) | (0.9792) | (0.1590) | (0.3282) |
| *FundFlowVola* | 0.0000 | 0.0001 | -0.0002 ** | -0.0001 | -0.0001 | 0.0001 |
| | (0.8177) | (0.3040) | (0.0125) | (0.1533) | (0.4122) | (0.7236) |
| *FundTER* | -1.1459 *** | -0.5049 | -0.6344 ** | 2.8158 | -0.2878 | 4.4132 |
| | (0.0000) | (0.6614) | (0.0123) | (0.1573) | (0.3781) | (0.2852) |
| Style × Year FE | Yes | No | Yes | No | Yes | No |
| Fund FE | No | Yes | No | Yes | No | Yes |
| Year FE | No | Yes | No | Yes | No | Yes |
| Observations | 5,792 | 5,792 | 5,792 | 5,792 | 5,792 | 5,792 |
| Adj. $R^2$ | 0.2568 | 0.2070 | 0.1711 | 0.0978 | 0.1942 | 0.1025 |

**Table 7 – Placebo test: Efficiency measure based on outsourced index funds**

This table presents results from pooled OLS regressions that analyze the impact of trading desk efficiency on mutual fund performance accounting for the effects of managerial outsourcing. We use three different net-of-fee performance measures: Jensen (1968) alpha (Jensen), Fama and French (1993) 3-Factor alpha (Fama French) and Carhart (1997) 4-Factor alpha (Carhart). The main independent variable is *Efficiency_Out*, estimated as the annualized average return difference between a family`s outsourced S&P500 index fund and the index around index adjustment dates within a year. As in Table 5, we relate fund performance with the dummy efficiency variables (*TopEff_Out* and *MedEff_Out*) in Panel A. As in Table 6, we relate fund performance with this efficiency measure in Panel B. Other independent variables and fixed effects are defined as in Table 5 and all independent variables are lagged by one year. P-values reported in parentheses are based on robust standard errors clustered at the family level. ***, **, * denote statistical significance at the 1%, 5%, and 10% significance level, respectively.

**Panel A: Dummy approach**

| Dependent variable: | Jensen | | Fama French | | Carhart | |
|---|---|---|---|---|---|---|
| *TopEff_Out* | -0.0129 | -0.0136 | -0.0148 | -0.0218 | -0.0050 | -0.0247 |
| | (0.4393) | (0.5173) | (0.3486) | (0.1541) | (0.7148) | (0.1113) |
| *MedEff_Out* | -0.0049 | -0.0057 | -0.0076 | -0.0160 | -0.0145 ** | -0.0294 * |
| | (0.7074) | (0.6975) | (0.4754) | (0.2637) | (0.0451) | (0.0768) |
| *FamSize* | -0.0013 | -0.0028 | -0.0020 | -0.0031 | 0.0014 | -0.0050 |
| | (0.7968) | (0.8352) | (0.6750) | (0.8688) | (0.7195) | (0.7004) |
| *FamFocus* | 0.0156 | 0.0165 | 0.0187 | 0.0157 | -0.0185 | -0.0192 |
| | (0.5706) | (0.8133) | (0.4817) | (0.7533) | (0.2402) | (0.6858) |
| *FundSize* | 0.0002 | -0.0372 ** | 0.0004 | -0.0305 * | 0.0008 | -0.0276 |
| | (0.9706) | (0.0253) | (0.9045) | (0.0725) | (0.8080) | (0.2605) |
| *FundAge* | -0.0010 | 0.0039 | -0.0020 | -0.0018 | -0.0027 | 0.0190 |
| | (0.8113) | (0.7983) | (0.5381) | (0.9583) | (0.6695) | (0.7731) |
| *FundTO* | 0.0089 | 0.0072 | 0.0047 | 0.0215 | 0.0113 | 0.0165 |
| | (0.4088) | (0.7680) | (0.7192) | (0.2976) | (0.2591) | (0.1653) |
| *Perf* | 0.0073 | -0.1612 ** | -0.0459 * | -0.0084 | 0.0093 | 0.0115 |
| | (0.9143) | (0.0241) | (0.0973) | (0.9435) | (0.7104) | (0.7279) |
| *FundFlow* | 0.0063 * | 0.0096 | 0.0052 | 0.0026 | 0.0032 | -0.0032 |
| | (0.0716) | (0.3671) | (0.2459) | (0.7621) | (0.5892) | (0.7724) |
| *FundFlowVola* | -0.0049 ** | -0.0042 | -0.0054 | -0.0018 | -0.0044 | 0.0005 |
| | (0.0432) | (0.5009) | (0.1180) | (0.6258) | (0.3039) | (0.9182) |
| *FundTER* | -1.6779 ** | -0.8883 | -0.4824 | 2.1510 | -0.8322 | 4.3955 * |
| | (0.0155) | (0.8112) | (0.5145) | (0.3593) | (0.2686) | (0.0847) |
| Style × Year FE | Yes | No | Yes | No | Yes | No |
| Fund FE | No | Yes | No | Yes | No | Yes |
| Year FE | No | Yes | No | Yes | No | Yes |
| Observations | 413 | 413 | 413 | 413 | 413 | 413 |
| Adj. $R^2$ | 0.2440 | 0.3443 | 0.3348 | 0.2890 | 0.2498 | 0.2418 |

**Table 7 – Placebo test: Efficiency measure based on outsourced index funds (continued)**

**Panel B: Continuous variable**

| Dependent variable: | Jensen | | Fama French | | Carhart | |
|---|---|---|---|---|---|---|
| *Efficiency_Out* | -47.4355 | -448.1663 | -123.2597 | -697.9042 | 33.5058 | -298.4491 |
| | (0.9001) | (0.4054) | (0.7856) | (0.1520) | (0.9121) | (0.3934) |
| *FamSize* | -0.0006 | -0.0017 | -0.0014 | 0.0001 | 0.0021 | 0.0005 |
| | (0.9012) | (0.8889) | (0.7737) | (0.9964) | (0.5910) | (0.9382) |
| *FamFocus* | 0.0117 | 0.0085 | 0.0144 | 0.0006 | -0.0191 * | -0.0371 |
| | (0.6345) | (0.8858) | (0.5297) | (0.9894) | (0.0518) | (0.4611) |
| *FundSize* | 0.0001 | -0.0366 ** | 0.0003 | -0.0306 * | 0.0002 | -0.0305 |
| | (0.9757) | (0.0259) | (0.9252) | (0.0726) | (0.9408) | (0.2144) |
| *FundAge* | -0.0007 | 0.0034 | -0.0016 | -0.0042 | -0.0015 | 0.0139 |
| | (0.8661) | (0.8441) | (0.5755) | (0.8926) | (0.8089) | (0.8154) |
| *FundTO* | 0.0088 | 0.0073 | 0.0046 | 0.0203 | 0.0103 | 0.0138 |
| | (0.4035) | (0.7607) | (0.7183) | (0.3214) | (0.2830) | (0.2172) |
| *Perf* | 0.0092 | -0.1651 ** | -0.0433 | -0.0103 | 0.0071 | 0.0108 |
| | (0.8913) | (0.0162) | (0.1145) | (0.9307) | (0.7686) | (0.7500) |
| *FundFlow* | 0.0060 * | 0.0101 | 0.0048 | 0.0028 | 0.0023 | -0.0041 |
| | (0.0836) | (0.3788) | (0.2861) | (0.7423) | (0.7094) | (0.7048) |
| *FundFlowVola* | -0.0047 ** | -0.0046 | -0.0052 | -0.0021 | -0.0040 | 0.0010 |
| | (0.0415) | (0.5007) | (0.1155) | (0.5256) | (0.3242) | (0.8504) |
| *FundTER* | -1.5359 ** | -1.1261 | -0.3771 | 1.9813 | -0.8003 | 4.4796 |
| | (0.0478) | (0.7740) | (0.6449) | (0.4676) | (0.2819) | (0.1205) |
| Style × Year FE | Yes | No | Yes | No | Yes | No |
| Fund FE | No | Yes | No | Yes | No | Yes |
| Year FE | No | Yes | No | Yes | No | Yes |
| Observations | 413 | 413 | 413 | 413 | 413 | 413 |
| Adj. $R^2$ | 0.2439 | 0.3495 | 0.3348 | 0.2962 | 0.2468 | 0.2335 |

**Table 8 – Turnover slope among bottom, medium and top efficiency funds**

This table presents results from pooled OLS regressions that analyze the impact of trading desk efficiency on the performance-turnover relationship. We use three different net-of-fee performance measures: Jensen (1968) alpha (Jensen), Fama and French (1993) 3-Factor alpha (Fama French) and Carhart (1997) 4-Factor alpha (Carhart). The efficiency measure is divided into three groupings. The bottom efficiency measure grouping (*BotEff*) and the highest efficiency measure grouping (*TopEff*) are binary variables that equal one if a fund family`s trading desk belongs, respectively, to the lowest or the highest quintile of efficiency measure and zero otherwise. The middle three efficiency measure quintiles are combined into one grouping (*MedEff*). The main independent variables are interaction terms between the efficiency measure group dummies and fund turnover. The coefficients on these piecewise decompositions of *FundTO* represent the slope of the performance- turnover relationship over their range of sensitivity. Fund turnover (*FundTO*) is the fund's yearly turnover ratio, defined as the minimum of security purchases and sales divided by the average total net assets under management during the calendar year. Other independent variables and fixed effects are defined as in Table 5 and all independent variables are lagged by one year. P-values reported in parentheses are based on robust standard errors clustered at the family level. ***, **, * denote statistical significance at the 1%, 5%, and 10% significance level, respectively.

| Dependent variable: | Jensen | | Fama French | | Carhart | |
|---|---|---|---|---|---|---|
| *FundTO × TopEff* | 0.0002 | 0.0122 *** | -0.0004 | 0.0087 * | -0.0006 | 0.0033 |
| | (0.9443) | (0.0072) | (0.8908) | (0.0767) | (0.8364) | (0.6013) |
| *FundTO × MedEff* | -0.0034 | 0.0051 * | -0.0033 | 0.0030 | -0.0021 | -0.0015 |
| | (0.1785) | (0.0621) | (0.3372) | (0.3692) | (0.5381) | (0.6996) |
| *FundTO × BotEff* | -0.0049 ** | 0.0023 | -0.0060 ** | -0.0020 | -0.0044 * | -0.0032 |
| | (0.0168) | (0.6262) | (0.0207) | (0.7639) | (0.0640) | (0.5377) |
| *FamSize* | 0.0022 *** | -0.0068 * | 0.0017 ** | -0.0019 | 0.0035 *** | 0.0002 |
| | (0.0023) | (0.0624) | (0.0480) | (0.6075) | (0.0000) | (0.9548) |
| *FamFocus* | -0.0114 | -0.0202 | -0.0185 | -0.0006 | -0.0238 ** | -0.0346 |
| | (0.2483) | (0.3381) | (0.1081) | (0.9843) | (0.0381) | (0.2114) |
| *FundSize* | -0.0047 *** | -0.0300 *** | -0.0029 *** | -0.0243 *** | -0.0035 *** | -0.0266 *** |
| | (0.0000) | (0.0000) | (0.0052) | (0.0001) | (0.0012) | (0.0000) |
| *FundAge* | 0.0085 *** | 0.0119 | 0.0064 *** | 0.0216 ** | 0.0065 ** | 0.0177 ** |
| | (0.0000) | (0.1291) | (0.0056) | (0.0299) | (0.0144) | (0.0393) |
| *Perf* | 0.0438 *** | -0.0531 *** | -0.0287 | -0.0981 *** | 0.0028 | -0.0686 *** |
| | (0.0005) | (0.0020) | (0.2179) | (0.0080) | (0.8915) | (0.0072) |
| *FundFlow* | -0.0002 | 0.0000 | -0.0002 | 0.0000 | -0.0006 | -0.0007 |
| | (0.3803) | (0.8852) | (0.7661) | (0.9731) | (0.1478) | (0.3145) |
| *FundFlowVola* | 0.0000 | 0.0002 | -0.0002 *** | -0.0001 | -0.0001 | 0.0001 |
| | (0.9223) | (0.2940) | (0.0075) | (0.2313) | (0.4255) | (0.6780) |
| *FundTER* | -1.1660 *** | -0.5536 | -0.6748 *** | 2.7972 | -0.3456 | 4.3639 |
| | (0.0000) | (0.6334) | (0.0065) | (0.1559) | (0.2800) | (0.2818) |
| *H0: Slope Top >= Slope Bot* | 0.0051 ** | 0.0099 *** | 0.0056 ** | 0.0107 ** | 0.0038 * | 0.0065 * |
| Style × Year FE | Yes | No | Yes | No | Yes | No |
| Fund FE | No | Yes | No | Yes | No | Yes |
| Year FE | No | Yes | No | Yes | No | Yes |
| Observations | 5,792 | 5,792 | 5,792 | 5,792 | 5,792 | 5,792 |
| Adj. $R^2$ | 0.2568 | 0.2077 | 0.1710 | 0.0981 | 0.1938 | 0.1018 |

**Table 9 – Trading efficiency and turnover**

This table shows results from a matched sample analysis (Panel A) and pooled OLS regressions (Panel B and C) that analyze the impact of trading desk efficiency on mutual funds` trading activity. We employ four measures of trading activity. The first one is fund turnover (*FundTO*), computed as the minimum of security purchases and sales divided by the average total net assets under management during the calendar year. The second and third measures are buy turnover (*BuyTO*) and sell turnover (*SellTO*), which are intended to separate buy and sell trading, as defined in Carhart (1997). The fourth measure is a position-adjusted turnover (*PositionTO*) as suggested in Edelen et al. (2013). For this measure, fund turnover is multiplied with the percentile rank of the fund`s position size, estimated by dividing its total net assets by the number of stocks in the portfolio. In Panel A each fund from families in the Top Efficiency group is matched with an equally weighted portfolio of funds from families in the Bottom Efficiency group using the following matching criteria: Year, Style, Family size, Fund size, Fund age, Fund turnover, Fund performance and Fund flow volatility, as described in Table 4. The main independent variables in the pooled regressions of Panel B are the *TopEff* and *MedEff* dummies introduced in Table 5. In the pooled regressions of Panel C, the main independent variable is *Efficiency*, which is described in Table 6. Fund performance (Perf) represents the fund`s net-off-fee Carhart (1997) 4-Factor alpha of the previous year. Other independent variables and fixed effects in both Panels B and C are defined as in Table 5. All independent variables are lagged by one year. P-values reported in parentheses are based on robust standard errors clustered at the family level. ***, **, * denote statistical significance at the 1%, 5%, and 10% significance level, respectively.

**Panel A: Matched sample analysis**

| Matching characteristics | Observations | Dependent variable: | | | |
|---|---|---|---|---|---|
| | | FundTO | BuyTO | SellTO | PositionTO |
| Year, Style, Family size, and Fund size | 305 | 0.1020 *** | 0.0996 *** | 0.1009 *** | -0.0082 |
| | | (0.0052) | (0.0066) | (0.0059) | (0.7744) |
| Year, Style, Family size, and Fund age | 289 | 0.1133 *** | 0.1105 *** | 0.1130 *** | 0.0600 ** |
| | | (0.0010) | (0.0014) | (0.0011) | (0.0112) |
| Year, Style, Family size, and Fund turnover | 246 | 0.0848 *** | 0.0833 *** | 0.0838 *** | 0.0370 * |
| | | (<.0001) | (<.0001) | (<.0001) | (0.0848) |
| Year, Style, Family size, and Fund performance | 302 | 0.1145 *** | 0.1080 *** | 0.1127 *** | 0.0711 *** |
| | | (0.0011) | (0.0025) | (0.0014) | (0.0061) |
| Year, Style, Family size, and Fund flow volatility | 278 | 0.1372 ** | 0.1383 ** | 0.1360 ** | 0.0508 * |
| | | (0.0377) | (0.0362) | (0.0401) | (0.0697) |

**Table 9 – Trading efficiency and turnover (continued)**

**Panel B: Dummy approach**

| Dependent variable: | FundTO | | BuyTO | | SellTO | | PositionTO | |
|---|---|---|---|---|---|---|---|---|
| *TopEff* | 0.0562 *** | 0.0431 ** | 0.0610 *** | 0.0478 *** | 0.0548 *** | 0.0415 ** | 0.0324 * | 0.0494 *** |
| | (0.0005) | (0.0125) | (0.0003) | (0.0087) | (0.0007) | (0.0165) | (0.0595) | (0.0002) |
| *MedEff* | 0.0053 | -0.0014 | 0.0054 | -0.0004 | 0.0060 | -0.0022 | -0.0040 | -0.0116 |
| | (0.6691) | (0.9066) | (0.6702) | (0.9735) | (0.6274) | (0.8565) | (0.7540) | (0.1830) |
| *FamSize* | 0.0233 *** | 0.0580 *** | 0.0255 *** | 0.0553 *** | 0.0223 *** | 0.0564 *** | 0.0075 | 0.0357 ** |
| | (0.0000) | (0.0007) | (0.0000) | (0.0021) | (0.0001) | (0.0009) | (0.3578) | (0.0371) |
| *FamFocus* | 0.0353 | 0.1304 | 0.0581 | 0.1127 | 0.0396 | 0.1288 | -0.0524 | 0.0982 |
| | (0.6701) | (0.2178) | (0.4707) | (0.2897) | (0.6308) | (0.2249) | (0.5583) | (0.2853) |
| *FundSize* | -0.0314 *** | -0.0356 *** | -0.0426 *** | -0.0714 *** | -0.0318 *** | -0.0336 *** | 0.1085 *** | 0.0966 *** |
| | (0.0000) | (0.0036) | (0.0000) | (0.0006) | (0.0000) | (0.0062) | (0.0000) | (0.0000) |
| *FundAge* | 0.0251 ** | -0.0404 | 0.0245 ** | -0.0225 | 0.0260 ** | -0.0376 | 0.0204 | -0.0897 ** |
| | (0.0128) | (0.3199) | (0.0207) | (0.6258) | (0.0104) | (0.3571) | (0.1324) | (0.0222) |
| *FundTO* | 0.7318 *** | 0.5700 *** | 0.7306 *** | 0.5657 *** | 0.7338 *** | 0.5707 *** | 0.3956 *** | 0.3271 *** |
| | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| *Perf* | -0.1106 * | -0.0514 | -0.0783 | -0.0360 | -0.1204 * | -0.0573 | 0.0460 | 0.0625 |
| | (0.0763) | (0.3813) | (0.2139) | (0.5551) | (0.0557) | (0.3344) | (0.4122) | (0.2940) |
| *FundFlow* | -0.0017 | -0.0006 | -0.0011 | -0.0005 | -0.0020 | -0.0007 | 0.0002 | -0.0011 |
| | (0.4673) | (0.6584) | (0.6025) | (0.7594) | (0.4270) | (0.5964) | (0.9265) | (0.4305) |
| *FundFlowVola* | -0.0001 | 0.0003 | 0.0003 | 0.0005 | -0.0001 | 0.0002 | -0.0002 | 0.0001 |
| | (0.8556) | (0.6352) | (0.5236) | (0.3699) | (0.8097) | (0.7150) | (0.8532) | (0.7450) |
| *FundTER* | 2.3783 | -11.0830 | 0.6136 | -10.1500 | 2.5863 | -11.4010 | 6.2671 *** | -5.6512 |
| | (0.1842) | (0.1256) | (0.7545) | (0.1613) | (0.1513) | (0.1155) | (0.0037) | (0.2894) |
| Style × Year FE | Yes | No | Yes | No | Yes | No | Yes | No |
| Fund FE | No | Yes | No | Yes | No | Yes | No | Yes |
| Year FE | No | Yes | No | Yes | No | Yes | No | Yes |
| Observations | 4,529 | 4,529 | 4,529 | 4,529 | 4,529 | 4,529 | 4,529 | 4,529 |
| Adj. $R^2$ | 0.7767 | 0.8156 | 0.7627 | 0.7997 | 0.7766 | 0.8156 | 0.5553 | 0.7549 |

**Table 9 – Trading efficiency and turnover (continued)**

**Panel C: Continuous variable**

| Dependent variable: | FundTO | | BuyTO | | SellTO | | PositionTO | |
|---|---|---|---|---|---|---|---|---|
| *Efficiency* | 1437.9100 *** | 515.6770 ** | 1399.2600 *** | 495.7900 ** | 1417.8200 *** | 493.3610 ** | 1545.2400 *** | 852.8730 ** |
| | (0.0008) | (0.0352) | (0.0007) | (0.0439) | (0.0010) | (0.0443) | (0.0071) | (0.0147) |
| *FamSize* | 0.0185 *** | 0.0581 *** | 0.0207 *** | 0.0555 *** | 0.0177 *** | 0.0565 *** | 0.0020 | 0.0355 ** |
| | (0.0002) | (0.0007) | (0.0000) | (0.0021) | (0.0005) | (0.0010) | (0.7987) | (0.0397) |
| *FamFocus* | 0.0469 | 0.1303 | 0.0691 | 0.1127 | 0.0510 | 0.1286 | -0.0381 | 0.0970 |
| | (0.5218) | (0.2192) | (0.3350) | (0.2906) | (0.4841) | (0.2265) | (0.6305) | (0.2954) |
| *FundSize* | -0.0297 *** | -0.0357 *** | -0.0410 *** | -0.0716 *** | -0.0302 *** | -0.0337 *** | 0.1103 *** | 0.0966 *** |
| | (0.0000) | (0.0035) | (0.0000) | (0.0007) | (0.0000) | (0.0060) | (0.0000) | (0.0000) |
| *FundAge* | 0.0232 ** | -0.0407 | 0.0224 ** | -0.0229 | 0.0242 ** | -0.0378 | 0.0191 | -0.0890 ** |
| | (0.0177) | (0.3177) | (0.0290) | (0.6195) | (0.0142) | (0.3551) | (0.1496) | (0.0229) |
| *FundTO* | 0.7380 *** | 0.5708 *** | 0.7367 *** | 0.5665 *** | 0.7399 *** | 0.5714 *** | 0.4019 *** | 0.3280 *** |
| | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| *Perf* | -0.1165 * | -0.0547 | -0.0841 | -0.0390 | -0.1262 ** | -0.0605 | 0.0391 | 0.0564 |
| | (0.0629) | (0.3529) | (0.1835) | (0.5223) | (0.0458) | (0.3092) | (0.4824) | (0.3440) |
| *FundFlow* | -0.0015 | -0.0005 | -0.0008 | -0.0004 | -0.0018 | -0.0006 | 0.0005 | -0.0009 |
| | (0.5153) | (0.7195) | (0.6705) | (0.8163) | (0.4674) | (0.6555) | (0.8220) | (0.5012) |
| *FundFlowVola* | -0.0001 | 0.0002 | 0.0003 | 0.0005 | -0.0001 | 0.0002 | -0.0002 | 0.0000 |
| | (0.8367) | (0.6594) | (0.4548) | (0.3843) | (0.7875) | (0.7418) | (0.8428) | (0.9274) |
| *FundTER* | 2.8269 | -11.2090 | 0.9886 | -10.3058 | 3.0267 * | -11.5147 | 7.0942 *** | -5.6849 |
| | (0.1024) | (0.1204) | (0.6078) | (0.1544) | (0.0827) | (0.1110) | (0.0011) | (0.2864) |
| Style × Year FE | Yes | No | Yes | No | Yes | No | Yes | No |
| Fund FE | No | Yes | No | Yes | No | Yes | No | Yes |
| Year FE | No | Yes | No | Yes | No | Yes | No | Yes |
| Observations | 4,529 | 4,529 | 4,529 | 4,529 | 4,529 | 4,529 | 4,529 | 4,529 |
| Adj. $R^2$ | 0.7778 | 0.8154 | 0.7636 | 0.7995 | 0.7777 | 0.8155 | 0.5593 | 0.7544 |

**Table 10 – Trading efficiency and cash holdings**

This table shows results from a matched sample analysis (Panel A) and pooled OLS regressions (Panel B and C) that analyze the impact of trading desk efficiency on mutual funds` cash holdings position. *Cash holdings* is the cash position reported by mutual funds to CRSP in their quarterly statements, relative to the size of the fund. In Panel A each fund from families in the Top Efficiency group is matched with an equally weighted portfolio of funds from families in the Bottom Efficiency group using the following matching criteria: Year, Style, Family size, Fund size, Fund age, Fund turnover, Fund performance and Fund flow volatility, as described in Table 4. The main independent variables in the pooled regressions of Panel B are the *TopEff* and *MedEff* dummies introduced in Table 5. In the pooled regressions of Panel C, the main independent variable is *Efficiency*, which is described in Table 6. Fund performance (*Perf*) represents the fund`s net-off-fee Carhart (1997) 4-Factor alpha of the previous year. The other control variables of the standard regression model in Column 1a/b of Panel B and C are described in Table 5. Additional independent controls include Front load and Deferred load (Column 2a/b). Front load (*FrontLoad)*, is the fund`s front-end load. Deferred load (*DeferredLoad)*, represents the fund`s back-end load. All independent variables are lagged by one year and fixed effects in both Panels B and C are defined as in Table 5. P-values reported in parentheses are based on robust standard errors clustered at the family level. ***, **, * denote statistical significance at the 1%, 5%, and 10% significance level, respectively.

**Panel A: Matched sample analysis**

| Matching characteristics | Observations | Dependent variable: Cash holdings |
|---|---|---|
| Year, Style, Family size, and Fund size | 400 | -0.0049 *** |
| | | (0.0032) |
| Year, Style, Family size, and Fund age | 375 | -0.0077 *** |
| | | (<.0001) |
| Year, Style, Family size, and Fund turnover | 343 | -0.0102 *** |
| | | (<.0001) |
| Year, Style, Family size, and Fund performance | 369 | -0.0069 *** |
| | | (0.0002) |
| Year, Style, Family size, and Fund flow volatility | 349 | -0.0050 *** |
| | | (0.0018) |

**Table 10 – Trading efficiency and cash holdings (continued)**

**Panel B: Dummy approach**

| Dependent variable: | Cash holdings | | | |
|---|---|---|---|---|
| Model: | (1a) | (1b) | (2a) | (2b) |
| *TopEff* | -0.0039 *** | -0.0076 *** | -0.0039 *** | -0.0076 *** |
| | (0.0019) | (0.0000) | (0.0021) | (0.0000) |
| *MedEff* | 0.0046 *** | -0.0013 | 0.0047 *** | -0.0014 |
| | (0.0008) | (0.2850) | (0.0006) | (0.2534) |
| *FamSize* | -0.0020 *** | -0.0020 | -0.002 *** | -0.0021 |
| | (0.0000) | (0.1856) | (0.0000) | (0.1791) |
| *FamFocus* | 0.0177 ** | 0.0054 | 0.0173 ** | 0.0047 |
| | (0.0406) | (0.5336) | (0.0447) | (0.5818) |
| *FundSize* | 0.0022 *** | -0.0014 | 0.0022 *** | -0.0015 |
| | (0.0000) | (0.1948) | (0.0000) | (0.1790) |
| *FundAge* | -0.0069 *** | -0.0200 *** | -0.0072 *** | -0.0201 *** |
| | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| *FundTO* | -0.0013 | -0.0014 | -0.0014 | -0.0015 |
| | (0.1308) | (0.4239) | (0.1086) | (0.4066) |
| *Perf* | 0.0037 | 0.0041 | 0.0037 | 0.0041 |
| | (0.4366) | (0.4109) | (0.4363) | (0.4083) |
| *FundFlow* | 0.0000 | -0.0002 * | 0.0000 | -0.0002 * |
| | (0.6756) | (0.0780) | (0.5740) | (0.0896) |
| *FundFlowVola* | -0.0002 *** | -0.0003 *** | -0.0002 *** | -0.0003 *** |
| | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| *FundTER* | 0.4321 * | -0.3062 | 0.4409 * | -0.3163 |
| | (0.0532) | (0.6413) | (0.0656) | (0.6290) |
| *FrontLoad* | | | 0.0446 | 0.031 |
| | | | (0.1519) | (0.2793) |
| *DeferredLoad* | | | -0.0835 | 0.1464 ** |
| | | | (0.2385) | (0.0170) |
| Style × Year FE | Yes | No | Yes | No |
| Fund FE | No | Yes | No | Yes |
| Year FE | No | Yes | No | Yes |
| Observations | 4,022 | 4,022 | 4,022 | 4,022 |
| Adj. $R^2$ | 0.0699 | 0.3480 | 0.0706 | 0.3486 |

**Table 10 – Trading efficiency and cash holdings (continued)**

**Panel C: Continuous variable**

| Dependent variable: | Cash holdings | | | |
|---|---|---|---|---|
| Model: | (1a) | (1b) | (2a) | (2b) |
| *Efficiency* | -43.7330 * | -62.3190 *** | -43.56100 * | -59.2100 *** |
| | (0.0749) | (0.0054) | (0.0749) | (0.0081) |
| *FamSize* | -0.0013 *** | -0.0022 | -0.0013 *** | -0.0022 |
| | (0.0031) | (0.1384) | (0.0038) | (0.1360) |
| *FamFocus* | 0.0162 * | 0.0046 | 0.0159 * | 0.0041 |
| | (0.0602) | (0.5992) | (0.0658) | (0.6404) |
| *FundSize* | 0.0019 *** | -0.0016 | 0.0020 *** | -0.0017 |
| | (0.0002) | (0.1430) | (0.0001) | (0.1356) |
| *FundAge* | -0.0068 *** | -0.0183 *** | -0.0070 *** | -0.0185 *** |
| | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| *FundTO* | -0.0016 * | -0.0014 | -0.0017 * | -0.0015 |
| | (0.0636) | (0.4264) | (0.0521) | (0.4082) |
| *Perf* | 0.0048 | 0.0046 | 0.0047 | 0.0046 |
| | (0.3154) | (0.3545) | (0.3144) | (0.3546) |
| *FundFlow* | -0.0001 | -0.0001 | -0.0001 | -0.0001 |
| | (0.4385) | (0.1063) | (0.3642) | (0.1210) |
| *FundFlowVola* | -0.0002 *** | -0.0003 *** | -0.0002 *** | -0.0003 *** |
| | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| *FundTER* | 0.3680 * | -0.3408 | 0.3795 | -0.3459 |
| | (0.0972) | (0.6027) | (0.1117) | (0.5959) |
| *FrontLoad* | | | 0.0406 | 0.0285 |
| | | | (0.1929) | (0.3147) |
| *DeferredLoad* | | | -0.0815 | 0.1386 ** |
| | | | (0.2528) | (0.0244) |
| Style × Time FE | Yes | No | Yes | No |
| Fund FE | No | Yes | No | Yes |
| Year FE | No | Yes | No | Yes |
| Observations | 4,022 | 4,022 | 4,022 | 4,022 |
| Adj. $R^2$ | 0.0615 | 0.3443 | 0.0620 | 0.3448 |

**Table 11 – Trading efficiency and portfolio liquidity**

This table shows results from a matched sample analysis (Panel A) and pooled OLS regressions (Panel B and C) that analyze the impact of trading desk efficiency on mutual funds` portfolio liquidity. We use five measures of portfolio liquidity: Market capitalization (*MarketCap*) is the value-weighted average of the market capitalization of all stocks held by a fund. Stock dollar volume (*DollarVol*) is the value-weighted average of the dollar volume of shares traded of all stocks held by a fund. The higher the value of these first two measures, the higher is the fund`s portfolio liquidity. In contrast, the following proxies measure a portfolio`s illiquidity level. Relative spread (*Relative Spread*) is the value-weighted relative spread of the individual stocks held, which is measured for each stock held as the difference between the logarithm of the best offer price and the logarithm of the best bid price. Amihud measure is the value-weighted average Amihud measure of individual stocks held, which is based on the illiquidity measure of Amihud (2002). Liquidity beta is the sensitivity (beta loading) to the liquidity factor as in the Pástor and Stambaugh (2003) 5-factor model. In Panel A each fund from families in the Top Efficiency group is matched with an equally weighted portfolio of funds from families in the Bottom Efficiency group using the following matching criteria: Year, Style, Family size, Fund size, Fund age, Fund turnover, Fund performance and Fund flow volatility, as described in Table 4. The main independent variables in the pooled regressions of Panel B are the *TopEff* and *MedEff* dummies introduced in Table 5. In the pooled regressions of Panel C, the main independent variable is *Efficiency*, which is described in Table 6. Fund performance (*Perf*) represents the fund`s net-off-fee Carhart (1997) 4-Factor alpha of the previous year. Other independent variables and fixed effects in both Panels B and C are defined as in Table 5. All independent variables are lagged by one year. P-values reported in parentheses are based on robust standard errors clustered at the family level. ***, **, * denote statistical significance at the 1%, 5%, and 10% significance level, respectively.

**Panel A: Matched sample analysis**

| Matching characteristics | Observations | Dependent variable: MarketCap | DollarVol | Relative spread | Amihud | LiqBeta |
|---|---|---|---|---|---|---|
| Year, Style, Family size, and Fund size | 316 | -4,120.2 *** | -6.1483 *** | 0.0005 *** | 0.4536 *** | 0.0205 *** |
| | | (0.0004) | (<.0001) | (<.0001) | (<.0001) | (0.0016) |
| Year, Style, Family size, and Fund age | 313 | -5,870.5 *** | -7.3934 *** | 0.0006 *** | 0.4454 *** | 0.0172 *** |
| | | (<.0001) | (<.0001) | (<.0001) | (<.0001) | (0.0017) |
| Year, Style, Family size, and Fund turnover | 251 | -6,434.1 *** | -7.7943 *** | 0.0003 *** | 0.3149 *** | 0.0063 |
| | | (<.0001) | (0.0002) | (0.0013) | (0.0083) | (0.3015) |
| Year, Style, Family size, and Fund performance | 317 | -3,982.3 *** | -6.3384 *** | 0.0004 *** | 0.4249 *** | 0.0118 ** |
| | | (0.0011) | (0.0003) | (0.0001) | (0.0002) | (0.0178) |
| Year, Style, Family size, and Fund flow volatility | 287 | -4,488.9 *** | -6.2973 *** | 0.0004 *** | 0.3940 *** | 0.0121 ** |
| | | (0.0006) | (0.0004) | (0.0011) | (0.0024) | (0.0482) |

**Table 11 – Trading efficiency and portfolio liquidity (continued)**

**Panel B: Dummy approach**

| Dependent variable: | MarketCap | | DollarVol | | Relative spread | | Amihud | | LiqBeta | |
|---|---|---|---|---|---|---|---|---|---|---|
| *TopEff* | 0.0731 | -0.0118 | 0.0444 | -0.0077 | -0.0001 | 0.0000 | 0.0108 | 0.0068 | 0.0045 | 0.0039 |
| | (0.1766) | (0.7291) | (0.4434) | (0.7984) | (0.2994) | (0.6570) | (0.4725) | (0.4806) | (0.2790) | (0.4250) |
| *MedEff* | -0.0385 | 0.0042 | -0.0189 | 0.0298 | 0.0000 | -0.0001 | 0.0071 | -0.0095 | -0.0038 | -0.0043 |
| | (0.5945) | (0.8986) | (0.7842) | (0.2353) | (0.9048) | (0.4083) | (0.5904) | (0.4845) | (0.3258) | (0.3371) |
| *FamSize* | 0.0197 | -0.0276 | -0.0112 | -0.0302 * | 0.0000 | -0.0001 | -0.0021 | -0.0109 | 0.0045 *** | -0.0006 |
| | (0.4970) | (0.2263) | (0.6742) | (0.0662) | (0.3926) | (0.5496) | (0.7534) | (0.5782) | (0.0041) | (0.8715) |
| *FamFocus* | 0.5193 * | -0.0929 | 0.3771 | -0.0794 | -0.0003 | 0.0002 | -0.0785 | -0.0714 | 0.0213 * | 0.0038 |
| | (0.0650) | (0.4355) | (0.1681) | (0.4761) | (0.1662) | (0.6243) | (0.2036) | (0.2950) | (0.0797) | (0.8577) |
| *FundSize* | 0.0118 | 0.0835 *** | -0.0227 | 0.0659 *** | 0.0000 | -0.0003 *** | 0.0057 | -0.0368 *** | -0.0041 *** | -0.0054 * |
| | (0.5667) | (0.0002) | (0.4204) | (0.0044) | (0.4790) | (0.0000) | (0.4393) | (0.0017) | (0.0012) | (0.0791) |
| *FundAge* | 0.0091 | -0.0414 | 0.1073 | -0.0855 ** | 0.0000 | 0.0001 | -0.0131 | 0.0074 | 0.0124 *** | 0.0063 |
| | (0.8979) | (0.2997) | (0.2413) | (0.0379) | (0.8028) | (0.4198) | (0.3524) | (0.6585) | (0.0000) | (0.3823) |
| *FundTO* | -0.0112 | -0.0195 | 0.0201 | -0.0082 | -0.0001 *** | 0.0000 | -0.0224 ** | -0.0005 | -0.0028 | -0.0033 |
| | (0.8469) | (0.2041) | (0.6776) | (0.6107) | (0.0028) | (0.7171) | (0.0106) | (0.9356) | (0.2959) | (0.2549) |
| *Perf* | -0.5885 *** | 0.0022 | -0.4357 *** | -0.0488 | 0.0001 | 0.0000 | 0.0250 | 0.0549 ** | -0.0068 | -0.0420 |
| | (0.0001) | (0.9771) | (0.0001) | (0.3669) | (0.5547) | (0.8915) | (0.4920) | (0.0357) | (0.8069) | (0.1342) |
| *FundFlow* | 0.0031 | -0.0020 | 0.0052 * | -0.0014 | 0.0000 | 0.0000 | -0.0005 | -0.0002 | 0.0004 | 0.0008 |
| | (0.3274) | (0.3792) | (0.0975) | (0.5306) | (0.2544) | (0.1724) | (0.1612) | (0.7340) | (0.3387) | (0.1326) |
| *FundFlowVola* | 0.0003 | 0.0005 | 0.0009 | 0.0010 *** | 0.0000 | 0.0000 | -0.0001 | 0.0004 | -0.0001 | -0.0004 *** |
| | (0.5149) | (0.5651) | (0.2010) | (0.0007) | (0.9930) | (0.1180) | (0.5166) | (0.2778) | (0.2569) | (0.0000) |
| *FundTER* | -15.5555 | -3.4577 | 10.6019 | -2.8962 | -0.0077 | 0.0016 | -2.4957 | -7.0446 | -0.2757 | -0.9722 |
| | (0.1442) | (0.6940) | (0.5392) | (0.7355) | (0.5200) | (0.9560) | (0.5825) | (0.2256) | (0.4064) | (0.7354) |
| Style × Year FE | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No |
| Fund FE | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes |
| Year FE | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes |
| Observations | 4,551 | 4,551 | 4,551 | 4,551 | 4,551 | 4,551 | 4,551 | 4,551 | 5,792 | 5,792 |
| Adj. $R^2$ | 0.7849 | 0.9737 | 0.7643 | 0.9660 | 0.8818 | 0.9033 | 0.4444 | 0.7096 | 0.0923 | 0.1188 |

**Table 11 – Trading efficiency and portfolio liquidity (continued)**

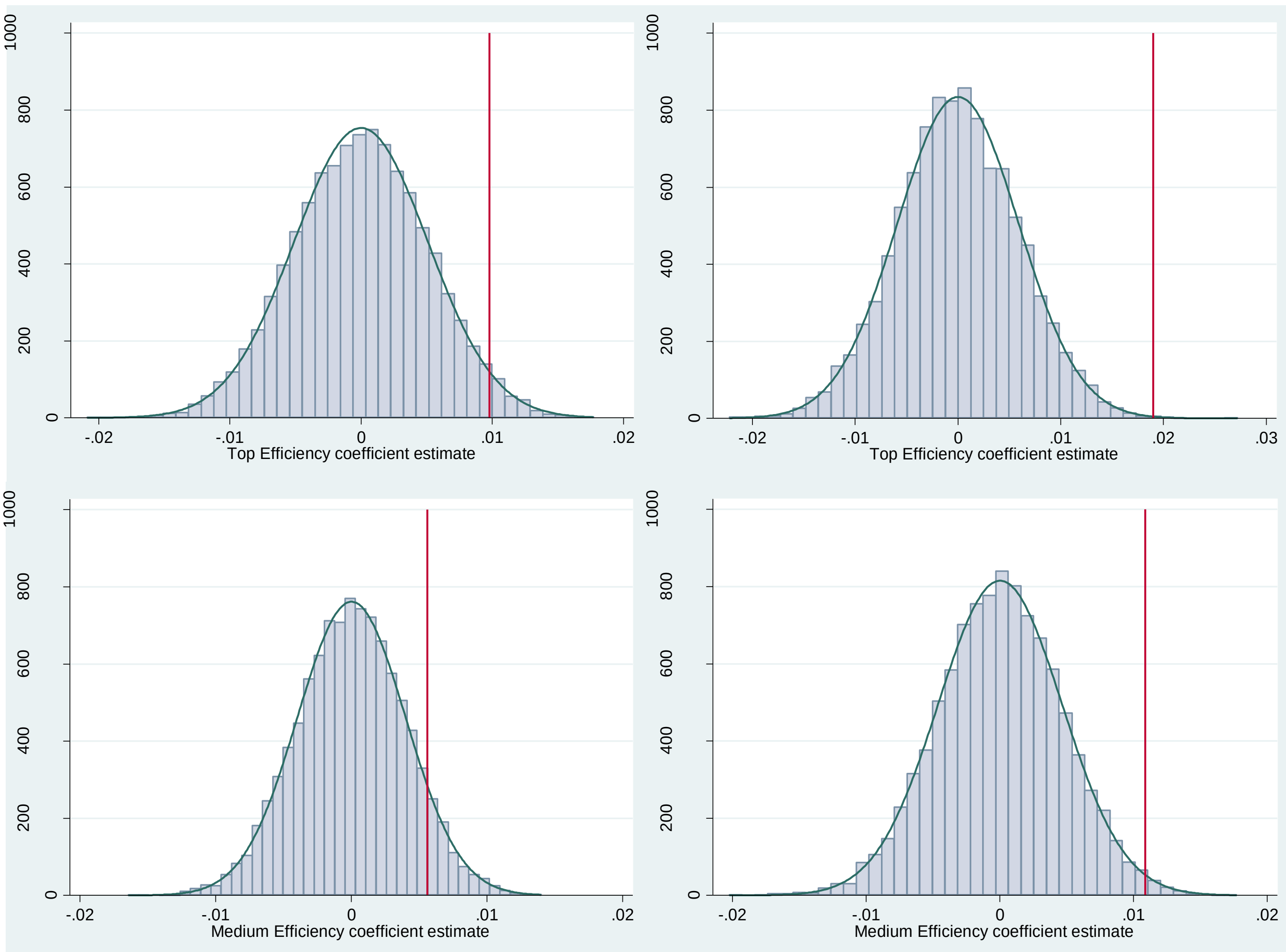
**Panel C: Continuous variable**

| Dependent variable: | MarketCap | | DollarVol | | Relative spread | | Amihud | | LiqBeta | |
|---|---|---|---|---|---|---|---|---|---|---|
| *Efficiency* | -317.3800 | 70.2270 | 554.8070 | 345.4700 | -0.2961 | -0.0115 | 69.7951 | 88.0707 | 0.3565 | 56.2856 |
| | (0.7859) | (0.8967) | (0.6143) | (0.3814) | (0.7514) | (0.9912) | (0.7101) | (0.4291) | (0.9958) | (0.3943) |
| *FamSize* | 0.0258 | -0.0278 | -0.0097 | -0.0302 * | 0.0000 | -0.0001 | -0.0018 | -0.0110 | 0.0041 *** | -0.0006 |
| | (0.3751) | (0.2201) | (0.6911) | (0.0721) | (0.4168) | (0.5458) | (0.7634) | (0.5830) | (0.0043) | (0.8581) |
| *FamFocus* | 0.5141 * | -0.0944 | 0.3812 | -0.0804 | -0.0003 | 0.0002 | -0.0786 | -0.0709 | 0.0213 * | 0.0038 |
| | (0.0725) | (0.4361) | (0.1647) | (0.4759) | (0.1704) | (0.6352) | (0.2061) | (0.3109) | (0.0833) | (0.8521) |
| *FundSize* | 0.0095 | 0.0836 *** | -0.0233 | 0.0658 *** | 0.0000 | -0.0003 *** | 0.0056 | -0.0367 *** | -0.0040 *** | -0.0054 * |
| | (0.6429) | (0.0002) | (0.3976) | (0.0044) | (0.4964) | (0.0000) | (0.4340) | (0.0017) | (0.0017) | (0.0847) |
| *FundAge* | 0.0136 | -0.0414 | 0.1098 | -0.0857 ** | 0.0000 | 0.0001 | -0.0129 | 0.0078 | 0.0121 *** | 0.0063 |
| | (0.8489) | (0.2984) | (0.2274) | (0.0386) | (0.7623) | (0.4131) | (0.3415) | (0.6380) | (0.0000) | (0.3816) |
| *FundTO* | -0.0173 | -0.0193 | 0.0193 | -0.0076 | -0.0001 *** | 0.0000 | -0.0226 ** | -0.0006 | -0.0024 | -0.0031 |
| | (0.7867) | (0.2134) | (0.7110) | (0.6341) | (0.0061) | (0.7224) | (0.0160) | (0.9204) | (0.3472) | (0.2757) |
| *Perf* | -0.5843 *** | 0.0008 | -0.4361 *** | -0.0517 | 0.0001 | 0.0000 | 0.0251 | 0.0550 ** | -0.0070 | -0.0426 |
| | (0.0001) | (0.9913) | (0.0001) | (0.3371) | (0.5557) | (0.8857) | (0.4893) | (0.0337) | (0.8023) | (0.1309) |
| *FundFlow* | 0.0028 | -0.0019 | 0.0052 * | -0.0013 | 0.0000 | 0.0000 | -0.0006 | -0.0002 | 0.0004 | 0.0008 |
| | (0.3652) | (0.4064) | (0.0930) | (0.5664) | (0.2765) | (0.1723) | (0.1355) | (0.6852) | (0.3285) | (0.1253) |
| *FundFlowVola* | 0.0004 | 0.0005 | 0.0009 | 0.0009 *** | 0.0000 | 0.0000 | 0.0000 | 0.0005 | -0.0001 | -0.0004 *** |
| | (0.3310) | (0.5828) | (0.1370) | (0.0011) | (0.8713) | (0.1173) | (0.5773) | (0.2609) | (0.2293) | (0.0000) |
| *FundTER* | -15.1942 | -3.4393 | 11.3103 | -2.9821 | -0.0080 | 0.0019 | -2.4818 | -7.0125 | -0.3252 | -0.9355 |
| | (0.1511) | (0.6935) | (0.5166) | (0.7265) | (0.4938) | (0.9473) | (0.5809) | (0.2254) | (0.3355) | (0.7489) |
| Style × Year FE | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No |
| Fund FE | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes |
| Year FE | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes |
| Observations | 4,551 | 4,551 | 4,551 | 4,551 | 4,551 | 4,551 | 4,551 | 4,551 | 5,792 | 5,792 |
| Adj. $R^2$ | 0.7844 | 0.9736 | 0.7641 | 0.9660 | 0.8818 | 0.9033 | 0.4443 | 0.7093 | 0.0917 | 0.1183 |

**Figure 1 – Placebo test: Bootstrap**

This figure shows the distribution of coefficient estimates on the key efficiency variables from 10,000 bootstrap simulations of the regression models (1) and (2). In each simulation, the efficiency measure of a fund family`s trading desk is randomly assigned to fund-year observations and then models (1) and (2) are estimated. The mutual fund performance measure used is the net-of-fee Carhart (1997) 4-Factor alpha (Carhart).

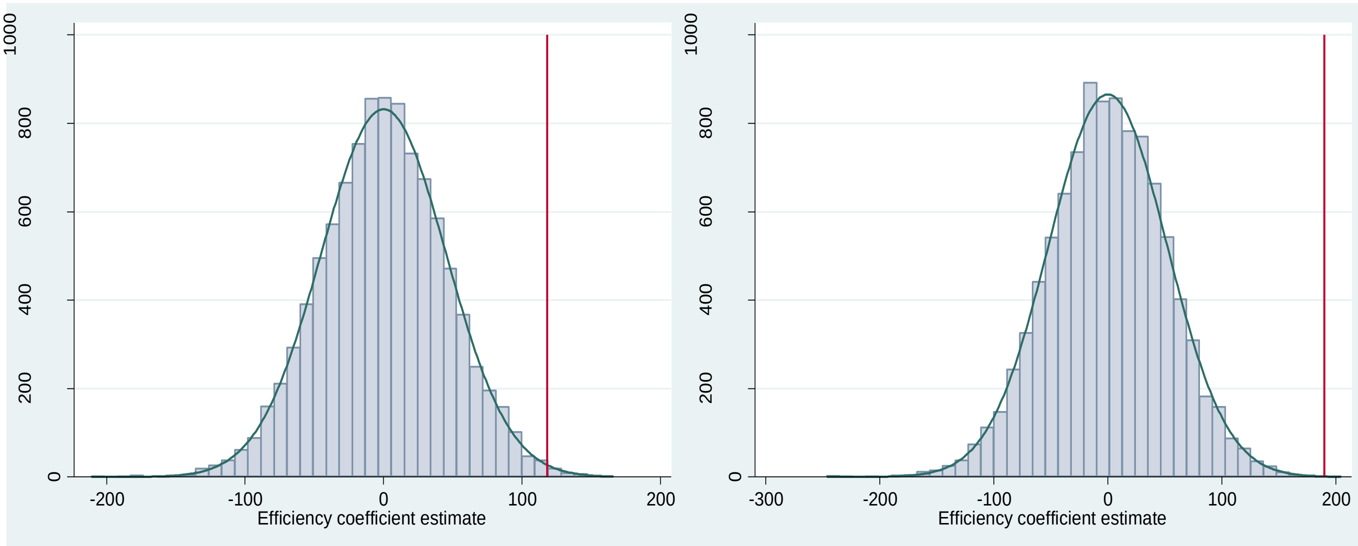
**Panel A: Efficiency measure ranks**




| | | |
|---|---|---|
| Family and fund controls | Yes | Yes |
| Style × Year FE | Yes | No |
| Fund FE | No | Yes |
| Year FE | No | Yes |
| Number of permutations | 10,000 | 10,000 |

**Figure 1 – Placebo test: Bootstrap (continued)**

**Panel B: Efficiency measure continuous**




| | | |
|---|---|---|
| Family and fund controls | Yes | Yes |
| Style × Year FE | Yes | No |
| Fund FE | No | Yes |
| Year FE | No | Yes |
| Number of permutations | 10,000 | 10,000 |

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