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G. Cici • L. K. Dahm • A. Kempf

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# Trading Efficiency of Fund Families:

# Impact on Fund Performance and Investment Behavior

Gjergji Cici, Laura K. Dahm, and Alexander Kempf *

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**ABSTRACT**

Mutual funds are part of larger organizations, which make decisions with consequences for all their member funds. This study examines how the efficiency of trading desks operated by fund families affects the performance and trading of affiliated funds. We introduce a novel approach to measure the efficiency of trading desks, which allows for comparisons across families with different investable universes. By operating efficient trading desks, which reduce trading costs, fund families improve the performance of their funds significantly. Furthermore, the lower trading costs resulting from more efficient trading desks enable mutual funds to trade more and hold less liquid portfolios.

JEL *classification:* D23; G23; G24

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* Cici is from Mason School of Business, The College of William & Mary. Email: gjergji.cici@mason.wm.edu. Cici is also a Research Fellow at the Centre for Financial Research (CFR), University of Cologne. Dahm is from Department of Finance and Centre for Financial Research (CFR), University of Cologne. Email: dahm@wiso.uni-koeln.de. Kempf is from Department of Finance and Centre for Financial Research (CFR), University of Cologne. Email: kempf@wiso.uni-koeln.de.

Until recently most academic research has viewed mutual funds as stand-alone entities, without much consideration for the fact that they are part of larger business entities, otherwise known as fund families. The drawbacks of this limited view become apparent when considering that fund families make strategic decisions with far-reaching consequences for the operations and performance of their member funds. Recent research has begun documenting 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, the trading desk can have a direct impact on the performance of a mutual fund 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

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[1] See, e.g., Gaspar, Massa, and Matos (2006), Kacperczyk and Seru (2012) and Chen, Hong, Jiang, and Kubik (2013).

[2] Trading desks operating within mutual fund families directly shape the execution of the trades of mutual fund managers. This is done by deciding which brokers to use, what trading venues to use, how and whether to split the orders, and what time frame to use for execution, among others (see, Anand, Irvine, Puckett, and Venkataraman (2012).

[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., Chalmers, Edelen, and Kadlec (1999), Wermers (2000), Chalmers, Edelen, and Kadlec (2001), Bollen and Busse (2006) and Edelen, Evans, and Kadlec (2013)) 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 between otherwise comparable funds and can be even more burdensome for some fund. For example, Wermers (2000) estimates mutual fund trading costs to range from 0.28% and 2.65% based on turnover-sorted fund quintiles.

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 more illiquid 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' 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 on the same day 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 its index fund's ability to closely track the S&P 500 index on index adjustment dates.[5] We interpret the ability of a given index fund to more closely track the index on these dates as an indication that the corresponding family's trading desk is better at trade execution.

Using a broad sample of US equity funds for the period 2000 to 2012, 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

[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] Mutual funds that replicate the S&P 500 index dominate the market for passively managed index funds. In particular, funds indexed to the S&P 500 held almost half of domestic equity index mutual fund assets (see Investment Company Institute (2014)).

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 ranging from 97 basis points to 147 basis points per year depending on the performance measure used.

A natural concern is that our measure of family trading efficiency is related to other unobservable family features that positively affect performance regardless of the quality of trade execution. For example, families that we categorize as having higher trading efficiency could possess certain structures that are conducive to better performance.[6] To rule out the possibility that our measure is capturing other factors besides trading efficiency, we employ three testing approaches.

First, we exploit a quasi-natural experimental setting. We argue that if our efficiency measure captures only family-specific trading efficiency and no other family-related aspects, then it should be related to the performance of funds managed in-house but not to the performance of outsourced funds. The idea is that the trading desk of a given fund family is not responsible for the execution of trades of outsourced funds, as this responsibility lies with the external advisors who manage the outsourced funds. Supporting our argument, we document a positive and significant relation of our trading efficiency measure with the performance of funds managed in-house but not with the performance of outsourced funds.

Second, we argue that if our measure actually captures trading desk efficiency but none of the aforementioned aspects, we would expect it to be positively related to fund reported

[6] For example, these families might be better at managing liquidity shocks placed on their funds by fund investors, which they could be doing by employing redemption or exchange fees in an effective way.

returns, which reflect trading costs, but not to holding returns from a portfolio that mimics most-recently reported fund holdings, which do not include trading costs. Consistent with this argument, we document that our family trading efficiency measure is positively and significantly related to reported fund returns but exhibits no relation with holding returns.

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 incurr higher trading costs, which act as a drag on fund performance.[7] 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 six 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 quarter smaller and also hold stocks that are significantly less liquid. These findings are consistent with theoretical arguments that trading

[7] See, e.g., Carhart (1997), Barras, Scaillet, and Wermers (2010), Kacperczyk and Seru (2012) and Jiang and Verardo (2013).

costs influence the investment decisions of investors (see, e.g., Demsetz (1968)) such that investors reduce the amount of trading (Constantinides (1986)) and hold more liquid securities (Amihud and Mendelson (1986)) when facing higher trading costs.

Our paper makes a contribution to a growing literature that looks at how strategies employed by mutual fund families affect the performance outcomes of its member funds. For instance, Gaspar, Massa, and Matos (2006) examine family-level cross-fund subsidization and how it affects the performance of individual funds. Kacperczyk and Seru (2012) analyze whether a family strategy to centralize decision making affects fund performance. In addition, Kostovetsky and Warner (2012), Chen, Hong, Jiang, and Kubik (2013), Moreno, Rodriguez, and Zambrana (2013), Debaere and Evans (2014) and Sorhage (2014) analyze the decision of mutual fund families to outsource part of their portfolio management and how this decision affects fund performance. 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, Hong, Huang, and Kubik (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.[8] 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.

Our paper is also related to a third strand of 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, Leftwich, and Mayers (1990) and Keim and Madhavan (1997)) and thus, investors accommodate trading costs by reducing the frequency and volume of their trades (Constantinides (1986)). Second, since less liquid stocks are associated with higher average returns (see, e.g., Amihud and Mendelson (1986), Brennan and Subrahmanyam (1996), Brennan, Chordia, and Subrahmanyam (1998) and Amihud (2002)) investors with lower trading costs hold less liquid assets (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 relation to the literature that looks at the importance of trading costs, our paper is also related to a fourth strand of literature that specifically examines the trading costs of mutual

[8] 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, Gruber, and Green (2007)).

funds. Some of these papers analyze the size of trading costs of mutual funds and their impact on fund performance (see, e.g., Bollen and Busse (2006), Alexander, Cici, and Gibson (2007) and Edelen, Evans, and Kadlec (2013)). Some others investigate heterogeneity in transaction costs among specific intermediaries. Keim and Madhavan (1997) and Christoffersen, Keim, and Musto (2008) show dispersion in trading costs of institutions and mutual funds. Additionally, Anand, Irvine, Puckett, and Venkataraman (2012) find that institutional trading desks can sustain relative performance over adjacent periods. We make a contribution to this literature by recognizing that trading costs of mutual funds are shaped to a large extent by the efficiency of their families' trading desks and by being the first to relate the efficiency of these trading desks to the performance and the investment behavior of the individual mutual funds that they support in their respective families.

The remainder of this paper is organized as follows. In section I, we discuss our data, the methodology we employ to measure trading desk efficiency, and sample summary statistics. Section II examines the impact of trading desk efficiency on mutual fund performance. We analyze how the efficiency of the trading desk affects the trading behavior of mutual funds in Section III. Section V concludes.

## I. Data and Methodology

### *A. 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.[9] Furthermore, the database includes an identifier which 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 CRPS Indices database we also obtain information on the S&P 500 returns and the index constituents at each point of time.

*B. 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 funds to more closely track the index on index adjustment dates. Thus, we

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

exploit instances when mutual fund families engage in informationless trading of the same securities on the same day to accomplish the similar task of tracking the same index.

To estimate the efficiency of a fund family`s trading desk, we follow several steps. We first identify all S&P 500 index funds. Then we standardize this group to include only index funds that follow similar rebalancing strategies in response to index adjustments. For these funds, we calculate their tracking ability by analyzing how closely they follow the index at the index adjustment date. We do so by looking at the absolute difference between the gross-of-fee return of an index fund, which reflects trading costs, and the index return. Next, we exclude sub-advised index funds since only in-house managed funds provide information about the quality of their families` trading desk. We employ the tracking ability of an in-house managed index fund as the measure of the trading desk efficiency of the corresponding fund family and assign it to all actively managed equity mutual funds of that fund family. [10] A more detailed description follows:

Step 1: We identify S&P 500 index funds following a similar approach as in Berk and Binsbergen (2013). 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.[11] From these funds, we eliminate all funds that do not closely track 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

[10] 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.

[11] Details on the construction of the 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.

1.02; and the $R^2$ of the corresponding regression is higher than 0.98.[12] Finally, we manually check the N-CSR reports filed with the SEC to make sure that the remaining funds are unleveraged and fully replicate S&P 500 index funds. This produces a subset of 135 index funds.

Step 2: Since the way in which index funds rebalance their portfolios might have an impact on the associated trading costs and consequently on the tracking error, we need to compare index funds with similar rebalancing strategies. Therefore, we focus on index funds that rebalance their portfolios just on index adjustment dates and exclude funds that trade strategically around these composition changes. The basic idea for identifying the latter group of funds is that for funds that rebalance their portfolios before or after the index adjustment date, the tracking error should be particularly high in the days leading to or following the index adjustment date. Our approach for identifying such funds is described in fuller detail in the Appendix. Similar to Green and Jame (2011), we find that about 40% of all index funds do not restrict their portfolio rebalancing to the index adjustment date. Excluding those funds produces a subset 86 funds.

Step 3: We calculate the absolute return difference between each index fund and the S&P 500 index for each index adjustment date. For convenience, we multiply this absolute difference by -1 so that a higher value corresponds to a better tracking ability. This is then averaged for each index fund across all index adjustment dates in a specific year to come up with our annual measure of the trading efficiency of each index fund.

Step 4: 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-

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

house managed. Thus, we exclude all outsourced index funds for which a sub-advisor is responsible since the tracking ability of these funds reflects the ability of the sub-advising company.[13] This leaves us with 78 fund families, for which we can measure the efficiency of their trading desk.

Step 5: We assign the efficiency measure of the trading desk 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 1,090 US equity funds and 7,298 fund-year observations[14] over the 2000 to 2012 period.[15]

*C. Sample characteristics*

Table I presents summary statistics on family and fund characteristics for our sample and the remaining actively managed US equity funds in CRSP.

- Insert Table I approximately here -

Table I suggests that our sample covers about 22 % of the number of funds and about a third of the assets controlled by all actively managed US equity funds. Funds in our sample come from larger and more diversified families than the remaining fund families. The average fund in our sample is almost twice as large as the average fund in the peer group and differs slightly with respect to age, expense ratio, 12b1 fee, and turnover. With respect to management fee, our funds are very similar to the funds in the peer group.

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[13] To identify sub-advised index funds, we follow Chen, Hong, Jiang, and Kubik (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] We exclude fund-year observations if at least one monthly return observation is missing.

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

## II. 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 II.A we test our first main 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 II.B we provide evidence supporting the validity of our key variable as a measure of the efficiency of a family' trading desk.

*A. Does trading desk efficiency have an impact on fund performance?*

Our first main hypothesis postulates that funds belonging to families with more efficient trading desks deliver a better performance than funds from families with less efficient trading desks. We test this hypothesis by running the following pooled regression model:

$$\begin{aligned} Perf_{i,t} = {} & \alpha + \beta_1 Efficiency_{i,t} + \gamma_1 FamSize_{i,t-1} + \gamma_2 FamFocus_{i,t-1} \\ & + \gamma_3 FundSize_{i,t-1} + \gamma_4 FundAge_{i,t} + \gamma_5 FundTO_{i,t} + \varepsilon_{i,t} \end{aligned} \tag{1}$$

The dependent variable is the performance (*Perf*) of fund $i$ in year $t$. We use five different measures of performance: (1) fund return, (2) Khorana (1996) objective-adjusted return, (3) Jensen (1968) alpha, (4) Fama and French (1993) 3-factor alpha, and (5) Carhart (1997) 4-factor alpha. We estimate these measures based on both net- and gross-of-fee returns and calculate the performance of year $t$ based on the monthly return observations of year $t$. We obtain monthly gross-of-fee returns by dividing a fund's yearly total expense ratio by twelve and adding it back to the monthly net-of-fee return.

The main independent variable is our measure of trading desk efficiency (*Efficiency*) as defined in Section I.B. 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 segments (*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*), and, the fund's yearly turnover ratio (*FundTO*). In addition, we add year and segment fixed effects to control for any unobservable time or segment effects and cluster standard errors by fund.

- Insert Table II approximately here -

Panel A of Table II provides strong evidence that the trading desk efficiency of a fund family is positively related to the performance of the families' funds. The more efficient the family's trading desk, the higher the performance of the fund. This holds true no matter how we measure performance and whether we look at net-of-fee or gross-of-fee returns.

Among the control variables, fund size and turnover have the strongest impact on fund performance. They are significant in all specifications. Consistent with the argument of Berk and Green (2004) for the presence of diseconomies of scale among mutual funds, we find that fund size has a significantly negative impact on fund performance in all specifications. We also find that fund turnover hurts fund performance, which is consistent with earlier evidence provided by Carhart (1997). The effects of fund age and family size on performance are somewhat weaker but consistently positive across the specifications. Family focus has no effect on performance whatsoever.

As a first methodological robustness check, we repeat the above analysis but now use a dummy approach. Each year we sort the funds into three groups based on the trading desk`s efficiency of the corresponding fund family. The top group consists of all funds belonging to families that 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*) equals one if the fund belongs to the top (medium) group and zero otherwise. The bottom group is our base group. Using these dummy variables we again run a pooled regression model as above, but use the two dummy variables instead of the continuous efficiency measure. The model now reads:

$$\begin{aligned} Perf_{i,t} &= \alpha + \beta_1 TopEff_{i,t} + \beta_2 MedEff_{i,t} + \gamma_1 FamSize_{i,t-1} + \gamma_2 FamFocus_{i,t-1} \\ &\quad + \gamma_3 FundSize_{i,t-1} + \gamma_4 FundAge_{i,t} + \gamma_5 FundTO_{i,t} + \varepsilon_{i,t} \end{aligned} \tag{2}$$

Panel B of Table II shows that funds belonging to families with most efficient trading desks deliver a significantly higher performance than the funds in base group. Looking at the medium group, we find a positive coefficient in all cases, but none is statistically significant at conventional levels. This suggests that noticeable performance gains materialize only for funds in highly efficient families.[16] This result is robust and holds for both net-of-fee and gross-of-fee returns and all performance measures at the 5%-level, at least. In economic terms, the estimated outperformance of the most efficient funds relative to the least efficient funds ranges from 97 basis points to 147 basis points per year. The impact of the control variables is as in Panel A.

As a second methodological robustness test, we run a matched sample analysis between funds in the top and the bottom efficiency group. Hereby, we match each fund of the top group with an equally weighted portfolio of all funds of the bottom group that belong to the

[16] We also ran the analysis looking at all quintiles separately (instead of combining the middle three quintiles into the medium group), but the conclusion is the same: Only for the top quintile we find a significantly positive effect on performance. For the funds in the second quintile, we find a marginally significant effect only in four out of ten cases, and for the third and fourth quintile we find no significant effects.

same market segment and share the same characteristics (meaning that they belong to the same quintile with respect to the characteristic in the respective year). We simultaneously use characteristics of the fund and the family to which the fund belongs. As family characteristic we use family size since it is the only family characteristic which is significant in Table II. As fund characteristics we use fund size, fund turnover, and fund age, respectively, since they all have a significant impact on performance as shown in Table II. For all funds in the top group we calculate the performance difference to the matching portfolio consisting of funds of the bottom efficiency group. The performance differences for the various matching criteria and performance measures are provided in Table III.

- Insert Table III approximately here -

Table III clearly confirms the conclusions drawn from Table II that funds belonging to efficient families significantly outperform funds from inefficient families. The difference is statistically significant in all cases at the 5%-level, at least, and has the same order of magnitude as in Panel B of Table II.

Overall, the results from Table II and Table III strongly support our first main hypothesis that funds belonging to families with efficient trading desks outperform funds of 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.

*B. Does our measure actually capture trading desk efficiency?*

In this section we address the concern that our efficiency measure does not measure the trading efficiency of mutual funds but instead captures other factors that are somehow correlated with fund performance. We do so by conducting three tests for the validity of our measure.

*B.1. In-house versus outsourced funds*

The presence of both outsourced and in-house managed funds provides us with a quasi-natural experimental setting to test the validity of our measure. If our efficiency measure indeed captures family-specific trading efficiency, then we would expect it to be related to the performance of in-house funds but not to the performance of outsourced funds. The rationale 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.

To test for this difference, in Table IV we differentiate between these two types of funds and conduct similar analysis as in Table II.[17] More specifically, we repeat the analysis of Panel A of Table II but now interact the efficiency measure with dummy variables capturing the type of the fund. *In-house* equals one if the fund is managed internally and zero otherwise, and *Outsourced* equals one if the management of the fund is outsourced to a sub-advisory firm and zero otherwise. We also repeat the analysis of Panel B of Table II but now

[17] To determine the actively managed funds of a family which are outsourced, we follow Chen, Hong, Jiang, and Kubik (2013) and compare the names of the fund family and the investment advisor and additionally control for their potential affiliation to classify a fund`s advisor structure. Thus, our approach is the same as we used to identify outsourced index funds. Based on this classification, our sample consists of 6425 observations for actively in-house managed funds and of 431 observations for outsourced funds.

interact the efficiency group dummies *TopEff* and *MedEff* with the dummies *In-house* and *Outsourced,* respectively.

- Insert Table IV approximately here -

Table IV clearly shows that the efficiency of a family`s trading desk has a performance impact only for funds which are managed internally. In Panel A, we find a highly significant impact of our efficiency measure on the performance of in-house funds, but no significant impact on the performance of outsourced funds. Panel B leads to the same conclusion. We find no effect of trading desk efficiency on performance when looking at outsourced funds. In contrast, in-house funds belonging to the top efficiency group significantly outperform the base group.

Overall, Table IV results prove that our measure of trading desk efficiency matters only for in-house funds, which supports our claim that our measure indeed captures trading desk efficiency. Given these findings, we restrict our sample to in-house funds in all remaining analyses.

*B.2. Fund returns versus holding returns*

Our second validity test exploits the fact that fund reported returns reflect trading costs while holding returns do not. The reason for this is that reported returns reflect post-transaction cost performance, while holding returns are the returns from a portfolio that mimics most-recently reported fund holdings, and, as such, reflect pre-transaction-cost performance. This difference between the two return types would mean that, if our measure actually captures trading desk efficiency, which helps reduce trading costs, we would expect it to be positively related to fund reported returns but not to holding returns.

To test this hypothesis, for each fund and quarter for which a holdings report exists we calculate its quarterly holding return, which is the return from a hypothetical portfolio that mimics the most recently–disclosed portfolio compositions. In Table V we repeat the tests of the previous tables based on reported fund returns (first column) and holding return (second column).

- Insert Table V approximately here -

As expected, Table V clearly shows that trading desk efficiency has a strong impact on reported fund returns but no effect on holding returns. This result holds independently of whether we measure efficiency as a continuous variable (Panel A) or use the efficiency group dummies *TopEff* and *MedEff* (Panel B). Again, this finding strongly supports our claim that our measure actually captures trading desk efficiency.

In the last column of Table V, the dependent variable is the return gap as defined in Kacperczyk, Sialm, and Zheng (2008). Since return gap measures the difference between the reported gross-of-fee fund return, which reflects trading costs, and its holding return, which ignores trading costs, we hypothesize that the return gap is higher for funds belonging to families with more efficient trading desks. Our results strongly support this hypothesis. This suggests that the return gap measures not only the unobserved actions of fund managers but also their unobservable trading costs. Therefore, the better future performance of funds with a high return gap documented by Kacperczyk, Sialm, and Zheng (2008) at least partly reflects the higher trading desk efficiency of the fund families to which the funds belong.

### *B.3. Impact of fund turnover on performance*

For our final validity test we exploit the negative impact of turnover on fund performance, which is well documented in the literature (see, e.g., Carhart (1997), Barras, Scaillet, and Wermers (2010), Kacperczyk and Seru (2012) and Jiang and Verardo (2013)). Arguably, the negative performance effect of turnover is due to the fact that portfolio turnover causes trading costs, which hurt performance.

If our measure reflects trading desk efficiency, we would expect the negative impact of turnover on performance to be weaker for funds of families with more efficient trading desks. 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. More specifically, 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 otherwise. Table VI provides regression estimates and results from testing whether the impact of turnover on performance is significantly smaller for funds in the top efficiency group than for funds in the bottom group.

- Insert Table VI approximately here -

The first insight from Table VI is that fund turnover has a negative impact on fund performance, which is consistent with earlier empirical evidence (see, e.g., Carhart (1997)). More importantly, however, the table shows that the impact is much smaller for funds in the top efficiency group than for funds in the medium or the bottom group. The difference between the top and the bottom group is statistically significant in almost all cases. The effect is huge in economic terms. For instance, when Carhart (1997) alpha is used as the performance measure, the negative impact of turnover on performance is about three times higher for funds from the less efficient families than for funds from the most efficient families.

## III. 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 (Constantinides (1986)). Second, investors with lower trading costs hold less liquid assets to earn the liquidity premium (Amihud and Mendelson (1986)). We test these hypotheses in this section. More specifically, in Section III.A we test whether funds that belong to families with efficient trading desks trade more. In Section III.B we explore whether trading desk efficiency impacts funds` portfolio liquidity.

### *A. 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. In the interest of brevity, here we restrict ourselves to the dummy approach as in Panel B of Table II, but the results are similar if we use the continuous variable approach. 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 the percentage change in fund`s total net assets under management, as in Carhart (1997). The third measure, *PositionTO*, represents the position-adjusted turnover ratio as suggested by Edelen, Evans, and Kadlec (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 VII approximately here -

Table VII provides 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 about 6 percentage points. This is robust to the various turnover measures. Thus, our findings are consistent with the view that funds from families with more efficient trading desks exploit this trading efficiency to pursue more opportunities, while funds from less efficient families are more constrained to do so.

*B. 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 and

Subrahmanyam (1996), Brennan, Chordia, and Subrahmanyam (1998) 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, they would need to hold less cash. To measure a fund`s *cash holding* position, we use the reported portfolio weight in cash reported in the CRSP MF database. We employ pooled regression models of the funds' *cash holding* position on our efficiency dummy variables and several controls used in the literature that studies the cash holdings of mutual funds (Chordia (1996), Yan (2006) and Simutin (2014)).

- Insert Table VIII approximately here -

The results of Table VIII show that for 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 about 0.5 percentage points smaller than the cash holding of funds from the least efficient families. This is an economically big difference given that funds hold on average only about 2 % of their assets in cash during our sample period.

Looking at the control variables shows that the optimal cash holding increases in front-end loads, which is consistent with the findings of Barber, Odean, and Zheng (2005) that front-end loads discourage new cash inflows, and fund size (Yan (2008)). In addition, the positive relation between past flows and cash holdings suggests that managers carry higher cash balances until they have had sufficient time to fully invest recent inflows (Simutin (2014)).

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 portfolio 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. *Stock turnover* is the number of shares traded of the stock (see, e.g., Amihud and Mendelson (1986)). *Stock dollar volume* is the stock turnover times the stock price (see, e.g., Brennan, Chordia, and Subrahmanyam (1998)). The higher each measure is, the more liquid a stock or portfolio is. In contrast, *Relative Spread* (see, e.g., Holden, Jacobsen, and Subrahmanyam (2014)), the difference between the logarithm of the best offer price and the logarithm of the best bid price, and *Amihud* (2002) measure, the stock`s absolute return divided by its dollar volume, define the level of a stock`s illiquidity.

- Insert Table IX approximately here -

The results of Panel A of Table IX suggest that the trading desk efficiency of fund families do not affect their funds` portfolio liquidity. A possible explanation is that the simple way in which we control for differences in family and fund characteristics is not appropriate. Since fund size and family size are strong predictors of both fund performance and portfolio liquidity (Chen, Hong, Huang, and Kubik (2004) and Busse, Chordia, Jiang, and Tang (2013)), we re-run the analysis but now control for these characteristics in a stricter way. More specifically, we restrict our sample to include only funds from the most efficient and least efficient families that are matched according to a propensity score matching, with fund and family size as matching criteria.[18] Results are reported in Panel B of Table IX.

The basic conclusion is that efficient funds hold less liquid assets when properly controlling for size effects. The coefficients on *Stock turnover* and *Stock dollar volume* are both negative, while the coefficients of *Relative spread* and *Amihud* are both positive. This suggests that the portfolios of funds from efficient families are less liquid. The portfolio liquidity difference is statistically significant in all cases at the 5%-level, at least. This is 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.

## IV. 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

[18] We estimate a logistic regression of the binary treatment indicator variable Efficiency (*TopEff* vs. *BotEff*) on a vector of fund and family size. Given the estimated coefficients, we calculate the propensity score for each observation. We restrict our sample to all *TopEff* observations and their nearest neighbor *BotEff* peers.

least efficient ones by 97 to 147 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 the possibility that our trading efficiency measure reflects other family-related factors that affect performance.

Besides a performance impact due to management of 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. 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.

## Appendix

### A. Identifying index funds that adjust portfolios before or after index adjustment dates

Our identification of funds that do not rebalance their portfolios on index adjustment dates is based on the rationale that for funds that rebalance their portfolios before or after the index adjustment date, the tracking error should be particularly high in the days leading to or following the index adjustment date.

We operationalize this idea by checking whether the tracking error in the pre-adjustment or post-adjustment week is abnormally high. The pre-adjustment (post-adjustment) week is defined as the period covering five trading days before (after) the index adjustment date. For example, to determine whether the tracking error is abnormally high in the pre-adjustment week, we compare the tracking error during the pre-adjustment week with the tracking error measure in the week before. Similarly, for the post-adjustment week, we compare the tracking error during the post-adjustment week with the tracking error in the following week. If this difference is larger than one standard deviation of the tracking error in all non-adjustment weeks, we classify a tracking error as abnormally high indicating that the index fund pursues a rebalancing strategy that is not restricted to trading on the adjustment date.

Our assumption that the pre-adjustment and the post-adjustment periods cover one week is based on evidence in Green and Jame (2011) who show that index funds that do not trade at the index adjustment date typically trade at the week before and after. To rule out the possibility that our results depend crucially on that assumptions with respect to the length of the adjustment periods, we re-ran the total analysis assuming that both the pre-adjustment period and the post-adjustment period cover two weeks. The results are qualitatively unchanged.

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**Table I – Sample characteristics for CRSP sub-sample**

This table reports descriptive statistics for the funds and fund families of our sample compared to the other CRSP universe. Due to the fact that we determine a fund family`s trading desk efficiency through the tracking ability of index funds on the S&P500 benchmark, we can only analyze funds of families that manage such an index fund. We separate these descriptive statistics in family and fund characteristics. Family size, is the total net assets under management of the fund family in millions of dollars. Family focus, represents the concentration of a fund family across investment objectives, defined as in Siggelkow (2003). Fund size, represents the total net assets under management of the fund in millions of dollars. Fund age, represents the fund age in years. Expense ratio, Management fee and 12b-1 fee are in percentage points and represent funds' fees charged for total services, portfolio management and distribution, respectively. Fund turnover, is defined as the minimum of security purchases and sales divided by the average total net assets under management during the calendar year. The last column of the table reports the difference in fund family and fund statistics between our sub-sample and the other 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 to 2012 | | | |
|---|---|---|---|---|
| | Sub-sample | Other CRSP universe | Difference | |
| ***Family characteristics:*** | | | | |
| Number of families | 78 | 821 | | |
| Family size (in million USD) | 26,644.34 | 4,463.04 | 22,181.30 | *** |
| Family focus (%) | 32.70 | 70.29 | -37.59 | *** |
| ***Fund characteristics:*** | | | | |
| Number of funds | 1,090 | 3,666 | | |
| Fund size (in million USD) | 1,367.17 | 739.36 | 627.81 | *** |
| Fund age (in years) | 9.95 | 8.40 | 1.55 | *** |
| Expense Ratio (%) | 1.16 | 1.33 | -0.17 | *** |
| Management fee (%) | 0.56 | 0.55 | 0.01 | |
| 12b1 fee (%) | 0.45 | 0.42 | 0.03 | *** |
| Fund turnover (%) | 93.30 | 98.69 | -5.39 | ** |

## Table II – Mutual fund performance

This table presents results from pooled OLS regressions that analyze the impact of trading desk efficiency on mutual fund performance using five different performance measures: Fund return (Return), Khorana (1996) objective-adjusted return (OAR), Jensen (1968) alpha (Jensen), Fama and French (1993) 3-Factor-alpha (Fama French) and Carhart (1997) 4-Factor alpha (Carhart). Results are reported for net and gross-of-fee returns separately. In Panel A the main independent variable is Efficiency, a variable that measures the average tracking ability of a family`s S&P500 index fund with respect to index changes in a year. In Panel B we analyze the rank of a fund family`s trading desk efficiency relative to other fund families` trading desks in the same year. The two binary variables Top Efficiency and Medium Efficiency 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. Additional independent controls include Family size, Family focus, Fund size, Fund age, Fund turnover. Family size, is the logarithm of the fund family's assets under management. Family focus, represents the concentration of a fund family across investment objectives, defined as in Siggelkow (2003). Fund size, represents the logarithm of the fund's total net assets under management. Family size, Family focus, Fund size are all lagged by one year. Fund age, is the logarithm of the fund's age in years. Fund turnover 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. Regressions are run with year and segment fixed effects. Robust standard errors reported in parentheses are based on standard errors clustered by fund. ***, **, * denote statistical significance at the 1%, 5%, and 10% significance level, respectively.

**Panel A: Efficiency Measure continuous**

| | Net-of-fee returns | | | | | Gross-of-fee returns | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Dependent variable: | Return | OAR | Jensen | Fama French | Carhart | Return | OAR | Jensen | Fama French | Carhart |
| *Efficiency* | 23.8835 ** | 20.8886 * | 30.4678 *** | 26.7003 *** | 26.1423 *** | 28.6176 *** | 27.3928 ** | 29.8479 *** | 26.0520 *** | 25.4921 *** |
| | (0.0250) | (0.0545) | (0.0041) | (0.0064) | (0.0057) | (0.0070) | (0.0125) | (0.0047) | (0.0075) | (0.0066) |
| *FamSize* (Family size) | 0.0056 *** | 0.0057 *** | 0.0029 ** | 0.0020 ** | 0.0013 | 0.0053 *** | 0.0049 *** | 0.0026 ** | 0.0017 * | 0.0010 |
| | (0.0000) | (0.0000) | (0.0127) | (0.0287) | (0.1291) | (0.0000) | (0.0001) | (0.0248) | (0.0629) | (0.2394) |
| *FamFocus* (Family focus) | -0.0126 | -0.0095 | -0.0076 | 0.0008 | -0.0084 | -0.0099 | -0.0077 | -0.0072 | 0.0013 | -0.0079 |
| | (0.2352) | (0.3839) | (0.4092) | (0.9124) | (0.2904) | (0.3635) | (0.4950) | (0.4383) | (0.8638) | (0.3182) |
| *FundSize* (Fund size) | -0.0088 *** | -0.0095 *** | -0.0050 *** | -0.0021 ** | -0.0021 ** | -0.0091 *** | -0.0095 *** | -0.0056 *** | -0.0027 *** | -0.0028 *** |
| | (0.0000) | (0.0000) | (0.0000) | (0.0141) | (0.0112) | (0.0000) | (0.0000) | (0.0000) | (0.0012) | (0.0009) |
| *FundAge* (Fund age) | 0.0081 *** | 0.0103 *** | 0.0059 ** | 0.0020 | 0.0010 | 0.0086 *** | 0.0105 *** | 0.0057 ** | 0.0018 | 0.0008 |
| | (0.0027) | (0.0005) | (0.0115) | (0.2578) | (0.5465) | (0.0020) | (0.0005) | (0.0143) | (0.3044) | (0.6194) |
| *FundTO* (Fund turnover) | -0.0112 *** | -0.0098 *** | -0.0105 *** | -0.0100 *** | -0.0083 *** | -0.0127 *** | -0.0119 *** | -0.0098 *** | -0.0093 *** | -0.0076 *** |
| | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| Year fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Segment fixed effects | Yes | No | Yes | Yes | Yes | Yes | No | Yes | Yes | Yes |
| Number of Observations | 6,856 | 6,856 | 6,856 | 6,856 | 6,856 | 6,856 | 6,856 | 6,856 | 6,856 | 6,856 |
| Adj.R-Squared | 0.8157 | 0.0506 | 0.1940 | 0.1444 | 0.1342 | 0.8369 | 0.0450 | 0.1973 | 0.1444 | 0.1347 |

**Table II – Mutual fund performance (continued)**

**Panel B: Efficiency Measure rank - Non-linearity effect**

| | Net-of-fee returns | | | | | Gross-of-fee returns | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Dependent variable: | Return | OAR | Jensen | Fama French | Carhart | Return | OAR | Jensen | Fama French | Carhart |
| *TopEff* (Top Efficiency) | 0.0124 *** | 0.0100 ** | 0.0147 *** | 0.0115 *** | 0.0099 *** | 0.0133 *** | 0.0119 *** | 0.0145 *** | 0.0113 *** | 0.0097 *** |
| | (0.0040) | (0.0224) | (0.0003) | (0.0023) | (0.0085) | (0.0017) | (0.0064) | (0.0003) | (0.0027) | (0.0096) |
| *MedEff* (Medium Efficiency) | 0.0048 | 0.0031 | 0.0030 | 0.0047 | 0.0033 | 0.0058 * | 0.0042 | 0.0029 | 0.0046 | 0.0032 |
| | (0.1533) | (0.3827) | (0.3864) | (0.1635) | (0.3192) | (0.0806) | (0.2364) | (0.3997) | (0.1717) | (0.3329) |
| Family size | 0.0054 *** | 0.0056 *** | 0.0026 ** | 0.0020 ** | 0.0013 | 0.0052 *** | 0.0048 *** | 0.0023 ** | 0.0017 * | 0.0010 |
| | (0.0000) | (0.0000) | (0.0238) | (0.0345) | (0.1354) | (0.0000) | (0.0001) | (0.0441) | (0.0736) | (0.2480) |
| Family focus | -0.0131 | -0.0100 | -0.0081 | 0.0000 | -0.0092 | -0.0108 | -0.0085 | -0.0076 | 0.0005 | -0.0087 |
| | (0.2228) | (0.3699) | (0.3900) | (0.9993) | (0.2447) | (0.3291) | (0.4587) | (0.4198) | (0.9476) | (0.2706) |
| Fund size | -0.0087 *** | -0.0094 *** | -0.0049 *** | -0.0020 ** | -0.0021 ** | -0.0091 *** | -0.0095 *** | -0.0055 *** | -0.0026 *** | -0.0027 *** |
| | (0.0000) | (0.0000) | (0.0000) | (0.0170) | (0.0133) | (0.0000) | (0.0000) | (0.0000) | (0.0016) | (0.0011) |
| Fund age | 0.0080 *** | 0.0103 *** | 0.0059 ** | 0.0019 | 0.0010 | 0.0086 *** | 0.0105 *** | 0.0057 ** | 0.0017 | 0.0009 |
| | (0.0031) | (0.0005) | (0.0124) | (0.2704) | (0.5402) | (0.0023) | (0.0006) | (0.0153) | (0.3180) | (0.6120) |
| Fund turnover | -0.0111 *** | -0.0097 *** | -0.0104 *** | -0.0100 *** | -0.0082 *** | -0.0127 *** | -0.0119 *** | -0.0097 *** | -0.0092 *** | -0.0075 *** |
| | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| Year fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Segment fixed effects | Yes | No | Yes | Yes | Yes | Yes | No | Yes | Yes | Yes |
| Number of Observations | 6,856 | 6,856 | 6,856 | 6,856 | 6,856 | 6,856 | 6,856 | 6,856 | 6,856 | 6,856 |
| Adj.R-Squared | 0.8158 | 0.051 | 0.1953 | 0.1446 | 0.1342 | 0.8369 | 0.0453 | 0.1985 | 0.1446 | 0.1347 |

## Table III – Mutual fund performance – Matched sample analysis

This table presents results from a matched sample analysis where each fund of families with efficient trading desks (Top Efficiency) is matched with an equally weighted portfolio of funds affiliated to families with inefficient trading desks (Bottom Efficiency) using the following matching criteria: Year, Segment, Family size, Fund size, Fund age, and Fund turnover. All of these attributes are ranked in quintiles independently before identifying top efficient and bottom efficient funds. Results are reported for net-of fee returns in Panel A and gross-of-fee returns in Panel B. In each Panel, efficient funds are matched to all inefficient funds that belong to the same segment and the same Family size quintile in a certain year. In rows one through three we use the quintile ranking based on Fund size, Fund age, and Fund turnover as additional matching criterion. Then performance differences between top efficient funds and the corresponding bottom efficient matching portfolio are tested for the performance measures: Fund return (Return), Jensen (1968) alpha (Jensen), Fama and French (1993) 3-Factor alpha (Fama French) and Carhart (1997) 4-Factor alpha (Carhart). ***, **, * denote statistical significance at the 1%, 5%, and 10% significance level, respectively.

**Panel A: Net-of-fee returns**

| | | Dependent variable: | | | |
|---|---|---|---|---|---|
| Matching characteristics: | Observations | Return | Jensen | Fama French | Carhart |
| Year, Segment, Family size, and Fund size | 709 | 0.0167 *** | 0.0220 *** | 0.0158 *** | 0.0116 *** |
| | | (<.0001) | (<.0001) | (<.0001) | (0.0007) |
| Year, Segment, Family size, and Fund age | 708 | 0.0085 ** | 0.0094 ** | 0.0110 *** | 0.0092 *** |
| | | (0.0384) | (0.0158) | (0.0016) | (0.0059) |
| Year, Segment, Family size, and Fund turnover | 637 | 0.0132 *** | 0.0204 *** | 0.0185 *** | 0.0135 *** |
| | | (0.0032) | (<.0001) | (<.0001) | (0.0004) |

**Panel B: Gross-of-fee returns**

| | | Dependent variable: | | | |
|---|---|---|---|---|---|
| Matching characteristics: | Observations | Return | Jensen | Fama French | Carhart |
| Year, Segment, Family size, and Fund size | 709 | 0.0180 *** | 0.0208 *** | 0.0146 *** | 0.0104 *** |
| | | (<.0001) | (<.0001) | (<.0001) | (0.0023) |
| Year, Segment, Family size, and Fund age | 708 | 0.0104 *** | 0.0078 ** | 0.0094 *** | 0.0076 ** |
| | | (0.0081) | (0.0458) | (0.0070) | (0.0236) |
| Year, Segment, Family size, and Fund turnover | 637 | 0.0145 *** | 0.0187 *** | 0.0168 *** | 0.0118 *** |
| | | (0.0007) | (<.0001) | (<.0001) | (0.0020) |

## Table IV – Mutual fund performance – Sub-advised control

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 five different performance measures: Fund return (Return), Khorana (1996) objective-adjusted return (OAR), Jensen (1968) alpha (Jensen), Fama and French (1993) 3-Factor-alpha (Fama French) and Carhart (1997) 4-Factor alpha (Carhart). Results are reported for net and gross-of-fee returns separately. The main independent variable in each Panel is Efficiency, as described in Table II. In Panel A we analyze the slope of the continuous efficiency measure using two binary variables In-house and Outsourced, as defined in Chen, Hong, Jiang, and Kubik (2013). In-house equals one if a fund is managed internally and zero otherwise. In contrast, Outsourced equals one if the management of a fund is outsourced to advisory firms and zero otherwise. Results for the slope of the efficiency measure ranks Top Efficiency and Medium Efficiency are shown in Panel B. Additional independent controls include Family size, Family focus, Fund size, Fund age, Fund turnover. Family size, is the logarithm of the fund family's assets under management. Family focus, represents the concentration of a fund family across investment objectives, defined as in Siggelkow (2003). Fund size, represents the logarithm of the fund's total net assets under management. Family size, Family focus, Fund size are all lagged by one year. Fund age, is the logarithm of the fund's age in years. Fund turnover 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. Regressions are run with year and segment fixed effects. Robust standard errors reported in parentheses are based on standard errors clustered by fund. ***, **, * denote statistical significance at the 1%, 5%, and 10% significance level, respectively.

**Panel A: Efficiency Measure continuous slope**

| | Net-of-fee returns | | | | | Gross-of-fee returns | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Dependent variable: | Return | OAR | Jensen | Fama French | Carhart | Return | OAR | Jensen | Fama French | Carhart |
| Efficiency*In-house | 23.4112 ** | 19.9284 * | 31.2789 *** | 28.3658 *** | 27.5465 *** | 28.4798 *** | 26.5950 ** | 30.8937 *** | 27.9504 *** | 27.1292 *** |
| | (0.0320) | (0.0746) | (0.0038) | (0.0050) | (0.0045) | (0.0086) | (0.0180) | (0.0040) | (0.0055) | (0.0048) |
| Efficiency*Outsourced | 26.3963 | 31.4833 | 12.1007 | -0.5942 | 3.5885 | 27.0476 | 36.7222 | 8.8171 | -3.8763 | 0.3024 |
| | (0.5121) | (0.4029) | (0.7612) | (0.9854) | (0.9146) | (0.4853) | (0.2961) | (0.8242) | (0.9047) | (0.9928) |
| Outsourced | 0.0051 | 0.0064 | 0.0007 | -0.0056 | -0.0050 | 0.0031 | 0.0050 | -0.0009 | -0.0072 | -0.0066 |
| | (0.6577) | (0.5734) | (0.9489) | (0.4996) | (0.5446) | (0.7772) | (0.6305) | (0.9366) | (0.3846) | (0.4243) |
| Family size | 0.0057 *** | 0.0058 *** | 0.0030 ** | 0.0020 ** | 0.0013 | 0.0053 *** | 0.0049 *** | 0.0027 ** | 0.0017 * | 0.0010 |
| | (0.0000) | (0.0000) | (0.0111) | (0.0273) | (0.1267) | (0.0000) | (0.0001) | (0.0223) | (0.0619) | (0.2404) |
| Family focus | -0.0127 | -0.0095 | -0.0079 | 0.0006 | -0.0086 | -0.0100 | -0.0077 | -0.0075 | 0.0011 | -0.0081 |
| | (0.2309) | (0.3824) | (0.3920) | (0.9395) | (0.2798) | (0.3579) | (0.4948) | (0.4202) | (0.8904) | (0.3070) |
| Fund size | -0.0088 *** | -0.0095 *** | -0.0049 *** | -0.0020 ** | -0.0021 ** | -0.0091 *** | -0.0095 *** | -0.0056 *** | -0.0027 *** | -0.0027 *** |
| | (0.0000) | (0.0000) | (0.0000) | (0.0154) | (0.0121) | (0.0000) | (0.0000) | (0.0000) | (0.0014) | (0.0010) |
| Fund age | 0.0079 *** | 0.0102 *** | 0.0057 ** | 0.0019 | 0.0010 | 0.0085 *** | 0.0104 *** | 0.0055 ** | 0.0018 | 0.0008 |
| | (0.0036) | (0.0007) | (0.0158) | (0.2735) | (0.5588) | (0.0025) | (0.0006) | (0.0187) | (0.3104) | (0.6154) |
| Fund turnover | -0.0111 *** | -0.0097 *** | -0.0105 *** | -0.0100 *** | -0.0083 *** | -0.0127 *** | -0.0119 *** | -0.0098 *** | -0.0093 *** | -0.0076 *** |
| | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| Year fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Segment fixed effects | Yes | No | Yes | Yes | Yes | Yes | No | Yes | Yes | Yes |
| Number of Observations | 6,856 | 6,856 | 6,856 | 6,856 | 6,856 | 6,856 | 6,856 | 6,856 | 6,856 | 6,856 |
| Adj.R-Squared | 0.8157 | 0.0504 | 0.194 | 0.1443 | 0.134 | 0.8368 | 0.0447 | 0.1972 | 0.1442 | 0.1345 |

## Table IV – Mutual fund performance – Sub-advised control (continued)

**Panel B: Efficiency Measure rank slope**

| | Net-of-fee returns | | | | | Gross-of-fee returns | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Dependent variable: | Return | OAR | Jensen | Fama French | Carhart | Return | OAR | Jensen | Fama French | Carhart |
| Top Efficiency*In-house | 0.0117 *** | 0.0091 ** | 0.0154 *** | 0.0128 *** | 0.0114 *** | 0.0128 *** | 0.0111 ** | 0.0153 *** | 0.0128 *** | 0.0114 *** |
| | (0.0076) | (0.0437) | (0.0002) | (0.0011) | (0.0035) | (0.0031) | (0.0134) | (0.0002) | (0.0010) | (0.0033) |
| Medium Efficiency*In-house | 0.0049 | 0.0030 | 0.0031 | 0.0051 | 0.0036 | 0.0060 * | 0.0042 | 0.0031 | 0.0050 | 0.0035 |
| | (0.1577) | (0.4050) | (0.3846) | (0.1540) | (0.3035) | (0.0785) | (0.2494) | (0.3959) | (0.1609) | (0.3151) |
| Top Efficiency*Outsourced | 0.0207 | 0.0223 | 0.0043 | -0.0084 | -0.0123 | 0.0193 | 0.0229 | 0.0016 | -0.0111 | -0.0149 |
| | (0.2291) | (0.1775) | (0.7872) | (0.4209) | (0.2579) | (0.2523) | (0.1531) | (0.9187) | (0.2810) | (0.1656) |
| Medium Efficiency*Outsourced | 0.0039 | 0.0043 | 0.0010 | -0.0012 | -0.0015 | 0.0030 | 0.0041 | 0.0006 | -0.0016 | -0.0019 |
| | (0.7638) | (0.7385) | (0.9284) | (0.8988) | (0.8868) | (0.8268) | (0.7500) | (0.9588) | (0.8631) | (0.8554) |
| Outsourced | 0.0021 | -0.0011 | 0.0091 | 0.0108 | 0.0103 | 0.0030 | -0.0010 | 0.0092 | 0.0108 | 0.0103 |
| | (0.8588) | (0.9227) | (0.3837) | (0.1849) | (0.2838) | (0.8038) | (0.9296) | (0.3787) | (0.1777) | (0.2810) |
| Family size | 0.0055 *** | 0.0056 *** | 0.0027 ** | 0.0020 ** | 0.0013 | 0.0052 *** | 0.0048 *** | 0.0024 ** | 0.0017 * | 0.0010 |
| | (0.0000) | (0.0000) | (0.0211) | (0.0327) | (0.1314) | (0.0000) | (0.0001) | (0.0403) | (0.0719) | (0.2464) |
| Family focus | -0.0130 | -0.0098 | -0.0084 | -0.0005 | -0.0098 | -0.0107 | -0.0083 | -0.0080 | -0.0001 | -0.0093 |
| | (0.2252) | (0.3782) | (0.3678) | (0.9458) | (0.2177) | (0.3310) | (0.4680) | (0.3941) | (0.9935) | (0.2397) |
| Fund size | -0.0088 *** | -0.0095 *** | -0.0048 *** | -0.0019 ** | -0.0020 ** | -0.0091 *** | -0.0095 *** | -0.0054 *** | -0.0026 *** | -0.0026 *** |
| | (0.0000) | (0.0000) | (0.0000) | (0.0215) | (0.0175) | (0.0000) | (0.0000) | (0.0000) | (0.0022) | (0.0016) |
| Fund age | 0.0079 *** | 0.0102 *** | 0.0057 ** | 0.0018 | 0.0010 | 0.0084 *** | 0.0104 *** | 0.0055 ** | 0.0017 | 0.0008 |
| | (0.0040) | (0.0007) | (0.0172) | (0.2975) | (0.5714) | (0.0028) | (0.0007) | (0.0203) | (0.3375) | (0.6300) |
| Fund turnover | -0.0110 *** | -0.0097 *** | -0.0104 *** | -0.0100 *** | -0.0083 *** | -0.0126 *** | -0.0118 *** | -0.0097 *** | -0.0093 *** | -0.0075 *** |
| | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| Year fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Segment fixed effects | Yes | No | Yes | Yes | Yes | Yes | No | Yes | Yes | Yes |
| Number of Observations | 6,856 | 6,856 | 6,856 | 6,856 | 6,856 | 6,856 | 6,856 | 6,856 | 6,856 | 6,856 |
| Adj.R-Squared | 0.8158 | 0.0508 | 0.1951 | 0.1446 | 0.1343 | 0.8369 | 0.0451 | 0.1984 | 0.1447 | 0.135 |

**Table V – Mutual fund holding return**

This table shows results from pooled OLS regressions that analyze the impact of trading desk efficiency on mutual fund holding return using three different measures: The actual reported fund gross-of-fee return (Gross Return), the return of a hypothetical portfolio that invests in the previously disclosed fund holdings (Holding Return) and Kacperczyk, Sialm, and Zheng (2008) return gap (Return Gap), defined as the difference between Gross Return and Holding Return. The main independent variable in each Panel is Efficiency, as described in Table II. Results for the continuous measure are reported in Panel A and results for the rank of a fund family`s trading desk are shown in Panel B. Additional independent controls include Family size, Family focus, Fund size, Fund age, Fund turnover. Family size, is the logarithm of the fund family's assets under management. Family focus, represents the concentration of a fund family across investment objectives, defined as in Siggelkow (2003). Fund size, represents the logarithm of the fund's total net assets under management. Family size, Family focus, Fund size are all lagged by one year. Fund age, is the logarithm of the fund's age in years. Fund turnover 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. Regressions are run with year and segment fixed effects. Robust standard errors reported in parentheses are based on standard errors clustered by fund. ***, **, * denote statistical significance at the 1%, 5%, and 10% significance level, respectively.

**Panel A: Efficiency measure continuous**

| Dependent variable: | Gross Return | Holding Return | Return Gap |
|---|---|---|---|
| Efficiency | 30.3663 *** | 15.8568 | 12.9114 ** |
| | (0.0025) | (0.1658) | (0.0105) |
| Family size | 0.0050 *** | 0.0038 *** | 0.0011 ** |
| | (0.0001) | (0.0075) | (0.0449) |
| Family focus | -0.0137 | -0.0211 | 0.0015 |
| | (0.2580) | (0.1110) | (0.8158) |
| Fund size | -0.0074 *** | -0.0059 *** | -0.0011 ** |
| | (0.0000) | (0.0000) | (0.0366) |
| Fund age | 0.0055 ** | 0.0046 * | 0.0009 |
| | (0.0316) | (0.0875) | (0.4227) |
| Fund turnover | -0.0098 *** | -0.0066 *** | 0.0016 |
| | (0.0000) | (0.0007) | (0.1938) |
| Year fixed effects | Yes | Yes | Yes |
| Segment fixed effects | Yes | Yes | Yes |
| Number of Observations | 5,177 | 5,177 | 5,177 |
| Adj.R-Squared | 0.8763 | 0.8261 | 0.0677 |

**Panel B: Efficiency measure rank**

| Dependent variable: | Gross Return | Holding Return | Return Gap |
|---|---|---|---|
| Top Efficiency | 0.0124 *** | 0.0077 | 0.0053 *** |
| | (0.0025) | (0.1055) | (0.0055) |
| Medium Efficiency | 0.0051 | 0.0027 | 0.0018 |
| | (0.1036) | (0.4665) | (0.1845) |
| Family size | 0.0050 *** | 0.0037 *** | 0.0010 * |
| | (0.0001) | (0.0091) | (0.0525) |
| Family focus | -0.0145 | -0.0211 | 0.0013 |
| | (0.2362) | (0.1128) | (0.8427) |
| Fund size | -0.0074 *** | -0.0058 *** | -0.0011 ** |
| | (0.0000) | (0.0000) | (0.0406) |
| Fund age | 0.0055 ** | 0.0046 * | 0.0009 |
| | (0.0315) | (0.0902) | (0.4162) |
| Fund turnover | -0.0098 *** | -0.0066 *** | 0.0016 |
| | (0.0000) | (0.0007) | (0.1888) |
| Year fixed effects | Yes | Yes | Yes |
| Segment fixed effects | Yes | Yes | Yes |
| Number of Observations | 5,177 | 5,177 | 5,177 |
| Adj.R-Squared | 0.8763 | 0.8261 | 0.0681 |

**Table VI - Mutual fund performance - 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 negative performance-portfolio turnover relationship. We use five different performance measures: Fund return (Return), Khorana (1996) objective-adjusted return (OAR), Jensen (1968) alpha (Jensen), Fama and French (1993) 3-Factor-alpha (Fama French) and Carhart (1997) 4-Factor alpha (Carhart). Results are reported for net and gross-of-fee returns separately. The Efficiency measure is divided into three unequal groupings. The bottom Efficiency measure grouping (Bottom Efficiency) and the highest Efficiency measure grouping (Top Efficiency) are binary variables that equal one if a fund family`s trading desk belongs to, respectively, the lowest or the highest quintile of Efficiency measure and zero otherwise. Analogously the middle three Efficiency measure quintiles are combined into one grouping (Medium Efficiency). The main independent variables are interaction terms that are the product of each Efficiency measure group and Fund turnover. Fund turnover 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 coefficients on these piecewise decompositions of Fund turnover represent the slope of the performance-portfolio turnover relationship over their range of sensitivity. Additional independent controls include Family size, Family focus, Fund size, Fund age. Family size, is the logarithm of the fund family's assets under management. Family focus, represents the concentration of a fund family across investment objectives, defined as in Siggelkow (2003). Fund size, represents the logarithm of the fund's total net assets under management. Family size, Family focus, Fund size are all lagged by one year. Fund age, is the logarithm of the fund's age in years. Regressions are run with year and segment fixed effects. Robust standard errors reported in parentheses are based on standard errors clustered by fund. ***, **, * denote statistical significance at the 1%, 5%, and 10% significance level, respectively.

| | Net-of-fee returns | | | | | Gross-of-fee returns | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Dependent variable: | Return | OAR | Jensen | Fama French | Carhart | Return | OAR | Jensen | Fama French | Carhart |
| Fund turnover*Top Efficiency | -0.0077 ** | -0.0065 ** | -0.0018 | -0.0063 ** | -0.0045 * | -0.0101 *** | -0.0093 *** | -0.0006 | -0.0051 ** | -0.0033 |
| | (0.0118) | (0.0494) | (0.5458) | (0.0123) | (0.0814) | (0.0006) | (0.0023) | (0.8328) | (0.0399) | (0.1924) |
| Fund turnover*Medium Efficiency | -0.0164 *** | -0.0148 *** | -0.0152 *** | -0.0140 *** | -0.0125 *** | -0.0190 *** | -0.0180 *** | -0.0141 *** | -0.0128 *** | -0.0114 *** |
| | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| Fund turnover*Bottom Efficiency | -0.0150 *** | -0.0106 *** | -0.0133 *** | -0.0152 *** | -0.0138 *** | -0.0180 *** | -0.0148 *** | -0.0121 *** | -0.0140 *** | -0.0125 *** |
| | (0.0000) | (0.0042) | (0.0001) | (0.0000) | (0.0001) | (0.0000) | (0.0001) | (0.0005) | (0.0001) | (0.0003) |
| Family size | 0.0058 *** | 0.0058 *** | 0.0029 ** | 0.0024 ** | 0.0015 * | 0.0056 *** | 0.0051 *** | 0.0025 ** | 0.0021 ** | 0.0012 |
| | (0.0000) | (0.0000) | (0.0167) | (0.0145) | (0.0998) | (0.0000) | (0.0001) | (0.0335) | (0.0354) | (0.1964) |
| Family focus | -0.0151 | -0.0115 | -0.0096 | 0.0014 | -0.0076 | -0.0126 | -0.0100 | -0.0093 | 0.0018 | -0.0073 |
| | (0.1751) | (0.3119) | (0.3265) | (0.8599) | (0.3563) | (0.2689) | (0.3953) | (0.3420) | (0.8279) | (0.3777) |
| Fund size | -0.0093 *** | -0.0099 *** | -0.0049 *** | -0.0019 ** | -0.0020 ** | -0.0097 *** | -0.0100 *** | -0.0054 *** | -0.0025 *** | -0.0026 *** |
| | (0.0000) | (0.0000) | (0.0000) | (0.0297) | (0.0228) | (0.0000) | (0.0000) | (0.0000) | (0.0048) | (0.0033) |
| Fund age | 0.0091 *** | 0.0112 *** | 0.0061 ** | 0.0021 | 0.0011 | 0.0099 *** | 0.0116 *** | 0.0059 ** | 0.0018 | 0.0009 |
| | (0.0013) | (0.0003) | (0.0133) | (0.2575) | (0.5427) | (0.0007) | (0.0003) | (0.0171) | (0.3116) | (0.6272) |
| Year fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Segment fixed effects | Yes | No | Yes | Yes | Yes | Yes | No | Yes | Yes | Yes |
| H0: Turnover*Bottom >= Turnover*Top | -0.0073 ** | -0.0041 | -0.0115 *** | -0.0089 *** | -0.0093 *** | -0.0079 ** | -0.0055 * | -0.0115 *** | -0.0089 *** | -0.0092 *** |
| Number of Observations | 6,425 | 6,425 | 6,425 | 6,425 | 6,425 | 6,425 | 6,425 | 6,425 | 6,425 | 6,425 |
| Adj.R-Squared | 0.8167 | 0.0511 | 0.1906 | 0.1429 | 0.1338 | 0.8379 | 0.0451 | 0.1943 | 0.1432 | 0.1347 |

**Table VII – Trading Activity**

This table presents results from pooled OLS regressions that analyze the impact of trading desk efficiency on mutual funds` trading activity. The dependent variables are categorized in three different trading activity measures. The first measure is Fund turnover, 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 are two additional variables from turnover ratio Buy Turnover and Sell Turnover separated for the effects of buy and sell trading by adding the percentage change in fund`s total net assets under management, as defined in Carhart (1997). The third measure is a Position-adjusted turnover as suggested in Edelen, Evans, and Kadlec (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. The main independent variables are Top Efficiency and Medium Efficiency as described in Table II. Additional independent controls include Family size, Family focus, Fund size, Fund age. Family size, is the logarithm of the fund family's assets under management. Family focus, represents the concentration of a fund family across investment objectives, defined as in Siggelkow (2003). Fund size, represents the logarithm of the fund's total net assets under management. Family size, Family focus, Fund size are all lagged by one year. Fund age, is the logarithm of the fund's age in years. All Regressions are run with year and segment fixed effects. Robust standard errors reported in parentheses are based on standard errors clustered by fund. ***, **, * denote statistical significance at the 1%, 5%, and 10% significance level, respectively.

| Dependent variable: | Fund turnover | *BuyTO* (Buy Turnover) | *SellTO* (Sell Turnover) | *PositionTO* (Position adjusted turnover) |
|---|---|---|---|---|
| Top Efficiency | 0.0659 ** | 0.0590 ** | 0.0629 ** | 0.0475 *** |
| | (0.0188) | (0.0375) | (0.0257) | (0.0098) |
| Medium Efficiency | 0.0281 | 0.0271 | 0.0280 | 0.0139 |
| | (0.2410) | (0.2637) | (0.2434) | (0.3527) |
| Family size | 0.0482 *** | 0.0505 *** | 0.0468 *** | 0.0157 ** |
| | (0.0000) | (0.0000) | (0.0000) | (0.0402) |
| Family focus | 0.2392 ** | 0.2566 ** | 0.2618 ** | 0.1028 |
| | (0.0362) | (0.0284) | (0.0243) | (0.1268) |
| Fund size | -0.0819 *** | -0.0891 *** | -0.0827 *** | 0.0712 *** |
| | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| Fund age | 0.1022 *** | 0.1037 *** | 0.1122 *** | 0.0546 *** |
| | (0.0000) | (0.0000) | (0.0000) | (0.0001) |
| Year fixed effects | Yes | Yes | Yes | Yes |
| Segment fixed effects | Yes | Yes | Yes | Yes |
| Number of Observations | 6,110 | 6,102 | 6,102 | 5,003 |
| Adj.R-Squared | 0.1082 | 0.1121 | 0.1060 | 0.2600 |

**Table VIII – Cash holdings**

This table presents results from pooled OLS regressions 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. The main independent variables are Top Efficiency and Medium Efficiency as described in Table II. The independent controls of the standard regression model (Column 1) include Family size, Family focus, Fund size, Fund age, Fund turnover. Family size, is the logarithm of the fund family's assets under management. Family focus, represents the concentration of a fund family across investment objectives, defined as in Siggelkow (2003). Fund size, represents the logarithm of the fund's total net assets under management. Family size, Family focus, Fund size are all lagged by one year. Fund age, is the logarithm of the fund's age in years. Fund turnover 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. Additional independent controls include Expense Ratio, Front load, Deferred load, Fund return, Fund flow, Fund flow volatility (Column 2 and 3). Expense ratio, is the fund`s total expense ratio. Front load, is the fund`s front-end load. Deferred load, represents the fund`s back-end load. Fund return, is the annual net-of-fee return of the fund. Fund flow, represents the fund`s percentage growth rate adjusted for internal growth of the fund, as defined in Sirri and Tufano (1998). Fund return and fund flow are all lagged by one year. Fund flow volatility, is the standard deviation of the fund`s monthly net-inflows during the previous year. All Regressions are run with year and segment fixed effects. Robust standard errors reported in parentheses are based on standard errors clustered by fund. ***, **, * denote statistical significance at the 1%, 5%, and 10% significance level, respectively.

| Dependent variable: | Cash holdings | | |
|---|---|---|---|
| Model: | (1) | (2) | (3) |
| Top Efficiency | -0.0047 *** | -0.0039 ** | -0.0038 ** |
| | (0.0005) | (0.0141) | (0.0178) |
| Medium Efficiency | -0.0029 ** | -0.0021 | -0.0023 * |
| | (0.0114) | (0.1198) | (0.0865) |
| Family size | -0.0010 ** | 0.0000 | -0.0001 |
| | (0.0177) | (0.9914) | (0.8763) |
| Family focus | 0.0083 * | 0.0104 ** | 0.0110 ** |
| | (0.0842) | (0.0452) | (0.0354) |
| Fund size | 0.0009 ** | 0.0010 ** | 0.0010 ** |
| | (0.0180) | (0.0381) | (0.0390) |
| Fund age | -0.0022 *** | -0.0014 | -0.0005 |
| | (0.0086) | (0.2034) | (0.6523) |
| Fund turnover | -0.0004 | -0.0007 | -0.0005 |
| | (0.3671) | (0.1400) | (0.2762) |
| Expense ratio | | 0.1443 | 0.1501 |
| | | (0.4325) | (0.4112) |
| Front load | | 0.1693 *** | 0.1745 *** |
| | | (0.0000) | (0.0000) |
| Deferred load | | -0.0961 | -0.0995 |
| | | (0.1737) | (0.1619) |
| Fund return | | | 0.0026 |
| | | | (0.5604) |
| Fund flow | | | 0.0003 ** |
| | | | (0.0354) |
| Fund flow volatility | | | -0.0007 *** |
| | | | (0.0091) |
| Year fixed effects | Yes | Yes | Yes |
| Segment fixed effects | Yes | Yes | Yes |
| Number of Observations | 5,071 | 4,101 | 4,009 |
| Adj.R-Squared | 0.1157 | 0.1404 | 0.136 |

### Table IX – Portfolio liquidity

This table presents results from pooled OLS regressions that analyze the impact of trading desk efficiency on mutual funds` portfolio liquidity. We use four measures for fund`s portfolio liquidity: Stock turnover, is the number of shares traded, defined as in Massa and Phalippou (2005). Correspondingly, Stock dollar volume, measures the portfolio weighted average of the dollar volume of shares traded of all stock in fund`s equity portfolio. The higher the value of these first two measures, the higher is the portfolio weighted average of a fund`s portfolio liquidity. In contrast, the following proxies measure a portfolio`s illiquidity level. Relative spread, represents the difference between the logarithm of the best offer price and the logarithm of the best bid price, as in Holden, Jacobsen, and Subrahmanyam (2014). Amihud, is based on the illiquidity measure of Amihud (2002). The main independent variables for each Panel are Top Efficiency and Medium Efficiency as described in Table II. Additional independent controls include Family size, Family focus, Fund size, Fund age, Fund turnover. Family size, is the logarithm of the fund family's assets under management. Family focus, represents the concentration of a fund family across investment objectives, defined as in Siggelkow (2003). Fund size, represents the logarithm of the fund's total net assets under management. Family size, Family focus, Fund size are all lagged by one year. Fund age, is the logarithm of the fund's age in years. Fund turnover 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. Regressions are run for the total sample in Panel A, and are restricted to the observations that fulfill a propensity matching on a vector of Fund and Family size in Panel B. In both panels, we run pooled OLS regressions with year and segment fixed effects. Robust standard errors reported in parentheses are based on standard errors clustered by fund. ***, **, * denote statistical significance at the 1%, 5%, and 10% significance level, respectively.

**Panel A: Total sample**

| Dependent variable: | Stock turnover | Stock dollar volume | Relative spread | Amihud |
|---|---|---|---|---|
| Top Efficiency | 0.3721 | 0.0639 | -0.0001 | -0.0514 |
| | (0.2535) | (0.1152) | (0.3162) | (0.4464) |
| Medium Efficiency | 0.0906 | 0.0215 | 0.0000 | -0.0453 |
| | (0.6460) | (0.5504) | (0.5848) | (0.4471) |
| Family size | -0.1602 | -0.0103 | 0.0001 *** | 0.1893 *** |
| | (0.2128) | (0.5663) | (0.0014) | (0.0000) |
| Family focus | -1.4633 | 0.1508 | -0.0007 *** | -0.1894 |
| | (0.2162) | (0.3678) | (0.0084) | (0.4902) |
| Fund size | -0.0530 | 0.0356 ** | 0.0000 | -0.0452 * |
| | (0.5867) | (0.0259) | (0.1493) | (0.0915) |
| Fund age | -0.1748 | -0.0112 | 0.0000 | -0.0513 |
| | (0.2587) | (0.8007) | (0.4223) | (0.4366) |
| Fund turnover | 0.6744 *** | 0.1148 *** | -0.0002 ** | -0.0650 |
| | (0.0010) | (0.0023) | (0.0102) | (0.2468) |
| Year fixed effects | Yes | Yes | Yes | Yes |
| Segment fixed effects | Yes | Yes | Yes | Yes |
| Number of Observations | 5,110 | 5,110 | 5,110 | 5,110 |
| Adj.R-Squared | 0.2158 | 0.7806 | 0.8282 | 0.6287 |

## Table IX – Portfolio liquidity (continued)

**Panel B: Size adjusted sub-sample**

| Dependent variable: | Stock turnover | | Stock dollar volume | | Relative spread | | Amihud | |
|---|---|---|---|---|---|---|---|---|
| Top Efficiency | -0.9858 | ** | -0.3705 | *** | 0.0010 | *** | 0.6320 | *** |
| | (0.0128) | | (0.0012) | | (0.0000) | | (0.0007) | |
| Family size | 0.2788 | * | 0.1567 | *** | -0.0007 | *** | 0.0421 | |
| | (0.0957) | | (0.0001) | | (0.0000) | | (0.3856) | |
| Family focus | -7.2245 | *** | 0.1849 | | 0.0008 | | 0.1464 | |
| | (0.0001) | | (0.7438) | | (0.6191) | | (0.8483) | |
| Fund size | -0.3100 | ** | 0.0366 | | 0.0003 | *** | -0.1446 | *** |
| | (0.0153) | | (0.3461) | | (0.0000) | | (0.0056) | |
| Fund age | -0.1348 | | 0.3055 | *** | -0.0010 | *** | -0.3596 | *** |
| | (0.6312) | | (0.0002) | | (0.0000) | | (0.0011) | |
| Fund turnover | 0.7846 | *** | -0.2296 | *** | 0.0003 | ** | 0.3391 | *** |
| | (0.0029) | | (0.0004) | | (0.0361) | | (0.0000) | |
| Year fixed effects | Yes | | Yes | | Yes | | Yes | |
| Segment fixed effects | Yes | | Yes | | Yes | | Yes | |
| Number of Observations | 2,807 | | 2,807 | | 2,807 | | 2,807 | |
| Adj.R-Squared | 0.0473 | | 0.1639 | | 0.1741 | | 0.2202 | |

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**centre for financial research**
cfr/university of cologne
Albertus-Magnus-Platz
D-50923 cologne
fon +49(0)221-470-6995
fax +49(0)221-470-3992
kempf@cfr-cologne.de
www.cfr-cologne.de