

Does Fund Size Erode Mutual Fund Performance? The Role of Liquidity and Organization

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We investigate the effect of scale on performance in the active money management industry. We first document that fund returns, both before and after fees and expenses, decline with lagged fund size, even after accounting for various performance benchmarks. We then explore a number of potential explanations for this relationship. This association is most pronounced among funds that have to invest in small and illiquid stocks, suggesting that these adverse scale effects are related to liquidity. Controlling for its size, a fund's return does not deteriorate with the size of the family that it belongs to, indicating that scale need not be bad for performance depending on how the fund is organized. Finally, using data on whether funds are solo-managed or team-managed and the composition of fund investments, we explore the idea that scale erodes fund performance because of the interaction of liquidity and organizational diseconomies. (JEL G2, G20, G23, L2, L22)

The mutual fund industry plays an increasingly important role in the U.S. economy. Over the past two decades, mutual funds have been among the fastest growing institutions in this country. At the end of 1980, they managed less than \$150 billion, but this figure had grown to over \$4 trillion by the end of 1997—a number that exceeds aggregate bank deposits (Robert C. Pozen, 1998). Indeed, almost 50 percent of households today invest in mutual funds (Investment Company Institute, 2000). The most important and fastest-growing part of this industry is funds that invest in stocks, particularly actively managed ones. The explosion of newsletters, magazines, and such rating services as Morningstar attest to the fact that investors spend significant resources in identifying managers with stock-picking ability. More important, actively managed funds control a sizeable

stake of corporate equity and play a pivotal role in the determination of stock prices (see, e.g., Mark Grinblatt et al., 1995; Paul Gompers and Andrew Metrick, 2001).

In this paper, we tackle an issue that is fundamental to understanding the role of these mutual funds in the economy—the economies of scale in the active money management industry. Namely, how does performance depend on the size or asset base of the fund? A better understanding of this issue would naturally be useful for investors, especially in light of the massive inflows that have increased the mean size of funds in the recent past. At the same time, the issue of the persistence of fund performance depends crucially on the scale-ability of fund investments (see, e.g., Martin J. Gruber, 1996; Jonathan Berk and Richard C. Green, 2002). Moreover, the nature of the economies of scale in this industry may also have implications for the agency relationship between managers and investors and the optimal compensation contract between them (see, e.g., Keith Brown et al., 1996; Stan Becker and Greg Vaughn, 2001). Therefore, understanding the effects of fund size on fund returns is an important first step toward addressing such critical issues.

While the effect of scale on performance is an important question, it has received little research attention to date. Some practitioners

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point out that there are advantages to scale, such as more resources for research and lower expense ratios. Others believe, however, that a large asset base erodes fund performance because of trading costs associated with liquidity or price impact (see, e.g., André Perold and Robert S. Salomon, 1991; Roger Lowenstein, 1997). Whereas a small fund can easily put all of its money in its best ideas, a lack of liquidity forces a large fund to have to invest in its not-so-good ideas and take larger positions per stock than is optimal, thereby eroding performance. Using a small sample of funds from 1974 to 1984, Grinblatt and Sheridan Titman (1989) find mixed evidence that fund returns decline with fund size. Needless to say, there is no consensus on this issue.

Using mutual fund data from 1962 to 1999, we begin our investigation by using cross-sectional variation to see whether performance depends on lagged fund size. Since funds may have different styles, we adjust for such heterogeneity by utilizing various performance benchmarks that account for the possibility that they load differently on small cap stock, value stock, and price momentum strategies. Moreover, fund size may be correlated with such other fund characteristics as fund age or turnover, and it may be these characteristics that are driving performance. Hence, we regress the various adjusted returns on lagged fund size (as measured by the log of total net assets under management), and also include in the regressions a host of other observable fund characteristics, including turnover, age, expense ratio, total load, past-year fund inflows, and past-year returns. A number of studies warn that the reported returns of the smallest funds (those with less than \$15 million in assets under management) might be upward biased. We exclude these funds from our baseline sample in estimating these regressions.

The regressions indicate that a fund's performance is inversely correlated with its lagged assets under management. For instance, using monthly gross returns (before fees and expenses are deducted), a two-standard deviation shock in the log of a fund's total assets under management this month yields anywhere from a 5.4- to 7.7-basis-point movement in next month's fund return, depending on the performance benchmark (or about 65 to 96 basis points an-

nually). The corresponding figures for net fund returns (after fees and expenses are deducted) are only slightly smaller. To put these magnitudes into some perspective, the funds in our sample on average underperform the market portfolio by about 96 basis points after fees and expenses. From this perspective, a 65- to 96-basis-point annual spread in performance is not only statistically significant but also economically important.¹

Even after utilizing various performance benchmarks and controlling for other observable fund characteristics, there are still a number of potential explanations that might be consistent with the inverse relationship between scale and fund returns. To further narrow the set of explanations, we proceed to test a direct implication of the hypothesis that fund size erodes performance because of trading costs associated with liquidity and price impact. If the "liquidity hypothesis" is true, then size ought to erode performance much more for funds that have to invest in small stocks, which tend to be illiquid. Consistent with this hypothesis, we find that fund size matters much more for the returns among such funds, identified as "small cap" funds in our database, than other funds.² Indeed, for other funds, size does not significantly affect performance. This finding strongly indicates that liquidity plays an important role in the documented diseconomies of scale.

We then delve deeper into the liquidity hypothesis by observing that liquidity means that big funds need to find more stock ideas than small funds do, but liquidity itself may not completely explain why they cannot go about doing this, i.e., why they cannot scale. Presumably, a large fund can afford to hire additional managers to cover more stocks. It can thereby generate additional good ideas so that it can take

¹ As we describe below, some theories suggest that the smallest funds may have inferior performance to medium-sized ones because they are being run at a suboptimally small scale. Because it is difficult to make inferences regarding the performance of the smallest funds, we do not attempt to measure such nonlinearities here.

² Throughout the paper, we will sometimes refer to funds with few assets under management as "small funds" and funds that, by virtue of their fund style, have to invest in small stocks as "small cap funds." So small cap funds are not necessarily small funds. Indeed, most are actually quite large in terms of assets under management.

small positions in lots of stocks as opposed to large positions in a few stocks. Indeed, the vast majority of stocks with small market capitalization are untouched by mutual funds (see, e.g., Hong, Lim, and Stein, 2000; Chen et al., 2002). So there is clearly scope for even very large funds to generate new ideas. Put another way, why can't two small funds (directed by two different managers) merge into one large fund and still have the performance of the large one be equal to the sum of the two small ones?

To see that assets under management need not be bad for the performance of a fund organization, we consider the effect that the size of the fund family has on fund performance. Many funds belong to fund families (e.g., the famous Magellan fund is part of the Fidelity family of funds), which allows us to measure separately the effect of fund size and the size of the rest of the family on fund performance. Controlling for fund size, we find that the assets under management of the other funds in the family that the fund belongs to actually increase the fund's performance. A two-standard deviation shock to the size of the other funds in the family leads to about a 4- to 6-basis-point movement in the fund's performance the following month (or about 48- to 72-basis-points movement annually) depending on the performance measure used. The effect is smaller than that of fund size on performance but is nonetheless statistically and economically significant. As we explain in detail below, the most plausible interpretation of this finding is that there are economies associated with trading commissions and lending fees at the family level. Bigger families like Fidelity are able to get better concessions on trading commissions and earn higher lending fees for the stocks held by their funds.

These two findings—that fund performance declines with the fund's own size but increases with the size of the other funds in the family—are both interesting and intuitively appealing. First, in our cross-sectional regressions, it is important to control for family size in order to find a sizeable impact of fund size on performance. The reason is that these two variables are positively correlated, and since family size is good for performance, it is important to control for it to identify the negative effect of fund size. Second, the finding on family size also rules out a number of alternative hypotheses for

our fund size finding. For instance, it is not likely that this finding is due to large funds not caring about returns, since large families apparently do make sufficient investments to maintain performance.

More important, these two findings make clear that liquidity and scale need not be bad for fund performance per se. In most families, major decisions are decentralized in that the fund managers make stock picks without substantial coordination with each other. So a family is an organization that credibly commits to letting each of its fund managers run his or her own assets. Moreover, being part of a family may economize on certain fixed costs, as explained above. Thus, if a large fund is organized like a fund family with different managers running small pots of money, then scale need not be bad per se, just as family size does not appear to be bad for family performance.

Therefore, given that managers care a great deal about performance and that scale need not be bad for performance per se, why does it appear that scale erodes fund performance because of liquidity? Later in this paper, we explore some potential answers to this question. Whereas a small fund can be run by a single manager, a large fund naturally needs more managers, and so issues of how the decision-making process is organized become important. We conjecture that liquidity and scale affect performance because of certain organizational diseconomies. We pursue this perspective as a means to motivate additional analysis involving fund stock holdings. We want to emphasize that our analysis is exploratory and that a number of alternative interpretations, which we describe below, are possible.

There are many types of organizational diseconomies that lead to different predictions on why small organizations outperform large ones.³ We conjecture that one type, known as hierarchy costs (see, e.g., Philippe Aghion and Jean Tirole, 1997; Jeremy C. Stein, 2002), may be especially relevant for mutual funds and motivate our analysis by testing some predictions from Stein (2002). The basic premise is that in

³ See Patrick Bolton and David S. Scharfstein (1998) and Bengt Holmstrom and John Roberts (1998) for surveys on the boundaries of the firm that discuss such organizational diseconomies.

large organizations with hierarchies, the process of agents fighting for (and potentially not having) their ideas implemented will affect agents' ex ante decisions of what ideas they want to work on. Stein (2002) argues that in the presence of such hierarchy costs, small organizations ought to outperform large ones at tasks that involve the processing of soft information, (i.e., information that cannot be directly verified by anyone other than the agent who produces it). If the information is soft, then agents have a harder time convincing others of their ideas and it becomes more difficult to pass this information up the organization.

In the context of mutual funds, soft information most naturally corresponds to research or investment ideas related to local stocks (companies located near a fund headquarters) since anecdotal evidence indicates that investing in such companies requires that the fund process soft information, e.g., speaking with CEOs as opposed to simply looking at hard information like price-earnings ratios. This means that in large funds with hierarchies in which managers fight to have their ideas implemented, managers may end up expending too much research effort on quantitative measures of a company (i.e., hard information) so as to convince others to implement their ideas than they ideally would if they controlled their own smaller funds. All else equal, large funds may perform worse than small ones.

Building on the work of Joshua D. Coval and Tobias J. Moskowitz (1999, 2001), we find that, consistent with Stein (2002), small funds, especially those investing in small stocks, are significantly more likely than their larger counterparts to invest in local stocks. Moreover, they do much better at picking local stocks than large funds do.⁴

Another implication of Stein (2002) is that controlling for fund size, funds that are managed by one manager are better at tasks that

involve the processing of soft information than funds managed by many managers. Consistent with Stein (2002), we find that solo-managed funds are significantly more likely than co-managed funds to invest in local stocks and to do better than co-managed funds at picking local stocks. Finally, we find that controlling for fund size, solo-managed funds outperform co-managed funds.

Note that such hierarchy costs are not present at the family level precisely because the family typically agrees not to reallocate resources across funds. Indeed, different funds in a family have their own boards that deal with such issues as replacement of managers. So the manager in charge of a fund generally does not have to worry about the family taking away the fund's resources and giving them to some other fund in the family. More generally, the idea that agents' incentives are weaker when they do not have control over asset allocation or investment decisions is in the work of Sanford J. Grossman and Oliver D. Hart (1986), Hart and John Moore (1990), and Hart (1995).

In sum, our paper makes a number of contributions. First, we carefully document that performance declines with fund size. Second, we establish the importance of liquidity in mediating this inverse relationship. Third, we point out that the adverse effect of scale on performance need not be inevitable because we find that family size actually improves fund performance. Finally, we provide some evidence that the reason fund size and liquidity do in fact erode performance may be due to organizational diseconomies related to hierarchy costs. It is important to note, however, that our analysis into the nature of the organizational diseconomies is exploratory and that there are other interpretations, which we discuss below.

Our paper proceeds as follows. In Section I we describe the data and in Section II the performance benchmarks. In Section III we present our empirical findings. We explore alternative explanations in Section IV and conclude in Section V.

I. Data

Our primary data on mutual funds come from the Center for Research in Security Prices (CRSP) Mutual Fund Database, which spans the

⁴ Stein's analysis also suggests that large organizations need not underperform small ones when it comes to processing hard information. In the context of the mutual fund industry, only passive index funds like Vanguard are likely to rely solely on hard information. Most active mutual funds rely to a significant degree on soft information. Interestingly, anecdotal evidence indicates that scale is not as big an issue for passive index funds as it is for active mutual funds.

years 1962 to 1999. Following many prior studies, we restrict our analysis to diversified U.S. equity mutual funds by excluding from our sample bond, international, and specialized sector funds.⁵ For a fund to be in our sample, it must report information on assets under management and monthly returns. We require also that it have at least one year of reported returns. This additional restriction is imposed because we need to form benchmark portfolios based on past fund performance.⁶ Finally, a mutual fund may enter the database multiple times in the same month if it has different share classes. We clean the data by eliminating such redundant observations.

Table 1 reports summary statistics for our sample. In panel (A), we report the means and standard deviations for the variables of interest for each fund size quintile, for all funds, and for funds in fund size quintiles two (next to smallest) to five (largest). Edwin J. Elton et al. (2001) warn that one has to be careful in making inferences regarding the performance of funds that have less than \$15 million in total net assets under management. They point out that there is a systematic upward bias in the reported returns among these observations. This bias is potentially problematic for our analysis since we are interested in the relationship between scale and performance. As we will see shortly, this critique applies only to observations in fund size quintile one (smallest), since the funds in the other quintiles typically have greater than \$15 million under management. Therefore, we focus our analysis on the subsample of funds in fund size quintiles two through five. It turns out that our results are robust whether or not we include the smallest funds in our analysis.

We utilize 3,439 distinct funds and a total

27,431 fund years in our analysis.⁷ In each month, our sample includes on average 741 funds. They have average total net assets (*TNA*) of \$282.5 million, with a standard deviation of \$925.8 million. The interesting thing to note from the standard deviation figure is that there is a substantial spread in *TNA*. Indeed, this becomes transparent when we disaggregate these statistics by fund size quintiles. Those in the smallest quintile have an average *TNA* of only about \$4.7 million, whereas the ones in the top quintile have an average *TNA* of over \$1.1 billion. The funds in fund size quintiles two through five have a slightly higher mean of \$352.3 million with a standard deviation of over \$1 billion. For the usual reasons related to scaling, the proxy of fund size that we will use in our analysis is the log of a fund's *TNA* (*LOGTNA*). The statistics for this variable are reported in the row below that of *TNA*. Another variable of interest is *LOGFAMSIZE*, which is the log of one plus the cumulative *TNA* of the other funds in the fund's family (i.e., the *TNA* of a fund's family excluding its own *TNA*).

In addition, the database reports a host of other fund characteristics that we utilize in our analysis. The first is fund turnover (*TURN-OVER*), defined as the minimum of purchases and sales over average *TNA* for the calendar year. The average fund turnover is 54.2 percent per year. The average fund age (*AGE*) is about 15.7 years. The funds in our sample have expense ratios as a fraction of year-end *TNA* (*EX-RATIO*) that average about 97 basis points per year. They charge a total load (*TOTLOAD*) of about 4.36 percent (as a percentage of new investments) on average. *FLOW* in month t is defined as the fund's *TNA* in month t minus the product of the fund's *TNA* at month $t - 12$ with the net fund return between months $t - 12$ and t , all divided by the fund's *TNA* at month $t - 12$. The funds in the sample have an average fund flow of 24.7 percent per year. These summary statistics are similar to those obtained for the subsample of funds in fund size quintiles two through five.

⁵ More specifically, we select mutual funds in the CRSP Mutual Fund Database that have reported one of the following investment objectives at any point. We first select mutual funds with the Investment Company Data, Inc. (ICDI) mutual fund objective of "aggressive growth," "growth and income," or "long-term growth." We then add in mutual funds with the Strategic Insight mutual fund objective of "aggressive growth," "flexible," "growth and income," "growth," "income-growth," or "small company growth." Finally, we select mutual funds with the Wiesenberg mutual fund objective code of "G," "G-I," "G-I-S," "G-S," "GCI," "I-G," "I-S-G," "MCG," or "SCG."

⁶ We have also replicated our analysis without this restriction. The only difference is that the sample includes more small funds, but the results are unchanged.

⁷ At the end of 1993, we have about 1,508 distinct funds in our sample, very close to the number reported by previous studies that have used this database. Moreover, the summary statistics below are similar to those reported in these other studies as well.

TABLE 1—SUMMARY STATISTICS

Panel A: Time-series averages of cross-sectional averages and standard deviations

	Mutual fund size quintile					All funds	Quintiles 2–5
	1	2	3	4	5		
Number of funds	148.2	147.8	147.8	147.8	147.3	741.4	590.6
<i>TNA</i>	4.7	22.2	60.6	165.4	1164.7	282.5	352.3
(\$ million)	[3.2]	[7.2]	[16.6]	[54.8]	[1797.1]	[925.8]	[1022.7]
<i>LOGTNA</i>	1.09	2.94	3.96	4.94	6.45	3.87	4.57
(\$ million)	[1.01]	[0.34]	[0.27]	[0.33]	[0.75]	[1.92]	[1.38]
<i>LOGFAMSIZE</i>	3.70	4.52	5.29	5.91	7.00	5.28	5.68
(\$ million)	[2.98]	[2.89]	[2.72]	[2.56]	[2.16]	[2.92]	[2.75]
<i>TURNOVER</i>	42.07	55.68	59.09	61.20	52.17	54.17	57.07
(% per year)	[83.03]	[74.00]	[68.60]	[64.28]	[54.56]	[71.84]	[67.21]
<i>AGE</i>	8.17	11.90	14.82	18.43	25.16	15.67	17.57
(years)	[8.54]	[10.73]	[12.85]	[14.38]	[15.06]	[13.96]	[14.33]
<i>EXPRATIO</i>	1.29	1.08	0.94	0.85	0.68	0.97	0.89
(% per year)	[1.11]	[0.59]	[0.46]	[0.37]	[0.31]	[0.68]	[0.48]
<i>TOTLOAD</i>	3.41	4.19	4.32	4.57	5.28	4.36	4.59
(%)	[3.32]	[3.32]	[3.34]	[3.39]	[2.88]	[3.36]	[3.32]
<i>FLOW</i>	30.79	30.66	26.97	21.27	13.54	24.67	23.13
(% per year)	[113.55]	[113.36]	[101.66]	[84.08]	[59.04]	[102.64]	[96.60]

Panel B: Time-series averages of (monthly) correlations between fund characteristics (using all funds)

	<i>TNA</i>	<i>LOGTNA</i>	<i>LOGFAMSIZE</i>	<i>TURNOVER</i>	<i>AGE</i>	<i>EXPRATIO</i>	<i>TOTLOAD</i>	<i>FLOW</i>
<i>TNA</i>	1.00	0.56	0.24	-0.05	0.27	-0.19	0.10	-0.03
<i>LOGTNA</i>		1.00	0.40	0.06	0.44	-0.31	0.19	-0.07
<i>LOGFAMSIZE</i>			1.00	0.08	0.08	-0.19	0.25	-0.01
<i>TURNOVER</i>				1.00	0.01	0.17	0.05	-0.01
<i>AGE</i>					1.00	-0.13	0.19	-0.18
<i>EXPRATIO</i>						1.00	-0.05	0.08
<i>TOTLOAD</i>							1.00	-0.04
<i>FLOW</i>								1.00

Panel C: Time-series averages of (monthly) correlations between fund characteristics (excluding smallest 20 percent of funds)

	<i>TNA</i>	<i>LOGTNA</i>	<i>LOGFAMSIZE</i>	<i>TURNOVER</i>	<i>AGE</i>	<i>EXPRATIO</i>	<i>TOTLOAD</i>	<i>FLOW</i>
<i>TNA</i>	1.00	0.66	0.23	-0.08	0.24	-0.24	0.09	-0.03
<i>LOGTNA</i>		1.00	0.35	-0.05	0.37	-0.36	0.13	-0.07
<i>LOGFAMSIZE</i>			1.00	0.07	0.03	-0.17	0.22	-0.01
<i>TURNOVER</i>				1.00	-0.04	0.26	0.03	0.01
<i>AGE</i>					1.00	-0.18	0.17	-0.19
<i>EXPRATIO</i>						1.00	0.01	0.10
<i>TOTLOAD</i>							1.00	-0.05
<i>FLOW</i>								1.00

Panel D: Time-series averages of (monthly) cross-sectional averages of market-adjusted fund returns

	Mutual fund size quintile					All funds	Quintiles 2–5
	1	2	3	4	5		
<i>FUNDRET</i>	0.09%	0.02%	0.03%	-0.06%	-0.06%	0.01%	-0.02%
(Gross)	[3.04%]	[2.64%]	[2.61%]	[2.46%]	[2.00%]	[2.62%]	[2.48%]
<i>FUNDRET</i>	-0.02%	-0.07%	-0.05%	-0.13%	-0.12%	-0.08%	-0.09%
(Net)	[3.04%]	[2.64%]	[2.61%]	[2.46%]	[2.00%]	[2.62%]	[2.48%]

Notes: This table reports summary statistics for the funds in our sample. "Number of funds" is the number of mutual funds that meet our selection criteria for being an active mutual fund in each month. *TNA* is the total net assets under management in millions of dollars. *LOGTNA* is the logarithm of *TNA*. *LOGFAMSIZE* is the logarithm of one plus the assets under management of the other funds in the family that the fund belongs to (excluding the asset base of the fund itself). *TURNOVER* is fund turnover, defined as the minimum of aggregate purchases and sales of securities divided by the average *TNA* over the calendar year. *AGE* is the number of years since the establishment of the fund. *EXPRATIO* is the total annual management fees and expenses divided by year-end *TNA*. *TOTLOAD* is the total front-end, deferred, and rear-end charges as a percentage of new investments. *FLOW* is the percentage new fund flow into the mutual fund over the past year. *TNA*, *LOGFAMSIZE*, and *FLOW* are reported monthly. All other fund characteristics are reported once a year. *FUNDRET* is the monthly market-adjusted fund return. These returns are calculated before (gross) and after (net) deducting fees and expenses. Panel (A) reports the time-series averages of monthly cross-sectional averages and monthly cross-sectional standard deviations (shown in brackets) of fund characteristics. Panels (B) and (C) report the time-series averages of the cross-sectional correlations between fund characteristics. Panel (D) reports the time-series averages of monthly cross-sectional averages of market-adjusted fund returns. In panels (A) and (B), fund size quintile 1 (5) has the smallest (largest) funds. The sample is from January 1963 to December 1999.

Panel (B) of Table 1 reports the time-series averages of the cross-sectional correlations between the various fund characteristics. A number of patterns emerge. First, *LOGTNA* is strongly correlated with *LOGFAMSIZE* (0.40). Second, *EXPRATIO* varies inversely with *LOGTNA* (-0.31), while *TOTLOAD* and *AGE* vary positively with *LOGTNA* (0.19 and 0.44, respectively). Panel (C) reports the analogous numbers for the funds in fund size quintiles two through five. The results are similar to those in panel (B). It is apparent from panels (B) and (C) that we need to control for these fund characteristics in estimating the cross-sectional relationship between fund size and performance.

Finally, we report in panel (D) the means and standard deviations for the monthly fund returns, *FUNDRET*, where we measure these returns in a couple of different ways. We first report summary statistics for gross fund returns adjusted by the return of the market portfolio (simple market-adjusted returns). Monthly gross fund returns are calculated by adding back the expenses to net fund returns by taking the year-end expense ratio, dividing it by 12, and adding it to the monthly returns during the year. For the whole sample, the average monthly performance is 1 basis point with a standard deviation of 2.62 percent. The funds in fund size quintiles two through five do slightly worse, with a mean of -2 basis points and a standard deviation of 2.48 percent. We also report these summary statistics using net fund returns. The funds in our sample underperform the market by 8 basis points per month, or 96 basis points per year, after fees and expenses are deducted.

These figures are almost identical to those documented in other studies. These studies find that fund managers do have the ability to beat or stay even with the market before management fees (see, e.g., Grinblatt and Titman, 1989; Grinblatt et al., 1995; Kent Daniel et al., 1997). However, mutual fund investors are apparently willing to pay a lot in fees for limited stock-picking ability, which results in their risk-adjusted fund returns being significantly negative (see, e.g., Michael C. Jensen, 1968; Burton G. Malkiel, 1995; Gruber, 1996).

Moreover, notice that smaller funds appear to outperform their larger counterparts. For instance, funds in quintile two have an average monthly gross return of 2 basis points, while

funds in quintile five underperform the market by 6 basis points. The difference of 8 basis points per month, or 96 basis points a year, is an economically interesting number. Net fund returns also appear to be negatively correlated with fund size, though the spread is somewhat smaller than using gross returns. We do not want to overinterpret these results since we have not controlled for heterogeneity in fund styles nor calculated any type of statistical significance in this table.

In addition to the CRSP Mutual Fund Database, we also utilize the CDA Spectrum Database to analyze the effect of fund size on the composition of fund stock holdings and the performance of these holdings. The reason we need to augment our analysis with this database is that the CRSP Mutual Fund Database does not contain information on fund positions in individual stocks. The CDA Spectrum Database reports a fund's stock positions on a quarterly basis but it is not available until the early 1980s and does not report a fund's cash positions. Russ Wermers (2000) compared the funds in these two databases and found that the active funds represented in the two databases are comparable. So while the CDA Spectrum Database is less effective than the CRSP Mutual Fund Database in measuring performance, it is adequate for analyzing the effects of fund size on stock positions. We will provide a more detailed discussion of this database in Section III.

II. Methodology

Our empirical strategy utilizes cross-sectional variation to see how fund performance varies with lagged fund size. We could have adopted a fixed-effects approach by looking at whether changes in a fund's performance are related to changes in its size. Such an approach is subject, however, to a regression-to-the-mean bias. A fund with a year or two of lucky performance will experience an increase in fund size. But performance will regress to the mean, leading to a spurious conclusion that an increase in fund size is associated with a decrease in fund returns. Measuring the effect of fund size on performance using cross-sectional regressions is less subject to such bias. Indeed, it may even be conservative given our goal, since larger funds are likely to be better funds or they would

not have become large in the first place. We are likely to be biased toward finding any diseconomies of scale using cross-sectional variation.

There are two major worries that arise, however, when using cross-sectional variation. The first is that funds of different sizes may be in different styles. For instance, small funds might be more likely than large funds to pursue small stock, value stock, and price momentum strategies, which have been documented to generate abnormal returns. While it is not clear that one necessarily wants to adjust for such heterogeneity, it would be more interesting if we found that past fund size influences future performance even after accounting for variations in fund styles. The second worry is that fund size might be correlated with other fund characteristics such as fund age or turnover, and it may be these characteristics that are driving performance. For instance, fund size may be measuring whether a fund is active or passive (which may be captured by fund turnover). While we have tried our best to rule out passive funds in our sample construction, it is possible that some funds may just be indexers. And if it turns out that indexers happen to be large funds because more investors put their money in such funds, then size may be picking up differences in the degree of activity among funds.

A. Fund Performance Benchmarks

A very conservative way to deal with the first worry about heterogeneity in fund styles is to adjust for fund performance by various benchmarks. In this paper, we consider, in addition to simple market-adjusted returns, returns adjusted by the Capital Asset Pricing Model (CAPM) of William F. Sharpe (1964). We also consider returns adjusted using the Eugene F. Fama and Kenneth R. French (1993) three-factor model, and this model augmented with the momentum factor of Narasimhan Jegadeesh and Titman (1993), which has been shown in various contexts to provide explanatory power for the observed cross-sectional variation in fund performance (see, e.g., Mark M. Carhart, 1997).

Panel (A) of Table 2 reports the summary statistics for the various portfolios that make up our performance benchmarks. Among these are the returns on the CRSP value-weighted

stock index net of the one-month Treasury rate (VWRF), the returns to the Fama and French (1993) SMB (small stocks minus large stocks) and HML (high book-to-market stocks minus low book-to-market stocks) portfolios, and the returns-to-price momentum portfolio MOM12 (a portfolio that is long stocks that are past-12-month winners and short stocks that are past-12-month losers and hold for one month). The summary statistics for these portfolio returns are similar to those reported in other mutual fund studies.

Since we are interested in the relationship between fund size and performance, we sort mutual funds at the beginning of each month based on the quintile rankings of their previous-month *TNA*.⁸ We then track these five portfolios for one month and use the entire time series of their monthly net returns to calculate the loadings to the various factors (VWRF, SMB, HML, MOM12) for each of these five portfolios. For each month, each mutual fund inherits the loadings of the one of these five portfolios that it belongs to. In other words, if a mutual fund stays in the same-size quintile throughout its life, its loadings remain the same. But if it moves from one size quintile to another during a certain month, it inherits a new set of loadings with which we adjust its next month's performance.

Panel (B) reports the loadings of the five fund-size (*TNA*) sorted mutual fund portfolios using the CAPM

(1)

$$R_{i,t} = \alpha_i + \beta_i \text{VWRF}_t + \varepsilon_{i,t} \quad t = 1, \dots, T$$

where $R_{i,t}$ is the (net fund) return on one of our five fund-size-sorted mutual fund portfolios in month t in excess of the one-month T-bill return, α_i is the excess return of that portfolio, β_i is the loading on the market portfolio, and $\varepsilon_{i,t}$ stands for a generic error term that is uncorrelated with all other independent variables. As

⁸ We also sort mutual funds by their past-12-month returns to form benchmark portfolios. Our results are unchanged when using these benchmark portfolios. We omit these results for brevity.

TABLE 2—SUMMARY STATISTICS FOR PERFORMANCE BENCHMARKS

<i>Panel A: Summary statistics of the factors</i>						
Factor	Mean return	SD of return	Cross-correlations			
			VWRF	SMB	HML	MOM12
VWRF	0.58%	4.37%	1.00	0.32	-0.39	-0.02
SMB	0.17%	2.90%		1.00	-0.16	-0.30
HML	0.34%	2.63%			1.00	-0.15
MOM12	0.96%	3.88%				1.00

<i>Panel B: Loadings calculated using the CAPM</i>		
Portfolio	CAPM	
	Alpha	VWRF
1 (small)	0.04%	0.87
2	-0.02%	0.91
3	-0.01%	0.93
4	-0.09%	0.92
5 (large)	-0.07%	0.91

<i>Panel C: Loadings calculated using the 3-Factor model and the 4-Factor model</i>									
Portfolio	3-Factor model				4-Factor model				MOM12
	Alpha	VWRF	SMB	HML	Alpha	VWRF	SMB	HML	
1 (small)	0.01%	0.82	0.29	0.03	-0.02%	0.82	0.30	0.04	0.03
2	-0.03%	0.84	0.27	-0.01	-0.09%	0.85	0.30	0.00	0.05
3	0.01%	0.87	0.22	-0.05	-0.06%	0.87	0.25	-0.03	0.06
4	-0.06%	0.87	0.18	-0.05	-0.13%	0.87	0.20	-0.04	0.06
5 (large)	-0.05%	0.88	0.08	-0.06	-0.10%	0.88	0.10	-0.05	0.05

Notes: This table reports the loadings of the five (equal-weighted) TNA-sorted fund portfolios on various factors. Panel (A) reports the summary statistics for the factors. VWRF is the return on the CRSP value-weighted stock index in excess of the one-month Treasury rate. SMB is the return on a portfolio of small stocks minus large stocks. HML is the return on a portfolio long high book-to-market stocks and short low book-to-market stocks. MOM12 is the return on a portfolio long stocks that are past-12-month winners and short those that are past-12-month losers. Panel (B) reports the loadings calculated using the CAPM. Panel (C) reports the loadings calculated using the Fama-French (1993) 3-Factor model and this model augmented with the momentum factor (4-Factor model). The sample period is from January 1963 to December 1999.

other papers have found, the average mutual fund has a beta of around 0.91, reflecting the fact that mutual funds hold some cash or bonds in their portfolios. Notice that there is only a slight variation in the market beta (β_i 's) from the smallest to the largest fund size portfolio: the smallest portfolio has a somewhat smaller beta, but not by much.

Panel (C) reports the loadings for two additional performance models, the Fama-French three-factor model and this three-factor model augmented by a momentum factor

$$(2) \quad R_{i,t} = \alpha_i + \beta_{i,1} \text{VWRF}_t + \beta_{i,2} \text{SMB}_t + \beta_{i,3} \text{HML}_t + \varepsilon_{i,t} \quad t = 1, \dots, T$$

$$(3) \quad R_{i,t} = \alpha_i + \beta_{i,1} \text{VWRF}_t + \beta_{i,2} \text{SMB}_t + \beta_{i,3} \text{HML}_t + \beta_{i,4} \text{MOM12}_t + \varepsilon_{i,t} \quad t = 1, \dots, T$$

where $R_{i,t}$ is the (net fund) return on one of our five size-sorted mutual fund portfolios in month t in excess of the one-month T-bill return, α_i is the excess return, β_i 's are loadings on the various portfolios, and $\varepsilon_{i,t}$ stands for a generic error term that is uncorrelated with all other independent variables. We see that small funds tend to have higher loadings on SMB and HML, but large funds tend to load a bit more on momentum. For instance, the loading on SMB for the

three-factor model for funds in quintile one is 0.29 while the corresponding loading for funds in quintile five is 0.08. And whereas large funds load negatively on HML (-0.06 for the largest funds), the smallest funds load positively on HML (0.03). (Eric G. Falkenstein [1996] also finds some evidence that larger funds tend to play large and glamour stocks by looking at fund holdings.)

We have also redone all of our analysis by calculating these loadings using gross fund returns instead of net fund returns. As the results are very similar to using net fund returns, for brevity we will use the loadings summarized in Table 2 to adjust fund performance below (whether it be gross or net returns). Using the entire time series of a particular fund (we require at least 36 months of data), we also calculate the loadings separately for each mutual fund using equations (1) to (3). This technique is not as good in the sense that we have a much more selective requirement on selection and the estimated loadings tend to be very noisy. In any case, our results are unchanged, so we omit these results for brevity.

B. Regression Specifications

To deal with the second concern related to the correlation of fund size with other fund characteristics, we analyze the effect of past fund size on performance in the regression framework proposed by Fama and James D. MacBeth (1973), where we can control for the effects of other fund characteristics on performance. Specifically, the regression specification that we utilize is

$$(4) \quad FUNDRET_{i,t} = \mu + \phi LOGTNA_{i,t-1} + \boldsymbol{\gamma} \mathbf{X}_{i,t-1} + \varepsilon_{i,t} \quad i = 1, \dots, N$$

where $FUNDRET_{i,t}$ is the return (either gross or net) of fund i in month t adjusted by various performance benchmarks, μ is a constant, $LOGTNA_{i,t-1}$ is the measure of fund size, and $\mathbf{X}_{i,t-1}$ is a set of control variables (in month $t - 1$) that includes $LOGFAMSIZE_{i,t-1}$, $TURNOVER_{i,t-1}$, $AGE_{i,t-1}$, $EXPRATIO_{i,t-1}$, $TOTLOAD_{i,t-1}$, and $FLOW_{i,t-1}$. In addition, we include in the right-hand side $LAGFUNDRET_{i,t-1}$, which is the past-year return of the fund. Here, $\varepsilon_{i,t}$ again

stands for a generic error term that is uncorrelated with all other independent variables. The coefficient of interest is ϕ , which captures the relationship between fund size and fund performance, controlling for other fund characteristics. $\boldsymbol{\gamma}$ is the vector of loadings on the control variables. We then take the estimates from these monthly regressions and follow Fama and MacBeth (1973) in taking their time series means and standard deviations to form our overall estimates of the effects of fund characteristics on performance.

We will also utilize an additional regression specification given by the following:

$$(5) \quad FUNDRET_{i,t} = \mu + \phi_1 LOGTNA_{i,t-1} + \phi_2 \text{Ind}_{\{\text{Style}\}} + \phi_3 LOGTNA_{i,t-1} \text{Ind}_{\{\text{Style}\}} + \boldsymbol{\gamma} \mathbf{X}_{i,t-1} + \varepsilon_{i,t} \quad i = 1, \dots, N$$

where the dummy indicator $\text{Ind}_{\{\text{Style}\}}$ (that equals one if a fund belongs to a certain style category and zero otherwise) and the remaining variables are the same as in equation (3). The coefficient of interest is ϕ_3 , which measures the differential effect of fund size on returns across different fund styles. It is important to note that we do not attempt to measure whether the relationship between fund performance and fund size may be nonlinear. While some theories might suggest that very small funds may have inferior performance to medium-sized ones because they are being operated at a suboptimally small scale, we are unable to get at this issue because inference regarding the performance of the smallest funds is problematic for the reasons articulated in Section II.

III. Results

A. Relationship between Fund Size and Performance

In Table 3, we report the estimation results for the baseline regression specification given in equation (4). We begin by reporting the results for gross fund returns. The sample consists of funds from fund size quintiles two through five. Notice that the coefficient in front of $LOGTNA$ is negative and statistically significant across the four performance measures. The coefficients

TABLE 3—REGRESSION OF FUND PERFORMANCE ON LAGGED FUND SIZE

	Gross fund returns				Net fund returns			
	Market-Adj	Beta-Adj	3-Factor	4-Factor	Market-Adj	Beta-Adj	3-Factor	4-Factor
<i>INTERCEPT</i>	0.056 (0.96)	0.087 (1.63)	0.080 (1.28)	0.019 (0.30)	0.026 (0.44)	0.056 (1.05)	0.049 (0.79)	-0.011 (0.18)
<i>LOGTNA</i> _{<i>i,t-1</i>}	-0.028 (3.02)	-0.028 (3.04)	-0.023 (2.42)	-0.020 (2.15)	-0.025 (2.75)	-0.025 (2.76)	-0.020 (2.16)	-0.018 (1.89)
<i>LOGFAMSIZE</i> _{<i>i,t-1</i>}	0.007 (2.26)	0.007 (2.27)	0.007 (2.22)	0.007 (2.21)	0.007 (2.33)	0.007 (2.34)	0.007 (2.29)	0.007 (2.28)
<i>TURNOVER</i> _{<i>i,t-1</i>}	0.000 (0.85)	0.000 (0.86)	0.000 (0.85)	0.000 (0.83)	0.000 (0.77)	0.000 (0.78)	0.000 (0.77)	0.000 (0.75)
<i>AGE</i> _{<i>i,t-1</i>}	-0.001 (0.62)	-0.001 (0.62)	-0.001 (0.64)	-0.001 (0.63)	0.000 (0.52)	0.000 (0.53)	-0.001 (0.55)	-0.001 (0.54)
<i>EXPRATIO</i> _{<i>i,t-1</i>}	-0.004 (0.11)	-0.004 (0.09)	-0.007 (0.18)	-0.007 (0.18)	-0.039 (0.97)	-0.038 (0.95)	-0.041 (1.04)	-0.041 (1.05)
<i>TOTLOAD</i> _{<i>i,t-1</i>}	0.003 (1.26)	0.003 (1.25)	0.003 (1.26)	0.003 (1.29)	0.003 (1.21)	0.003 (1.20)	0.003 (1.21)	0.003 (1.25)
<i>FLOW</i> _{<i>i,t-1</i>}	0.000 (0.50)	0.000 (0.50)	0.000 (0.51)	0.000 (0.49)	0.000 (0.47)	0.000 (0.47)	0.000 (0.48)	0.000 (0.46)
<i>LAGFUNDRET</i> _{<i>i,t-1</i>}	0.029 (6.00)	0.028 (5.98)	0.028 (6.00)	0.029 (5.99)	0.029 (6.03)	0.029 (6.01)	0.029 (6.03)	0.029 (6.02)
No. of months	444	444	444	444	444	444	444	444

Notes: This table shows the Fama-MacBeth (1973) estimates of monthly fund returns regressed on fund characteristics lagged one month. The sample includes only funds that fall within fund size quintiles two to five. Fund returns are calculated before (gross) and after (net) deducting fees and expenses. These returns are adjusted using the market model, the CAPM, the Fama-French (1993) 3-Factor model, and the 4-Factor model. The dependent variable is *FUNDRET*. *LOGTNA* is the natural logarithm of *TNA*. *LOGFAMSIZE* is the natural logarithm of one plus the size of the family that the fund belongs to. *TURNOVER* is fund turnover and *AGE* is the number of years since the organization of the mutual fund. *EXPRATIO* is the total annual management fees and expenses divided by *TNA*. *TOTLOAD* is the total front-end, deferred, and rear-end charges as a percentage of new investments. *FLOW* is the percentage new fund flow into the mutual fund over the past one year. *LAGFUNDRET* is the cumulative (buy-hold) fund return over the past 12 months. The sample is from January 1963 to December 1999. The *t*-statistics are adjusted for serial correlation using Newey-West (1987) lags of order three and are shown in parentheses.

obtained using either market-adjusted or CAPM-adjusted returns are around -0.028 with *t*-statistics of around three. Since one standard deviation of *LOGTNA* is 1.38, a two-standard deviation shock to fund size means that performance changes by -0.028 times 2.8, or 8 basis points per month (96 basis points per year). For the other two performance benchmarks, the 3-factor and 4-factor adjusted returns, the coefficients are slightly smaller at -0.02 , but both are still statistically significant with *t*-statistics of between 2.1 and 2.5. For these coefficients, a two-standard deviation shock to fund size means that performance changes by around 70 basis points annually.

To put these magnitudes into some perspective, observe that a standard deviation of mutual fund returns is around 10 percent annually, with slight variations around this figure depending on the performance measure. Hence, a two-

standard deviation shock in fund size yields a movement in next year's fund return that is approximately 10 percent of the annual volatility of mutual funds (96 basis points divided by 10 percent). Another way to think about these magnitudes is that the typical fund has a gross fund performance net of the market return that is basically near zero. As a result, a spread in fund performance of anywhere from 70 to 96 basis points a year is quite economically significant.

Table 3 also reveals a number of other interesting findings. The only other variables beside fund size that are statistically significant are *LOGFAMSIZE* and *LAGFUNDRET*. Interestingly, *LOGFAMSIZE* predicts better fund performance. We will have much more to say about the coefficient in front of *LOGFAMSIZE* later. It should be emphasized at this point that it is important to control for family size in order

to find a sizeable impact of fund size on performance. This is because fund and family size are positively correlated, and since family size is good for performance, it is important to control for it to identify the negative effect of fund size. This is a major reason why other studies that have had fund size as a control variable in explaining fund returns do not find any significant effect. As a result, these studies mention fund size only in passing and do not provide any analysis whatsoever.

The fact that the coefficient in front of *LAGFUNDRET* is significant suggests that there is some persistence in fund returns. As for the rest of the variables, some come in with expected signs, though none is statistically significant. The coefficient in front of *EXPRATIO* is negative, consistent with industry observations that larger funds have lower expense ratios. The coefficients in front of *TOTLOAD* and *TURNOVER* are positive, as these two variables are thought to be proxies for whether a fund is active or passive. Fund flow has a negligible ability to predict fund returns, and the age of the fund comes in with a negative sign but is statistically insignificant.

We next report the results of the baseline regression using net fund returns. The coefficient in front of *LOGTNA* is still negative and statistically significant across all performance benchmarks. Indeed, the coefficient in front of *LOGTNA* is only slightly smaller using net fund returns than using gross fund returns. The observations regarding the economic significance of fund size made earlier continue to hold. If anything, they are even more relevant in this context since the typical fund tends to underperform the market by about 96 basis points annually. The coefficients in front of the other variables have similar signs to those obtained using gross fund returns. Importantly, keep in mind that the coefficient in front of *LOGFAMSIZE* is just as statistically and economically significant using net fund returns as gross fund returns.

In Table 4, we present various permutations involving the regression specification in equation (4) to see if the results in Table 3 are robust. In panel (A), we present the results using all the funds in our sample, including those in the smallest fund size quintile. As we mentioned earlier, the performance of the funds in the

bottom fund size quintile is biased upward, so we should not draw too much from this analysis other than that our results are unchanged by including them in the sample. For brevity, we report only the coefficients in front of *LOGTNA* and *LOGFAMSIZE*. Using gross fund returns, the coefficient in front of *LOGTNA* ranges from -0.019 to -0.026 depending on the performance measure. For net fund returns, it ranges from -0.015 to -0.022 . All the coefficients are statistically significant at the 5-percent level, with the exception of the coefficient obtained using 3-factor adjusted net fund returns. The coefficient in this instance is significant only at the 10-percent level of significance. The magnitudes are somewhat smaller using the full sample than the sample that excludes the smallest quintile. This difference, however, is not large. Moreover, the coefficients in front of *LOGFAMSIZE* are similar in magnitude to those obtained in Table 3. As such, we conclude that our key findings in Table 3 are robust to including all funds in the sample.

In panel (B), we attempt to predict a fund's cumulative return next year rather than its return next month. Not surprisingly, we find similar results to those in Table 3. The coefficient in front of *LOGTNA* is negative and statistically significant across all performance benchmarks. Indeed, the economic magnitudes implied by these estimates are similar to those obtained in Table 3. These statements apply equally to *LOGFAMSIZE*.

In panels (C) and (D), we split our benchmark sample in half to see whether our estimates on *LOGTNA* and *LOGFAMSIZE* depend on particular subperiods 1963 to 1980 and 1981 to 1999. It appears that *LOGTNA* has a strong negative effect on performance regardless of the subperiods, since the economic magnitudes are very similar to those obtained in Table 3. We would not be surprised if the coefficients were not statistically significant since we have smaller sample sizes in panels (C) and (D). But even with only half the sample size, *LOGTNA* comes in significantly for a number of the performance measures. In contrast, it appears that the effect of *LOGFAMSIZE* on performance is much more pronounced in the latter half of the sample.

The analyses in Tables 3 and 4 strongly indicate that fund size is negatively related to

TABLE 4—REGRESSION OF FUND RETURNS ON LAGGED FUND SIZE, ROBUSTNESS CHECKS

<i>Panel A: Sample includes all funds</i>								
	Gross fund returns				Net fund returns			
	Market-Adj	Beta-Adj	3-Factor	4-Factor	Market-Adj	Beta-Adj	3-Factor	4-Factor
$LOGTNA_{i,t-1}$	-0.023 (2.59)	-0.026 (2.94)	-0.019 (2.22)	-0.021 (2.48)	-0.020 (2.16)	-0.022 (2.49)	-0.015 (1.76)	-0.017 (2.02)
$LOGFAMSIZE_{i,t-1}$	0.006 (1.99)	0.006 (2.03)	0.006 (1.99)	0.006 (2.05)	0.006 (2.10)	0.006 (2.15)	0.006 (2.11)	0.006 (2.17)
No. of months	444	444	444	444	444	444	444	444
<i>Panel B: Dependent variable is 12-month (non-overlapping) fund returns</i>								
	Gross fund returns				Net fund returns			
	Market-Adj	Beta-Adj	3-Factor	4-Factor	Market-Adj	Beta-Adj	3-Factor	4-Factor
$LOGTNA_{i,t-1}$	-0.436 (3.26)	-0.440 (3.27)	-0.345 (2.40)	-0.312 (2.19)	-0.402 (3.07)	-0.406 (3.07)	-0.312 (2.20)	-0.280 (1.99)
$LOGFAMSIZE_{i,t-1}$	0.088 (2.05)	0.089 (2.06)	0.088 (2.05)	0.088 (2.07)	0.090 (2.10)	0.091 (2.12)	0.090 (2.11)	0.090 (2.12)
No. of years	37	37	37	37	37	37	37	37
<i>Panel C: Sample period is from 1963 to 1980</i>								
	Gross fund returns				Net fund returns			
	Market-Adj	Beta-Adj	3-Factor	4-Factor	Market-Adj	Beta-Adj	3-Factor	4-Factor
$LOGTNA_{i,t-1}$	-0.035 (2.41)	-0.034 (2.42)	-0.021 (1.51)	-0.019 (1.33)	-0.032 (2.22)	-0.032 (2.23)	-0.019 (1.32)	-0.016 (1.15)
$LOGFAMSIZE_{i,t-1}$	0.002 (0.49)	0.002 (0.50)	0.002 (0.45)	0.002 (0.44)	0.002 (0.56)	0.002 (0.58)	0.002 (0.53)	0.002 (0.52)
No. of months	216	216	216	216	216	216	216	216
<i>Panel D: Sample period is from 1981 to 1999</i>								
	Gross fund returns				Net fund returns			
	Market-Adj	Beta-Adj	3-Factor	4-Factor	Market-Adj	Beta-Adj	3-Factor	4-Factor
$LOGTNA_{i,t-1}$	-0.021 (1.84)	-0.022 (1.86)	-0.024 (1.93)	-0.022 (1.71)	-0.019 (1.64)	-0.019 (1.65)	-0.022 (1.74)	-0.019 (1.53)
$LOGFAMSIZE_{i,t-1}$	0.012 (2.53)	0.012 (2.53)	0.012 (2.50)	0.012 (2.50)	0.012 (2.55)	0.012 (2.55)	0.012 (2.52)	0.012 (2.52)
No. of months	228	228	228	228	228	228	228	228

Notes: This table presents robustness checks of the regression specification in Table 3. In panel (A), the sample includes all funds. In panel (B), the dependent variable is 12-month fund returns and the regressions are non-overlapping. In panel (C), the sample consists only of observations from 1963 to 1980. In panel (D), the sample consists only of observations from 1981 to 1999. $LOGTNA$ is the natural logarithm of TNA . $LOGFAMSIZE$ is the natural logarithm of one plus the size of the family that the fund belongs to. Estimates of the intercept and other independent variables are omitted for brevity. The other independent variables include $TURNOVER$, AGE , $EXPRATIO$, $TOTLOAD$, $FLOW$, and $LAGFUNDRET$. The t -statistics are adjusted for serial correlation using Newey-West (1987) lags of order three and are shown in parentheses.

future fund performance. Moreover, we are able to rule out that this relationship is driven by differences in fund styles or mechanical correlations of fund size with other observable fund characteristics. However, there still remain a

number of potential explanations for this relationship.

Three explanations come to mind. First, the lagged fund size and performance relationship is due to transaction costs associated with li-

quidity or price impact. We call this the “liquidity hypothesis.” Second, perhaps investors in large funds are less discriminating about returns than investors in small funds. One reason why this might be the case is that such large funds as Magellan are better at marketing and are able to attract investors through advertising. In contrast, small funds without such marketing operations may need to rely more on performance to attract and maintain investors. We call this the “clienteles hypothesis.” Third, fund size is inversely related to performance because of fund incentives to lock in assets under management after a long string of good past performances.⁹ When a fund is small and has a limited reputation, the manager goes about the business of stock picking. But as the fund gets large because of good past performance, the manager may for various reasons lock in his fund size by being passive (or being a “closet indexer” as practitioners put it). We call this the “agency-risk-taking hypothesis.” The general theme behind the second and third hypotheses is that after funds reach a certain size, they no longer care about maximizing returns.

B. The Role of Liquidity: Fund Size, Fund Styles, and the Number of Stocks in a Fund's Portfolio

In order to narrow the list of potential explanations, we design a test of the liquidity hypothesis. To the extent that liquidity is driving our findings above, we would expect to see that fund size matters much more for performance among funds that have to invest in small stocks (i.e., stocks with small market capitalization) than funds that get to invest in large stocks. The

reason is that small stocks are notoriously illiquid. As a result, funds that have to invest in small stocks are more likely to need new stock ideas with asset base growth, whereas large funds can simply increase their existing positions without being hurt too much by price impact.

Importantly, this test of the liquidity hypothesis also allows us to discriminate between the other two hypotheses. First, existing research finds that there is little variation in incentives between “small cap” funds (i.e., funds that have to invest in small stocks) and other funds (see, e.g., Andres Almazan et al., 2001). Hence, this prediction ought to help us discriminate between our hypothesis and the alternative “agency-risk-taking” story involving fund incentives. Moreover, since funds that have to invest in small stocks tend to do better than other funds, it is not likely that our results are due to the clienteles of these funds being more irrational than those investing in other funds. This allows us to distinguish the liquidity story from the clienteles story.

In the CRSP Mutual Fund Database, we are fortunate that each fund self-reports its style, and so we looked for style descriptions containing the words “small cap.” It turns out that one style, “Small Cap Growth,” fits this criterion. Funds in this category are likely to have to invest in small stocks by virtue of their style designation. Thus, we identify a fund in our sample as either Small Cap Growth if it has ever reported itself as such or “Not Small Cap Growth.” (Funds rarely change their self-reported style.) Unfortunately, funds with this designation are not prevalent until the early 1980s. Therefore, throughout the analysis in this section, we limit our sample to the 1981–1999 period. During this period, there are on average 165 such funds each year. The corresponding number for the overall sample during this period is about 1,000. Therefore, Small Cap Growth represents a small but healthy slice of the overall population. Also, the average *TNA* of these funds is \$212.9 million with a standard deviation of \$566.7 million. The average *TNA* of a fund in the overall sample during this latter period is \$431.5 million with a standard deviation of \$1.58 billion. Thus, Small Cap Growth funds are smaller than the typical fund. But they are still quite big and there is a healthy fund size

⁹ More generally, it may be that after many years of good performance, bad performance follows for whatever reason. We are offering here a plausible economic mechanism for why this might come about. The *ex ante* plausibility of this alternative story is, however, somewhat mixed. On the one hand, the burgeoning empirical literature on career concerns suggests that fund managers ought to be bolder with past success (see, e.g., Judith A. Chevalier and Glenn D. Ellison, 1999 and Hong, Kubik, and Solomon, 2000). On the other hand, the fee structure means that funds may want to lock in assets under management because investors are typically slow to pull their money out of funds (Brown et al., 1996; Chevalier and Ellison, 1997).

distribution among them, so that we can measure the effect of fund size on performance.

Table 5, panel (A), reports what happens to the results in Table 3 when we augment the regression specifications by including a dummy indicator $\text{Ind}_{\{\text{not SCG}\}}$ (which equals one if a fund is not Small Cap Growth and zero otherwise) and an additional interaction term involving LOGTNA and $\text{Ind}_{\{\text{not SCG}\}}$ as in equation (5). We first report the results for gross fund returns. The coefficient in front of LOGTNA is about -0.06 (across the four performance benchmarks). Importantly, the coefficient in front of the interaction term is positive and statistically significant (about 0.04 across the four performance benchmarks). This is the sign predicted by the liquidity hypothesis since it says that for Not Small Cap Growth funds, there is a smaller effect of fund size on performance. The effect is economically interesting as well. Since the two coefficients, -0.06 and 0.04 , are similar in magnitude, a sizeable fraction of the effect of fund size on performance comes from small cap funds. The results using net fund returns reported are similar.

In panel (A) of Table 5, we compared Small Cap Growth funds to all other funds. In panel (B) of Table 5, we delve a bit deeper into the “liquidity hypothesis” by looking at how fund performance varies with fund size depending on whether a fund is a Large Cap fund, one that is supposed to invest in large-cap stocks.¹⁰ We augment the regression specification of Table 3 by introducing a dummy variable $\text{Ind}_{\{\text{LC}\}}$ (which equals one if a fund is a Large

Cap fund and zero otherwise) and an additional interaction term involving LOGTNA and $\text{Ind}_{\{\text{LC}\}}$ as in equation (5). We first report the results for gross fund returns. The coefficient in front of LOGTNA is about -0.03 (across the four performance benchmarks). Importantly, the coefficient in front of the interaction term is positive and statistically significant (about 0.03 across the four performance benchmarks). This is the sign predicted by the liquidity hypothesis since it says that for Large Cap funds, there is no effect of fund size on performance. The results using net fund returns reported are similar.

These findings suggest that liquidity plays an important role in eroding performance. Moreover, as many practitioners have pointed out, since managers of funds get compensated on assets under management, they are not likely voluntarily to keep their funds small just because it hurts the returns of their investors, who may not be aware of the downside of scale (see Becker and Vaughn, 2001, and Section IV for further discussion).¹¹

As we pointed out in the beginning of the paper, however, liquidity means that large funds need to find more stock ideas than small funds, but it does not therefore follow that they cannot. Indeed, large funds can hire more managers to follow more stocks. To see that this is possible, we calculate some basic summary statistics on fund holdings by fund size quintiles. Since the CRSP Mutual Fund Database does not have this information, we turn to the CDA Spectrum Database. We take data from the end of September 1997 and calculate the number of stocks held by each fund. The median fund in the smallest fund size quintile has about 16 stocks in its portfolio, while the median fund in the largest fund size quintile has about 66 stocks in its portfolio, even though the large funds are many times bigger than their smaller counterparts. These numbers make clear that large funds do not significantly scale up the number of stocks that they hold or cover relative to their smaller counterparts. Yet, there is plenty

¹⁰ We merged the CRSP Mutual Fund Database and the CDA Spectrum Database so that we have information on the stocks held by the funds in our sample. We have verified that mutual funds with the self-reported fund style of Small Cap Growth do indeed invest in stocks with a much lower market capitalization than held by funds of other styles. In contrast, mutual funds whose self-reported fund style is “Growth and Income” invest in much larger stocks when compared to funds with other styles. As a result, we characterize these funds as Large Cap funds in our analysis above. Moreover, we have also verified that Small Cap funds hold stocks that are more illiquid in the sense that the stocks in their portfolios tend to have much larger Kyle lambdas and bid-ask spreads than the stocks held by funds of other styles. And Large Cap funds hold stocks that are much more liquid than those held by funds of other styles.

¹¹ Related literature finds that mutual fund investors are susceptible to marketing (see, e.g., Gruber, 1996; Eric R. Sirri and Peter Tufano, 1998; Lu Zheng, 1999).

TABLE 5—EFFECT OF FUND SIZE ON PERFORMANCE BY FUND STYLE

Panel A: Small Cap Growth funds								
	Gross fund returns				Net fund returns			
	Market-Adj	Beta-Adj	3-Factor	4-Factor	Market-Adj	Beta-Adj	3-Factor	4-Factor
<i>INTERCEPT</i>	0.205 (1.27)	0.257 (1.53)	0.320 (2.44)	0.263 (1.98)	0.175 (1.08)	0.226 (1.34)	0.289 (2.20)	0.231 (1.75)
<i>IND</i> _{not SCG}	-0.250 (1.54)	-0.252 (1.55)	-0.260 (1.62)	-0.262 (1.63)	-0.249 (1.53)	-0.251 (1.54)	-0.259 (1.61)	-0.261 (1.62)
<i>LOGTNA</i> _{<i>i,t-1</i>}	-0.058 (3.15)	-0.058 (3.17)	-0.063 (3.40)	-0.061 (3.29)	-0.055 (3.03)	-0.056 (3.05)	-0.060 (3.28)	-0.058 (3.17)
<i>LOGTNA</i> _{<i>i,t-1</i>} *	0.040 (2.36)	0.041 (2.39)	0.043 (2.53)	0.044 (2.56)	0.040 (2.35)	0.041 (2.37)	0.043 (2.52)	0.044 (2.55)
<i>IND</i> _{not SCG}								
<i>LOGFAMSIZE</i> _{<i>i,t-1</i>}	0.012 (2.57)	0.012 (2.57)	0.011 (2.54)	0.011 (2.54)	0.012 (2.59)	0.012 (2.59)	0.012 (2.57)	0.012 (2.56)
<i>TURNOVER</i> _{<i>i,t-1</i>}	0.000 (1.62)	0.000 (1.61)	0.000 (1.62)	0.000 (1.61)	0.000 (1.57)	0.000 (1.56)	0.000 (1.57)	0.000 (1.57)
<i>AGE</i> _{<i>i,t-1</i>}	-0.001 (0.98)	-0.001 (0.97)	-0.001 (0.98)	-0.001 (0.97)	-0.001 (0.87)	-0.001 (0.87)	-0.001 (0.88)	-0.001 (0.87)
<i>EXPRATIO</i> _{<i>i,t-1</i>}	-0.018 (0.44)	-0.018 (0.43)	-0.019 (0.46)	-0.019 (0.44)	-0.062 (1.49)	-0.062 (1.48)	-0.064 (1.52)	-0.063 (1.51)
<i>TOTLOAD</i> _{<i>i,t-1</i>}	0.001 (0.54)	0.001 (0.54)	0.001 (0.52)	0.001 (0.52)	0.001 (0.48)	0.001 (0.47)	0.001 (0.46)	0.001 (0.46)
<i>FLOW</i> _{<i>i,t-1</i>}	0.000 (0.96)	0.000 (0.95)	0.000 (0.90)	0.000 (0.92)	0.000 (1.02)	0.000 (1.02)	0.000 (0.96)	0.000 (0.99)
<i>FUNDRET</i> _{<i>i,t-1</i>}	0.022 (3.45)	0.022 (3.45)	0.021 (3.43)	0.021 (3.42)	0.022 (3.48)	0.022 (3.48)	0.022 (3.45)	0.022 (3.45)
No. of months	228	228	228	228	228	228	228	228

Panel B: Large Cap funds								
	Gross fund returns				Net fund returns			
	Market-Adj	Beta-Adj	3-Factor	4-Factor	Market-Adj	Beta-Adj	3-Factor	4-Factor
<i>INTERCEPT</i>	0.016 (0.19)	0.068 (0.84)	0.128 (1.72)	0.068 (0.92)	-0.017 (0.20)	0.035 (0.43)	0.095 (1.27)	0.034 (0.47)
<i>IND</i> _{LC}	-0.119 (1.31)	-0.121 (1.33)	-0.119 (1.33)	-0.120 (1.34)	-0.112 (1.23)	-0.114 (1.25)	-0.112 (1.24)	-0.113 (1.26)
<i>LOGTNA</i> _{<i>i,t-1</i>}	-0.029 (2.22)	-0.029 (2.24)	-0.032 (2.45)	-0.029 (2.25)	-0.027 (2.02)	-0.027 (2.05)	-0.029 (2.26)	-0.027 (2.05)
<i>LOGTNA</i> _{<i>i,t-1</i>} *	0.031 (2.29)	0.031 (2.32)	0.031 (2.34)	0.031 (2.36)	0.030 (2.23)	0.030 (2.26)	0.030 (2.28)	0.030 (2.30)
<i>IND</i> _{LC}								
<i>LOGFAMSIZE</i> _{<i>i,t-1</i>}	0.011 (2.54)	0.011 (2.54)	0.011 (2.51)	0.011 (2.51)	0.011 (2.58)	0.011 (2.58)	0.011 (2.55)	0.011 (2.55)
<i>TURNOVER</i> _{<i>i,t-1</i>}	0.000 (1.80)	0.000 (1.79)	0.000 (1.80)	0.000 (1.79)	0.000 (1.75)	0.000 (1.75)	0.000 (1.76)	0.000 (1.75)
<i>AGE</i> _{<i>i,t-1</i>}	-0.001 (1.26)	-0.001 (1.25)	-0.001 (1.26)	-0.001 (1.25)	-0.001 (1.17)	-0.001 (1.17)	-0.001 (1.17)	-0.001 (1.16)
<i>EXPRATIO</i> _{<i>i,t-1</i>}	-0.020 (0.49)	-0.019 (0.48)	-0.021 (0.52)	-0.020 (0.50)	-0.065 (1.63)	-0.065 (1.62)	-0.066 (1.66)	-0.065 (1.64)
<i>TOTLOAD</i> _{<i>i,t-1</i>}	0.001 (0.35)	0.001 (0.35)	0.001 (0.34)	0.001 (0.35)	0.001 (0.30)	0.001 (0.30)	0.001 (0.29)	0.001 (0.29)
<i>FLOW</i> _{<i>i,t-1</i>}	0.000 (0.84)	0.000 (0.82)	0.000 (0.77)	0.000 (0.79)	0.000 (0.89)	0.000 (0.88)	0.000 (0.83)	0.000 (0.85)
<i>FUNDRET</i> _{<i>i,t-1</i>}	0.020 (3.10)	0.020 (3.09)	0.020 (3.07)	0.020 (3.07)	0.021 (3.13)	0.020 (3.12)	0.020 (3.10)	0.020 (3.09)
No. of months	228	228	228	228	228	228	228	228

Notes: This table reports the Fama-MacBeth (1973) estimates of monthly fund returns regressed on fund characteristics lagged one month. The sample includes only funds that fall within fund size quintiles two to five. Fund returns are calculated before (gross) and after (net) deducting fees and expenses. These fund returns are adjusted using the market model, the CAPM, the Fama-French (1993) 3-Factor model, and the 4-Factor model. In panel (A), the regression specification is the one in Table 3 but augmented with $IND_{\{not\ SCG\}}$, which is a dummy variable that equals one if the self-reported fund style is not Small Cap Growth and zero otherwise and this indicator variable interacted with $LOGTNA$. In panel (B), instead of $IND_{\{not\ SCG\}}$, we augment the regression with $IND_{\{LC\}}$, which is a dummy variable that equals one if the fund style is identified as a Large Cap fund. The sample is from January 1981 to December 1999. The *t*-statistics are adjusted for serial correlation using Newey-West (1987) lags of order three and are shown in parentheses.

TABLE 6—EFFECT OF FAMILY SIZE ON PERFORMANCE BY FUND STYLE

Panel A: Fund size quintiles two to five								
	Gross fund returns				Net fund returns			
	Market-Adj	Beta-Adj	3-Factor	4-Factor	Market-Adj	Beta-Adj	3-Factor	4-Factor
$LOGTNA_{i,t-1}$	-0.051 (2.83)	-0.052 (2.86)	-0.056 (3.13)	-0.054 (3.02)	-0.048 (2.70)	-0.049 (2.72)	-0.053 (3.01)	-0.051 (2.89)
$LOGTNA_{i,t-1} *$ $IND_{\{not\ SCG\}}$	0.033 (1.94)	0.034 (1.98)	0.036 (2.12)	0.037 (2.15)	0.033 (1.93)	0.033 (1.96)	0.036 (2.10)	0.036 (2.14)
$LOGFAMSIZE_{i,t-1}$	0.007 (0.70)	0.007 (0.70)	0.007 (0.69)	0.007 (0.70)	0.007 (0.70)	0.007 (0.70)	0.007 (0.69)	0.007 (0.70)
$LOGFAMSIZE_{i,t-1} *$ $IND_{\{not\ SCG\}}$	0.004 (0.41)	0.004 (0.41)	0.004 (0.41)	0.004 (0.40)	0.004 (0.42)	0.004 (0.42)	0.004 (0.42)	0.004 (0.41)
No. of months	228	228	228	228	228	228	228	228

Panel B: All fund size quintiles one to five								
	Gross fund returns				Net fund returns			
	Market-Adj	Beta-Adj	3-Factor	4-Factor	Market-Adj	Beta-Adj	3-Factor	4-Factor
$LOGTNA_{i,t-1}$	-0.067 (3.67)	-0.070 (3.83)	-0.071 (3.87)	-0.072 (3.91)	-0.064 (3.51)	-0.067 (3.67)	-0.068 (3.71)	-0.069 (3.76)
$LOGTNA_{i,t-1} *$ $IND_{\{not\ SCG\}}$	0.065 (3.52)	0.065 (3.52)	0.067 (3.61)	0.066 (3.56)	0.065 (3.53)	0.065 (3.53)	0.067 (3.62)	0.066 (3.57)
$LOGFAMSIZE_{i,t-1}$	0.012 (1.13)	0.012 (1.13)	0.012 (1.11)	0.012 (1.11)	0.012 (1.15)	0.012 (1.15)	0.012 (1.13)	0.012 (1.13)
$LOGFAMSIZE_{i,t-1} *$ $IND_{\{not\ SCG\}}$	-0.003 (0.23)	-0.002 (0.21)	-0.002 (0.23)	-0.002 (0.21)	-0.002 (0.23)	-0.002 (0.21)	-0.002 (0.22)	-0.002 (0.21)
No. of months	228	228	228	228	228	228	228	228

Notes: This table reports the Fama-MacBeth (1973) estimates of monthly fund returns regressed on fund characteristics lagged one month. Fund returns are calculated before (gross) and after (net) deducting fees and expenses. These returns are adjusted using the market model, the CAPM, the Fama-French (1993) 3-Factor model, and the 4-Factor model. The regression specification is the one in Table 5 but augmented with $IND_{\{not\ SCG\}}$, which is a dummy variable which equals one if the self-reported fund style is Not Small Cap Growth and zero otherwise, interacted with $LOGFAMSIZE$. Estimates of the intercept and the other independent variables are omitted for brevity. The other independent variables include $TURNOVER$, AGE , $EXPRATIO$, $TOTLOAD$, $FLOW$, and $LAGFUNDRET$. The sample is from January 1981 to December 1999. The t -statistics are adjusted for serial correlations using Newey-West (1987) and are shown in parentheses.

of scope for them to do so given the thousands of stocks available.

C. The Role of Organization: The Effect of Family Size on Performance

To see that assets under management need not be bad for the performance of a fund organization, recall from Table 3 that controlling for fund size, assets under management of the other funds in the family that the fund belongs to actually increase the fund's performance. The coefficient in front of $LOGFAMSIZE$ is roughly 0.007 regardless of the performance benchmark used. One standard deviation of this variable is 2.75, so a two-standard deviation shock in the size of the family that the fund belongs to leads

to about a 3.85-basis-point movement in the fund's performance the following month (or about a 46-basis-point movement annually) depending on the performance measure used. The effect is smaller than that of fund size on returns but is nonetheless statistically and economically significant. In other words, assets under management are not bad for a fund organization's performance per se.

In Table 6, we extend our analysis of the effect of family size on fund returns by seeing whether this effect varies across fund styles. Our hope is that family size is just as important for Small Cap Growth funds as for other funds. After all, it is these funds that are most affected by scale. For us to claim that scale is not bad per se, even accounting for liquidity, we would like

to find that the benefits of family size are derived even by funds that are most affected by liquidity. To see whether this is the case, we augment the regression specification in Table 5 by adding an interaction term involving *LOG-FAMSIZE* and the dummy indicator $Ind_{\{\text{not SCG}\}}$ (which equals one if a fund is not Small Cap Growth and zero otherwise). The variable of interest is the coefficient in front of this interaction term.

Panel (A) presents the regression results for funds in fund size quintiles two through five. The coefficient in front of this interaction term is positive but is not statistically significant. In other words, it does not appear that there are major differences between the effect of family size on performance among Small Cap Growth funds and other funds. This finding is consistent with our story. To make sure that this finding holds more generally, we reestimate this regression specification using all funds. The coefficient in front of the interaction term is negative, but is again not statistically significant. Using either sample, it does not appear that the effect of family size is limited to Not Small Cap Growth funds. So we can be assured that funds do benefit from being part of a large family.

This finding—fund performance declines with own fund size but increases with the size of the other funds in the family—fits nicely with anecdotal evidence from industry practitioners (see, e.g., Pozen, 1998; Albert J. Fredman and Russ Wiles, 1998). One plausible interpretation of the family size finding is that it is capturing economies of scale associated with marketing. This begs the question, however, of why a fund's expense ratio is not capturing this scale effect since a fund's expense ratio is on the right-hand side of the cross-sectional fund return regressions.

It turns out that the expense ratio reported by mutual funds accounts for only management, administrative, and marketing fees.¹² Trading commissions charged by brokers and lending fees for (shorting) stocks are not treated as part of expenses but are simply deducted or added to income and hence net returns. It is well known that there are tremendous economies of scale

associated with trading commissions and lending fees at the family level. Bigger families like Fidelity are able to get better concessions on trading commissions and earn higher lending fees for the stocks held by their funds.

It is difficult to figure out these trading commissions because families bury them in their fund prospectuses. Nonetheless, practitioners believe these costs are substantial and can be as much as a few percentage points a year. Hence, the spread in performance between funds belonging to large versus those in small families can easily be accounted for by the economies of scale in trading commissions and lending fees at the family level.¹³

Importantly, according to industry anecdotes, in most families, major decisions are decentralized in that the fund managers make stock picks without substantial coordination with other managers. Managers in charge of different funds choose stocks as they see fit without worrying about resources being taken away from them by the family. So a family is an organization that credibly commits to letting each of its fund managers run his own assets.

As such, the family size finding makes clear that liquidity and scale need not be bad for fund performance, depending on how the fund is organized. After all, if a large fund is organized like a fund family with a number of small funds run by different managers, then scale need not be bad per se, just as family size does not appear to be bad for family performance.

More importantly, the finding regarding family size also helps us further to rule out alternative hypotheses related to managers of large funds not caring about maximizing net returns. This line of argument does not likely support our findings since managers in large families apparently do care enough about net fund returns to make sufficient investments to maintain performance at the family level. Moreover, most of the extant evidence on fund flows indicates that managers care about net fund returns,

¹² See John Hechinger (2004) for a detailed discussion of mutual fund expense accounting.

¹³ Zoran Ivkovic (2002) argues that being part of a large family may improve performance because of other spillovers. In his analysis of family size, he happened to control for fund size and found that fund size indeed erodes performance. Though the goal of his paper was not to examine fund size, it is comforting to know that some of our baseline results have been independently verified.

since better past returns lead to larger assets under management (see, e.g., Sirri and Tufano, 1998; Anthony W. Lynch and David Musto, 2003).

D. *Organizational Diseconomies and Fund Performance*

If managers care about net fund returns and scale need not be bad for performance per se, why then does it appear that scale erodes fund performance because of liquidity? We hypothesize that in addition to liquidity, fund size erodes performance because of organizational diseconomies. To make things concrete, imagine that there is a small fund company *X* with one fund operated by one manager who picks the stocks. Since the fund is small, the manager can easily invest the assets under management by generating a few stock ideas. Now imagine that there is a large fund *Y* in which the manager no longer has the capacity to invest all the money. So the manager needs co-managers to help him run the fund. For fund *Y*, the stock picks need to be coordinated among many more agents and therefore organizational form (e.g., flat versus hierarchical) becomes important. So organizational diseconomies may arise.

There are many types of organizational diseconomies that lead to different predictions on why small organizations outperform large ones. One set of diseconomies, from the work of Oliver E. Williamson (1975, 1988), includes bureaucracy and related coordination costs. Another set of diseconomies comes from the influence-cost literature (see, e.g., Paul R. Milgrom and Roberts, 1988). Yet another set of diseconomies centers on the adverse effects of hierarchies (or authority) for the incentives of agents who do not have any control over asset-allocation decisions (see, e.g., Aghion and Tirole, 1997; Stein, 2002).

Interestingly, the findings in Tables 3 and 6 allow us to discriminate among different types of organizational diseconomies. For instance, if Williamsonian diseconomies are behind the relationship between size and performance, then one expects that funds that belong to large families do worse, since bureaucracy ought to be more important in huge fund complexes. The fact that we do not find this indicates that bureaucracy is not likely an important reason

behind why performance declines with fund size.

We conjecture that hierarchy costs may be especially relevant for mutual funds. We take a closer look at the effect of organizational diseconomies due to hierarchy costs on fund performance by testing some predictions from Stein (2002). Stein argues that in the presence of such hierarchy costs, small organizations ought to outperform large ones at tasks that involve the processing of soft information, (i.e., information that cannot be directly verified by anyone other than the agent who produces it). The basic premise is that in larger organizations with hierarchies, the process of agents fighting to have their ideas implemented will affect outcomes. If the information is soft, then agents have a hard time convincing others of their ideas and it is more difficult to pass this information up the organization.¹⁴

In the context of mutual funds, this means that in funds in which managers fight to have their ideas implemented, efforts to uncover certain investment ideas in this setting are diminished relative to a situation in which the managers control their own smaller funds. For instance, managers may end up expending too much research effort on quantitative measures of a company (i.e., hard information) so as to convince others to implement their ideas even though more time and effort might ideally be invested in talking to CEOs of companies and getting an impression of them (i.e., soft information). All else equal, large funds may perform worse than small ones.

Note that one of our previous findings—that fund performance does not decline with family size—is consistent with Stein (2002) since hi-

¹⁴ Stein's analysis also indicates that large organizations may actually be very efficient at processing hard information. In the context of the mutual fund industry, one can think of passive funds that mimic indices as primarily processing hard information. As such, one would expect these types of funds not to be very much affected by scale. Two pieces of evidence are consistent with this prediction. First, Vanguard seems to dominate the business for index funds. Indeed, for indexers, being large is an asset since one can then acquire better tracking technologies and better computer programmers. Second, our evidence in Table 5 that fund size affects only small cap funds is consistent with this observation since most index funds, which tend to mimic the S&P 500 index, trade predominantly large stocks.

erarchy costs are not present at the family level precisely because the family typically agrees not to reallocate resources across funds. Different funds in a family have their own boards that deal with such issues as managerial replacement. So the manager in charge of a fund generally does not have to worry about the family taking away his resources and giving those resources to some other fund in the family.

Below, we test several predictions of Stein (2002) to see if the inverse relationship between fund size and performance is indeed influenced by organizational diseconomies.

Fund Size and Fund Investments.—One prediction of Stein (2002) is that we expect that small funds are better than large ones, which are more likely to have hierarchies, at the processing of soft information. To test this prediction, we compare the investments of large and small funds in local stocks (companies located near where a fund is headquartered). Investing in such companies requires that the organization process soft information as opposed to a strictly quantitative investing approach, which would typically process hard information like price-to-earnings ratios.

Our work in testing this prediction builds on the very interesting work of Coval and Moskowitz (1999, 2001) whose central thesis is that mutual fund managers do have ability when it comes to local stocks. Anecdotal evidence indicates that this ability comes in the form of processing soft information, e.g., talking to and evaluating CEOs of local companies. They find that funds can earn superior returns on their local investments. We focus on the effect of size on investment among small cap funds. We are also interested in the effect of family size on the composition of fund investments.

The CDA Spectrum Database does not have the same information on fund characteristics as the CRSP Mutual Fund Database. Luckily, we are able to construct from the fund stock holdings data a proxy for fund size, which is simply the value of the fund's stock portfolio at the end of a quarter. While this is not exactly the same as asset base since funds hold cash and bonds, we believe that the proxy is a reasonable one because we can look at the tails of the size distribution to draw inferences, i.e., compare very small funds to other funds. Moreover, the

TABLE 7—EFFECT OF FUND AND FAMILY SIZE ON INVESTMENTS IN LOCAL STOCKS

	(1)	(2)	(3)
<i>SMALLFUND</i>	0.0759 (9.49)	0.0580 (6.74)	0.0584 (6.79)
<i>SMALLCAPFUND</i>	0.0515 (6.28)	0.0340 (3.86)	0.0341 (3.88)
<i>SMALLFUND</i> *		0.1244	0.1229
<i>SMALLCAPFUND</i>		(5.58)	(5.80)
<i>FAMILYSIZE</i>			0.0001 (1.01)
Momentum effects	Yes	Yes	Yes
Book-to-market effects	Yes	Yes	Yes
Fund city effects	Yes	Yes	Yes

Notes: This table shows the effect of fund and family size on mutual fund investments in local stocks. The dependent variable is the percentage of the value of a fund's portfolio invested in local stocks. *SMALLFUND* equals one if a fund's size is in the bottom 10 percent of the fund size distribution and zero otherwise. *SMALLCAPFUND* equals one if a fund's Daniel, Grinblatt, Titman, and Wermers (1997) small cap style score is in the bottom 10 percent across funds. *FAMILYSIZE* is the number of funds in the family that the fund belongs to. Momentum effects and book-to-market effects control for other differences in fund styles. Data are from the end of September 1997. Robust *t*-statistics are reported in parentheses.

noise in our fund size measure does not obviously bias our estimates.

In addition, we can construct better style controls for each fund by looking at their stock holdings. We use a style measure constructed by Daniel et al. (1997), which we call the DGTW style adjustment. For each month, each stock in our sample is characterized by its location in the (across-stocks) size quintiles, book-to-market quintiles, and price-momentum quintiles. So a stock in the bottom of the size, book-to-market, and momentum quintiles in a particular month would be characterized by a triplet (1, 1, 1). For each fund, we can characterize its style along the size, book-to-market, and momentum dimension by taking the average of the DGTW characteristics of the stocks in their portfolio weighted by the percentage of the value of their portfolio that they devote to each stock. We can then define a small cap fund as one whose DGTW size measure falls in the bottom 10 percent when compared to other funds.

Table 7 reports the effect of fund size on the percentage of the value of a fund's portfolio

devoted to local stocks, where locality is defined relative to the headquarters of the funds, as in Coval and Moskowitz (1999, 2001). Specifically, a stock is considered a local fund investment if the headquarters of the company is in the same census region as the mutual fund's headquarters.¹⁵ The dependent variable is the total value of the local stocks in the fund portfolio divided by the total value of the stocks in the fund portfolio. The first independent variable is *SMALLFUND*, which is a dummy variable that equals one if the fund is in the bottom 10 percent of the fund size distribution. *SMALLCAPFUND* equals one if a fund has an average DGTW size score for its stocks that is in the bottom 10 percent across funds. The regressions always have Fund City Effects (i.e., the city where the fund is headquartered) as controls.

From column (1), small funds are more likely to invest a larger percentage of their portfolio in local stocks than do small cap funds. The average percentage of stocks that are local in a funds' portfolio is 16.57 percent. The coefficient on *SMALLFUND* is 0.0759. That means that being a small fund increases the amount of local stocks a fund owns by 0.0759 divided by 0.1657, or 46 percent. In column (2), the coefficient of interest is the interaction term involving small and small cap funds. It is positive and statistically significant, which is consistent with our conjecture. The coefficient of 0.1244 means that being a small fund and a small cap fund raises the percentage of local stock investments on average by 0.1244 divided by 0.1657, or 75 percent.

One interesting question is the degree to which family size affects a fund's investment policy. In column (3), we add a family-size proxy as measured by the number of funds in the family. The coefficient in front of this variable is positive but the economic magnitude is small and it attracts a *t*-statistic of only one. In other words, family size does not have an effect

TABLE 8—EFFECT OF FUND AND FAMILY SIZE ON THE PERFORMANCE OF INVESTMENTS IN LOCAL STOCKS

	(1)	(2)	(3)
<i>SMALLFUND</i>	0.0258 (1.83)	0.0143 (0.94)	0.0150 (0.99)
<i>SMALLCAPFUND</i>	0.1190 (8.21)	0.1078 (6.95)	0.1079 (6.96)
<i>SMALLFUND</i> * <i>SMALLCAPFUND</i>		0.0795 (2.02)	0.0776 (1.96)
<i>FAMILYSIZE</i>			0.0002 (1.02)
Momentum effects	Yes	Yes	Yes
Book to market effects	Yes	Yes	Yes
Fund city effects	Yes	Yes	Yes

Notes: This table shows the effect of fund and family size on the performance of mutual fund investments in local stocks. The dependent variable is the 4-quarter return to fund investments in local stocks. *SMALLFUND* equals one if a fund's size is in the bottom 10 percent of the fund size distribution and zero otherwise. *SMALLCAPFUND* equals one if a fund's Daniel, Grinblatt, Titman, and Wermers (1997) small cap style score is in the bottom 10 percent across funds. *FAMILYSIZE* is the number of funds in the family that the fund belongs to. Momentum effects and book-to-market effects control for other differences in fund styles. Data are from the end of September 1997. Robust *t*-statistics are reported in parentheses.

on whether a fund invests in local stocks. If we define family size as the log of the assets of the other funds in the fund's family, then we get similarly small economic magnitudes and *t*-statistics near zero. For brevity, we omit these additional results. Again, one can interpret this result as consistent with Stein's model to the extent that fund size has an effect on fund action but not family size.

These findings, however, may also be consistent with larger funds that have more resources to visit companies not located nearby. To distinguish between this explanation and our preferred explanation that small funds and funds belonging to larger families are better at the processing of soft information, we see in Table 8 whether the local stocks picked by small funds do better than those picked by large funds. The dependent variable is the return to the fund's investments in local stocks. In column (1), we find that small funds and small cap funds not only invest more of their assets in local stocks but also do better at investing in them. The standard deviation of local stock investment returns in our sample is 0.2077. Being a small

¹⁵ There are nine census regions: New England (CT, MA, ME, NH, RI, VT); Middle Atlantic (NJ, NY, PA); East North Central (IL, IN, MI, OH, WI); West North Central (IA, KS, MN, MO, NE, ND, SD); South Atlantic (DE, FL, GA, MD, NC, SC, VA, WV); East South Central (AL, KY, MS, TN); West South Central (AR, LA, OK, TX); Mountain (AZ, CO, ID, MT, NE, NM, UT, WY); and Pacific (AK, CA, HI, OR, WA).

fund raises local return by 0.0258 divided by 0.2077, or 12 percent of a standard deviation. In column (2), we add an interaction term involving these two variables and find that the performance difference between small funds and other funds is especially big in small cap funds. In column (3), we add a family size proxy as measured by the number of funds in the family. The coefficient is positive but is statistically insignificant. So a fund that belongs to a large family does not do better in local stock investments. Similar results obtain using total net assets for the family.

The findings in Table 8 suggest that the performance differences between small and large funds have something to do with their differing ability to invest in local stocks. Note that Tables 7 and 8 report the results using only the cross-section in September 1997. We have replicated our analysis using the other quarters in the period of 1997 to 1998. The results are very robust across quarters.

Management Structure and the Composition of Fund Investments.—Perhaps a more direct implication of Stein's model is to look at the relationship between the management structure of a fund and the fund's investments. When a fund is co-managed and there is more fighting to implement ideas, then we should find that, controlling for fund size, funds run by committee should invest less in local stocks (i.e., managers should pitch hard-information stock ideas) and do worse in these soft-information stocks.

To test this prediction, we obtain data on the number of managers running a fund for the cross-section of funds described in Tables 7 and 8. In the CRSP database, there is a field that lists the names of managers in charge of picking stocks. We create a new variable *MT*, which captures how many managers are running the fund. If there is only one name, then *MT* equals one. If there are two names, then *MT* equals two, and so forth. The maximum number of names in the database is four. Moreover, a small fraction of the funds are listed as "Team Managed." For these funds, we set *MT* equal to four as well. Thus, *MT* can take on values of one, two, three, or four. From reading the prospectuses of various funds, it appears that funds that have co-managers do make decisions within a

TABLE 9—EFFECT OF MANAGEMENT STRUCTURE ON THE AMOUNT AND PERFORMANCE OF INVESTMENTS IN LOCAL STOCKS

	Holdings (1)	Returns (2)
<i>MULTI-MANAGER</i>	-0.0102 (-1.75)	-0.0190 (-1.73)
Fundsize effects	Yes	Yes
Family size effects	Yes	Yes
Momentum effects	Yes	Yes
Book-to-market effects	Yes	Yes
Style effects	Yes	Yes
Fund city effects	Yes	Yes

Notes: This table shows the effect of fund management structure on the holdings and performance of mutual fund investments in local stocks. The dependent variable in column (1) is the percentage of the value of a fund's portfolio invested in local stocks. The dependent variable in column (2) is the 4-quarter return-to-fund investments in local stocks. *MULTI-MANAGER* is an indicator that the fund is managed by more than one person. Fundsize effects, family size effects, momentum effects, book-to-market effects and style effects control for other differences in fund styles. Fund city effects are indicators for the city where the fund is located. Data are from the end of September 1997. Robust *t*-statistics are reported in parentheses.

committee. We lose a fraction of the cross-section of funds in Tables 7 and 8 because some funds do not have entries in the manager field.

In Table 9, we consider the effect of managerial structure on the composition of fund investments in local stocks and the performance of these local investments. The first column of Table 9 is similar to those in Table 7 except that we have added a dummy variable *MULTI-MANAGER*, which equals one when *MT* is greater than one and is zero otherwise, as an additional explanatory variable. Moreover, since we are concerned with isolating the effect of managerial structure, we have introduced into this regression very conservative fund size, family size, and style controls. Even with these conservative controls, the coefficient in front of *MULTI-MANAGER* is -0.012 with a *t*-statistic of 1.75. In other words, a solo-managed fund is significantly more likely to invest in local stocks than team-managed funds. The economic magnitude is smaller than that of being a small fund but is still economically interesting. In this sample, the average percentage of stocks that are local in a fund's portfolio is 15.2 percent. Since the coefficient on *MULTI-MANAGER* is

−0.012, being a committee-managed fund decreases the amount of local stocks a fund owns by 0.012 divided by 0.152, or about 8 percent.

The second column of Table 9 is similar to those in Table 8 except that we have added the variable *MULTI-MANAGER* as an additional explanatory variable for the performance of fund local investments. Again, we have introduced into this regression very conservative fund size, family size, and style controls. The coefficient in front of *MULTI-MANAGER* is −0.0190 with a *t*-statistic of 1.73, suggesting that co-managed funds also do worse at picking local companies. The standard deviation of local stock investment returns in this sample is 0.186. So being a committee-managed fund decreases local return by 0.0190 divided by 0.186, or 10 percent of a standard deviation. Both findings are consistent with Stein's model.

Management Structure and Fund Performance.—Finally, we look to see whether solo-managed funds outperform team-managed ones after controlling for fund size. Our prior is that organization form might be a less powerful predictor of performance than size. The reason is that few managers would turn away more money even if it hurt net fund returns for investors. But conditional on a certain fund size, one might think that the fund would choose the better organizational form to maximize net fund returns. In other words, conditional on size, form may be a less powerful predictor of performance. Moreover, we are much more limited in terms of data when looking at the effect of managerial structure on fund performance. Whereas we are able to obtain data on fund size back to the 1960s, we are able to obtain data on managerial structure only back to 1992 because the data on how many managers are running a fund are unavailable from the CRSP before that date. As before, we create the MT variable for as many funds as possible back to 1992. Despite these caveats, it is interesting to look at the effect of managerial structure on fund performance.

The result for the effect of management structure on fund returns is given in Table 10. The upshot is that all the previous results regarding fund size continue to hold. For instance, the coefficient in front of fund size is the same as in Table 3. We find that funds run by com-

mittee underperform by about 4 basis points a month or 48 basis points a year. This effect is economically smaller than the effect of fund size but is statistically significant. Again, this finding on performance is consistent with Stein's model.

IV. Alternative Explanations and Further Discussion

In Section III, we ruled out a number of alternative explanations for our findings in establishing the role of liquidity and organization in influencing the relationship between fund size and performance. In this section, we discuss additional explanations. One institutional reason for our finding may be that it is easier for fund families to manipulate the performance of small funds in small cap stocks. While this alternative explanation is possible, we do not think that it is driving our results, for several reasons. First, we exclude the very smallest funds for which this is likely and our results are unchanged. Moreover, in analysis that is not reported for reasons of brevity, we have also dropped out very young funds, for which such manipulation is most likely, and our results are again unchanged. Finally, such manipulation cannot account for the relationship between fund size and the composition of fund investments, or for the relationship between managerial structure and fund investments and performance documented in Section III D.

Besides such institutional reasons, it may be the case that our findings are due to other organization-related issues as well as the hierarchy-cost hypothesis presented in Section III D. For instance, many managers talk about how difficult it is to train new hires when their fund grows. We view such comments as broadly supportive of our contention that organization matters for fund performance.

Ideally, we would like to have information about the incentives inside fund organizations. For instance, our hierarchy-cost hypothesis also suggests that a crucial unobservable determinant of fund performance is the nature of the incentives inside the fund. More concretely, suppose that the organizational diseconomies are due to the adverse effects of a hierarchy on managerial effort. Then an optimal organizational structure is to limit managers to a small

TABLE 10—EFFECT OF FUND MANAGEMENT STRUCTURE ON PERFORMANCE

	Gross fund returns				Net fund returns			
	Market-Adj	Beta-Adj	3-Factor	4-Factor	Market-Adj	Beta-Adj	3-Factor	4-Factor
<i>INTERCEPT</i>	-0.069 (0.66)	-0.018 (0.19)	0.039 (0.25)	-0.008 (0.05)	-0.092 (0.88)	-0.042 (0.44)	0.014 (0.09)	-0.032 (0.21)
<i>MULTI-MANAGER_i</i>	-0.040 (2.22)	-0.040 (2.23)	-0.041 (2.30)	-0.041 (2.30)	-0.040 (2.26)	-0.041 (2.27)	-0.042 (2.34)	-0.042 (2.34)
<i>LOGTNA_{i,t-1}</i>	-0.024 (2.34)	-0.023 (2.30)	-0.026 (1.98)	-0.025 (1.83)	-0.022 (2.19)	-0.022 (2.15)	-0.025 (1.86)	-0.023 (1.70)
<i>LOGFAMSIZE_{i,t-1}</i>	0.016 (2.38)	0.016 (2.38)	0.016 (2.38)	0.016 (2.38)	0.016 (2.40)	0.016 (2.39)	0.016 (2.40)	0.016 (2.39)
<i>TURNOVER_{i,t-1}</i>	0.000 (1.28)	0.000 (1.29)	0.000 (1.28)	0.000 (1.29)	0.000 (1.26)	0.000 (1.26)	0.000 (1.26)	0.000 (1.26)
<i>AGE_{i,t-1}</i>	-0.001 (0.64)	-0.001 (0.65)	-0.001 (0.64)	-0.001 (0.64)	-0.001 (0.60)	-0.001 (0.61)	-0.001 (0.59)	-0.001 (0.59)
<i>EXPRATIO_{i,t-1}</i>	-0.002 (0.03)	-0.002 (0.03)	-0.003 (0.04)	-0.003 (0.04)	-0.043 (0.54)	-0.043 (0.54)	-0.045 (0.55)	-0.045 (0.55)
<i>TOTLOAD_{i,t-1}</i>	-0.002 (0.28)	-0.002 (0.29)	-0.002 (0.30)	-0.002 (0.29)	-0.002 (0.36)	-0.002 (0.36)	-0.002 (0.37)	-0.002 (0.37)
<i>FLOW_{i,t-1}</i>	0.000 (1.64)	0.000 (1.68)	0.000 (1.68)	0.000 (1.69)	0.000 (1.64)	0.000 (1.68)	0.000 (1.68)	0.000 (1.69)
<i>FUNDRET_{i,t-1}</i>	0.030 (3.38)	0.030 (3.38)	0.029 (3.34)	0.029 (3.34)	0.031 (3.41)	0.030 (3.41)	0.030 (3.37)	0.030 (3.37)
No. of months	96	96	96	96	96	96	96	96

Notes: This table reports the Fama-MacBeth (1973) estimates of monthly fund returns regressed on fund characteristics lagged one month. The sample includes only funds that fall within fund size quintiles two to five. Fund returns are calculated before (gross) and after (net) deducting fees and expenses. These returns are adjusted using the market model, the CAPM, the Fama-French (1993) 3-Factor model, and the 4-Factor model. The regression specification is the one in Table 3 but augmented with *MULTI-MANAGER_i*, which is a dummy variable that equals one if the fund is managed by two or more individuals or by a team. The sample is from January 1992 to December 1999. The *t*-statistics are adjusted for serial correlation using Newey-West (1987) lags of order three and are shown in parentheses.

pot of money and let them manage it as they choose. With such an organizational structure, scale may not affect performance. This is exactly what happens at the family level and probably why performance does not decline with family size.

Our analysis here is similar to the work of Allen N. Berger et al. (2002). They test the idea in Stein (2002) that small organizations are better than large ones in activities that require the processing of soft information in the context of bank lending to small firms. They find that large banks are less willing than small ones to lend to firms that do not keep formal financial records. They also find that large banks lend at a greater distance, interact more impersonally with their borrowers, have shorter and less exclusive relationships, and do not alleviate credit constraints as effectively. Interestingly, they find that the size of the bank-holding company that a bank belongs to does not affect the lending policies of the bank. In other words, size itself is not nec-

essarily bad for banks. This finding is related to our finding regarding the neutral-to-beneficial effects of family size on fund performance. They argue that their findings are most consistent with the property-rights approach of Grossman-Hart-Moore regarding the disadvantages of integration.

Our paper is also related to other papers that attempt to test the basic Grossman-Hart-Moore insight in particular settings. Notable examples include George P. Baker and Thomas Hubbard (2000), whose work centers on the trucking industry and the question of whether drivers should own the trucks they operate, and Duncan Simester and Binger Wernerfelt (2000), who look at the ownership of tools in the carpentry industry.

V. Conclusion

To the best of our knowledge, we are the first to find strong evidence that fund size erodes

performance. We then consider various explanations for why this might be the case. We find that this relationship is not driven by heterogeneity in fund styles, fund size being correlated with other observable fund characteristics, or any type of survivorship bias. Instead, we find that the effect of fund size on fund returns is most pronounced for funds that play small cap stocks. This suggests that liquidity is an important reason why size erodes performance. Moreover, we argue that organizational diseconomies related to hierarchy costs may also play a role in addition to liquidity in the documented diseconomies of scale. Consistent with this view, we find that the size of a fund's family does not significantly erode fund performance. Finally, using data on whether funds are solo-managed or co-managed and the composition of fund investments, we find that organizational diseconomies affect the relationship between fund size and performance along the lines predicted by Stein (2002).

Importantly, our findings have relevance for the ongoing research into the question of Ronald H. Coase (1937) regarding the determinants of the boundaries of the firm. While an enormous amount of theoretical research has been done on this question, there has been far less empirical work. Our findings suggest that mutual funds may be an invaluable laboratory with which to study related issues in organization. The amount of data on mutual funds, unlike that on corporations, is plentiful because of disclosure regulations and the fact that the tasks and performance of mutual funds are measurable. We plan to refine our understanding of the nature of organizations in the future using this laboratory.

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