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#### Citation

Busse, Jeffrey; Chordia, Tarun; JIANG, Lei; and TANG, Yuehua. Mutual Fund Trading Costs and Diseconomies of Scale. (2017). 1-90.

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# Mutual Fund Trading Costs\*

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April 2017

## ABSTRACT

Trading costs of actively-managed U.S. equity mutual funds average 0.75% per year and are persistent and negatively related to fund performance. We provide algorithms for determining mutual fund trading costs using trade-, stock-, and fund-level characteristics. Larger trades in smaller stocks and low priced stocks incur higher transaction costs. Growth-oriented funds have higher trading costs than value-oriented funds as do funds with higher turnover. Larger funds have lower trading costs than smaller funds despite their larger trade sizes because they endogenously hold and trade bigger, more liquid stocks and trade less frequently.

Keywords: Mutual funds, transaction costs, trading cost algorithm, liquidity, fund size, fund performance

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\* We are grateful for comments from Viral Acharya, Vikas Agarwal, Gennaro Bernile, Lauren Cohen, Philip Dybvig, Slava Fos, Fangjian Fu, Gary Gorton, Bruce Grundy, Jennifer Huang, Raymond Kan, Luboš Pástor, Gordon Phillips, Joshua Pollet, Michael Powers, Jon Reuter, Ronnie Sadka, Clemens Sialm, Jun Tu, Kumar Venkataraman, Chishen Wei, Youchang Wu, Hong Yan, Xuemin Yan, Huacheng Zhang, Xiaoyan Zhang, Guofu Zhou, and seminar participants at Boston College, Cheung Kong GSB, Oxford University, University of Illinois, the 2014 China International Conference in Finance, the 2014 Singapore Management University Summer Institute of Finance Conference, the 2015 Singapore Scholars Symposium, the 2014 Tsinghua Finance Workshop, and the 2015 Western Finance Association Meetings. We would like to thank Baozhong Yang for sharing the link table between the Abel Noser and Thomson Reuters Mutual Fund Holdings databases, Luboš Pástor, Robert Stambaugh, and Luke Taylor for CRSP and Morningstar merged mutual fund data, and Richard Evans for data on fund ticker creation date. Lei Jiang gratefully acknowledges support from AXA research fund and Tsinghua National Laboratory for Information Science and Technology.

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In testing market efficiency, Jensen (1968) examines whether mutual fund managers outperform risk adjusted benchmarks. Since Jensen (1968), the performance of mutual funds has consistently been a popular research topic in financial economics. Over the years, studies have analyzed almost all of the important contributors to net shareholder returns, from the main drivers, such as the gross returns of portfolio holdings, to the less influential but still important costs reflected in the expense ratio. Despite all this scrutiny, the transaction costs incurred in the course of buying and selling securities have received little attention.<sup>1</sup> This paper aims to fill this gap in the literature by analyzing mutual fund trading costs.

The reason mutual fund trading costs have not been analyzed as comprehensively as other components of fund performance is because precise estimates of transaction costs require detailed fund trade data.<sup>2</sup> Such information, which often amounts to thousands of individual transactions for a single fund over time, is neither required to be disclosed by regulation nor typically offered voluntarily by funds, probably to avoid revealing trading strategies.

We utilize trade data for a sample of 583 actively-managed U.S. equity mutual funds from Abel Noser Solutions, a leading execution quality measurement service provider for institutional investors. Our sample period, 1999–2011, encompasses two recessions, including the early 2000s recession and the particularly harsh financial crisis of 2008–2009. Periods of uncertainty in the market are important in this context insofar as they are characterized by substantial increases in transaction costs in the face of abnormally low liquidity. The most important insights, however, stem not from examining the Abel Noser trade data in isolation, but from utilizing a wealth of cross sectional data that we obtain by matching the Abel Noser data to the CRSP, Morningstar, and Thomson Reuters mutual fund databases. Consequently, besides relating transaction costs to trade-level variables such as the size of the trade and the liquidity of the stock traded, we also examine how fund-level characteristics, including total net assets (TNA) and investment style, influence trading costs. Examining the impact of fund level characteristics on trading costs provides insights into how fund portfolio strategies vary over time.

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<sup>1</sup> The SEC has proposed asking mutual funds to disclose more about their transaction costs in its concept release 33-8349 entitled, “Measures to Improve Disclosure of Mutual Fund Transaction Costs.”

<sup>2</sup> Fama and French (2010) talk about the “...unavoidable absence of accurate trading cost estimates for active funds.”

We estimate transaction costs based on the difference between the executed stock price and three alternative benchmarks, including execution shortfall (Anand et al. (2012)), which uses the stock price at the time of order placement as a benchmark. The measures capture implicit transaction costs associated with a fund's actual trades, including price impact and costs related to the bid-ask spread. We obtain total trading costs by summing the implicit costs and explicit trading costs including commissions, taxes, and other fees.

On a purely descriptive level, our precise estimates of trading costs are interesting in their own right. At 0.75% per year on average (as a percentage of TNA), mutual fund trading costs are economically meaningful and comparable to the average annual expense ratio of 1.17%. More importantly, we also provide algorithms for estimating mutual fund trading costs that incorporate ticket-level,<sup>3</sup> stock-level, and fund-level variables. For ticket- and stock-level characteristics, we find that larger trades in smaller stocks and low priced stocks incur higher transaction costs, as expected. For fund-level characteristics, we find that growth-oriented funds have higher trading costs than value-oriented funds, suggesting that growth funds are more aggressive in their trades than value funds. In addition, funds with higher turnover and those belonging to smaller fund families as measured by fund family TNA also incur higher trading costs. Lastly, we find that fund trading costs are highly persistent over time.

Trading costs are negatively related to net fund performance (i.e., net of operating expenses and trading costs). When we sort funds into quintiles based on estimates of total trading costs, the lowest cost quintile shows a 1.7% to 3.5% higher annual four-factor alpha than the highest cost quintile, depending on the transaction cost benchmark. This difference in alpha is comparable to the difference in post-ranking, four-factor alpha in mutual fund performance persistence studies (e.g., Carhart (1997) and Bollen and Busse (2005)). Stated differently, an investor would do as well by buying low trading cost funds as by buying funds with high past four-factor alpha. Despite these important performance implications, trading costs are not transparent to investors. Funds typically do not report trading costs, and these costs fall under far less regulatory scrutiny than expense ratios. Our findings suggest that fund managers are unable to fully recoup the cost of their

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<sup>3</sup> Orders are submitted to the trading desk in the form of tickets, and a ticket may comprise more than one trade.

transactions by moving into (out of) better (worse) performing assets or strategies. Thus, fund managers' skill in managing trading costs is positively correlated with their overall ability to deliver abnormal performance to investors.

Expected transaction costs impact the types of stocks in terms of size and liquidity that actively-managed mutual funds choose to hold in their portfolios. Conditional on trading the same stock, large funds have higher trading costs than smaller funds because large funds transact larger dollar amounts and trading costs increase in trade size due to price impact. However, the choice of fund holdings is endogenous, and fund managers account for transaction costs when choosing the composition of their portfolios. We find that large funds hold and trade larger, more liquid stocks, and smaller funds hold and trade smaller, less liquid stocks. As a result, larger funds have *lower* trading costs than smaller funds. Moreover, we find that funds with higher cash inflows in a given month shift their portfolio holdings towards larger stocks over the subsequent months.<sup>4</sup> The finding that funds rebalance their portfolios towards bigger and more liquid stocks as their asset base grows suggests that transaction costs impact the intertemporal dynamics of fund portfolios.

Large funds also alter their portfolios less often than small funds. Funds with above (below) the median style TNA have an average annual turnover of 80% (108%), with larger funds showing statistically significantly lower turnover in all nine investment styles that we consider. By choosing stocks with greater liquidity and trading less often, larger funds experience lower trading costs per dollar of TNA. When sorted on TNA, funds that are above (below) the median style TNA experience an annual performance drag due to total trading costs of 0.67% (1.04%) based on execution shortfall, with larger funds showing statistically significantly lower trading costs in seven of nine investment styles. In addition, the average annual expense ratio is 1.00% for above-style-median TNA funds and 1.40% for below-style-median TNA funds, possibly due to economies of scale in management fees, back office support, etc. Together, lower trading costs

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<sup>4</sup> Pollet and Wilson (2008) examine how asset growth affects fund diversification and scaling behavior. They study whether TNA growth leads funds to increase the number of unique stock positions in their portfolio, but do not examine how the market capitalization of the new holdings differs from those of seasoned positions as we do in our fund flows analysis. Furthermore, while they also note that a positive relation exists between TNA and mean holding market capitalization, we are the first to measure trading costs using fund trade data and explicitly show that larger TNA funds have lower trading costs than smaller funds.

and lower expense ratios provide large funds with a substantial cost advantage that amounts to approximately 0.77% per year.

Despite these cost advantages, large funds do not outperform small funds on a net shareholder return basis, possibly because small funds hold smaller, less liquid stocks. Presumably, if large funds emphasized in their portfolios the types of stocks held by smaller funds, the trading costs would subsume any potential gain from the illiquidity premium. After controlling for risk or portfolio stock characteristics, we find that large funds and small funds have statistically indistinguishable Carhart (1997) four-factor alphas and DGTW (Daniel et al. (1997)) benchmark-adjusted returns. Apparently, the universe of relatively illiquid stocks provides small funds the opportunity to generate enough alpha to overcome their cost disadvantages relative to large funds.

Most studies estimate mutual fund trading costs using an algorithm provided by Keim and Madhavan (1997) (henceforth, KM). This approach, however, may not accurately reflect trading costs over more recent sample periods because the KM algorithm is based on a sample of 21 institutions over a short three-year sample period (our sample is four times longer) from 1991–1993, before significant innovations in the microstructure of the stock market, including the tick size change from eighths to sixteenths in 1997 and the move to pennies in 2000–2001.<sup>5</sup> We find that the KM algorithm often produces negative transaction cost estimates over our sample of trades, especially for large-cap stocks. Wermers (2000) uses the KM algorithm to find average mutual fund trading costs of 0.80% per year over the period from 1976 to 1994. Kacperczyk, Sialm, and Zheng (2008) also use the KM algorithm to estimate trading costs and find that it is negatively related to their return gap measure. Edelen, Evans, and Kadlec (2013) use transaction data from the trade and quote (TAQ) dataset to infer trading costs, and they find that larger funds incur higher trading costs as a percentage of TNA than smaller funds. Agarwal, Gay, and Ling (2014) apply average trading cost estimates across all institutions in the Abel Noser database to mutual funds and find that funds that window dress their portfolio holdings incur higher trading costs.<sup>6</sup> One

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<sup>5</sup> Chan and Lakonishok (1995) examine the transaction costs of 37 large investment managers over the 1986–1988 period. Other studies on trading costs of institutional investors include Jones and Lipson (2001), Conrad, Johnson, and Wahal (2001), Chiyachantana, Jain, Jiang, and Wood (2004), and Goldstein, Irvine, Kandel, and Weiner (2009).

<sup>6</sup> Bollen and Busse (2006) and Cici, Dahm, and Kempf (2015) use an indirect method to estimate mutual fund trading costs by comparing daily returns between a fund and a benchmark. Keim (1999) studies the trading costs of one DFA index fund.

common limitation of these four studies is their use of semi-annual or quarterly snapshots of portfolio holdings to infer trades when estimating mutual fund trading costs.

Two recent papers examine the trading costs of institutional investors, with some notable differences relative to our study. Anand et al. (2012) also utilize the Abel Noser database to analyze the trading costs of a broader sample of institutional investors (not only mutual funds). They do not identify specific institutions within their sample and are unable to examine the relation between costs and institutional characteristics, such as assets under management or investment style. We show that these fund characteristics are important determinants of trading costs. Frazzini, Israel, and Moskowitz (2015) analyze the trades of one large institution. Consequently, they are unable to observe heterogeneity in costs across management firms or cross sectional relations between costs and fund attributes. Neither of these two papers is able to provide algorithms for estimating trading costs that incorporate ticket-, stock-, and fund-level variables. Our paper contributes to the trading cost literature by providing a comprehensive analysis of mutual fund trading costs based on actual mutual fund trades. We hope that our algorithms will prove useful to other researchers as well as practitioners when estimating trading costs of mutual funds or of certain trading strategies.

## **I. Data**

### *A. Data Description*

We construct our sample from multiple data sources. Fund names, returns, total net assets, expense ratios, turnover ratios, and other fund characteristics are obtained from the Center for Research in Security Prices (CRSP) Survivorship Bias Free Mutual Fund Database. To ensure data accuracy, we only retain in our sample funds in the Morningstar and CRSP merged database of Pástor, Stambaugh, and Taylor (2015) (henceforth, PST).<sup>7</sup> We obtain fund investment styles (i.e., based on the three by three style box) from Morningstar Direct. Portfolio holdings are obtained

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<sup>7</sup> PST find that discrepancies exist between the Morningstar and CRSP mutual fund databases. To correct for these discrepancies, they create a CRSP and Morningstar merged mutual fund dataset and test the hypothesis of industry-level decreasing returns to scale (Pástor and Stambaugh (2012)). The Data Appendix of their paper provides detailed matching and cleaning procedures: [http://faculty.chicagobooth.edu/lubos.pastor/research/Data\\_Appendix\\_Aug\\_2013\\_V3.pdf](http://faculty.chicagobooth.edu/lubos.pastor/research/Data_Appendix_Aug_2013_V3.pdf).

from Thomson Reuters Mutual Fund Holdings (formerly CDA/Spectrum S12), which provides portfolio holdings for all U.S. equity mutual funds, usually at a quarterly frequency.<sup>8</sup> We merge the CRSP Mutual Fund database and the Thomson Reuters Mutual Fund Holdings database using the MFLINKS table available on WRDS (see Wermers (2000)). We focus on actively-managed U.S. equity mutual funds and exclude index funds.<sup>9</sup> We exclude funds with fewer than 10 stocks to focus on diversified funds. Following Elton, Gruber, and Blake (2001), Chen et al. (2004), Yan (2008), and PST, we exclude funds with less than \$15 million in TNA. We also follow Evans (2010) and use the date the fund ticker was created to address incubation bias.<sup>10</sup>

Mutual fund transactions data are obtained from Abel Noser Solutions, a leading execution quality measurement service provider for institutional investors.<sup>11</sup> Different from prior studies who use Abel Noser data, we are among the first to merge the sample of actual fund trades with their portfolio holdings by matching money managers in the Abel Noser database with funds reporting portfolio holdings to the Thomson Reuters holdings database. Specifically, for each client manager X (as identified by “clientmgrcode”) in the Abel Noser dataset and for each reporting period between two adjacent portfolio report dates for a fund M in the Thomson S12 data, we compute the change in holdings (i.e., across all trades with shares adjusted for splits and distributions) for client manager X in each stock during the reporting period. We also compute split-adjusted changes in holdings by fund M for that reporting period. We then compare the change in holdings for fund managers X and M for each stock to find a match. Lastly, we manually verify the matches identified above using fund names from the Thomson S12 and CRSP Mutual Fund databases and

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<sup>8</sup> Prior to May 2004, mutual funds were required by the Securities Exchange Commission (SEC) to report their portfolio holdings at a semi-annual frequency, though many funds voluntarily disclosed their holdings at a quarterly frequency to Thomson Reuters. See Agarwal et al. (2015) for more details.

<sup>9</sup> Following Busse and Tong (2012) and Ferson and Lin (2014), we exclude funds whose names contain any of the following text strings: Index, Ind, Idx, Indx, Mkt, Market, Composite, S&P, SP, Russell, Nasdaq, DJ, Dow, Jones, Wilshire, NYSE, iShares, SPDR, HOLDRs, ETF, Exchange-Traded Fund, PowerShares, StreetTRACKS, 100, 400, 500, 600, 1000, 1500, 2000, 3000, 5000. We also remove funds with CRSP index fund flag “D” (pure index fund) or “E” (enhanced index fund).

<sup>10</sup> We address incubation bias as follows. As in Evans (2010), we use the fund ticker creation date to identify funds that are incubated (i.e., when the difference between the earliest ticker creation date and the date of the first reported monthly return is greater than 12 months). If a fund is classified as incubated, we eliminate all data before the ticker creation date. The ticker creation date data cover all funds in existence at any point in time between January 1999 and January 2008. For a small set of funds that are not covered in the ticker creation date data (i.e., those that first appear after January 2008), we remove the first 3 years of return history as suggested by Evans (2010).

<sup>11</sup> Previous studies that use Abel Noser data include Goldstein et al. (2009), Chemmanur, He, and Hu (2009), Puckett and Yan (2011), Anand et al. (2012, 2013), and Busse, Green, and Jegadeesh (2012), among others.



a client manager name list (with the names for all “clientmgrcode”) disclosed by Abel Noser in 2011.<sup>12</sup>

Our initial matched Abel Noser sample covers 1,079 unique funds in the merged Thomson S12–CRSP Mutual Fund database. Out of these funds, 583 are actively-managed U.S. equity funds based on the criteria specified above. Our final sample consists of trade-by-trade data for these 583 funds from January 1999 to September 2011. The January 1999 starting point for the trade data corresponds to the beginning of the period we can identify matches from the Abel Noser database. Abel Noser stopped providing the fund-level identifier in the institutional trading data after September 2011. Consequently, we cannot match Abel Noser data to Thomson S12 data at the fund level after September 2011. The final sample has a monthly average of 198 funds over the sample period from January 1999 to September 2011. Although our sample is limited to funds in Abel Noser, it represents the only transaction-level dataset that can be used to precisely estimate trading costs from actual mutual fund transactions.

## *B. Variable Construction*

### *B.1. Trading Cost Measures*

We use Abel Noser data to construct trading cost measures based on the difference between the trade execution price and a benchmark price:

$$\text{Trade Cost} = D * \frac{\text{Price} - \text{Benchmark Price}}{\text{Benchmark Price}}, \quad (1)$$

where *Price* is the execution price of a trade, and *D* denotes the trade direction, taking a value of 1 for a buy and –1 for a sell. Similar to KM, Anand et al. (2012), and Frazzini, Israel, and Moskowitz (2015), we use pre-ticket prices for *Benchmark Price*, including (i) the price at the time the fund places the order ticket (i.e., execution shortfall, Anand et al. (2012)), (ii) the opening price on the day the first share in the order ticket trades (Anand et al. (2013) and Frazzini, Israel, and Moskowitz (2015)), and (iii) the closing price the day before the first share in the order ticket

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<sup>12</sup> It is important to note that our holdings and name matching procedures are performed at the fund level as identified by “clientmgrcode” in the Abel Noser data, rather than at the institution/fund family level as identified by “managercode”. Multiple Abel Noser “clientmgrcode” may match to the same S12 fund for different periods. See Agarwal, Tang, and Yang (2012) for more details on the matching procedure. Also see the appendix in Puckett and Yan (2011) for more details about the different identifiers in the Abel Noser data.

trades (KM and Frazzini, Israel, and Moskowitz (2015)). The transaction cost measures capture implicit trading costs, including price impact and costs related to the bid-ask spread.

Abel Noser groups individual trades into trade tickets. Fund managers transmit orders to the trading desk in the form of tickets, which often encompass a number of individual trades. Following KM and Anand et al. (2012), we evaluate costs on the basis of tickets rather than individual trades. As in Anand et al. (2012), we follow Abel Noser specifications to group trades by the same fund manager and the same broker on the same stock into tickets by matching on the price at the time of order submission and ensuring that the sum of the trade share volumes equals the ticket volume as stated by Abel Noser.<sup>13</sup> Computing costs at the ticket level, rather than at the individual trade level, directly impacts the price benchmark associated with a trade because all of the trades within a ticket utilize the same price benchmark. We compute ticket-level data as the value weighted average of the trade-level data using trading volume as the weight on each trade. In our sample, each ticket includes an average of 1.26 trades.

We aggregate the above per ticket costs to obtain two trading cost measures at the fund-month level: (i) trading costs per trade dollar and (ii) trading costs per TNA dollar. For a given fund month, we compute trading costs per trade dollar as the value-weighted average of the execution shortfall, open price cost, or prior-day close cost based on the dollar value of each ticket by aggregating over all of a fund's tickets in a given month. To obtain trading cost per TNA dollar, we multiply the alternative cost measures by the dollar value of each ticket and then sum over all tickets in a month for a given fund. We then divide by the average TNA of the previous and current month-ends to obtain a monthly trading cost per TNA dollar. In order to make this cost measure comparable to the fund expense ratio, we multiply the time series average of the monthly fund-level trading cost per TNA by twelve to get an annual measure. We also use the Abel Noser data to calculate two explicit trading cost measures, commission and tax plus fee, aggregated, as above, on a per trade dollar basis or on a per TNA dollar basis. We obtain total trading costs by adding

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<sup>13</sup> In a previous version we estimated costs using stitched tickets, which combine tickets submitted on consecutive days by the same fund manager to the same broker in the same stock and in the same direction (buy or sell). Since stitched tickets take longer to execute, trading cost estimates using stitched tickets are higher overall and also comparatively higher for larger funds that trade larger amounts. Even with stitched tickets, trading costs per TNA dollar are lower for larger funds, and the overall message that larger funds hold more liquid stocks to manage transaction costs remains unchanged.

the corresponding commission and tax plus fee to the trading cost per trade dollar or the trading cost per TNA dollar.

### *B.2. Fund Characteristics*

To measure performance, we compute alphas using the Carhart (1997) four-factor model. Specifically, the four-factor alpha is calculated as the difference between a fund's net return in a given month and the sum of the product of the four-factor betas estimated over the previous 36 months and the factor returns during that month.<sup>14</sup> The four-factor model includes the CRSP value-weighted excess market return (Mktrf), size (SMB), book-to-market (HML), and momentum (UMD) factors. We require a minimum of 12 monthly observations when estimating the betas.

Other fund characteristics are constructed as follows. Since the CRSP mutual fund database lists multiple share classes separately, we aggregate share class-level data to fund-level data. We compute fund TNA by summing TNA across all share classes. Fund age is the age of the oldest share class in the fund. We calculate value-weighted averages of the expense ratio and fund turnover across all share classes. Family TNA is the aggregate TNA across all funds in a family, excluding the fund itself. Fund flows are measured as the average monthly net growth in fund assets beyond capital gains and reinvested dividends (e.g., Sirri and Tufano (1998)) and are value-weighted across all share classes to obtain the total net flow across all share classes.

### *B.3. Portfolio Holding Characteristics*

For each stock in a fund's portfolio, we calculate stock-level characteristics using data from CRSP and COMPUSTAT. The stock level characteristics are market capitalization, book-to-market ratio, past six-month cumulative return, and the Amihud (2002) measure of illiquidity. We restrict our sample to stocks with CRSP share codes 10 or 11 (i.e., common stocks).<sup>15</sup> We calculate monthly fund-level market capitalization, book-to-market ratio, momentum, and the Amihud illiquidity measure by weighting each firm-level stock characteristic according to its dollar weight in the most recent fund portfolio. We obtain monthly measures by assuming constant fund holdings between portfolio holding snapshots, which are typically available at a quarterly frequency.

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<sup>14</sup> Using the past 24 and 60 months for beta estimation yields similar results. Results for the five-factor alpha (adding the Pástor and Stambaugh (2003) liquidity factor to the Carhart (1997) four-factor model) are also similar.

<sup>15</sup> We base our reported results on all mutual fund stock holdings regardless of share price. Our results are unchanged if we eliminate stocks with share price below \$5 at the previous month-end.

Book-to-market ratio is calculated as the book value of equity (assumed to be available six months after the fiscal year end) divided by the market capitalization. We obtain book value from COMPUSTAT supplemented by book values from Ken French’s website.<sup>16</sup> We winsorize the book-to-market ratio at the 0.5 and 99.5 percentile levels to eliminate outliers, although our results are not sensitive to this winsorization. Momentum is the six-month cumulative stock return over the period from month  $t - 7$  to  $t - 2$ . For a given stock, the Amihud (2002) illiquidity measure is the average ratio of the daily absolute return to its dollar trading volume over all the trading dates in a given month.<sup>17</sup> Following Acharya and Pedersen (2005), we normalize the Amihud ratio and truncate it at 30 to eliminate the effect of outliers as follows:

$$L_{i,t} = \frac{1}{D_{i,t}} \sum_{d=1}^{D_{i,t}} \frac{|r_{i,d,t}|}{DVOL_{i,d,t}} \times 1,000,000 \quad (2)$$

$$Amihud_{i,t} = \min(0.25 + 0.3L_{i,t} \times P_{t-1}^M, 30), \quad (3)$$

where  $r_{i,d,t}$  is the return on stock  $i$  on day  $d$  in month  $t$ ,  $DVOL_{i,d,t}$  is the dollar trading volume,  $D_{i,t}$  represents the number of days in month  $t$  that stock  $i$  trades, and  $P_{t-1}^M$  is the ratio of the capitalizations of the market portfolio at the end of month  $t - 1$  and at the end of July 1962.

## II. Sample Overview and Preliminary Analyses

Before examining the sample statistics, one potential concern is that mutual fund clients of Abel Noser are not representative of the universe of funds typically examined in the literature. For a point of comparison, in Appendix A we examine statistics associated with the sample selection criteria of PST applied to the standard CRSP Survivor-Bias-Free U.S. Mutual Fund database, without narrowing the sample to funds that have trade data available from Abel Noser. When we compare our Abel Noser sample to PST along the dimensions of fund size and style composition, we find broad similarities. Although our fund sample does skew toward larger TNA funds, it

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<sup>16</sup> See [http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data\\_library.html](http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html).

<sup>17</sup> Given that trading volume was overstated on Nasdaq due to inter-dealer trades, we follow Gao and Ritter (2010) to adjust NASDAQ trading volume when computing the Amihud illiquidity measure.

nonetheless largely captures the heterogeneity in TNA of a standard CRSP-sourced sample. See Table A and discussion in Appendix A for details.

Our Abel Noser sample averages 198 funds per month. Table I reports summary statistics of trading cost measures, fund performance, fund characteristics, and holdings stock characteristics. Panel A reports the unconditional mean sample statistics, and Panel B reports the statistics by investment style, dividing funds in each style into two groups based on their lagged TNA relative to the style median. For investment style, we use Morningstar's three by three style box, based on tercile groupings along market capitalization and growth/value dimensions. For fund-level variables, we first compute the cross-sectional average each month across all of the funds in each below/above median group and then take the time-series mean of the cross-sectional averages.

[Insert Table I here]

This paper is the first to provide precise estimates of mutual fund trading costs using actual mutual fund trades. Prior studies typically estimate trading costs based on KM's analysis of the trades of 21 institutions from 1991–1993. We examine both implicit costs and total costs per TNA dollar. Total costs represent the sum of implicit costs and explicit costs including commissions, taxes, and fees per TNA dollar. Based on equation (1), Panel A of Table I reports that, across the entire sample, the three total trading cost estimates average 0.75%, 0.89%, and 1.01%, roughly comparable to the 1.17% average expense ratio (which represents annual fund operating expenses as a percentage of TNA, including the management fee, administrative fee, and 12b-1 fee), where we take the time-series mean of the monthly cross-sectional sample average. Moreover, the three implicit trading cost measures average 0.47%, 0.61%, and 0.74%, accounting for a larger portion of total costs than the explicit cost component.

In Table I, Panel B, we examine how trading costs vary with fund size within each investment style. In Panel B1 of Table I, a strong negative relation between fund size and both implicit and total trading costs exists across all large-cap investment styles, which together comprise more than half of the fund sample and fund-month observations. Based on execution shortfall, across the large-cap growth, blend, and value styles, funds below the median fund TNA show a mean implicit (total) trading cost of 0.53% (0.82%), whereas funds above the median fund

TNA show a mean implicit (total) trading cost of 0.20% (0.35%).<sup>18</sup> Thus, smaller funds experience trading costs that are more than twice the costs experienced by larger funds. Results based on the prior-day close cost and open price cost are similar: open price costs average 0.80% (implicit) and 1.09% (total) for funds below the median style TNA and 0.32% (implicit) and 0.47% (total) for funds above the median TNA. Prior-day close costs average 1.03% (implicit) and 1.33% (total) for funds below the median style TNA and 0.44% (implicit) and 0.59% (total) for funds above the median TNA.

The evidence in Panel B2 for mid-cap funds also suggests that bigger funds experience lower trading costs than smaller funds, with 15 of the 18 alternative cost estimates across the three mid-cap styles being larger for funds below the median TNA than for funds above the median TNA. Mid-cap funds below the median TNA have a mean implicit (total) trading cost of 0.66%, 0.74%, and 0.75% (1.08%, 1.15%, and 1.18%) based on execution shortfall, open price cost, and prior-day close cost, respectively. Mid-cap funds above the median TNA show a mean implicit (total) trading cost of 0.35%, 0.43%, and 0.40% (0.56%, 0.64%, and 0.62%), roughly half the costs experienced by the below-median TNA funds.

Compared to the large-cap and mid-cap results, the more sparsely populated small-cap results in Panel B3 are somewhat mixed. Overall, below-style-median TNA funds show higher implicit and total trading costs than above-style-median TNA funds: Implicit (total) costs show a mean of 0.81% (1.26%) for the below-median TNA funds and 0.71% (1.06%) for above-median TNA funds. But smaller funds have greater trading costs than larger funds only within the growth small-cap sub-style (which is the largest small-cap category in terms of aggregate TNA). Trading costs are significantly greater for larger small-cap value funds, and they are mostly higher for larger small-cap blend funds. Note, however, that the difference in mean TNA between above- and below-median TNA small cap funds is much smaller than the corresponding differences within large cap and mid cap investment styles, such that one would not expect trading costs to differ across above- and below-median TNA small cap funds as much as in the larger style categories.<sup>19</sup>

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<sup>18</sup> In this section, we equal weight the statistics across the investment styles.

<sup>19</sup> Less variation in fund size exists among small cap funds probably because SEC Rule 35d-1 “Investment Company Names” (effective since 2001) requires a fund that uses the terms small, mid, or large capitalization in its name to invest at least 80% of its assets in the type of investment suggested by the name. Maintaining compliance with the rule effectively restricts TNA growth in

Overall, if we weight each of the nine investment styles equally, funds below the style TNA median show a mean implicit (total) transaction cost estimate of 0.65%, 0.78%, and 0.88% (1.04%, 1.17%, and 1.27%) based on execution shortfall, open-price cost, and prior-day close cost, respectively, whereas funds above the style TNA median show a mean implicit (total) trading cost estimate of 0.42%, 0.48%, and 0.51% (0.67%, 0.72%, and 0.75%). These “hidden” costs, which typically are not reported to investors, are comparable to the average annual expense ratio of 1.17%. Examining the explicit costs by themselves, we find that commission fees are also significantly lower for larger funds within seven of the nine investment styles, which is not surprising given that funds with higher trade volume would be able to negotiate lower per-share commissions. We should also note that weighting the trading cost results across the investment styles by TNA provides somewhat stronger evidence consistent with smaller funds showing higher trading costs, insofar as the results are strongest within the large-cap style categories, which comprises more than half of the assets under management in our sample.

Beyond the effects relating trading costs to fund size, we also find that trading costs are greater for growth funds than for value funds. For example, the mean implicit (total) trading cost for growth funds (i.e., averaged across above- and below-style median TNA large, mid, and small-cap styles and the three alternative cost measures) is 0.94% (1.29%), whereas the mean implicit (total) trading cost for value funds is 0.36% (0.69%). This finding is consistent with prior evidence that suggests that growth fund managers are more aggressive than value fund managers (e.g., KM).

Trading costs directly impact fund shareholder returns, such that, given their higher trading costs, we would expect smaller funds to underperform larger funds, other things equal. Note that this expectation runs counter to results in some studies that suggest that larger funds underperform smaller funds (see, for example, Chen et al. (2004)). The performance statistics reported in Panel B of Table I, however, show no significant performance advantage for large funds.<sup>20</sup> For example, focusing on net shareholder return and four-factor alpha, performance measures that are net of trading costs, larger funds do not significantly outperform smaller funds in any of the 18

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small cap funds because it limits their ability to shift into bigger and more liquid stocks to mitigate increases in trading costs as fund size increases.

<sup>20</sup> Our evidence is consistent with Elton, Gruber, and Blake (2012), who also find no performance difference across fund size after controlling fund style.

comparisons (i.e., two performance measures across nine investment styles). Smaller funds show higher point estimates of net returns and alphas than larger funds in slightly more than half (11 out of 18) of the comparisons. The only evidence of significant relative outperformance is within the large-cap blend style, where smaller funds outperform larger funds despite incurring higher trading costs. The DGTW adjusted return also shows no significant difference in performance between small and large funds.<sup>21</sup>

The tendency for smaller funds to perform no worse than larger funds can be explained by examining differences in the characteristics of the stock holdings of smaller funds compared to larger funds. In particular, smaller funds hold smaller, less liquid stocks. For example, within seven of the nine investment styles, the mean market capitalization of the portfolio holdings of funds below the style TNA median is less than the mean market capitalization of the portfolio holdings of funds above the style TNA median, with six of the seven instances statistically significant. In the two styles where smaller funds do not hold smaller stocks (small-cap growth and small-cap value), the difference in the mean market capitalization between small and large funds is not statistically significant. Furthermore, within eight out of nine investment styles, smaller funds have higher mean estimates of the Amihud illiquidity measure, with seven of the eight instances being statistically significant.

The pattern that we see thus far in Table I, where larger (smaller) funds show both lower (higher) transaction costs and greater (lower) liquidity in their holdings, is no coincidence. Fund managers account for expected transaction costs when forming their portfolios. All things equal, managers prefer to trade more liquid stocks. The preference for more liquid stocks is likely stronger for larger funds because their larger portfolio positions require larger trades on average. Consequently, our finding that large funds have lower trading costs is endogenous to the fund managers' decision to hold stocks that generate lower transaction costs, and this endogeneity likely relates to fund size.<sup>22</sup>

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<sup>21</sup> To compute each portfolio's Daniel et al. (DGTW, 1997) characteristic-adjusted return, we form 125 portfolios in June of each year based on a three-way quintile sort along the size (using the NYSE size quintile), B/M, and momentum dimensions. The abnormal performance of a stock is its return in excess of its DGTW benchmark portfolio, and the DGTW-adjusted return for each fund aggregates over all the component stocks using the most recent portfolio dollar value weighting.

<sup>22</sup> This pattern breaks down when larger funds are constrained to hold less liquid stocks due to regulation, such as SEC Rule 35d-



In addition to holding less liquid stocks, smaller funds also hold stocks with higher book-to-market ratios (i.e., value stocks), with below-style-median-TNA funds showing significantly higher book-to-market ratios than above-style-median-TNA funds in six out of nine investment styles. Since it has been well documented that smaller, less liquid, and higher book-to-market stocks are characterized by greater average returns, it is apparent that, compared to larger funds, smaller funds focus on stocks that produce greater return premia, on average.<sup>23</sup> The emphasis that small funds place on these types of stocks provides return premia that appears to fully offset the transaction cost disadvantage they experience when they trade. In fact, the two effects associated with smaller funds—higher trading costs and less-liquid, higher return premia holdings—are directly connected, since transaction costs are inversely related to liquidity.

Smaller funds have significantly higher mean expense ratios and significantly higher portfolio turnover than larger funds within all nine investment styles, where funds below (above) the style TNA median show a mean expense and turnover ratio of 1.40% (1.00%) and 108% (80%), respectively (averaged across all investment styles). The finding of no statistically significant performance difference between small and large funds indicates that the emphasis smaller funds place on less liquid holdings provides enough extra return premia to not only offset their trading cost disadvantage compared to large funds but also the cost disadvantages associated with their expense ratios and the tendency toward greater portfolio turnover. Note also that even after controlling for risk via the four-factor model, small funds do not underperform large funds despite incurring higher trading costs. The finding that smaller funds do not underperform larger funds after controlling for the extra risk associated with their less liquid holdings suggests that either smaller funds identify undervalued stocks within their less liquid investment universe or that the four-factor model does not fully control for risk in the stocks that they invest in (see, for example, Fama and French (1996)).

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1 mentioned earlier. For example, small cap value funds with above-style-median TNA hold stocks of almost the same market capitalization as small cap value funds with below-style-median TNA (i.e., \$1.3 billion vs. \$1.4 billion) and more illiquid stocks (0.975 vs. 0.853), resulting in higher transaction costs for the larger funds because of their larger trade sizes.

<sup>23</sup> See Banz (1981), Fama and French (1992), Daniel and Titman (1997), Amihud and Mendelson (1986), Brennan, Chordia, Subrahmanyam (1998), and Avramov and Chordia (2006a, 2006b).

Given that we see no difference in DGTW-adjusted portfolio returns, we might expect smaller funds to underperform larger funds net of trading costs (i.e., on a net return basis) as DGTW-adjusted performance does not account for trading costs. However, DGTW-adjusted performance is based on quarterly portfolio holding snapshots, rather than actual shareholder returns, and has been shown to miss important intra-quarterly performance that might favor smaller, higher turnover funds (see Kacperczyk, Sialm, and Zheng (2008) and Puckett and Yan (2011)). Thus, based on the DGTW performance measure, we are unable to reach any definitive conclusion regarding the abnormal performance of smaller funds compared to larger funds.

In Table 1, Panel C, we pool the Table I, Panel B statistics across investment styles by subtracting the style mean statistic from the fund level statistic for each fund-month observation. The resulting larger sample size (compared to the nine sets of individual style results in Panel B) facilitates examining the statistics over finer fund size increments—e.g., here we examine the statistics by fund size quintile—while providing the opportunity to draw a broader, industry-wide perspective.

Consistent with the results in Panel B, Panel C shows a strong inverse relation between fund size and trading costs. The lowest fund size quintile (i.e., the smallest funds) shows statistically significantly greater trading costs than the highest fund size quintile for all three transaction cost measures and for both implicit and total transaction costs. The difference in trading costs between the small fund quintile and the large fund quintile averages 0.56% per TNA dollar in implicit costs and 0.79% per TNA dollar in total costs. Small funds also incur greater expenses and higher portfolio turnover, with the smallest fund quintile showing a 0.68% (50%) greater annual expense (turnover) ratio than the largest fund quintile.

Also consistent with the results in Panel B, no statistically significant difference exists in performance across the fund size quintiles. The smallest fund quintile outperforms the largest fund quintile by an insignificant 0.05% in net shareholder return, but underperforms by an insignificant -0.04% and -0.01% in four-factor alpha and DGTW adjusted return, respectively. Thus, as in Panel B, small funds show no worse performance than large funds despite their significantly greater trading costs and greater fund expenses.

Consistent with the inference associated with the statistics in Panel B, the holding statistics in Panel C indicate that the reason smaller funds are able to provide performance that is competitive with that of larger funds is because they hold smaller, less liquid stocks that presumably generate higher returns. The smallest fund quintile shows mean portfolio holding market capitalization (Amihud illiquidity) that is \$7.6 billion lower (0.007 higher) than that of the highest fund quintile. Although the less liquid holdings lead smaller funds to earn insignificantly greater net shareholder returns than larger funds despite their trading cost and operating expense disadvantage, the extra risk and higher benchmark returns associated with these holdings results in insignificantly lower risk- or characteristic-adjusted performance for small funds compared to large funds.

There are two caveats to the trading cost analysis. First, our data provides transaction cost estimates only for trades that were consummated. It could be the case that a fraction of the desired trades were not executed due to high trading costs. Given that our data consists of actual trades, we cannot estimate the cost of forgone trades. Second, some funds could have higher total trading costs due to soft-dollar arrangements whereby research services are bundled with brokerage commissions.<sup>24</sup>

### **III. Results**

In this section, we first use the Abel Noser trade data to more comprehensively analyze the determinants of mutual fund trading costs. We study the effects of trade, stock, and fund characteristics on trading costs first at the ticket level and then at the fund level. We then examine whether trading costs affect fund performance. Lastly, we examine how funds rebalance their portfolios to manage trading costs as they grow over time.

#### *A. Trading Costs Per Trade Dollar*

We first analyze monthly fund trading costs scaled by dollar value traded (unannualized). Recall that these costs are the fund-month, ticket-dollar weighted averages of the transaction cost estimates computed using equation (1). We refer to these costs as trading costs per trade dollar.

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<sup>24</sup> See, e.g., Conrad, Johson, and Wahal (2001).

Similar to trading costs per TNA dollar that we examine in Table I, these per trade dollar costs decrease with the size of the fund. Panel A of Table II shows that all three implicit cost estimates decrease by approximately 7–13 basis points per month from funds in the smallest quintile to funds in the largest quintile. The decrease in total costs, which includes commissions, taxes, and fees, is a bit larger, ranging from 9–15 basis points. The reason why the differences here are smaller than the per TNA dollar results reported in Table I is because smaller funds show greater portfolio turnover than larger funds, such that smaller funds incur the costs reported in Table II, Panel A more often, on average, than larger funds. The large difference in turnover combined with the small disadvantage in trading costs per trade dollar results in the greater disadvantage in costs per TNA dollar for smaller funds.

[Insert Table II here]

Note that trading costs as measured by the open price or prior-day close cost are slightly greater than those measured using execution shortfall. The difference between these costs is about 2–3 basis points on average. This suggests that there is a slight slippage in price between the closing price the day before or the opening price the day of a ticket's first trade and the time the order is placed, possibly because (i) fund managers condition on returns and chase prices, or (ii) other traders anticipate fund managers' trading intentions and front-run them. Without knowing the exact time when portfolio managers send the order to the trading desk, we are unable to distinguish between these two explanations.

Larger funds exhibit lower trading costs per trade dollar despite their larger positions and larger stock trades. Panel A2 of Table II shows that the average ticket size of funds in the largest quintile (\$2.0 million and 60,400 shares) is more than twice the average ticket size of funds in the smallest quintile (\$888,000 and 28,100 shares). Although tickets are broken up into smaller size trades, the difference in the number of trades per ticket across the quintiles is small relative to the range of ticket sizes, such that the average trade size for large funds greatly exceeds the average trade size for small funds. Consistent with the earlier evidence regarding the characteristics of stocks that mutual funds hold in their portfolios, Panel A3 of Table II suggests the reason larger funds show lower trading costs per trade dollar than smaller funds is because large funds trade

larger, more liquid stocks. The average market capitalization of stocks traded by a quintile 5 fund (\$40.0 billion) is considerably greater than the average market capitalization traded by a quintile 1 fund (\$27.0 billion), as large funds proactively select stocks to avoid incurring prohibitively high transaction costs.

As discussed earlier, the trading requirements faced by large funds likely affect their portfolio decisions and thus impact the trading cost estimates in Table I and in Panel A of Table II. To control for this endogeneity between realized trading costs and fund size, Panel B of Table II compares trading costs across fund quintiles conditional on small funds and big funds trading the same stock in a given month. Specifically, we analyze trade tickets where the same stock is traded by at least one fund in both quintile 1 and quintile 5 in a given month, which is 63.7% (i.e., 5,852,590 trade tickets) of the full sample.<sup>25</sup> For each stock-month combination, we compute the ticket value-weighted trading cost of each fund quintile. Then, we average across all stocks each month and finally compute the time-series average across all sample months.<sup>26</sup>

Similar to the pattern within the broader sample in Panel A of Table II, large funds trade considerably larger tickets and also larger trades within tickets compared to small funds after conditioning on trading the same stock. In Panel B of Table II, large funds average \$1.7 million and 51,000 shares per ticket, while small funds average \$124,000 and 4,300 shares per ticket. The large difference in ticket size results in a big difference in trading cost estimates between small and large funds when trading the same stock. Conditional on the stock traded, top TNA quintile funds experience a value-weighted execution shortfall, open price cost, and price-day close cost of 0.17%, 0.25%, and 0.31%, respectively, which is significantly higher than the 0.12%, 0.18%, and 0.20% costs for bottom quintile funds. The difference between the top and bottom quintiles in all three implicit cost estimates is approximately 5–11 basis points, and all differences are statistically significant. The transaction cost disadvantage for large funds when conditioning on the stock traded and the preference for trading larger, more liquid stocks as in Panel A3 of Table

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<sup>25</sup> We obtain qualitatively similar results if we compare trading costs across TNA quintiles conditional on funds in all five quintiles (i.e., at least one fund) trading the same stock in a given month.

<sup>26</sup> We note that the way we compute averages differs in Panel A vs. Panel B of Table II. In Panel A1, we first compute value-weighted cost measures for each fund-month combination, then average across all funds in a quintile, and lastly average across all months. In Panel B1, we first compute value-weighted cost measures at the stock-month level for each quintile (aggregating across all funds in a quintile), then average across all stocks each month, and lastly average across all months.

II suggest that fund managers account for expected trading costs when deciding which stocks to include in their portfolios.

In sum, large funds incur higher trading costs on a per trade dollar basis when conditioning on the underlying stock that is traded. However, overall, large funds realize lower trading costs than small funds per TNA dollar and also per trade dollar because they trade stocks that are less costly to trade. Large funds realize an additional cost advantage compared to small funds per TNA dollar than per trade dollar because large funds trade less frequently than small funds.

### *B. Determinants of Ticket-Level Transaction Costs*

We now examine how ticket-level transaction costs relate to trade ticket characteristics, such as ticket size, and characteristics of the traded stock, including market capitalization and share price. Unlike KM and Anand et al. (2012), our unique matched dataset allows us to analyze fund-level determinants of trading costs. The goal is to provide an algorithm for computing mutual fund trading costs using variables at the ticket level and at the fund level.

To document how trading costs change over calendar time, we first report estimates of execution shortfall and total costs by year in Panel A of Table III. We compute execution shortfall at the ticket level by taking an equally weighted average of the cost per trade dollar across all tickets in a year. The results for the other cost estimates, open price and prior-day close cost, are similar, and we present them in Table IA.I in the Internet Appendix.<sup>27</sup>

[Insert Table III here]

The overall average execution shortfall for all tickets amounts to 0.12%, and for buys (sells) it is 0.09% (0.15%). After accounting for commissions, taxes, and fees, the average total trading cost is 0.24%.<sup>28</sup> Trading costs vary somewhat by year, and they are noticeably greater during periods of market uncertainty. For instance, note the increase in 2008, likely due to market dislocations during the financial crisis. During the heart of the financial crisis, September 2008

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<sup>27</sup> In the rest of the paper, unless otherwise noted, we present only the results for execution shortfall. Results associated with the open price and prior-day close costs are similar to those reported for execution shortfall.

<sup>28</sup> These measures differ from those in Panel A of Table II because we take an equal weighted average across all tickets in a year, rather than value weighting by the dollar trading volume for each fund-month.

through March 2009, total trading costs average 0.34%, substantially higher than the 0.20% and 0.11% transaction cost averages during 2007 and 2010, respectively. In general, the cost associated with buy transactions is lower than the cost associated with sell transactions, especially when the market is unusually volatile.<sup>29</sup> For instance, the cost to sell increases substantially as liquidity dries up in 2008.

Our transaction cost estimates at the ticket level are comparable to cost estimates reported recently by others. For example, Frazzini, Israel, and Moskowitz (2015) report an equal-weighted average market impact cost of 0.16% for the long-only portfolios of one large institution. In addition, Anand et al. (2012) report a volume-weighted mean execution shortfall of 0.25% for a broader sample of institutional investors within the same Abel Noser database that we use.

To examine the determinants of transaction costs, we estimate monthly cross-sectional regressions of ticket-level transaction costs on several trade and fund level variables as follows,

$$TradeCost_{i,j,k,t} = \alpha + \beta_1 TicketSize_{i,k,t} + \beta_2 \frac{1}{P_k} + \beta_3 LogMktCap_{k,t-1} + \beta_4 Nasdaq_{k,t} + \beta_5 IVOL_{k,t-1} + \beta_6 side_{i,t} * market_t + \lambda Z_{j,t-1} + \zeta_{i,j,k,t}, \quad (4)$$

where  $TradeCost_{i,j,k,t}$  is the ticket-level execution shortfall or total cost per trade dollar for ticket  $i$ , stock  $k$ , and fund  $j$  at time  $t$ ,  $TicketSize_{i,k,t}$  is the trading volume of ticket  $i$  normalized by the average daily trading volume in the same stock in the previous calendar month,<sup>30</sup>  $P_k$  is stock  $k$ 's closing price the day prior to the ticket's first trade,  $LogMktCap_{k,t-1}$  is the logarithm of stock  $k$ 's market capitalization (in millions of dollars) at the end of the month prior to the ticket's first trade,  $Nasdaq_{k,t}$  is a dummy variable that equals 1 if stock  $k$  is a Nasdaq listed stock,  $IVOL_{k,t-1}$  is the idiosyncratic volatility calculated as the standard deviation of the residuals from a regression of daily returns on the CRSP value-weighted market return in a 12-month period ending with the last month end,  $side_{i,t}$  equals 1 if ticket  $i$  is a buy and  $-1$  if it is a sell,  $market_t$  is the CRSP value-weighted market return on the ticket's execution date, and  $Z_{j,t-1}$  is a set of fund-level control

<sup>29</sup> See also Keim and Madhavan (1997), Anand et al. (2012), and Brennan et al. (2012).

<sup>30</sup> Our ticket size variable in equation (4) differs slightly from the one used in Keim and Madhavan (1997). They calculate ticket size as shares traded divided by stock shares outstanding. We obtain similar results with their version of ticket size.

variables at the end of the month prior to the ticket's first trade, including investment style, expense ratio, turnover, net flow, Log(fund age), Log(TNA), Log(family TNA), and fund net return.

We estimate regression (4) via two alternative specifications. In our first specification,  $Z_{j,t-1}$  includes dummy variables for investment style. The dummy variables control for style-related trading cost differences relative to large-cap blend funds. Our second specification estimates regression (4) separately for each investment style (i.e., without style dummy variables). The advantage of the first specification is we include all funds in one regression, thereby increasing the precision of the coefficient estimates. The second specification allows us to examine how the regression coefficients differ across investment styles.

Panel B of Table III reports the time series average of the monthly coefficient estimates as in Fama-MacBeth (1973) based on execution shortfall. Table IA.I in the Internet Appendix reports results based on the open price and prior-day close transaction cost measures. In Panel B1, where we have the investment style dummy variables, we analyze implicit and total transaction costs for buy transactions, sell transactions, and all (i.e., both buy and sell) transactions. Panel B2 presents the results based on estimating regression (4) separately for each investment style, and we report results only for total transaction costs. Given that transaction costs persist, we adjust the Fama-MacBeth (1973) standard errors in both specifications using the Newey-West (1987) correction.

Focusing first on the transaction level variables, we find that execution shortfall is strongly positively related to ticket size, the inverse of price, and the stock market return, and it is negatively related to firm size. The strong relation between trade cost and ticket size is apparent in all of the alternative specifications in both panels and is consistent with prior expectations. The negative relation between trade cost and stock price is possibly a result of the higher proportional bid-ask spread among low price stocks. This negative relation is especially evident in the total cost results in columns (4)–(6) of Panel B1 and in Panel B2. Institutions typically pay brokers a fixed commission fee per traded share (e.g., \$0.01 per share), such that a trade's commission expense expressed as a percentage of the total dollar value of the trade increases as share price decreases. The strong inverse relation between trading costs and the market capitalization of the traded stock is consistent with the positive relation between a stock's market capitalization and its liquidity.



The positive coefficient on *IVOL* for sell transactions suggests that selling costs are higher for stocks with greater information uncertainty. Nasdaq stocks seem to have higher implicit trading costs but lower commissions and fees, especially among investment styles focusing on relatively large stocks. Note also the strong significance of the *side\*market* variable, which serves to remove the market's effect on the cost estimate. Movements in the market impact the difference between a transacted price and its pre-ticket benchmark. For example, other things equal, a buy will transact at a higher (lower) price if the market moved up (down) between the pre-trade benchmark time and the time of execution.

The fund-level variables indicate that ticket-level trading costs are higher for larger funds, especially based on the open price and prior-day close costs (see Table IA.I in the Internet Appendix), possibly due to an imperfect control for ticket size, given that larger funds trade larger tickets. The positive relation between costs and fund turnover suggests funds with greater turnover trade more aggressively. The remaining fund level variables are largely insignificant, except on occasion within a minority of the investment styles.

The regression intercepts in Panel B2 are consistent with value-oriented funds experiencing lower trading costs than growth-oriented funds, especially among large-cap funds. This result is consistent with KM and anecdotal evidence that suggests that value funds are patient, whereas growth funds are more aggressive in their trades. Overall, the statistical significance of the fund characteristic coefficients indicates that it is important to include them when estimating trading costs. Based on the increase of adjusted R-square (untabulated), we find that fund-level variables explain about 30% more of the cross-sectional variation of ticket-level trading costs on average after controlling for ticket- and stock-level variables.

To assess economic significance, we focus on column (4) of Panel B1 for the total cost of all trades. A one standard deviation increase in ticket size increases total trading cost by about 6.3 basis points. For stock characteristics, a one standard deviation increase in the price inverse (market capitalization) of the stock increases (decreases) total costs by 14.9 (2.6) basis points. For the fund level variables, a one standard deviation increase in  $\text{Log}(\text{TNA})$  (fund turnover) increases total trading costs by 1.1 (2.0) basis points, while a one standard deviation increase in expense

ratio increases cost by 2.3 basis points. These numbers are significant in relation to the average total cost of 23.6 basis points (from Panel A of Table III).

### *C. Determinants of Fund-Level Trading Costs*

Table III examined trading costs at the ticket level. We now examine cross sectional determinants of trading costs at the fund-month level. This analysis augments the univariate fund size analysis in Table I.

Panel A of Table IV presents fund-month level trading costs by year. We compute the alternative trading cost measures (execution shortfall, open-price cost, and prior-day close cost) as before, and we aggregate them into two measures for each fund-month: (i) per trade dollar and (ii) per TNA dollar, neither of which is annualized. We then take the equally-weighted cross-sectional average across all fund-month observations in a year and report the averages by year. We present results for execution shortfall in Table IV, Panel A, and we report results based on the other transaction cost benchmarks in Table IA.II in the Internet Appendix. The overall fund-month trading cost pattern in Table IV, Panel A is similar to the pattern for costs at the ticket level in Panel A of Table III, with a large increase during 2008 coinciding with market uncertainty.<sup>31</sup>

[Insert Table IV here]

We now examine the relation between total trading costs and several fund-level attributes in monthly Fama-MacBeth (1973) cross-sectional regressions similar to equation (4), but after excluding the ticket- and stock-level variables. As before, we run two alternative specifications, one including dummy variables for investment style and another where we run regressions separately for each investment style. We again follow Newey-West (1987) to adjust the Fama-MacBeth (1973) standard errors. Table IV, Panels B and C report the results using execution shortfall; Table IA.II in the Internet Appendix shows results based on open price cost and prior-day close cost. Panels B1 and C1 of Table IV show results based on the investment style dummy

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<sup>31</sup> To understand the consistency between per trade dollar costs and per TNA dollar costs, one needs to multiply the per trade dollar costs by twice the annual fund turnover rate (to reflect selling holdings and then buying replacements) and multiply the monthly per TNA dollar costs by 12. Also note that the turnover rate reported by CRSP understates actual trading activity, insofar as it represents the *minimum* of securities purchased or sold divided by average TNA.

variable specification, and Panels B2 and C2 of Table IV show results based on running separate regressions for each investment style.

Table IV, Panel B1 shows a negative relation between implicit or total trading costs per trade dollar and  $\log(\text{TNA})$  when other fund-level controls are not included in the regression. The first panel of results in Table IV, Panel B2 shows that this relation holds for seven of the nine investment styles, with six of the seven negative coefficients statistically significant. The results on per TNA dollar trading costs in Panels C1 and C2 appear to be stronger, with eight (seven) of nine coefficients negative (significantly negative) in Panel C2. The finding that larger funds show lower trading costs is consistent with our earlier evidence in Table I and Panel A of Table II.<sup>32</sup> Note that the negative relation between per trade dollar trading costs and fund size becomes weaker once we include other fund-level variables (see Panels B1 and B2).

Table IV, Panels B and C show a significant positive relation between trading costs and fund turnover that holds for growth funds and, to a less extent, blend funds, where six out of six (three out of six) coefficients for growth (blend) style funds across both panels are statistically significant. This result again suggests that high-turnover funds are less patient, and their trading aggressiveness leads to higher trading costs. There is a negative relation between costs and family TNA (especially for large cap styles), possibly because large families hire more skilled traders or negotiate lower commissions. The other fund specific characteristics, including expense ratio, flow, age, and lag fund return, show no consistent relation to trading costs across investment styles.

When we include lag trade cost as a regressor, the results indicate that trading costs are highly persistent, as evidenced by large, significant, positive coefficients on lag trade cost in Panels B1 and C1 and positive coefficients across all nine investment styles in Panels B2 and C2, with 17 of the 18 coefficients statistically significant. Note also that the average R-squared in the panels is substantially greater when lag trade cost is included as a regressor.

Examining the investment style dummies in Table IV, Panels B1 and C1 and comparing the intercepts across the style regressions in Table IV, Panels B2 and C2 reveals one main effect.

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<sup>32</sup> It could be argued that there is a mechanical relation between  $\log(\text{TNA})$  and trading cost per TNA dollar. However, TNA also impacts the numerator of trading costs per TNA dollar because it is related to the type of stocks traded and to fund turnover. In other words, if large funds traded the same stocks as smaller funds and had the same turnover, then the trading costs per TNA dollar would be higher for larger funds.

Growth-oriented funds realize greater trading costs than value-oriented funds, consistent with the results in Tables I and III. In Panels B1 and C1, the coefficient on the growth dummy is greater than the coefficient on the value dummy for most specifications, and in Panels B2 and C2, the intercepts are by and large greater in the regressions for growth funds than in the regressions for value funds, both consistent with higher costs for growth funds after controlling for the explanatory variables.

Overall, our results in Tables III and IV provide an algorithm for estimating mutual fund trading costs at the ticket and at the fund-month level, respectively.

#### *D. Comparison to Keim and Madhavan (1997)*

The most commonly utilized approach for estimating fund trading costs is based on the transaction level regressions of KM. We next compare trading cost estimates based on KM with our estimates based on the transaction level regression results of equation (4) as reported in Table III. Appendix B provides the fitted regression model that we use to estimate transaction costs following KM. It is worthwhile to note that neither Anand et al. (2012) nor Frazzini, Israel, and Moskowitz (2015) provide algorithms that can be used by other researchers to estimate trading cost levels.<sup>33</sup> Thus, we focus on comparing our transaction level estimates based on equation (4) with those of KM.

Table V reports total trading cost estimates based on the two alternative transaction level trading cost algorithms. Panel A reports total trading cost estimates for tickets double sorted each month along the dimensions of ticket size and the market capitalization of the traded stock. We sort independently along these two dimensions each month. The time series averages of the cutoff points for ticket size quintiles are 0.09%, 0.40%, 1.31%, and 4.38% (i.e., the fraction of the average daily trading volume of the previous calendar month). For market capitalization quintiles, the

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<sup>33</sup> Anand et al. (2012) and Frazzini, Israel, and Moskowitz (2015) both use regressions with fixed-effects to study how trading costs vary with various trade-level and stock-level variables (see Table 3 of Anand et al. (2012) and Table 5 of Frazzini, Israel, and Moskowitz (2015)). However, neither of the two studies reports the intercepts of the regressions, which makes it impossible to use their results to estimate the *level* of trading costs. In addition, both studies use trades for not only mutual funds, but also hedge funds and pension funds. Also, neither study uses fund-level characteristics in their estimates, which the results of Table V indicate are important to accurately estimate trading costs.

cutoff points are \$0.82 billion, \$2.30 billion, \$6.35 billion, and \$22.86 billion. Panel A1 of Table V reports estimates based on KM (equations (B1) and (B2) in Appendix B). Panel A2 of Table V provides estimates of execution shortfall costs per trade dollar based on the equation (4) regression coefficients. Specifically, Panel A2 reports results based on both ticket-level and fund-level variables, i.e., based on all of the coefficients in columns (5) and (6) of Table III, Panel B1. KM also base their cost estimates on a pre-trade benchmark (the stock's closing price the day before the first trade).<sup>34</sup>

[Insert Table V here]

The results in Table V, Panel A1 show that in five out of the 25 cases, particularly trades in the largest quintile stocks, the KM algorithm produces negative transaction cost estimates. By contrast, all of the transaction cost estimates in Panel A2 based on equation (4) are positive. Moreover, the patterns across ticket size and market capitalization in Panel A2 are consistent with expectations. That is, estimates of transaction costs per trade dollar increase nearly monotonically with ticket size and decrease monotonically with the market capitalization of the traded stock. By contrast, in all five stock size quintiles, the KM algorithm cost estimates decrease with ticket size. Lastly, while the KM algorithm cost estimates show a negative relation with market capitalization in Panel A1, the differences between the smallest and largest quintiles are three to four times the magnitude of those based on the equation (4) estimates in Panel A2.

Panel B of Table V reports total trading cost estimates for funds sorted into quintiles based on TNA. Panel B1 again utilizes equations (B1) and (B2), and Panel B2 utilizes equation (4) with either ticket-level variables or both ticket- and fund-level variables. For both alternatives, we aggregate each fund's trading costs across transactions in a given month and report fund-month level cost estimates both on a per trade dollar basis and on a per TNA dollar basis. The KM algorithm produces a strong negative relation between fund size and trading costs per TNA dollar and a weaker negative relation for trading costs per trade dollar. Our algorithm using both ticket- and fund-level variables shows a similar but more moderate negative relation between fund TNA and trading cost estimate. The stronger negative relation between fund size and the KM cost

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<sup>34</sup> We obtain similar results in Panels A2 and B2 of Table V if we use the prior-day close cost measure as in KM.

estimates in Panel B1 is most likely due to the significantly larger differences in cost estimates across different market capitalization quintiles in Panel A1 than in Panel A2, since large funds tend to hold and trade bigger stocks. Overall, our results in Table V, especially those in Panel A, highlight the limitations of the KM algorithm when applying it to a more recent sample period. Furthermore, if using only ticket-level variables, cost estimates on a per trade dollar basis are positively related to TNA, which highlights the importance of including fund-level variables to accurately estimate trading costs.

Note that Panel A2 of Table V provides a quick estimate of mutual fund transaction costs for trading a particular stock, given its market capitalization and the size of the trade ticket. For instance, a fund trading 5% of the average daily volume of a \$2 billion market capitalization stock incurs a transaction cost of about 34 basis points.

#### *E. Trading Costs and Fund Performance*

In this section, we study the impact of trading costs on fund net performance (i.e., net of fund operating expenses and trading costs). We run monthly cross-sectional regressions of fund net returns on contemporaneous trading costs, while controlling for fund-level variables, as follows,

$$FundRet_{i,t} = \alpha + \beta TradeCost_{i,t} + \lambda X_{i,t-1} + \mu_{i,t}, \quad (5)$$

where  $FundRet_{i,t}$  denotes the four-factor alpha of fund  $i$  in month  $t$ ,  $TradeCost_{i,t}$  represents trading cost estimates per TNA dollar as defined in equation (1), and  $X_{i,t-1}$  represents the set of fund-level control variables in month  $t - 1$ , including  $\text{Log}(\text{TNA})$ , expense ratio, turnover, fund flow,  $\text{Log}(\text{fund age})$ ,  $\text{Log}(\text{family TNA})$ , and dummy variables for fund investment styles.

Table VI, Panel A reports time-series averages of the monthly coefficient estimates based on our three transaction cost measures. Since persistence in fund performance could lead to serial correlation in the coefficient estimates, we use the Newey-West (1987) correction to adjust the Fama-MacBeth standard errors.

[Insert Table VI here]

Regardless of the transaction cost price benchmark, the coefficient on the trading cost estimate is negative and significant at the 1% level or better for both implicit and total cost

specifications. For example, for execution shortfall, the coefficient on trading cost is statistically significantly negative at  $-0.532$  for implicit cost and  $-0.401$  for total cost after controlling for fund-level variables. If the coefficient estimate on trading costs were zero, then this would imply that trading costs are fully offset by superior performance as funds move into (out of) better (worse) performing assets or strategies. If the coefficient estimate were  $-1$ , then this would indicate that funds incur trading costs without any consequent benefit of investing in superior performing assets or strategies. The trading cost coefficients, which range from  $-0.354$  to  $-0.532$  in Table VI, suggest that fund managers are unable to fully recoup the cost of their transactions by moving into (out of) substantially better (worse) performing assets. The costs they incur detrimentally affect performance net of any benefits associated with the new positions. In other words, the results suggest that the trading cost estimates are not entirely driven by price impact associated with mutual funds trading on private information. If trading is motivated by private information, then the coefficient estimates on trading costs should not be negative. Overall, trading costs adversely affect fund risk-adjusted performance in the cross-section.<sup>35</sup>

The only other variable in Panel A of Table VI that significantly relates to fund performance is  $\text{Log}(\text{Family TNA})$ . Similar to evidence in prior studies (e.g., Chen et al. (2004) and Yan (2008)), the coefficient estimate on  $\text{Log}(\text{Family TNA})$  is positive and significant, suggesting that funds belonging to larger fund families earn higher returns, possibly because larger fund families are able to attract and/or develop better managers by providing exposure to many different kinds of funds.

At first glance, it is unclear whether the negative relation between trading costs and performance documented in Table VI captures the same effect documented by Pollet and Wilson (2008), who show a positive relation between portfolio diversification and fund performance. That is, diversifying could reduce transaction costs and improve fund performance. To examine whether transaction costs differentially affect performance beyond effects associated with portfolio diversification, we repeat our analysis in Panel A of Table VI except that we control for the

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<sup>35</sup> Del Guercio and Reuter (2014) find that funds sold through brokers face a weaker incentive to generate alpha. To examine whether differing incentives affect the relation between alpha and trading costs, we repeat the regression (5) analysis separately for load and no load funds. The results indicate no difference between load and no load funds.

additional variables used in Pollet and Wilson (2008). In particular, we include in the regressions indicator variables for quintiles of fund value-weighted holding stock size, the reciprocal of the number of stocks held by funds, and their interaction terms with TNA. We report these results in Table IA.III of the Internet Appendix. Our main finding that trading costs adversely affect fund performance remains unchanged, consistent with transaction costs impacting performance after controlling for the effect of portfolio diversification.

Table VI, Panel B reports the difference in four-factor alpha between funds in the lowest trading cost quintile and funds in the highest trading cost quintile. For quintiles based on either implicit or total transaction costs, we find a statistically significant negative relation between trading costs and performance regardless of the price benchmark. The negative relation between trading costs and performance in Panel B is consistent with the regression evidence in Panel A and again suggests that funds are unable to fully recoup the transaction costs they incur when they alter their portfolio. Thus, a fund manager's skill in managing trading costs is an important component of his overall ability to deliver abnormal performance to investors (net of operating expenses and trading costs).

The economic significance of the results in Panel B is also noteworthy. For example, the difference in four-factor alpha between the lowest total trading cost quintile and the highest total trading cost quintile ranges from 0.142% per month to 0.295% per month, or from 1.7% per year to 3.5% per year. These differences are comparable to or larger than post-ranking performance differences typically documented in the mutual fund performance persistence literature, e.g., Carhart (1997) or Bollen and Busse (2005). For example, Carhart (1997) finds a 2.3% annual difference in four-factor alpha between top and bottom quintiles based on past performance (i.e., past one-year cumulative net returns) during the first post-sort year. However, since trading costs are not transparent, investors would be unable to exploit this strong relation.

#### *F. Fund Flows and the Change in Holding Stock Size*

Managing transaction costs could be particularly important for funds that grow over time. In this section, we examine the impact of fund flows on the types of stocks that funds hold in their



portfolios. Our analysis relates somewhat to Pollet and Wilson (2008), who examine how funds increase the number of unique stock positions in their portfolio as they grow. We analyze how funds manage transaction costs via the liquidity of the stocks that they trade and hold. Our hypothesis is that as funds grow, they tilt their portfolios towards larger stocks in order to manage their trading costs.

Since we do not need transactions cost data in this analysis, we utilize the Thomson S12 dataset, which begins about two decades before the Abel Noser data. Table VII, Panel A reports summary statistics for the Thomson S12 database. The Thomson S12 sample averages 764 funds each month, with an average of about 153 funds in each fund size quintile over the sample period from April 1980 to June 2012. The Thomson S12 sample is considerably larger than the Abel Noser sample, mainly because Abel Noser has a limited number of clients. Consistent with our earlier comparison to standard data samples in this literature, the Thomson S12 sample includes smaller funds than the Abel Noser sample. The average fund TNA is \$36 million for quintile 1 and \$3.8 billion for quintile 5 in the Thomson S12 sample. Corresponding averages in the Abel Noser sample are \$46 million and \$13.0 billion, respectively. Similar to the Abel Noser sample, the Thomson S12 sample shows that, on average, smaller funds hold smaller, less liquid stocks and have a higher expense ratio than larger funds.

[Insert Table VII here]

We first examine the distribution of stocks by firm size in the mutual fund quintile portfolios. Specifically, we sort funds into quintiles based on their last month's TNA and also independently based on the firm size of their previous quarter's holdings using NYSE breakpoints. Panel B of Table VII reports the time-series average of the proportion of fund holdings in each firm size quintile such that the holdings of each fund quintile add up to one. The results clearly show that, compared to small funds, large funds hold fewer small stocks and more large stocks in their portfolios. Small funds invest 7.75% (11.03%) of their assets in the smallest (second smallest) quintile of stocks, while the corresponding proportions for large funds are 1.80% (4.13%). Furthermore, small (large) funds invest 48.74% (69.01%) of their assets in the largest quintile of

stocks. The holding differences between large and small funds are statistically significant across all stock size quintiles.

Next, we focus on fund cash flows, the capital movements in and out of funds that cumulate over time into fund TNA. Examining flows provides insight into the time series dynamics that affect the characteristics of fund holdings. Given our analysis thus far, we anticipate that after a fund receives inflows, the average market capitalization of their portfolio stock holdings will increase. This expectation is based on the long-run relation between cash flows and TNA: cash inflows lead to TNA increases, and TNA is positively related to average portfolio holding market capitalization. Our analysis thus directly tests whether an increase in fund size due to capital inflows leads to an increase in the market capitalization of the stocks in the fund portfolio.

To analyze a fund's portfolio management response to fund flows, we first calculate the change in holding stock size due to active portfolio rebalancing as follows,

$$\Delta StockSize_{i,t-1,t} = \sum_{j=1}^N (\hat{\omega}_{i,j,t} - \omega_{i,j,t-1}) MktCap_{j,t-1},$$

$$\omega_{i,j,t-1} = \frac{S_{i,j,t-1}P_{j,t-1}}{\sum_{k=1}^N S_{i,k,t-1}P_{k,t-1}}, \hat{\omega}_{i,j,t} = \frac{S_{i,j,t}P_{j,t-1}}{\sum_{k=1}^N S_{i,k,t}P_{k,t-1}}, \quad (6)$$

where  $MktCap_{j,t-1}$  is the natural logarithm of market capitalization (in millions of dollars) of stock  $j$  as of time  $t - 1$ ;  $N$  is the number of stocks held by fund  $i$ ; and  $S_{i,j,t-1}$  and  $S_{i,j,t}$  are the number of shares of stock  $j$  held by fund  $i$  at time  $t - 1$  and  $t$ , respectively;  $P_{j,t-1}$  is the price of stock  $j$  at time  $t - 1$ ;  $\omega_{i,j,t-1}$  is the weight of stock  $j$  in fund  $i$ 's portfolio as of time  $t - 1$ ;  $\hat{\omega}_{i,j,t}$  is the imputed weight of stock  $j$  in fund  $i$ 's portfolio at time  $t$  assuming stock prices do not change from time  $t - 1$  to time  $t$ . We use the imputed weight in order to abstract from stock size changes that occur solely due to price changes and not due to funds actively adjusting their portfolios.  $\Delta StockSize_{i,t-1,t}$  captures only the changes in holding stock size attributable to funds actively rebalancing their portfolios. If a fund does not rebalance its portfolio holdings from time  $t - 1$  to time  $t$ , the measure takes a value of zero. We calculate changes in portfolio holding stock size over a 3-, 6-, 12-, or 24-month window (i.e., the period from time  $t - 1$  to time  $t$  spans 3, 6, 12, or 24 months), rolling this window by one quarter at a time.

We examine the relation between fund flows and the subsequent change in the average market capitalization of the portfolio holdings using the following cross sectional regressions,

$$\Delta StockSize_{i,t,t+k} = \alpha + \beta_1 Flow_{i,t-1,t} + \lambda X_{i,t} + \epsilon_{i,t,t+k}, \quad (7)$$

and

$$\begin{aligned} \Delta StockSize_{i,t,t+k} = & \alpha + \beta_1 PosFlow_{i,t-1,t} * Flow_{i,t-1,t} \\ & + \beta_2 NegFlow_{i,t-1,t} * Flow_{i,t-1,t} + \lambda X_{i,t} + \epsilon_{i,t,t+k}, \end{aligned} \quad (8)$$

where  $\Delta StockSize_{i,t,t+k}$ , as defined in equation (6), represents the change in fund  $i$ 's mean logged stock holding market capitalization from quarter end  $t$  to quarter end  $t + k$ , ( $k = 1, 2, 4$ , or  $8$ ),  $Flow_{i,t-1,t}$  represents fund  $i$ 's cumulative monthly dollar flow from quarter end  $t - 1$  to quarter end  $t$  divided by fund TNA at  $t - 1$ ,  $PosFlow_{i,t-1,t}$  is a dummy variable equal to 1 when  $Flow_{i,t-1,t} > 0$ ,  $NegFlow_{i,t-1,t}$  is a dummy variable equal to 1 when  $Flow_{i,t-1,t} < 0$ , and  $X_{i,t}$  represents a set of fund-level control variables at quarter end  $t$ , including fund return, expense ratio, turnover, Log(fund age), and Log(family TNA). Again, we calculate Fama-MacBeth (1973)  $t$ -statistics with Newey-West corrected standard errors.

As before, we follow Sirri and Tufano (1998) in ensuring that our fund flow measure excludes any increase in fund size due to capital gains or dividends. This is important because we do not want to bias our results in favor of finding a relation between fund size changes and changes in the market capitalization of holdings that would mechanically occur as funds grow larger or smaller along with the stocks they hold. We break this mechanical link between fund flows and changes in the market capitalization of holdings by using pure inflows or outflows as independent variables in (7) and (8) and also by using  $P_{j,t-1}$  with  $\hat{\omega}_{i,j,t}$  in equation (6) to focus only on active adjustments to the portfolios.

Panel C of Table VII presents the results. We reject the null of no relation between fund flows and the change in holdings. Fund flows positively correlate with subsequent changes in the mean portfolio holding market capitalization. The positive coefficient on inflows indicates that inflows lead to an increase in the mean portfolio holding market capitalization for up to two years. The converse is true for outflows, i.e., outflows lead to a decrease in portfolio holding market

capitalization. Our flow results provide evidence that the relation between fund stock holding characteristics and TNA is not solely attributable to fund style, since a positive relation exists between the liquidity of a fund's stock holdings and its TNA in the time series. It also indicates that in order to manage their trading costs when facing high cash inflows, funds tend to buy larger stocks.

One concern is that fund managers may invest inflows first into larger, more liquid stocks before slowly deploying these inflows into smaller, less liquid stocks, which is why we also examine changes in holding stock size over longer horizons. The results are similar for the 6-, 12-, and 24-month time horizons, with the magnitude of the fund flow coefficients being larger compared to the one for the 3-month horizon. In economic terms, based on our estimates in columns (5) and (7), a one standard deviation increase in cumulative fund flow leads to an increase in the size of holdings by 2.4% (4.2%) over the next 12 (24) months. We also find that fund flows persist (the average autocorrelation coefficient is about 0.32), suggesting that fund managers can deploy initial investments quickly into smaller stocks, because, on average, they can expect to meet any possible future redemptions with additional inflows. Since it is unlikely that it takes 6, 12, or 24 months to deploy any inflows into smaller, less liquid stocks, we can safely conclude that funds actively tilt their portfolios towards larger stocks in response to an increase in size due to inflows.

#### **IV. Conclusion**

We use detailed mutual fund transactions data to estimate and provide algorithms for estimating trading costs using trade-level, stock-level, and fund-level characteristics. Mutual fund trading costs vary considerably as a function of trade size and the liquidity of the traded stock. Growth-oriented funds have higher trading costs than value-oriented funds as do funds with higher turnover and funds belonging to smaller fund families. Larger funds have lower trading costs than smaller funds despite their larger trade sizes because they endogenously hold and trade bigger, more liquid stocks and trade less frequently. Moreover, we find that trading costs adversely affect fund net performance (i.e., net of operating expenses and trading costs), suggesting that a fund

manager's skill in managing trading costs is an important component of his overall ability to deliver abnormal performance to investors.

Despite incurring higher trading costs, small funds do not underperform relative to large funds because they hold smaller, less liquid stocks that provide greater returns, on average. The relatively higher liquidity of the holdings of larger funds helps fund managers contain transaction costs that positively correlate with trade size and stock illiquidity, but at the expense of relatively low return premia. The finding that a fund's preference to hold a particular type of stock depends in part on the fund's size provides insights into the competitive equilibrium in the mutual fund industry. Although a few dominant management companies, such as Vanguard and Fidelity, control a significant fraction of industry assets, small fund companies and small funds do exist and, in many instances, prosper. A small fund enjoys the distinct advantage of access to a universe of stocks (i.e., with small-cap and low liquidity) that big funds are less able to exploit given their scale. Whereas small funds are unable to compete with big funds on expenses, they make up for the expense disadvantage by accessing an investment pool that generates higher gross returns. Nonetheless, on the basis of net, risk-adjusted performance, investing in less liquid stocks only allows small funds to offset their cost disadvantages relative to large-cap funds, resulting in no statistically significant difference in four-factor alpha across TNA-quintiles.

Our results also shed light on the evolution of fund strategies as a function of assets under management. Smaller funds prefer less-liquid holdings than larger funds. As funds increase in size, their trades increase in size, which leads to higher transaction costs. The transaction costs of less liquid stocks are especially susceptible to large trades, and it becomes increasingly costly for funds to trade less liquid stocks as fund size increases. As a result, funds are forced to trade and hold more liquid stocks, thereby reducing their opportunity to outperform. Thus, our results are consistent with a fund life cycle characterized by a transition from high costs and high return premia for small funds to low costs and low return premia for large funds. This transition is driven by the inability of funds to achieve a sustained transaction cost advantage in illiquid stocks as fund and trade size increases.

## **Appendix A: Comparison Sample Based on Pástor, Stambaugh, and Taylor (2015)**

Panel A of Table A reports summary statistics for the sample based on the selection criteria of Pástor, Stambaugh, and Taylor (2015) (PST) and our Abel Noser sample. PST show that discrepancies exist between the Morningstar and CRSP mutual fund databases. They create a CRSP and Morningstar merged mutual fund dataset and check the accuracy of the matched data across the two databases. We apply these criteria to the standard CRSP Survivor-Bias-Free U.S. Mutual Fund database. In Panel B, we report the sample distribution across the three by three Morningstar style box for both the Abel Noser sample and the Pástor, Stambaugh, and Taylor (2015) sample over the period from January 1999 to September 2011.

We find broad similarities between our sample and that of PST along the dimensions of fund size and style composition, although our sample does skew toward larger TNA funds. For example, the mean TNA of funds in our smallest (largest) quintile is \$46 million (\$13 billion), whereas the corresponding mean TNA of funds in the comparison sample are \$34 million (\$5 billion). The mean market capitalization of stocks held by our smallest (largest) quintile is \$35 billion (\$58 billion), whereas the corresponding mean market capitalization of funds in the comparison sample is \$38 billion (\$49 billion). In terms of fund age, funds in our smallest (largest) fund quintile average 8.7 (22.7) years, whereas funds in the comparison sample average 7.5 (21.2) years. The style compositions of the two samples are also similar. For example, large-cap growth, blend, and value funds comprise 24.1%, 16.5%, and 16.8%, respectively, of our sample and 20.8%, 18.1%, and 14.9%, respectively, of the PST sample. Small-cap growth, blend, and value funds comprise 5.8%, 5.3%, and 4.8%, respectively, of our sample and 9.5%, 5.8%, and 4.7%, respectively, of the PST sample. In particular, Panel A of Table A compares a full set of the statistics that we report in Section II (excluding trading costs) to the comparison sample based on the PST selection criteria, and Panel B of Table A compares the investment style compositions of the two samples. We also note that it is unclear whether Abel Noser clients have higher or lower costs than the average fund. Although Abel Noser would be expected to help clients reduce trading costs, funds with relatively high trading costs or that trade more have greater incentive to seek the services of Abel Noser.

## Appendix B: Keim and Madhavan (1997) Transaction Cost Algorithm

The regression results of Keim and Madhavan (1997) can be used to estimate transaction costs as follows:

$$C_{i,t}^B = 0.767 + 0.336D_{i,t}^{Nasdaq} + 0.092Trsize_{i,t} - 0.084Log(mcap_{i,t}) + 13.807\left(\frac{1}{P_{i,t}}\right) + 0.492D_{i,t}^{Tech} + 0.305D_{i,t}^{Index}, \quad (B1)$$

and

$$C_{i,t}^S = 0.505 + 0.058D_{i,t}^{Nasdaq} + 0.214Trsize_{i,t} - 0.059Log(mcap_{i,t}) + 6.537\left(\frac{1}{P_{i,t}}\right) + 0.718D_{i,t}^{Tech} + 0.432D_{i,t}^{Index}, \quad (B2)$$

where  $C_{i,t}^B$  and  $C_{i,t}^S$  represent stock  $i$ 's transaction costs for buy and sell transactions, respectively,  $D_{i,t}^{Nasdaq}$  is a dummy variable equal to 1 for Nasdaq stocks,  $Trsize_{i,t}$  is the trade size in dollars divided by the market capitalization of the stock,  $mcap_{i,t}$  is the market capitalization of the stock in thousands,  $P_{i,t}$  is the stock price,  $D_{i,t}^{Tech}$  is a dummy variable equal to 1 for “technical or momentum” traders (as opposed to “value- or fundamentals-based” traders), and  $D_{i,t}^{Index}$  is a dummy variable equal to 1 for index traders (whose objective is to construct a portfolio that closely mimics the behavior of a specific stock index). Our sample includes only actively managed funds, so  $D_{i,t}^{Index} = 0$ . Because we cannot assign fund type into the style of “value” or “technical” as in Keim and Madhavan (1997), we set  $D_{i,t}^{Tech} = 0.45$  for buys and 0.60 for sells based on the fraction of tickets by each trader type in Keim and Madhavan (1997).

**Table A: Sample Based on Pástor, Stambaugh, and Taylor (2015)**

Panel A reports summary statistics of fund characteristics and holdings characteristics based on the sample selection criteria of Pástor, Stambaugh, and Taylor (2015) applied to the CRSP Survivor-Bias-Free U.S. Mutual Fund database and the matched sample of the Thomson Reuters Mutual Fund Holdings database, the CRSP Mutual Fund database, and the Abel Noser institutional trading data. The sample period is January 1999 through September 2011. We first sort funds each month by lagged total net assets (TNA) into quintile portfolios and then compute the time-series averages of the monthly cross-sectional means for the overall sample and for each mutual fund size quintile. All variables and computations are defined in Table I. Statistical significance of one, five, and ten percent are indicated by \*\*\*, \*\*, and \* respectively. Panel B compares the Abel Noser sample used in our main analysis and the Pástor, Stambaugh, and Taylor (2015) sample.

Panel A: Summary Statistics of the Pástor, Stambaugh, and Taylor (2015) Sample

| Variables                                | All Funds | Mutual Fund Size Quintile |        |        |        |           | Diff: 1-5  | t-stat.   |
|--|-----------|---------------------------|--------|--------|--------|-----------|------------|-----------|
|  |           | 1 (Small)                 | 2      | 3      | 4      | 5 (Large) |            |           |
| A1: PST Sample                           |           |                           |        |        |        |           |            |           |
| Number of funds                          | 1,673     | 335                       | 335    | 335    | 335    | 334       |            |           |
| TNA (\$ million)                         | 1,227     | 34                        | 98     | 241    | 629    | 5,140     | -5,106***  | (-70.06)  |
| <i><u>Fund Performance</u></i>           |           |                           |        |        |        |           |            |           |
| Net shareholder return (%)               | 0.416     | 0.538                     | 0.459  | 0.406  | 0.386  | 0.290     | 0.248***   | (4.40)    |
| Four-factor alpha (%)                    | -0.039    | 0.003                     | -0.026 | -0.055 | -0.052 | -0.060    | 0.063*     | (1.93)    |
| DGTW adjusted return (%)                 | 0.050     | 0.102                     | 0.042  | 0.039  | 0.050  | 0.020     | 0.081*     | (1.94)    |
| <i><u>Holdings Characteristics</u></i>   |           |                           |        |        |        |           |            |           |
| Stock size (\$ billion)                  | 41.4      | 37.9                      | 40.4   | 38.1   | 40.4   | 49.1      | -11.2***   | (-24.24)  |
| B/M ratio                                | 0.426     | 0.429                     | 0.427  | 0.425  | 0.424  | 0.423     | 0.006**    | (1.98)    |
| Momentum (%)                             | 12.82     | 12.68                     | 13.31  | 13.25  | 12.96  | 11.90     | 0.78**     | (2.49)    |
| Amihud illiquidity                       | 0.367     | 0.424                     | 0.412  | 0.370  | 0.335  | 0.307     | 0.117***   | (13.12)   |
| <i><u>Other Fund Characteristics</u></i> |           |                           |        |        |        |           |            |           |
| Expense ratio (%)                        | 1.28      | 1.46                      | 1.34   | 1.31   | 1.22   | 1.07      | 0.39***    | (131.33)  |
| Fund age                                 | 12.7      | 7.5                       | 9.7    | 11.2   | 13.8   | 21.2      | -13.7***   | (-116.12) |
| Turnover (%)                             | 101.9     | 144.1                     | 110.9  | 99.8   | 87.9   | 67.9      | 76.2***    | (39.67)   |
| Family TNA (\$ billion)                  | 121.0     | 56.8                      | 72.5   | 92.2   | 131.0  | 252.8     | -196.0***  | (-25.78)  |
| A2: Abel Noser Sample                    |           |                           |        |        |        |           |            |           |
| Number of funds                          | 198       | 40                        | 40     | 40     | 40     | 39        |            |           |
| TNA (\$ million)                         | 3,029     | 46                        | 184    | 518    | 1,594  | 12,955    | -12,909*** | (-40.46)  |
| <i><u>Fund Performance</u></i>           |           |                           |        |        |        |           |            |           |
| Net shareholder return (%)               | 0.445     | 0.528                     | 0.430  | 0.480  | 0.489  | 0.296     | 0.232      | (1.58)    |
| Four-factor alpha (%)                    | -0.009    | 0.002                     | -0.041 | 0.005  | 0.019  | -0.019    | 0.021      | (0.26)    |
| DGTW adjusted return (%)                 | 0.074     | 0.075                     | 0.068  | 0.111  | 0.089  | 0.029     | 0.046      | (0.52)    |
| <i><u>Holdings Characteristics</u></i>   |           |                           |        |        |        |           |            |           |
| Stock size (\$ billion)                  | 43.2      | 34.6                      | 37.0   | 41.7   | 44.0   | 58.2      | -23.68***  | (-22.61)  |
| B/M ratio                                | 0.437     | 0.466                     | 0.460  | 0.455  | 0.415  | 0.388     | 0.078***   | (14.97)   |
| Momentum (%)                             | 11.91     | 9.96                      | 11.26  | 12.55  | 14.52  | 11.13     | -1.17*     | (-1.89)   |
| Amihud illiquidity                       | 0.323     | 0.333                     | 0.356  | 0.308  | 0.330  | 0.290     | 0.043***   | (9.82)    |
| <i><u>Other Fund Characteristics</u></i> |           |                           |        |        |        |           |            |           |
| Expense ratio (%)                        | 1.17      | 1.51                      | 1.37   | 1.17   | 1.06   | 0.78      | 0.73***    | (68.30)   |
| Fund age                                 | 14.3      | 8.7                       | 10.4   | 13.0   | 16.4   | 22.7      | -14.0***   | (-149.77) |
| Turnover (%)                             | 98.0      | 122.0                     | 102.5  | 97.2   | 98.4   | 69.5      | 52.5***    | (32.89)   |
| Family TNA (\$ billion)                  | 518.1     | 432.1                     | 343.5  | 447.5  | 542.8  | 829.1     | -397.0***  | (-14.59)  |



Panel B: Comparison of the Abel Noser Sample and the Pástor, Stambaugh, and Taylor (2015) Sample

| Variables  | Large Growth | Large Blend | Large Value | Mid Growth | Mid Blend | Mid Value | Small Growth | Small Blend | Small Value | All Funds |
|--|--------------|-------------|-------------|------------|-----------|-----------|--------------|-------------|-------------|-----------|
| <i><u>PST Sample</u></i>                               |              |             |             |            |           |           |              |             |             |           |
| Number of fund-month obs.                              | 53,136       | 46,420      | 38,209      | 32,098     | 16,873    | 18,135    | 24,207       | 14,912      | 12,046      | 256,036   |
| % based on number of obs.                              | 20.8%        | 18.1%       | 14.9%       | 12.5%      | 6.6%      | 7.1%      | 9.5%         | 5.8%        | 4.7%        | 100%      |
| Number of unique funds                                 | 821          | 834         | 557         | 575        | 440       | 380       | 351          | 268         | 235         | 2,659     |
| <i><u>Abel Noser Sample</u></i>                        |              |             |             |            |           |           |              |             |             |           |
| Number of fund-month obs.                              | 7,292        | 4,999       | 5,066       | 3,853      | 1,730     | 2,504     | 1,746        | 1,605       | 1,443       | 30,238    |
| % based on number of obs.                              | 24.1%        | 16.5%       | 16.8%       | 12.7%      | 5.7%      | 8.3%      | 5.8%         | 5.3%        | 4.8%        | 100%      |
| Number of unique funds                                 | 180          | 161         | 137         | 119        | 73        | 75        | 59           | 53          | 48          | 583       |
| <i><u>% of Abel Noser Sample out of PST Sample</u></i> |              |             |             |            |           |           |              |             |             |           |
| Number of fund-month obs.                              | 13.7%        | 10.8%       | 13.3%       | 12.0%      | 10.3%     | 13.8%     | 7.2%         | 10.8%       | 12.0%       | 11.8%     |
| Number of unique funds                                 | 21.9%        | 19.3%       | 24.6%       | 20.7%      | 16.6%     | 19.7%     | 16.8%        | 19.8%       | 20.4%       | 21.9%     |

## References

- Acharya, Viral and Lasse Pedersen, 2005, Asset Pricing with Liquidity Risk, *Journal of Financial Economics* 77, 375–410.
- Agarwal, Vikas, Gerald Gay, and Leng Ling, 2014, Window Dressing in Mutual Funds, *Review of Financial Studies* 27, 3133–3170.
- Agarwal, Vikas, Kevin Mullally, Yuehua Tang, and Baozhong Yang, 2015, Mandatory Portfolio Disclosure, Stock Liquidity, and Mutual Fund Performance, *Journal of Finance* 70, 2733–2776.
- Agarwal, Vikas, Yuehua Tang, and Baozhong Yang, 2012, Do Mutual Funds Have Market Timing Ability? Evidence from Mutual Fund Trades, Working Paper, Georgia State University and University of Florida.
- Amihud, Yakov, 2002, Illiquidity and Stock Returns: Cross Section and Time Series Effects, *Journal of Financial Markets* 5, 31–56.
- Amihud, Yakov and Haim Mendelson, 1986, Asset Pricing and the Bid-Ask Spread, *Journal of Financial Economics* 17, 223–249.
- Anand, Amber, Paul Irvine, Andy Puckett, and Kumar Venkataraman, 2012, Performance of Institutional Trading Desks: An Analysis of Persistence in Trading Costs, *Review of Financial Studies* 25, 557–598.
- Anand, Amber, Paul Irvine, Andy Puckett, and Kumar Venkataraman, 2013, Institutional Trading and Stock Resiliency: Evidence from the 2007–2009 Financial Crisis, *Journal of Financial Economics* 108, 773–797.
- Avramov, Doron and Tarun Chordia, 2006a, Asset Pricing Models and Financial Market Anomalies, *Review of Financial Studies* 19, 1001–1040.
- Avramov, Doron and Tarun Chordia, 2006b, Predicting Stock Returns, *Journal of Financial Economics* 82, 387–415.
- Banz, Rolf, 1981, The Relationship Between Return and Market Value of Common Stocks, *Journal of Financial Economics* 9, 3–18.
- Bollen, Nicolas and Jeffrey Busse, 2005, Short-term Persistence in Mutual Fund Performance, *Review of Financial Studies* 18, 569–597.
- Bollen, Nicolas and Jeffrey Busse, 2006, Tick Size and Institutional Trading Costs: Evidence from Mutual Funds, *Journal of Financial and Quantitative Analysis* 41, 915–937.

- Brennan, Michael, Tarun Chordia, and Avanidhar Subrahmanyam, 1998, Alternative Factor Specifications, Security Characteristics, and the Cross-section of Expected Stock Returns, *Journal of Financial Economics* 49, 345–373.
- Brennan, Michael, Tarun Chordia, Avanidhar Subrahmanyam, and Qing Tong, 2012, Sell-Order Illiquidity and the Cross-Section of Expected Stock Returns, *Journal of Financial Economics* 105, 523–541.
- Busse, Jeffrey, T. Clifton Green, and Narasimhan Jegadeesh, 2012, Buy-Side Trades and Sell-Side Recommendations: Interactions and Information Content, *Journal of Financial Markets* 15, 207–232.
- Busse, Jeffrey and Qing Tong, 2012, Mutual Fund Industry Selection and Persistence, *Review of Asset Pricing Studies* 2, 245–274.
- Carhart, Mark, 1997, On Persistence in Mutual Fund Performance, *Journal of Finance* 52, 57–82.
- Chan, Louis and Josef Lakonishok, 1995, The Behavior of Stock Prices Around Institutional Trades, *Journal of Finance* 50, 1147–1174.
- Chemmanur, Thomas, Shan He, and Gang Hu, 2009. The Role of Institutional Investors in Seasoned Equity Offerings, *Journal of Financial Economics* 94, 384–411.
- Chen, Joseph, Harrison Hong, Ming Huang, and Jeffrey Kubik, 2004, Does Fund Size Erode Mutual Fund Performance? The Role of Liquidity and Organization, *American Economic Review* 94, 1276–1302.
- Chiyachantana, Chiraphol, Pankaj Jain, Christine Jiang, and Robert Wood, 2004, International Evidence on Institutional Trading Behavior and the Determinants of Price Impact, *Journal of Finance* 59, 865–898.
- Cici, Gjergji, Laura Dahm, and Alexander Kempf, 2015, Trading Efficiency of Fund Families: Impact on Fund Performance and Investment Behavior, Working Paper, College of William and Mary.
- Conrad, Jennifer, Kevin Johnson, and Sunil Wahal, 2001, Institutional Trading and Soft Dollars, *Journal of Finance* 56, 397–416.
- Daniel, Kent, Mark Grinblatt, Sheridan Titman, and Russ Wermers, 1997, Measuring Mutual Fund Performance with Characteristic-Based Benchmarks, *Journal of Finance* 52, 1035–1058.
- Daniel, Kent and Sheridan Titman, 1997, Evidence on the Characteristics of Cross Sectional Variation in Stock Returns, *Journal of Finance* 52, 1–33.
- Del Guercio, Diane and Jonathan Reuter, 2014, Mutual Fund Performance and the Incentive to Generate Alpha, *Journal of Finance* 69, 1673–1704.

- Edelen, Roger, Richard Evans, and Gregory Kadlec, 2013, Shedding Light on “Invisible” Costs: Trading Costs and Mutual Fund Performance, *Financial Analysts Journal* 69, 33–44.
- Elton, Edwin, Martin Gruber, and Christopher Blake, 2001, A First Look at the Accuracy of the CRSP Mutual Database and a Comparison of the CRSP and Morningstar Mutual Fund Databases, *Journal of Finance* 56, 2415–2430.
- Elton, Edwin, Martin Gruber, and Christopher Blake, 2012, Does Mutual Fund Size Matter? The Relationship Between Size and Performance, *Review of Asset Pricing Studies* 2, 31–55.
- Evans, Richard, 2010, Mutual Fund Incubation, *Journal of Finance* 65, 1581–1611.
- Fama, Eugene and Kenneth French, 1992, The Cross-section of Expected Stock Returns, *Journal of Finance* 47, 427–465.
- Fama, Eugene and Kenneth French, 1996, Multifactor Explanations of Asset Pricing Anomalies, *Journal of Finance* 51, 55–84.
- Fama, Eugene and Kenneth French, 2010, Luck versus Skill in the Cross-Section of Mutual Fund Returns, *Journal of Finance* 65, 1915–1947.
- Fama, Eugene and James MacBeth, 1973, Risk, Return, and Equilibrium: Empirical Tests, *Journal of Political Economy* 81, 607–636.
- Person, Wayne and Jerchern Lin, 2014, Alpha and Performance Measurement: The Effects of Investor Disagreement and Heterogeneity, *Journal of Finance* 69, 1565–1596.
- Frazzini, Andrea, Ronen Israel, and Tobias Moskowitz, 2015, Trading Costs of Asset Pricing Anomalies, Working Paper, AQR Capital Management.
- Gao, Xiaohui and Jay Ritter, 2010, The Marketing of Seasoned Equity Offerings, *Journal of Financial Economics* 97, 33–52.
- Goldstein, Michael, Paul Irvine, Eugene Kandel, and Zvi Weiner, 2009, Brokerage Commissions and Institutional Trading Patterns, *Review of Financial Studies* 22, 5175–5212.
- Jensen, Michael, 1968, The Performance of Mutual Funds in the Period 1945–1964, *Journal of Finance* 23, 389–416.
- Jones, Charles and Marc Lipson, 2001, Sixteenths: Direct Evidence on Institutional Execution Costs, *Journal of Financial Economics* 59, 253–278.
- Kacperczyk, Marcin, Clemens Sialm, and Lu Zheng, 2008, Unobserved Actions of Mutual Funds, *Review of Financial Studies* 21, 2379–2416.

- Keim, Donald, 1999, An Analysis of Mutual Fund Design: The Case of Investing in Small-Cap Stocks, *Journal of Financial Economics* 51, 173–194.
- Keim, Donald and Ananth Madhavan, 1997, Transaction Costs and Investment Style: An Inter-exchange Analysis of Institutional Equity Trades, *Journal of Financial Economics* 46, 265–292.
- Newey, Whitney and Kenneth West, 1987, A Simple, Positive Semi-definite, Heteroskedasticity and Autocorrelation Consistent Covariance Matrix, *Econometrica* 55, 703–708.
- Pástor, Luboš and Robert Stambaugh, 2003, Liquidity Risk and Expected Stock Returns, *Journal of Political Economy* 111, 642–85.
- Pástor, Luboš and Robert Stambaugh, 2012, On the Size of the Active Management Industry, *Journal of Political Economy* 120, 740–781.
- Pástor, Luboš, Robert Stambaugh, and Lucian Taylor, 2015, Scale and Skill in Active Management, *Journal of Financial Economics* 116, 23–45.
- Pollet, Joshua and Mungo Wilson, 2008, How Does Size Affect Mutual Fund Behavior? *Journal of Finance* 63, 2941–69.
- Puckett, Andy and Xuemin Yan, 2011, The Interim Trading Skills of Institutional Investors, *Journal of Finance* 66, 601–633.
- Sirri, Erik and Peter Tufano, 1998, Costly Search and Mutual Fund Flows, *Journal of Finance* 53, 1589–1622.
- Wermers, Russ, 2000, Mutual Fund Performance: An Empirical Decomposition into Stock-Picking Talent, Style, Transactions Costs, and Expenses, *Journal of Finance* 55, 1655–1695.
- Yan, Xuemin, 2008, Liquidity, Investment Style, and the Relation between Fund Size and Fund Performance, *Journal of Financial and Quantitative Analysis* 43, 741–767.

## Table I: Summary Statistics

The table reports summary statistics of fund characteristics, holdings characteristics, and trading cost measures based on the matched sample of the Thomson Reuters Mutual Fund Holdings database, the CRSP Mutual Fund database, and the Abel Noser institutional trading data. The sample period is January 1999 through September 2011. Panel A reports the time-series average of the cross-section average sample statistic. In Panel B, we categorize funds by investment style. We first sort funds each month in each investment style into below/above median portfolios based on lagged TNA and then compute the time-series averages of the monthly cross-sectional means for each portfolio in each investment style. In Panel C, we first sort funds each month by lagged total net assets (TNA) into quintile portfolios and report summary statistics after subtracting the mean fund style statistics from the fund level statistics for each fund-month observation. Number of funds is the average number of funds each month in each portfolio. TNA (\$ million) is the sum of assets under management across all share classes of a fund. Fund age is the age of the fund's oldest share class (in years). Four-factor alphas are estimated based on the Carhart (1997) model, calculated as the difference between the realized fund net return in a given month and the sum of the product of the four-factor betas estimated over the previous 36 months and factor returns during that month. DGTW adjusted return is the Daniel et al. (1997, DGTW) benchmark-adjusted returns of a fund. Net shareholder return, four-factor alpha, and DGTW adjusted return are in percentage point. We compute the Amihud (2002) illiquidity measure as the monthly average ratio of the absolute value of daily returns to the dollar trading volume using equation (2) and further normalize it using equation (3). Momentum is the six-month cumulative stock returns over the period from month  $t - 7$  to month  $t - 2$ . Holding characteristics, including stock size (\$ billion), B/M ratio, momentum (%), and Amihud illiquidity are fund-level value-weighted averages of the corresponding variable computed based on a fund's most recent portfolio holdings. Fund flow (%) is the average monthly net growth in fund assets beyond reinvested dividends and portfolio returns, summed over all share classes. Fund turnover and the expense ratio (both in percentage point) are the value weighted averages across all share classes. Family TNA (\$ billion) is the sum of the total assets under management of all the funds in a fund family excluding the fund itself. We calculate the execution shortfall, open price cost, and prior-day close cost measures from the Abel Noser institutional trading data using equation (1). We first compute these cost measures for each ticket, then multiply by the dollar value of each ticket and sum over all tickets in a month for a given fund. Then we divide by the average fund TNA of the previous and current month-ends to obtain a monthly trading cost per TNA dollar. The number reported is annualized by multiplying the time-series average of the monthly cross-sectional mean fund-level trading cost per TNA dollar by twelve. We calculate commission, taxes, and fees on a per TNA dollar basis as in the case of the trading cost measures. Total trading costs for all four measures are sums of the respective cost and commissions, taxes, and fees. All trading cost measures are in percentage point. Statistical significance of one, five, and ten percent are indicated by \*\*\*, \*\*, and \* respectively.

Panel A. Mean Sample Statistics

| Fund Trading Costs per TNA Dollar |       | Fund Performance           |        | Holdings Characteristics |       | Other Fund Characteristics |       |
|-----------------------------------|-------|----------------------------|--------|--------------------------|-------|----------------------------|-------|
| Execution shortfall (%)           | 0.470 | Net shareholder return (%) | 0.445  | Stock size (\$ billion)  | 43.2  | TNA (\$ million)           | 3,029 |
| Open price (%)                    | 0.609 | Four-factor alpha (%)      | -0.009 | B/M ratio                | 0.44  | Expense ratio (%)          | 1.17  |
| Prior-day close (%)               | 0.735 | DGTW adjusted return (%)   | 0.074  | Momentum (%)             | 11.90 | Fund age                   | 14.2  |
| Commission (%)                    | 0.265 |                            |        | Amihud illiquidity       | 0.323 | Fund flow (%)              | 0.689 |
| Tax and fee (%)                   | 0.005 |                            |        |                          |       | Turnover (%)               | 98.0  |
| Total, exec. shortfall (%)        | 0.751 |                            |        |                          |       | Family TNA (\$ billion)    | 518.1 |
| Total, open price cost (%)        | 0.887 |                            |        |                          |       |                            |       |
| Total, prior-day close (%)        | 1.014 |                            |        |                          |       |                            |       |

Panel B. Sample Statistics by Investment Style

| Variables                                | Growth    |           |           |                 | Blend     |           |           |                 | Value     |           |           |                 |
|--|-----------|-----------|-----------|-----------------|-----------|-----------|-----------|-----------------|-----------|-----------|-----------|-----------------|
|  | 1 (Small) | 2 (Large) | Diff: 1-2 | <i>t</i> -stat. | 1 (Small) | 2 (Large) | Diff: 1-2 | <i>t</i> -stat. | 1 (Small) | 2 (Large) | Diff: 1-2 | <i>t</i> -stat. |
| B1. Large-cap Funds                      |           |           |           |                 |           |           |           |                 |           |           |           |                 |
| Num. of fund-month obs.                  | 3,684     | 3,608     |           |                 | 2,534     | 2,465     |           |                 | 2,570     | 2,496     |           |                 |
| TNA (\$ million)                         | 303       | 7,508     | -7,204*** | (-49.02)        | 258       | 9,995     | -9,737*** | (-21.93)        | 218       | 7,481     | -7,263*** | (-24.93)        |
| <i>Fund Trading Costs per TNA Dollar</i> |           |           |           |                 |           |           |           |                 |           |           |           |                 |
| Execution shortfall (%)                  | 0.693     | 0.255     | 0.439***  | (9.38)          | 0.534     | 0.183     | 0.351***  | (9.91)          | 0.347     | 0.150     | 0.196***  | (6.49)          |
| Open price (%)                           | 0.960     | 0.274     | 0.686***  | (9.58)          | 0.990     | 0.460     | 0.530***  | (7.83)          | 0.439     | 0.226     | 0.213***  | (5.90)          |
| Prior-day close (%)                      | 1.323     | 0.391     | 0.932***  | (8.85)          | 1.326     | 0.724     | 0.602***  | (5.89)          | 0.454     | 0.189     | 0.265***  | (4.75)          |
| Commission (%)                           | 0.248     | 0.146     | 0.102***  | (16.00)         | 0.288     | 0.141     | 0.147***  | (12.32)         | 0.277     | 0.159     | 0.118***  | (9.58)          |
| Tax and fee (%)                          | 0.009     | 0.006     | 0.003***  | (4.93)          | 0.012     | 0.002     | 0.010***  | (8.81)          | 0.005     | 0.001     | 0.004***  | (6.89)          |
| Total, exec. shortfall (%)               | 0.980     | 0.411     | 0.569***  | (10.52)         | 0.843     | 0.326     | 0.518***  | (12.19)         | 0.637     | 0.315     | 0.323***  | (7.93)          |
| Total, open price cost (%)               | 1.236     | 0.431     | 0.804***  | (10.62)         | 1.311     | 0.603     | 0.708***  | (9.69)          | 0.720     | 0.387     | 0.334***  | (7.80)          |
| Total, prior-day close (%)               | 1.599     | 0.548     | 1.051***  | (9.65)          | 1.641     | 0.867     | 0.774***  | (7.36)          | 0.741     | 0.350     | 0.391***  | (6.37)          |
| <i>Fund Performance</i>                  |           |           |           |                 |           |           |           |                 |           |           |           |                 |
| Net shareholder return (%)               | 0.219     | 0.347     | -0.129    | (-1.07)         | 0.383     | 0.233     | 0.150**   | (2.22)          | 0.311     | 0.250     | 0.061     | (0.77)          |
| Four-factor alpha (%)                    | -0.142    | -0.004    | -0.138    | (-1.65)         | -0.028    | -0.089    | 0.062     | (1.08)          | -0.017    | -0.051    | 0.034     | (0.51)          |
| DGTW adjusted return (%)                 | 0.009     | 0.073     | -0.064    | (-0.80)         | 0.042     | -0.003    | 0.045     | (0.82)          | 0.026     | 0.014     | 0.012     | (0.19)          |
| <i>Holdings Characteristics</i>          |           |           |           |                 |           |           |           |                 |           |           |           |                 |
| Stock size (\$ billion)                  | 64.2      | 66.3      | -2.1***   | (-3.43)         | 66.2      | 81.5      | -15.3***  | (-18.07)        | 57.5      | 66.3      | -8.7***   | (-13.07)        |
| B/M ratio                                | 0.313     | 0.293     | 0.020***  | (6.79)          | 0.418     | 0.389     | 0.029***  | (7.70)          | 0.545     | 0.528     | 0.017***  | (6.86)          |
| Momentum (%)                             | 13.99     | 14.67     | -0.69     | (-1.26)         | 10.55     | 9.30      | 1.25***   | (5.09)          | 6.35      | 7.00      | -0.65**   | (-2.19)         |
| Amihud illiquidity                       | 0.263     | 0.258     | 0.004***  | (8.12)          | 0.274     | 0.255     | 0.019***  | (4.85)          | 0.259     | 0.256     | 0.003***  | (6.49)          |
| <i>Other Fund Characteristics</i>        |           |           |           |                 |           |           |           |                 |           |           |           |                 |
| Expense ratio (%)                        | 1.34      | 1.00      | 0.35***   | (46.20)         | 1.27      | 0.83      | 0.45***   | (35.48)         | 1.37      | 0.83      | 0.54***   | (46.75)         |
| Fund age                                 | 11.0      | 19.9      | -9.0***   | (-54.76)        | 11.9      | 24.8      | -12.9***  | (-40.66)        | 10.6      | 19.5      | -8.9***   | (-39.59)        |
| Fund flow (%)                            | 0.968     | 0.053     | 0.915***  | (5.24)          | 0.693     | -0.221    | 0.913***  | (5.97)          | 0.751     | -0.376    | 1.127***  | (6.60)          |
| Turnover (%)                             | 126.2     | 98.2      | 28.1***   | (16.62)         | 113.2     | 85.2      | 28.0***   | (13.69)         | 76.0      | 58.3      | 17.7***   | (14.75)         |
| Family TNA (\$ billion)                  | 483.2     | 739.4     | -256.2*** | (-20.22)        | 490.9     | 767.1     | -276.2*** | (-12.85)        | 368.0     | 630.9     | -262.8*** | (-14.61)        |



Panel B continued.

| Variables                                | Growth    |           |           |                 | Blend     |           |           |                 | Value     |           |           |                 |
|--|-----------|-----------|-----------|-----------------|-----------|-----------|-----------|-----------------|-----------|-----------|-----------|-----------------|
|  | 1 (Small) | 2 (Large) | Diff: 1-2 | <i>t</i> -stat. | 1 (Small) | 2 (Large) | Diff: 1-2 | <i>t</i> -stat. | 1 (Small) | 2 (Large) | Diff: 1-2 | <i>t</i> -stat. |
| B2. Mid-cap Funds                        |           |           |           |                 |           |           |           |                 |           |           |           |                 |
| Num. of fund-month obs.                  | 1,968     | 1,885     |           |                 | 906       | 824       |           |                 | 1,293     | 1,211     |           |                 |
| TNA (\$ million)                         | 198       | 2,863     | -2,665*** | (-33.09)        | 145       | 4,273     | -4,128*** | (-15.56)        | 114       | 2,591     | -2,477*** | (-21.34)        |
| <i>Fund Trading Costs per TNA Dollar</i> |           |           |           |                 |           |           |           |                 |           |           |           |                 |
| Execution shortfall (%)                  | 0.917     | 0.470     | 0.447***  | (8.15)          | 0.677     | 0.278     | 0.399***  | (5.43)          | 0.377     | 0.298     | 0.079**   | (2.01)          |
| Open price (%)                           | 1.109     | 0.715     | 0.393***  | (4.39)          | 0.972     | 0.257     | 0.716***  | (5.63)          | 0.143     | 0.318     | -0.175**  | (-2.28)         |
| Prior-day close (%)                      | 1.444     | 0.813     | 0.631***  | (4.74)          | 0.915     | 0.140     | 0.776***  | (4.13)          | -0.107    | 0.249     | -0.356*** | (-3.00)         |
| Commission (%)                           | 0.438     | 0.251     | 0.187***  | (11.65)         | 0.401     | 0.176     | 0.226***  | (9.71)          | 0.375     | 0.193     | 0.182***  | (12.42)         |
| Tax and fee (%)                          | 0.009     | 0.002     | 0.007***  | (7.27)          | 0.006     | 0.002     | 0.003***  | (4.50)          | 0.004     | 0.001     | 0.003***  | (13.50)         |
| Total, exec. shortfall (%)               | 1.408     | 0.728     | 0.680***  | (11.00)         | 1.084     | 0.456     | 0.628***  | (7.07)          | 0.741     | 0.496     | 0.244***  | (4.81)          |
| Total, open price cost (%)               | 1.553     | 0.987     | 0.567***  | (5.92)          | 1.379     | 0.436     | 0.943***  | (6.68)          | 0.511     | 0.507     | 0.004     | (0.05)          |
| Total, prior-day close (%)               | 1.902     | 1.084     | 0.818***  | (6.04)          | 1.344     | 0.327     | 1.016***  | (5.14)          | 0.279     | 0.443     | -0.163    | (-1.37)         |
| <i>Fund Performance</i>                  |           |           |           |                 |           |           |           |                 |           |           |           |                 |
| Net shareholder return (%)               | 0.552     | 0.642     | -0.090    | (-0.44)         | 0.915     | 0.698     | 0.217     | (0.86)          | 0.728     | 0.639     | 0.089     | (0.54)          |
| Four-factor alpha (%)                    | 0.080     | 0.174     | -0.094    | (-0.79)         | 0.269     | 0.200     | 0.069     | (0.43)          | 0.128     | 0.061     | 0.067     | (0.48)          |
| DGTW adjusted return (%)                 | 0.137     | 0.214     | -0.077    | (-0.55)         | 0.533     | 0.121     | 0.412**   | (2.04)          | 0.070     | 0.193     | -0.126    | (-0.73)         |
| <i>Holdings Characteristics</i>          |           |           |           |                 |           |           |           |                 |           |           |           |                 |
| Stock size (\$ billion)                  | 15.5      | 17.7      | -2.1**    | (-2.20)         | 15.0      | 15.5      | -0.5      | (-0.59)         | 12.2      | 14.9      | -2.7***   | (-8.11)         |
| B/M ratio                                | 0.326     | 0.328     | -0.002    | (-0.54)         | 0.541     | 0.502     | 0.039***  | (3.31)          | 0.627     | 0.593     | 0.035***  | (6.24)          |
| Momentum (%)                             | 16.49     | 20.49     | -4.00***  | (-4.91)         | 11.85     | 16.08     | -4.23***  | (-3.78)         | 7.12      | 9.04      | -1.84***  | (-4.09)         |
| Amihud illiquidity                       | 0.302     | 0.281     | 0.022***  | (7.02)          | 0.334     | 0.318     | 0.016     | (1.59)          | 0.296     | 0.286     | 0.010***  | (2.97)          |
| <i>Other Fund Characteristics</i>        |           |           |           |                 |           |           |           |                 |           |           |           |                 |
| Expense ratio (%)                        | 1.53      | 1.06      | 0.46***   | (43.00)         | 1.41      | 0.98      | 0.44***   | (23.85)         | 1.44      | 0.98      | 0.45***   | (24.00)         |
| Fund age                                 | 9.7       | 14.4      | -4.7***   | (-18.90)        | 10.0      | 12.6      | -2.6***   | (-8.32)         | 10.9      | 13.3      | -2.4***   | (-7.72)         |
| Fund flow (%)                            | 1.445     | 0.488     | 0.957***  | (3.06)          | 3.252     | 1.371     | 1.881***  | (3.49)          | 2.949     | 0.204     | 2.745***  | (5.79)          |
| Turnover (%)                             | 142.3     | 114.0     | 28.2***   | (10.20)         | 111.8     | 75.7      | 36.1***   | (9.37)          | 108.7     | 65.0      | 43.7***   | (17.19)         |
| Family TNA (\$ billion)                  | 423.2     | 579.2     | -155.9*** | (-9.54)         | 461.1     | 772.7     | -311.6*** | (-11.56)        | 513.9     | 579.2     | -65.3***  | (-3.15)         |

Panel B continued.

| Variables                                | Growth    |           |           |                 | Blend     |           |           |                 | Value     |           |           |                 |
|--|-----------|-----------|-----------|-----------------|-----------|-----------|-----------|-----------------|-----------|-----------|-----------|-----------------|
|  | 1 (Small) | 2 (Large) | Diff: 1-2 | <i>t</i> -stat. | 1 (Small) | 2 (Large) | Diff: 1-2 | <i>t</i> -stat. | 1 (Small) | 2 (Large) | Diff: 1-2 | <i>t</i> -stat. |
| B3. Small-cap Funds                      |           |           |           |                 |           |           |           |                 |           |           |           |                 |
| Num. of fund-month obs.                  | 910       | 836       |           |                 | 839       | 766       |           |                 | 756       | 687       |           |                 |
| TNA (\$ million)                         | 235       | 2,401     | -2,167*** | (-38.64)        | 216       | 2,296     | -2,080*** | (-12.11)        | 161       | 1,740     | -1,579*** | (-19.77)        |
| <i>Fund Trading Costs per TNA Dollar</i> |           |           |           |                 |           |           |           |                 |           |           |           |                 |
| Execution shortfall (%)                  | 1.236     | 0.579     | 0.657***  | (5.17)          | 0.372     | 0.477     | -0.105*   | (-1.76)         | 0.729     | 1.112     | -0.382*** | (-3.36)         |
| Open price (%)                           | 1.804     | 0.597     | 1.208***  | (5.76)          | 0.347     | 0.635     | -0.288**  | (-2.06)         | 0.280     | 0.854     | -0.573*** | (-3.24)         |
| Prior-day close (%)                      | 2.573     | 0.756     | 1.817***  | (6.30)          | 0.399     | 0.541     | -0.142    | (-0.66)         | -0.415    | 0.810     | -1.225*** | (-4.19)         |
| Commission (%)                           | 0.547     | 0.316     | 0.231***  | (8.40)          | 0.214     | 0.220     | -0.006    | (-0.31)         | 0.516     | 0.504     | 0.011     | (0.41)          |
| Tax and fee (%)                          | 0.005     | 0.003     | 0.002**   | (2.17)          | 0.010     | 0.001     | 0.009***  | (6.33)          | 0.003     | 0.001     | 0.002***  | (4.00)          |
| Total, exec. shortfall (%)               | 1.834     | 0.935     | 0.899***  | (6.06)          | 0.599     | 0.714     | -0.114    | (-1.53)         | 1.241     | 1.607     | -0.366*** | (-2.73)         |
| Total, open price cost (%)               | 2.434     | 0.955     | 1.478***  | (6.65)          | 0.576     | 0.862     | -0.286*   | (-1.90)         | 0.787     | 1.315     | -0.528*** | (-2.79)         |
| Total, prior-day close (%)               | 3.156     | 1.111     | 2.046***  | (6.89)          | 0.634     | 0.780     | -0.146    | (-0.65)         | 0.100     | 1.264     | -1.164*** | (-3.92)         |
| <i>Fund Performance</i>                  |           |           |           |                 |           |           |           |                 |           |           |           |                 |
| Net shareholder return (%)               | 0.464     | 0.546     | -0.082    | (-0.41)         | 0.683     | 0.540     | 0.143     | (0.83)          | 0.788     | 0.771     | 0.017     | (0.15)          |
| Four-factor alpha (%)                    | -0.242    | -0.103    | -0.139    | (-0.90)         | -0.009    | -0.129    | 0.120     | (0.86)          | -0.138    | -0.007    | -0.131    | (-1.25)         |
| DGTW adjusted return (%)                 | -0.049    | 0.002     | -0.049    | (-0.48)         | -0.016    | -0.060    | 0.044     | (0.28)          | 0.126     | 0.050     | 0.076     | (0.64)          |
| <i>Holdings Characteristics</i>          |           |           |           |                 |           |           |           |                 |           |           |           |                 |
| Stock size (\$ billion)                  | 2.6       | 1.9       | 0.7       | (1.60)          | 1.7       | 2.1       | -0.4***   | (-4.43)         | 1.4       | 1.3       | 0.1       | (1.13)          |
| B/M ratio                                | 0.402     | 0.406     | -0.006    | (-1.24)         | 0.567     | 0.565     | 0.002     | (0.17)          | 0.722     | 0.671     | 0.052***  | (7.39)          |
| Momentum (%)                             | 19.22     | 18.23     | 2.53**    | (2.44)          | 11.69     | 15.06     | -3.38***  | (-2.71)         | 8.43      | 9.00      | -0.57     | (-1.58)         |
| Amihud illiquidity                       | 0.498     | 0.422     | 0.078***  | (4.23)          | 0.599     | 0.505     | 0.094***  | (3.12)          | 0.853     | 0.975     | -0.123*** | (-3.07)         |
| <i>Other Fund Characteristics</i>        |           |           |           |                 |           |           |           |                 |           |           |           |                 |
| Expense ratio (%)                        | 1.48      | 1.09      | 0.39***   | (16.39)         | 1.34      | 0.99      | 0.35***   | (19.11)         | 1.42      | 1.24      | 0.18***   | (10.57)         |
| Fund age                                 | 9.1       | 19.0      | -9.9***   | (-14.49)        | 7.9       | 12.0      | -4.1***   | (-13.08)        | 8.1       | 12.6      | -4.5***   | (-16.14)        |
| Fund flow (%)                            | 1.290     | 0.221     | 1.069***  | (2.97)          | 1.452     | 0.870     | 0.582*    | (1.70)          | 1.618     | 0.022     | 1.596***  | (3.80)          |
| Turnover (%)                             | 138.1     | 88.4      | 49.7***   | (9.41)          | 77.9      | 67.6      | 10.3***   | (3.24)          | 75.7      | 63.3      | 12.4***   | (5.92)          |
| Family TNA (\$ billion)                  | 152.9     | 500.5     | -347.6*** | (-17.82)        | 240.5     | 474.8     | -234.3*** | (-14.43)        | 47.0      | 116.9     | -69.9***  | (-7.45)         |

Panel C. Sample Statistics by Quintile: Subtracting Style Mean

| Variables                                | Mutual Fund Size Quintile |        |        |        |           | Diff: 1-5  | t-stat.   |
|--|---------------------------|--------|--------|--------|-----------|------------|-----------|
|  | 1 (Small)                 | 2      | 3      | 4      | 5 (Large) |            |           |
| Number of funds                          | 40                        | 40     | 40     | 40     | 39        |            |           |
| TNA (\$ million)                         | -2,513                    | -2,577 | -2,373 | -1,493 | 9,093     | -11,606*** | (-46.85)  |
| <i>Fund Trading Costs per TNA Dollar</i> |                           |        |        |        |           |            |           |
| Execution shortfall (%)                  | 0.138                     | 0.231  | -0.022 | -0.083 | -0.273    | 0.411***   | (16.09)   |
| Open price (%)                           | 0.245                     | 0.229  | -0.008 | -0.145 | -0.328    | 0.574***   | (14.54)   |
| Prior-day close (%)                      | 0.279                     | 0.298  | -0.009 | -0.158 | -0.417    | 0.696***   | (11.41)   |
| Commission (%)                           | 0.103                     | 0.066  | -0.017 | -0.038 | -0.116    | 0.219***   | (31.70)   |
| Tax and fee (%)                          | 0.001                     | 0.005  | 0.000  | -0.002 | -0.004    | 0.004***   | (8.60)    |
| Total, execution shortfall (%)           | 0.236                     | 0.328  | -0.042 | -0.131 | -0.405    | 0.640***   | (21.21)   |
| Total, open price cost (%)               | 0.346                     | 0.316  | -0.025 | -0.189 | -0.457    | 0.803***   | (18.74)   |
| Total, prior-day close (%)               | 0.383                     | 0.381  | -0.023 | -0.203 | -0.547    | 0.930***   | (14.73)   |
| <i>Fund Performance</i>                  |                           |        |        |        |           |            |           |
| Net shareholder return (%)               | 0.016                     | -0.021 | 0.024  | 0.018  | -0.035    | 0.051      | (0.60)    |
| Four-factor alpha (%)                    | -0.028                    | -0.007 | 0.012  | 0.016  | 0.014     | -0.043     | (-0.74)   |
| DGTW adjusted return (%)                 | -0.015                    | 0.003  | 0.032  | -0.004 | -0.007    | -0.008     | (-0.13)   |
| <i>Holdings Stock Characteristics</i>    |                           |        |        |        |           |            |           |
| Stock size (\$ billion)                  | -2.4                      | -3.0   | -1.7   | 1.7    | 5.2       | -7.603***  | (-18.07)  |
| B/M ratio                                | 0.007                     | 0.007  | 0.006  | -0.004 | -0.016    | 0.023***   | (12.72)   |
| Momentum (%)                             | -1.07                     | -0.22  | 0.32   | 1.24   | -0.33     | -0.74**    | (-2.54)   |
| Amihud illiquidity                       | 0.009                     | 0.004  | -0.020 | 0.007  | 0.001     | 0.007**    | (2.27)    |
| <i>Other Fund Characteristics</i>        |                           |        |        |        |           |            |           |
| Expense ratio (%)                        | 0.32                      | 0.18   | 0.01   | -0.12  | -0.37     | 0.682***   | (72.03)   |
| Fund age                                 | -5.13                     | -3.37  | -1.19  | 2.17   | 7.63      | -12.77***  | (-120.93) |
| Fund flow (%)                            | 1.233                     | 0.140  | -0.298 | -0.488 | -0.607    | 1.840***   | (8.54)    |
| Turnover (%)                             | 20.8                      | 6.3    | 3.0    | -1.1   | -29.2     | 50.0***    | (40.13)   |
| Family TNA (\$ billion)                  | -89.4                     | -146.0 | -60.9  | 34.3   | 266.0     | -355.3***  | (-14.32)  |

**Table II: Mutual Fund Trading Costs per Trade Dollar**

Panel A reports summary statistics of fund level value-weighted trading costs per trade dollar, trade statistics, and trading stock characteristics. Each month, we sort funds into quintiles based on lagged TNA. In Panel A1, for a given fund-month combination, we compute trading costs per trade dollar as the value-weighted average of the execution shortfall, open price cost, and prior-day close cost (implicit or total) based on the dollar value of each ticket by aggregating over all of a fund's tickets in a given month. In Panel A2, for each fund-month combination, we calculate the total number of tickets and the equal-weighted averages of the dollar and share size per ticket, and trades per ticket. In Panel A3, for a given fund-month combination, we compute trading dollar weighted stock characteristics (market capitalization, book-to-market ratio, momentum, and Amihud illiquidity measure) based on all of a fund's trades in a given month. After that, for Panels A1, A2, and A3, we compute the time-series average of monthly cross-sectional averages for the overall sample and each of the mutual fund size quintiles. Panel B reports statistics associated with tickets conditional on quintile 1 and quintile 5 funds trading the same stock in a particular month. In Panel B1, for each stock-month combination, we first compute the value-weighted trading costs across all tickets from funds in quintile 1 or 5. In Panel B2, for each stock-month combination, we compute the equal-weighted averages of the dollar and share size per ticket, and trades per ticket, for quintile 1 or 5. After that, for both Panels B1 and B2, we average across all stocks each month and then compute the time-series average across all sample months. Statistical significance of one, five, and ten percent are indicated by \*\*\*, \*\*, and \* respectively.

## Panel A: All Tickets

| Variables                          | All Funds | Mutual Fund Size Quintile |       |       |       |           | Diff:1-5  | t-stat.  |
|------------------------------------|-----------|---------------------------|-------|-------|-------|-----------|-----------|----------|
|                                    |           | 1 (Small)                 | 2     | 3     | 4     | 5 (Large) |           |          |
| A1. Trading Costs per trade dollar |           |                           |       |       |       |           |           |          |
| Execution shortfall (%)            | 0.134     | 0.137                     | 0.197 | 0.140 | 0.135 | 0.059     | 0.079***  | (8.80)   |
| Open price (%)                     | 0.160     | 0.176                     | 0.222 | 0.167 | 0.125 | 0.108     | 0.068***  | (4.79)   |
| Prior-day close (%)                | 0.153     | 0.194                     | 0.248 | 0.149 | 0.103 | 0.069     | 0.125***  | (5.47)   |
| Total, execution shortfall (%)     | 0.260     | 0.262                     | 0.343 | 0.273 | 0.260 | 0.162     | 0.100***  | (11.05)  |
| Total, open price (%)              | 0.286     | 0.300                     | 0.367 | 0.300 | 0.250 | 0.210     | 0.090***  | (6.36)   |
| Total, prior-day close (%)         | 0.279     | 0.320                     | 0.393 | 0.283 | 0.228 | 0.172     | 0.148***  | (6.53)   |
| A2. Trade Statistics               |           |                           |       |       |       |           |           |          |
| Tickets per fund month             | 296       | 151                       | 186   | 209   | 425   | 511       | -360***   | (-30.05) |
| Ticket size (\$ thousands)         | 888       | 178                       | 451   | 697   | 1,089 | 2,047     | -1,869*** | (-62.51) |
| Ticket size (shares thousands)     | 28.1      | 6.4                       | 16.1  | 23.7  | 34.5  | 60.4      | -54.0***  | (-70.24) |
| Trades per ticket                  | 1.26      | 1.22                      | 1.31  | 1.30  | 1.34  | 1.13      | 0.09***   | (4.39)   |
| A3. Trading Stock Characteristics  |           |                           |       |       |       |           |           |          |
| Stock size (\$ billion)            | 31.5      | 26.9                      | 26.8  | 31.3  | 32.8  | 39.9      | -13.0***  | (-14.70) |
| B/M ratio                          | 0.463     | 0.493                     | 0.482 | 0.483 | 0.439 | 0.419     | 0.074***  | (10.18)  |
| Momentum (%)                       | 11.86     | 10.23                     | 11.13 | 12.56 | 13.78 | 11.59     | -1.36*    | (-1.79)  |
| Amihud illiquidity                 | 0.315     | 0.316                     | 0.346 | 0.316 | 0.313 | 0.283     | 0.033***  | (6.29)   |

Panel B: Tickets Conditional on Trading Same Stock

| Variables                          | All Funds | Mutual Fund Size Quintile |       |       |       |           | Diff:1-5  | <i>t</i> -stat. |
|------------------------------------|-----------|---------------------------|-------|-------|-------|-----------|-----------|-----------------|
|                                    |           | 1 (Small)                 | 2     | 3     | 4     | 5 (Large) |           |                 |
| B1. Trading Costs per trade dollar |           |                           |       |       |       |           |           |                 |
| Execution shortfall (%)            | 0.191     | 0.123                     | 0.167 | 0.169 | 0.203 | 0.171     | -0.048*** | (-4.83)         |
| Open price (%)                     | 0.247     | 0.183                     | 0.210 | 0.226 | 0.213 | 0.254     | -0.071*** | (-4.13)         |
| Prior-day close (%)                | 0.295     | 0.202                     | 0.262 | 0.275 | 0.261 | 0.310     | -0.109*** | (-4.87)         |
| Total, execution shortfall (%)     | 0.310     | 0.234                     | 0.279 | 0.283 | 0.309 | 0.284     | -0.050*** | (-5.23)         |
| Total, open price (%)              | 0.366     | 0.293                     | 0.322 | 0.339 | 0.319 | 0.367     | -0.074*** | (-4.40)         |
| Total, prior-day close (%)         | 0.413     | 0.312                     | 0.373 | 0.387 | 0.366 | 0.423     | -0.112*** | (-5.10)         |
| B2. Trade Statistics               |           |                           |       |       |       |           |           |                 |
| Ticket size (\$ thousands)         | 914       | 124                       | 339   | 568   | 907   | 1,680     | -1,555*** | (-47.28)        |
| Ticket size (shares thousands)     | 28.3      | 4.3                       | 11.0  | 17.8  | 27.8  | 51.0      | -47.0***  | (-63.20)        |
| Trades per ticket                  | 1.27      | 1.19                      | 1.31  | 1.29  | 1.36  | 1.12      | 0.078***  | (4.36)          |

**Table III: Determinants of Ticket Level Transaction Costs**

Panel A reports the annual equal-weighted average of trading cost measures at the ticket level. The average of execution shortfall and total trading cost (i.e., execution shortfall + commissions + taxes and fees) are reported for all tickets, buys, and sells separately. In Panel A, we also report the equal-weighted average across all tickets during the financial crisis period from September 2008 to March 2009. Panel B reports Fama-MacBeth (1973) coefficient estimates from the regression of mutual fund transaction costs (in percentage point) at the ticket level on the trade and fund level variables as shown in equation (4). Results in Panel B1 are based on utilizing investment style dummy variables in (4); results in Panel B2 (total trading cost) are based on estimating (4) separately for each investment style. Ticket Size is the share volume of a ticket normalized by dividing by the average daily trading volume of the previous month (in decimal number). Price inverse is defined as one over the closing price of the trading day prior to the order placement date (in decimal number). Log(mktcap) is the logarithm of market capitalization (in \$ million) of the traded stock at the previous month-end. Nasdaq is a dummy variable for stocks listed on Nasdaq stock exchange. Idiosyncratic volatility of a stock is the standard deviation of daily idiosyncratic returns of the month (in percentage point) based on the CAPM model. Return on the value-weighted market portfolio is also in percentage point. All fund level independent variables are defined in Table I and lagged by one month with the same unit except family TNA is in \$ million. We first estimate cross-sectional regressions each month and then report the time-series average of the monthly coefficients. Fama-MacBeth (1973) *t*-statistics (in parenthesis) are corrected following Newey-West (1987). Statistical significance of one, five, and ten percent are indicated by \*\*\*, \*\*, and \* respectively.

Panel A: Ticket Level Transaction Costs by Year - Execution Shortfall (%)

|               | All       |          |       | Buys      |          |       | Sells     |          |       |
|---------------|-----------|----------|-------|-----------|----------|-------|-----------|----------|-------|
|               | Tickets   | Implicit | Total | Tickets   | Implicit | Total | Tickets   | Implicit | Total |
| 1999          | 408,585   | 0.190    | 0.278 | 205,279   | 0.118    | 0.202 | 203,306   | 0.263    | 0.356 |
| 2000          | 592,105   | 0.134    | 0.219 | 315,907   | 0.054    | 0.134 | 276,198   | 0.227    | 0.317 |
| 2001          | 585,018   | 0.136    | 0.248 | 325,943   | 0.110    | 0.222 | 259,075   | 0.168    | 0.281 |
| 2002          | 545,519   | 0.104    | 0.316 | 294,168   | 0.037    | 0.237 | 251,351   | 0.183    | 0.408 |
| 2003          | 627,080   | 0.112    | 0.308 | 350,952   | 0.119    | 0.310 | 276,128   | 0.104    | 0.305 |
| 2004          | 688,276   | 0.114    | 0.267 | 387,672   | 0.104    | 0.244 | 300,599   | 0.128    | 0.297 |
| 2005          | 827,614   | 0.111    | 0.239 | 436,709   | 0.094    | 0.212 | 390,905   | 0.129    | 0.268 |
| 2006          | 950,906   | 0.111    | 0.192 | 517,323   | 0.096    | 0.173 | 433,583   | 0.129    | 0.214 |
| 2007          | 1,033,545 | 0.123    | 0.195 | 562,291   | 0.089    | 0.157 | 471,254   | 0.164    | 0.239 |
| 2008          | 1,090,401 | 0.189    | 0.279 | 558,824   | 0.120    | 0.198 | 531,577   | 0.263    | 0.365 |
| 2009          | 1,085,285 | 0.114    | 0.235 | 556,389   | 0.120    | 0.236 | 528,896   | 0.107    | 0.233 |
| 2010          | 618,670   | 0.012    | 0.111 | 312,245   | 0.004    | 0.102 | 306,425   | 0.020    | 0.120 |
| 2011          | 166,191   | 0.069    | 0.156 | 86,653    | 0.058    | 0.142 | 79,538    | 0.081    | 0.172 |
| 2008m9-2009m3 | 762,746   | 0.214    | 0.336 | 391,932   | 0.113    | 0.222 | 370,814   | 0.320    | 0.457 |
| All           | 9,219,195 | 0.121    | 0.236 | 4,910,355 | 0.092    | 0.201 | 4,308,835 | 0.154    | 0.275 |

Panel B: Determinants of Ticket Level Transaction Costs – Execution Shortfall (%)

B1: Investment Style Dummy Variables

| VARIABLES        | Implicit             |                      |                     | Total                |                      |                      |
|------------------|----------------------|----------------------|---------------------|----------------------|----------------------|----------------------|
|                  | All<br>(1)           | Buy<br>(2)           | Sell<br>(3)         | All<br>(4)           | Buy<br>(5)           | Sell<br>(6)          |
| Ticket size      | 0.811***<br>(7.84)   | 0.773***<br>(6.90)   | 0.843***<br>(7.66)  | 1.034***<br>(9.50)   | 0.981***<br>(8.37)   | 1.074***<br>(9.26)   |
| Price inverse    | 0.605***<br>(3.44)   | 0.078<br>(0.54)      | 0.863***<br>(4.24)  | 2.558***<br>(15.10)  | 2.010***<br>(13.37)  | 2.839***<br>(15.24)  |
| Log(mktcap)      | -0.013***<br>(-6.05) | -0.020***<br>(-6.69) | -0.004*<br>(-1.70)  | -0.014***<br>(-6.22) | -0.022***<br>(-7.37) | -0.004*<br>(-1.72)   |
| Nasdaq           | 0.010*<br>(1.66)     | 0.016**<br>(2.60)    | 0.002<br>(0.20)     | -0.025***<br>(-4.61) | -0.017**<br>(-1.98)  | -0.035***<br>(-4.96) |
| IVOL             | 0.013***<br>(2.73)   | -0.004<br>(-0.81)    | 0.035***<br>(6.19)  | 0.017***<br>(3.71)   | -0.001<br>(-0.13)    | 0.041***<br>(7.13)   |
| Side*market      | 0.190***<br>(18.74)  | 0.199***<br>(18.31)  | 0.179***<br>(18.46) | 0.190***<br>(18.65)  | 0.199***<br>(18.18)  | 0.180***<br>(18.38)  |
| Log(TNA)         | 0.006**<br>(2.08)    | 0.008***<br>(2.76)   | 0.003<br>(0.97)     | 0.006**<br>(2.07)    | 0.008***<br>(2.97)   | 0.002<br>(0.74)      |
| Expense ratio    | 0.041***<br>(4.36)   | 0.068***<br>(5.13)   | 0.009<br>(0.65)     | 0.055***<br>(6.47)   | 0.080***<br>(6.64)   | 0.023*<br>(1.66)     |
| Fund turnover    | 0.035***<br>(4.98)   | 0.041***<br>(4.81)   | 0.023***<br>(3.14)  | 0.029***<br>(3.86)   | 0.039***<br>(4.15)   | 0.014*<br>(1.87)     |
| Fund flow        | -0.001<br>(-1.50)    | -0.001<br>(-1.31)    | 0.000<br>(0.61)     | -0.001<br>(-1.59)    | -0.001<br>(-1.39)    | 0.000<br>(0.59)      |
| Log(fund age)    | -0.008<br>(-1.57)    | -0.008<br>(-1.53)    | -0.012**<br>(-2.01) | -0.006<br>(-1.11)    | -0.004<br>(-0.75)    | -0.012*<br>(-1.90)   |
| Log(family TNA)  | 0.002<br>(0.59)      | 0.009**<br>(2.09)    | -0.005<br>(-1.35)   | -0.007*<br>(-1.80)   | 0.001<br>(0.13)      | -0.014***<br>(-4.10) |
| Lag fund return  | 0.000<br>(0.19)      | 0.001<br>(0.19)      | 0.000<br>(0.12)     | 0.000<br>(0.09)      | 0.000<br>(0.06)      | 0.000<br>(0.08)      |
| Large-cap growth | 0.023*<br>(1.96)     | 0.012<br>(0.93)      | 0.036***<br>(3.02)  | 0.024**<br>(2.20)    | 0.013<br>(1.06)      | 0.038***<br>(3.40)   |
| Large-cap value  | -0.028**<br>(-2.15)  | -0.042***<br>(-2.93) | -0.018<br>(-1.32)   | -0.035***<br>(-2.71) | -0.045***<br>(-3.23) | -0.027**<br>(-2.04)  |
| Mid-cap blend    | -0.011<br>(-0.42)    | -0.019<br>(-0.65)    | 0.011<br>(0.42)     | -0.031<br>(-1.27)    | -0.033<br>(-1.20)    | -0.013<br>(-0.52)    |
| Mid-cap growth   | 0.026**<br>(2.02)    | 0.007<br>(0.52)      | 0.048***<br>(3.24)  | 0.025**<br>(2.00)    | 0.011<br>(0.75)      | 0.043***<br>(2.99)   |
| Mid-cap value    | 0.035***<br>(3.20)   | 0.033**<br>(2.30)    | 0.045***<br>(3.42)  | 0.032***<br>(2.83)   | 0.038***<br>(2.61)   | 0.034**<br>(2.54)    |
| Small-cap blend  | 0.040*<br>(1.96)     | 0.035<br>(1.56)      | 0.051**<br>(2.23)   | 0.014<br>(0.75)      | 0.011<br>(0.51)      | 0.028<br>(1.17)      |
| Small-cap growth | -0.030*<br>(-1.96)   | -0.055**<br>(-2.55)  | 0.009<br>(0.57)     | -0.043***<br>(-2.80) | -0.065***<br>(-3.07) | -0.006<br>(-0.32)    |
| Small-cap value  | -0.007<br>(-0.32)    | -0.002<br>(-0.07)    | -0.004<br>(-0.20)   | -0.029<br>(-1.30)    | -0.019<br>(-0.64)    | -0.032<br>(-1.51)    |
| Constant         | -0.015<br>(-0.26)    | -0.053<br>(-0.83)    | 0.031<br>(0.48)     | 0.112*<br>(1.96)     | 0.065<br>(1.06)      | 0.170***<br>(2.61)   |
| Adj. R-squared   | 0.033                | 0.039                | 0.036               | 0.047                | 0.048                | 0.054                |
| Observations     | 8,611,113            | 4,551,446            | 4,059,667           | 8,611,113            | 4,551,446            | 4,059,667            |
| # of months      | 153                  | 153                  | 153                 | 153                  | 153                  | 153                  |

B2: Analysis by Investment Style

| VARIABLES       | Large Cap             |                      |                      | Mid Cap              |                      |                     | Small Cap            |                      |                      |
|-----------------|-----------------------|----------------------|----------------------|----------------------|----------------------|---------------------|----------------------|----------------------|----------------------|
|                 | Growth                | Blend                | Value                | Growth               | Blend                | Value               | Growth               | Blend                | Value                |
| Ticket size     | 0.971***<br>(4.66)    | 1.206***<br>(8.08)   | 0.784***<br>(3.66)   | 0.921***<br>(7.98)   | 0.970***<br>(6.14)   | 1.092***<br>(7.38)  | 1.180***<br>(7.67)   | 0.915***<br>(6.85)   | 1.366***<br>(12.99)  |
| Price inverse   | 2.424***<br>(14.60)   | 2.587***<br>(14.91)  | 2.976***<br>(9.92)   | 2.524***<br>(19.03)  | 2.782***<br>(10.98)  | 2.790***<br>(9.86)  | 2.751***<br>(15.23)  | 2.214***<br>(11.19)  | 3.052***<br>(13.82)  |
| Log(mktcap)     | -0.020***<br>(-5.99)  | -0.012***<br>(-3.75) | -0.018***<br>(-5.58) | -0.017***<br>(-5.99) | -0.023***<br>(-3.60) | -0.015**<br>(-2.10) | -0.027***<br>(-2.84) | -0.049***<br>(-5.04) | -0.018***<br>(-3.50) |
| Nasdaq          | -0.022**<br>(-2.47)   | -0.032***<br>(-3.89) | -0.048***<br>(-3.86) | -0.045***<br>(-3.43) | -0.024*<br>(-1.76)   | -0.009<br>(-0.71)   | -0.020<br>(-1.62)    | -0.022<br>(-1.57)    | -0.025**<br>(-2.37)  |
| IVOL            | 0.018***<br>(4.13)    | 0.004<br>(0.54)      | -0.028***<br>(-3.76) | 0.027***<br>(4.65)   | 0.003<br>(0.31)      | 0.005<br>(0.49)     | 0.014*<br>(1.97)     | 0.012<br>(1.39)      | 0.028***<br>(3.35)   |
| Side*market     | 0.178***<br>(13.13)   | 0.153***<br>(17.28)  | 0.187***<br>(19.10)  | 0.201***<br>(13.72)  | 0.195***<br>(12.70)  | 0.145***<br>(12.46) | 0.321***<br>(18.11)  | 0.255***<br>(13.48)  | 0.172***<br>(10.47)  |
| Log(TNA)        | 0.001<br>(0.28)       | -0.020***<br>(-2.73) | 0.004<br>(0.66)      | 0.003<br>(0.22)      | 0.009<br>(0.23)      | 0.017<br>(1.17)     | -0.030<br>(-1.51)    | -0.052<br>(-1.57)    | 0.107<br>(1.42)      |
| Expense ratio   | 0.034*<br>(1.81)      | -0.022<br>(-0.62)    | 0.154***<br>(4.30)   | -0.101<br>(-1.65)    | -0.061<br>(-0.78)    | 0.053<br>(0.48)     | -0.056<br>(-0.76)    | 0.008<br>(0.22)      | 1.220*<br>(1.88)     |
| Fund turnover   | 0.069***<br>(4.77)    | -0.008<br>(-0.89)    | 0.074**<br>(2.56)    | 0.045<br>(1.34)      | -0.022<br>(-0.31)    | -0.000<br>(-0.00)   | -0.028<br>(-0.58)    | 0.137**<br>(2.56)    | 0.063<br>(0.32)      |
| Fund flow       | 0.001<br>(0.51)       | -0.002<br>(-1.18)    | 0.003<br>(0.73)      | -0.005<br>(-1.65)    | 0.013<br>(0.44)      | -0.007<br>(-0.55)   | -0.010<br>(-0.93)    | -0.045**<br>(-2.52)  | 0.021<br>(0.73)      |
| Log(fund age)   | 0.042***<br>(3.41)    | 0.009<br>(0.90)      | 0.074***<br>(5.82)   | -0.037*<br>(-1.76)   | 0.056<br>(1.19)      | -0.036<br>(-1.04)   | -0.051<br>(-1.38)    | 0.059<br>(1.29)      | -0.169*<br>(-1.92)   |
| Log(family TNA) | -0.059***<br>(-10.57) | -0.022**<br>(-2.11)  | 0.001<br>(0.15)      | -0.025**<br>(-2.29)  | 0.377<br>(1.19)      | 0.004<br>(0.48)     | -0.014<br>(-0.79)    | 0.029<br>(1.39)      | 0.055<br>(1.60)      |
| Lag fund return | -0.001<br>(-0.35)     | -0.001<br>(-0.15)    | 0.002<br>(0.34)      | -0.002<br>(-0.61)    | -0.005<br>(-0.36)    | 0.015<br>(0.44)     | -0.021<br>(-1.16)    | 0.018<br>(0.64)      | 0.060<br>(1.00)      |
| Constant        | 0.791***<br>(8.51)    | 0.543***<br>(3.84)   | -0.142<br>(-1.26)    | 0.640***<br>(3.01)   | -5.180<br>(-1.17)    | -0.023<br>(-0.09)   | 0.729***<br>(3.36)   | -0.014<br>(-0.05)    | -2.353<br>(-1.64)    |
| Adj. R-squared  | 0.051                 | 0.046                | 0.059                | 0.061                | 0.077                | 0.059               | 0.061                | 0.075                | 0.087                |
| Observations    | 2,032,062             | 1,266,198            | 994,844              | 831,789              | 431,410              | 364,167             | 851,761              | 554,452              | 1,284,430            |
| # of months     | 153                   | 153                  | 153                  | 153                  | 153                  | 153                 | 153                  | 153                  | 153                  |



**Table IV: Determinants of Fund Level Trading Costs**

Panel A reports the number of observations and summary statistics for execution shortfall and total trading cost (i.e., execution shortfall + commissions + taxes and fees) per trade dollar or per TNA dollar each year. Costs are first estimated at the fund-month level, then cross-sectionally averaged each month, and finally averaged each year. Panels B and C report Fama-MacBeth (1973) coefficient estimates from monthly cross-sectional regressions of trading cost measures (in percentage point) on fund attributes. The dependent variables are execution shortfall per trade dollar (in panel B) and execution shortfall per TNA Dollar (in panel C). Results in Panels B1 and C1 are based on utilizing investment style dummy variables in (4); results in Panels B2 and C2 are based on estimating (4) separately for each investment style. Fund attributes (independent variables) are defined in Table I and lagged by one month with the same unit except family TNA is in \$ million. Fama-MacBeth (1973) *t*-statistics (in parenthesis) are corrected following Newey-West (1987). Statistical significance of one, five, and ten percent are indicated by \*\*\*, \*\*, and \* respectively.

Panel A: Fund Level Trading Costs by Year - Execution Shortfall (%)

|      | # Obs. | Per Trade Dollar |       | Per TNA Dollar |       |
|------|--------|------------------|-------|----------------|-------|
|      |        | Implicit         | Total | Implicit       | Total |
| 1999 | 1,443  | 0.166            | 0.267 | 0.046          | 0.063 |
| 2000 | 1,665  | 0.151            | 0.241 | 0.053          | 0.072 |
| 2001 | 2,053  | 0.133            | 0.252 | 0.044          | 0.069 |
| 2002 | 2,388  | 0.139            | 0.331 | 0.039          | 0.075 |
| 2003 | 2,711  | 0.130            | 0.323 | 0.031          | 0.064 |
| 2004 | 2,563  | 0.122            | 0.285 | 0.030          | 0.056 |
| 2005 | 2,941  | 0.105            | 0.251 | 0.033          | 0.058 |
| 2006 | 2,977  | 0.119            | 0.221 | 0.036          | 0.055 |
| 2007 | 2,799  | 0.123            | 0.210 | 0.034          | 0.051 |
| 2008 | 2,853  | 0.203            | 0.302 | 0.064          | 0.088 |
| 2009 | 2,858  | 0.158            | 0.282 | 0.045          | 0.072 |
| 2010 | 1,990  | 0.110            | 0.224 | 0.027          | 0.045 |
| 2011 | 997    | 0.063            | 0.168 | 0.023          | 0.038 |
| All  | 30,238 | 0.135            | 0.264 | 0.039          | 0.063 |

Panel B: Execution Shortfall per Trade Dollar (%)

B1: Investment Style Dummy Variables

| VARIABLES        | Implicit Trading Costs |                      |                      | Total Trading Costs  |                      |                      |
|------------------|------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
|                  | (1)                    | (2)                  | (3)                  | (4)                  | (5)                  | (6)                  |
| Log(TNA)         | -0.018***<br>(-6.47)   | -0.003<br>(-1.17)    | -0.002<br>(-1.23)    | -0.020***<br>(-7.44) | -0.003<br>(-1.14)    | -0.003<br>(-1.37)    |
| Lag trade cost   |                        |                      | 0.416***<br>(30.86)  |                      |                      | 0.409***<br>(30.87)  |
| Expense ratio    |                        | 0.028**<br>(2.15)    | 0.014<br>(1.58)      |                      | 0.039***<br>(3.19)   | 0.022**<br>(2.44)    |
| Fund turnover    |                        | 0.083***<br>(14.46)  | 0.052***<br>(11.17)  |                      | 0.079***<br>(12.47)  | 0.050***<br>(10.44)  |
| Fund flow        |                        | -0.001<br>(-1.52)    | -0.001<br>(-1.65)    |                      | -0.001<br>(-1.56)    | -0.001*<br>(-1.72)   |
| Log(fund age)    |                        | 0.007<br>(1.52)      | 0.006*<br>(1.83)     |                      | 0.014***<br>(2.83)   | 0.011***<br>(2.96)   |
| Log(family TNA)  |                        | -0.013***<br>(-3.95) | -0.008***<br>(-4.05) |                      | -0.021***<br>(-6.15) | -0.013***<br>(-5.99) |
| Lag fund return  |                        | -0.001<br>(-0.61)    | -0.000<br>(-0.19)    |                      | -0.001<br>(-0.68)    | -0.001<br>(-0.28)    |
| Large-cap growth | 0.067***<br>(5.92)     | 0.032**<br>(2.26)    | 0.022**<br>(2.31)    | 0.071***<br>(6.26)   | 0.031**<br>(2.22)    | 0.020**<br>(2.08)    |
| Large-cap value  | -0.069***<br>(-4.49)   | -0.035**<br>(-2.32)  | -0.016<br>(-1.57)    | -0.061***<br>(-4.12) | -0.033**<br>(-2.27)  | -0.016<br>(-1.58)    |
| Mid-cap blend    | -0.025<br>(-0.96)      | -0.009<br>(-0.31)    | -0.002<br>(-0.09)    | 0.001<br>(0.03)      | 0.015<br>(0.52)      | 0.010<br>(0.56)      |
| Mid-cap growth   | 0.096***<br>(5.59)     | 0.055**<br>(2.40)    | 0.034**<br>(2.46)    | 0.117***<br>(6.41)   | 0.068***<br>(2.88)   | 0.041***<br>(2.84)   |
| Mid-cap value    | -0.035*<br>(-1.88)     | 0.006<br>(0.34)      | 0.004<br>(0.33)      | -0.010<br>(-0.48)    | 0.028<br>(1.58)      | 0.016<br>(1.34)      |
| Small-cap blend  | -0.073***<br>(-2.87)   | -0.054**<br>(-2.10)  | -0.024<br>(-1.34)    | -0.008<br>(-0.31)    | -0.001<br>(-0.03)    | 0.006<br>(0.30)      |
| Small-cap growth | 0.145***<br>(7.63)     | 0.098***<br>(4.17)   | 0.050***<br>(3.01)   | 0.207***<br>(11.10)  | 0.147***<br>(6.29)   | 0.080***<br>(4.74)   |
| Small-cap value  | -0.078**<br>(-2.19)    | -0.113***<br>(-2.67) | -0.060**<br>(-2.28)  | 0.031<br>(0.85)      | -0.037<br>(-0.83)    | -0.016<br>(-0.56)    |
| Constant         | 0.230***<br>(9.22)     | 0.140***<br>(2.91)   | 0.088***<br>(2.68)   | 0.353***<br>(12.97)  | 0.304***<br>(5.85)   | 0.185***<br>(5.17)   |
| Adj. R-squared   | 0.031                  | 0.061                | 0.230                | 0.038                | 0.074                | 0.237                |
| Observations     | 29,859                 | 29,029               | 27,455               | 29,859               | 29,029               | 27,455               |
| # of months      | 153                    | 153                  | 152                  | 153                  | 153                  | 152                  |

B2: Analysis by Investment Style

| VARIABLES       | Large Cap                         |                      |                    | Mid Cap              |                    |                     | Small Cap            |                     |                    |
|-----------------|-----------------------------------|----------------------|--------------------|----------------------|--------------------|---------------------|----------------------|---------------------|--------------------|
|                 | Growth                            | Blend                | Value              | Growth               | Blend              | Value               | Growth               | Blend               | Value              |
|                 | Cost vs. Fund Size                |                      |                    |                      |                    |                     |                      |                     |                    |
| Log(TNA)        | -0.039***<br>(-6.12)              | -0.026***<br>(-5.29) | -0.008*<br>(-1.79) | -0.018**<br>(-2.25)  | -0.017<br>(-1.57)  | 0.017**<br>(2.33)   | -0.083***<br>(-5.52) | -0.068*<br>(-1.95)  | 0.005<br>(0.29)    |
| Constant        | 0.556***<br>(10.98)               | 0.384***<br>(12.13)  | 0.224***<br>(7.81) | 0.447***<br>(8.02)   | 0.340***<br>(6.15) | 0.157***<br>(3.86)  | 0.969***<br>(8.31)   | 0.654***<br>(2.99)  | 0.236***<br>(2.75) |
| Adj. R-squared  | 0.023                             | 0.015                | -0.002             | 0.004                | 0.002              | 0.014               | -0.010               | 0.050               | -0.038             |
| Observations    | 7,163                             | 4,928                | 5,023              | 3,795                | 1,698              | 2,474               | 1,736                | 1,599               | 1,443              |
| # of months     | 153                               | 153                  | 153                | 153                  | 153                | 153                 | 153                  | 153                 | 153                |
|                 | Cost vs. All Fund-Level Variables |                      |                    |                      |                    |                     |                      |                     |                    |
| Log(TNA)        | -0.011<br>(-1.62)                 | -0.010<br>(-0.99)    | -0.007<br>(-0.98)  | -0.020<br>(-1.32)    | -0.022<br>(-0.72)  | 0.024<br>(1.54)     | -0.006<br>(-0.24)    | -0.065**<br>(-2.25) | 0.029<br>(0.54)    |
| Expense ratio   | 0.103***<br>(3.44)                | 0.045<br>(1.29)      | 0.086**<br>(2.12)  | -0.137**<br>(-2.20)  | -0.077<br>(-0.78)  | -0.176**<br>(-2.55) | 0.013<br>(0.24)      | 0.089<br>(1.44)     | 0.309<br>(0.74)    |
| Fund turnover   | 0.105***<br>(6.03)                | 0.059***<br>(4.44)   | 0.055**<br>(2.47)  | 0.125***<br>(4.61)   | -0.035<br>(-0.49)  | 0.053<br>(0.95)     | 0.207***<br>(2.76)   | 0.189***<br>(3.74)  | -0.026<br>(-0.16)  |
| Fund flow       | 0.001<br>(0.18)                   | 0.003<br>(1.16)      | -0.001<br>(-0.31)  | -0.005<br>(-1.28)    | -0.012<br>(-0.80)  | 0.006<br>(0.55)     | -0.011<br>(-0.99)    | -0.007<br>(-0.46)   | 0.022<br>(0.79)    |
| Log(fund age)   | 0.114***<br>(6.22)                | 0.028***<br>(3.92)   | 0.064***<br>(6.21) | 0.000<br>(0.01)      | -0.035<br>(-0.58)  | -0.054<br>(-1.42)   | -0.018<br>(-0.35)    | 0.111**<br>(2.56)   | -0.047<br>(-0.40)  |
| Log(family TNA) | -0.077***<br>(-11.62)             | -0.049***<br>(-4.23) | -0.007<br>(-1.60)  | -0.045***<br>(-4.86) | 0.188<br>(1.46)    | -0.016<br>(-1.51)   | -0.031<br>(-1.44)    | 0.017<br>(0.82)     | -0.004<br>(-0.14)  |
| Lag fund return | 0.001<br>(0.26)                   | 0.003<br>(0.43)      | 0.009<br>(1.57)    | -0.006<br>(-1.22)    | -0.008<br>(-0.38)  | 0.046<br>(1.32)     | -0.011<br>(-0.56)    | 0.019<br>(0.70)     | 0.050<br>(0.67)    |
| Constant        | 0.733***<br>(6.61)                | 0.631***<br>(4.78)   | 0.043<br>(0.50)    | 0.995***<br>(4.57)   | -2.044<br>(-1.19)  | 0.466**<br>(2.60)   | 0.509*<br>(1.89)     | -0.300<br>(-1.07)   | -0.175<br>(-0.18)  |
| Adj. R-squared  | 0.152                             | 0.142                | -0.007             | 0.079                | 0.124              | -0.010              | 0.083                | -0.088              | -0.068             |
| Observations    | 7,075                             | 4,803                | 4,835              | 3,624                | 1,662              | 2,393               | 1,691                | 1,543               | 1,403              |
| # of months     | 153                               | 153                  | 153                | 153                  | 153                | 153                 | 153                  | 153                 | 153                |

Panel B2 continued.

| VARIABLES  | Large Cap             |                      |                     | Mid Cap              |                   |                      | Small Cap         |                    |                   |
|--|-----------------------|----------------------|---------------------|----------------------|-------------------|----------------------|-------------------|--------------------|-------------------|
|  | Growth                | Blend                | Value               | Growth               | Blend             | Value                | Growth            | Blend              | Value             |
| Cost vs. All Fund Level Variables and Lag Trade Cost |                       |                      |                     |                      |                   |                      |                   |                    |                   |
| Log(TNA)   | -0.008<br>(-1.48)     | -0.008<br>(-0.98)    | -0.010**<br>(-2.13) | -0.006<br>(-0.47)    | -0.054<br>(-1.37) | 0.002<br>(0.06)      | -0.004<br>(-0.14) | -0.041<br>(-1.64)  | 0.039<br>(0.25)   |
| Lag trade cost                                       | 0.428***<br>(13.70)   | 0.379***<br>(10.41)  | 0.385***<br>(12.00) | 0.508***<br>(11.41)  | 0.472<br>(1.54)   | 0.417***<br>(3.16)   | 0.162*<br>(1.77)  | 0.327***<br>(5.11) | 1.077*<br>(1.76)  |
| Expense ratio  | 0.037*<br>(1.77)      | 0.028<br>(1.25)      | 0.026<br>(1.22)     | -0.122**<br>(-2.29)  | -0.124<br>(-1.33) | -0.161***<br>(-2.70) | 0.180<br>(1.06)   | -0.006<br>(-0.15)  | 0.689<br>(0.86)   |
| Fund turnover  | 0.065***<br>(3.52)    | 0.045***<br>(4.28)   | 0.035*<br>(1.95)    | 0.021<br>(0.47)      | -0.034<br>(-0.45) | 0.037<br>(0.72)      | 0.053<br>(0.68)   | 0.102**<br>(2.26)  | -0.018<br>(-0.04) |
| Fund flow  | 0.003<br>(0.81)       | 0.001<br>(0.31)      | -0.003<br>(-1.44)   | -0.003<br>(-0.88)    | 0.031<br>(0.98)   | -0.007<br>(-0.64)    | -0.048<br>(-1.21) | 0.001<br>(0.13)    | 0.084<br>(1.25)   |
| Log(fund age)  | 0.077***<br>(4.48)    | 0.025***<br>(3.72)   | 0.040***<br>(5.28)  | -0.032<br>(-1.18)    | -0.098<br>(-1.01) | 0.044<br>(0.91)      | 0.150<br>(0.86)   | 0.033<br>(0.78)    | 0.561<br>(0.99)   |
| Log(family TNA)                                      | -0.047***<br>(-11.10) | -0.040***<br>(-3.39) | -0.002<br>(-0.51)   | -0.021***<br>(-2.83) | 0.010<br>(0.09)   | -0.008<br>(-0.56)    | -0.033<br>(-1.58) | 0.004<br>(0.35)    | 0.021<br>(0.21)   |
| Lag fund return                                      | 0.007<br>(1.31)       | 0.006<br>(1.00)      | 0.013**<br>(2.22)   | -0.015<br>(-1.51)    | 0.020<br>(0.83)   | 0.037<br>(1.03)      | -0.001<br>(-0.04) | -0.030<br>(-1.18)  | -0.337<br>(-1.29) |
| Constant   | 0.470***<br>(6.99)    | 0.520***<br>(3.94)   | 0.071<br>(1.03)     | 0.629***<br>(3.04)   | 1.000<br>(0.66)   | 0.222<br>(1.08)      | -0.126<br>(-0.17) | 0.179<br>(0.82)    | -2.934<br>(-1.21) |
| Adj. R-squared                                       | 0.334                 | 0.329                | 0.160               | 0.351                | 0.349             | 0.132                | 0.211             | 0.195              | 0.154             |
| Observations   | 6,551                 | 4,405                | 4,504               | 3,309                | 1,422             | 2,186                | 1,595             | 1,449              | 1,322             |
| # of months  | 152                   | 152                  | 152                 | 152                  | 152               | 152                  | 152               | 152                | 152               |

Panel C: Execution Shortfall per TNA Dollar (%)

C1: Investment Style Dummy Variables

| VARIABLES        | Implicit Trading Costs |                      |                      | Total Trading Costs   |                      |                      |
|------------------|------------------------|----------------------|----------------------|-----------------------|----------------------|----------------------|
|                  | (1)                    | (2)                  | (3)                  | (4)                   | (5)                  | (6)                  |
| Log(TNA)         | -0.008***<br>(-11.47)  | -0.004***<br>(-6.16) | -0.002***<br>(-4.88) | -0.012***<br>(-15.12) | -0.007***<br>(-8.18) | -0.003***<br>(-6.06) |
| Lag trade cost   |                        |                      | 0.588***<br>(20.30)  |                       |                      | 0.636***<br>(23.26)  |
| Expense ratio    |                        | -0.011***<br>(-3.90) | -0.005***<br>(-2.75) |                       | -0.013***<br>(-4.25) | -0.005***<br>(-2.79) |
| Fund turnover    |                        | 0.026***<br>(10.96)  | 0.010***<br>(6.40)   |                       | 0.035***<br>(11.16)  | 0.012***<br>(6.64)   |
| Fund flow        |                        | -0.000<br>(-0.50)    | -0.000<br>(-0.77)    |                       | -0.000<br>(-0.70)    | -0.000<br>(-0.97)    |
| Log(fund age)    |                        | -0.002*<br>(-1.79)   | -0.000<br>(-0.43)    |                       | -0.002<br>(-1.06)    | -0.000<br>(-0.15)    |
| Log(family TNA)  |                        | -0.003***<br>(-5.69) | -0.001***<br>(-4.27) |                       | -0.005***<br>(-6.61) | -0.002***<br>(-4.65) |
| Lag fund return  |                        | -0.001*<br>(-1.93)   | -0.000<br>(-0.66)    |                       | -0.001*<br>(-1.84)   | -0.001<br>(-1.10)    |
| Large-cap growth | 0.010***<br>(3.44)     | 0.002<br>(1.02)      | -0.000<br>(-0.07)    | 0.010***<br>(2.66)    | -0.000<br>(-0.01)    | -0.002<br>(-0.88)    |
| Large-cap value  | -0.012***<br>(-3.53)   | -0.001<br>(-0.36)    | -0.001<br>(-0.44)    | -0.014***<br>(-3.33)  | 0.000<br>(0.11)      | -0.001<br>(-0.30)    |
| Mid-cap blend    | 0.003<br>(0.65)        | 0.007<br>(1.25)      | 0.001<br>(0.51)      | 0.005<br>(0.85)       | 0.010<br>(1.44)      | 0.002<br>(0.67)      |
| Mid-cap growth   | 0.023***<br>(7.20)     | 0.012***<br>(2.72)   | 0.007**<br>(2.31)    | 0.033***<br>(7.56)    | 0.018***<br>(3.37)   | 0.008**<br>(2.60)    |
| Mid-cap value    | -0.013***<br>(-4.19)   | -0.001<br>(-0.38)    | -0.000<br>(-0.11)    | -0.014***<br>(-3.57)  | 0.001<br>(0.24)      | 0.001<br>(0.31)      |
| Small-cap blend  | -0.001<br>(-0.19)      | 0.007<br>(1.40)      | 0.002<br>(0.71)      | -0.003<br>(-0.56)     | 0.006<br>(1.03)      | 0.001<br>(0.29)      |
| Small-cap growth | 0.042***<br>(5.08)     | 0.026***<br>(3.13)   | 0.009<br>(1.58)      | 0.060***<br>(6.17)    | 0.039***<br>(4.02)   | 0.014*<br>(1.93)     |
| Small-cap value  | 0.038***<br>(3.54)     | 0.036***<br>(3.15)   | 0.009*<br>(1.70)     | 0.057***<br>(4.28)    | 0.053***<br>(3.77)   | 0.013**<br>(2.14)    |
| Constant         | 0.080***<br>(13.03)    | 0.087***<br>(8.61)   | 0.042***<br>(6.13)   | 0.127***<br>(17.84)   | 0.133***<br>(10.56)  | 0.058***<br>(6.72)   |
| Adj. R-squared   | 0.040                  | 0.084                | 0.432                | 0.055                 | 0.104                | 0.493                |
| Observations     | 29,859                 | 29,029               | 27,455               | 29,859                | 29,029               | 27,455               |
| # of months      | 153                    | 153                  | 152                  | 153                   | 153                  | 152                  |

C2: Analysis by Investment Style

| VARIABLES       | Large Cap                         |                      |                      | Mid Cap              |                      |                      | Small Cap            |                      |                      |
|-----------------|-----------------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
|                 | Growth                            | Blend                | Value                | Growth               | Blend                | Value                | Growth               | Blend                | Value                |
|                 | Cost vs. Fund Size                |                      |                      |                      |                      |                      |                      |                      |                      |
| Log(TNA)        | -0.016***<br>(-7.24)              | -0.013***<br>(-7.01) | -0.008***<br>(-7.87) | -0.017***<br>(-6.82) | -0.013***<br>(-6.47) | -0.007***<br>(-4.26) | -0.028***<br>(-2.63) | -0.003<br>(-0.56)    | 0.016**<br>(2.08)    |
| Constant        | 0.170***<br>(8.62)                | 0.134***<br>(9.81)   | 0.087***<br>(9.89)   | 0.188***<br>(10.16)  | 0.142***<br>(8.73)   | 0.092***<br>(8.70)   | 0.269***<br>(3.62)   | 0.074**<br>(2.29)    | 0.024<br>(0.58)      |
| Adj. R-squared  | 7,163                             | 4,928                | 5,023                | 3,795                | 1,698                | 2,474                | 1,736                | 1,599                | 1,443                |
| Observations    | 0.061                             | 0.037                | 0.008                | 0.034                | -0.025               | 0.032                | 0.067                | -0.025               | -0.021               |
| # of months     | 153                               | 153                  | 153                  | 153                  | 153                  | 153                  | 153                  | 153                  | 153                  |
|                 | Cost vs. All Fund Level Variables |                      |                      |                      |                      |                      |                      |                      |                      |
| Log(TNA)        | -0.012***<br>(-7.68)              | -0.014***<br>(-3.93) | -0.009***<br>(-3.97) | -0.008*<br>(-1.81)   | -0.048***<br>(-3.96) | -0.008***<br>(-2.73) | -0.021***<br>(-2.72) | -0.005<br>(-0.73)    | 0.093***<br>(4.12)   |
| Expense ratio   | -0.044***<br>(-4.27)              | -0.049***<br>(-3.87) | -0.005<br>(-0.53)    | 0.012<br>(0.89)      | -0.112***<br>(-3.15) | -0.067***<br>(-4.29) | 0.073**<br>(2.42)    | 0.026**<br>(2.31)    | 0.128<br>(1.40)      |
| Fund turnover   | 0.036***<br>(9.31)                | 0.006<br>(1.09)      | 0.001<br>(0.10)      | 0.046***<br>(5.54)   | -0.019<br>(-1.00)    | 0.036***<br>(3.45)   | 0.078***<br>(4.02)   | 0.093***<br>(6.43)   | 0.243***<br>(3.67)   |
| Fund flow       | 0.001<br>(0.93)                   | -0.000<br>(-0.48)    | -0.000<br>(-0.46)    | -0.001<br>(-0.56)    | 0.003<br>(0.59)      | -0.002<br>(-1.54)    | -0.004<br>(-1.18)    | -0.003<br>(-0.76)    | -0.005<br>(-0.57)    |
| Log(fund age)   | 0.007<br>(1.53)                   | -0.005<br>(-1.34)    | 0.004<br>(0.93)      | 0.000<br>(0.07)      | 0.022<br>(1.06)      | 0.005<br>(0.59)      | 0.038*<br>(1.76)     | 0.016*<br>(1.96)     | -0.128***<br>(-3.07) |
| Log(family TNA) | -0.015***<br>(-9.94)              | -0.016***<br>(-5.03) | -0.001<br>(-0.69)    | -0.005***<br>(-2.67) | 0.036*<br>(1.80)     | -0.013***<br>(-5.75) | 0.006<br>(1.35)      | 0.007**<br>(2.28)    | -0.017*<br>(-1.88)   |
| Lag fund return | 0.000<br>(0.19)                   | -0.001<br>(-0.64)    | 0.000<br>(0.14)      | -0.003*<br>(-1.78)   | 0.001<br>(0.12)      | 0.005*<br>(1.81)     | -0.004<br>(-0.66)    | -0.001<br>(-0.31)    | 0.002<br>(0.09)      |
| Constant        | 0.295***<br>(7.81)                | 0.378***<br>(7.10)   | 0.100***<br>(3.65)   | 0.118**<br>(2.60)    | 0.027<br>(0.09)      | 0.270***<br>(4.65)   | -0.113*<br>(-1.90)   | -0.154***<br>(-3.16) | -0.289<br>(-1.41)    |
| Adj. R-squared  | 0.217                             | 0.169                | 0.051                | 0.092                | 0.099                | 0.113                | 0.156                | 0.025                | 0.103                |
| Observations    | 7,075                             | 4,803                | 4,835                | 3,624                | 1,662                | 2,393                | 1,691                | 1,543                | 1,403                |
| # of months     | 153                               | 153                  | 153                  | 153                  | 153                  | 153                  | 153                  | 153                  | 153                  |

Panel C2 continued.

| VARIABLES       | Large Cap  |                      |                      | Mid Cap            |                    |                     | Small Cap         |                    |                    |
|-----------------|--|----------------------|----------------------|--------------------|--------------------|---------------------|-------------------|--------------------|--------------------|
|                 | Growth   | Blend                | Value                | Growth             | Blend              | Value               | Growth            | Blend              | Value              |
|                 | Cost vs. All Fund Level Variables and Lag Trade Cost |                      |                      |                    |                    |                     |                   |                    |                    |
| Log(TNA)        | -0.006***<br>(-5.30)                                 | -0.008***<br>(-3.17) | -0.003***<br>(-3.63) | 0.000<br>(0.09)    | -0.011*<br>(-1.70) | -0.006<br>(-1.42)   | 0.001<br>(0.06)   | -0.008<br>(-1.12)  | -0.061<br>(-0.81)  |
| Lag trade cost  | 0.599***<br>(13.86)                                  | 0.449***<br>(6.65)   | 0.597***<br>(13.52)  | 0.645***<br>(8.24) | 0.404***<br>(3.63) | 0.564***<br>(8.60)  | 0.356*<br>(1.81)  | 0.515***<br>(5.75) | 0.558***<br>(4.05) |
| Expense ratio   | -0.026***<br>(-3.10)                                 | -0.023**<br>(-2.40)  | 0.000<br>(0.03)      | -0.002<br>(-0.13)  | 0.009<br>(0.51)    | -0.020*<br>(-1.69)  | 0.097<br>(1.47)   | -0.001<br>(-0.16)  | -0.146<br>(-0.91)  |
| Fund turnover   | 0.015***<br>(4.40)                                   | -0.002<br>(-0.33)    | 0.003<br>(0.72)      | 0.020***<br>(2.89) | 0.001<br>(0.09)    | 0.013<br>(1.54)     | 0.025<br>(1.35)   | 0.032***<br>(3.94) | 0.684<br>(1.05)    |
| Fund flow       | 0.001<br>(0.92)                                      | -0.000<br>(-0.54)    | -0.000<br>(-0.73)    | -0.000<br>(-0.42)  | 0.000<br>(0.01)    | -0.001<br>(-0.64)   | -0.022<br>(-1.57) | -0.004<br>(-1.46)  | 0.006<br>(0.77)    |
| Log(fund age)   | 0.003<br>(1.02)                                      | -0.002<br>(-0.92)    | 0.002<br>(1.01)      | -0.008<br>(-1.16)  | -0.009<br>(-0.75)  | 0.009<br>(1.26)     | 0.064<br>(1.49)   | 0.005<br>(1.02)    | 0.341<br>(0.94)    |
| Log(family TNA) | -0.007***<br>(-5.64)                                 | -0.009***<br>(-3.53) | -0.001<br>(-0.74)    | -0.002<br>(-1.06)  | -0.007<br>(-0.21)  | -0.005**<br>(-2.43) | 0.004<br>(1.09)   | 0.005**<br>(2.13)  | -0.044<br>(-1.08)  |
| Lag fund return | -0.000<br>(-0.24)                                    | 0.000<br>(0.13)      | 0.001<br>(0.64)      | -0.001<br>(-0.70)  | 0.010<br>(1.61)    | 0.003<br>(0.76)     | 0.006<br>(0.49)   | -0.002<br>(-0.73)  | -0.073<br>(-1.04)  |
| Constant        | 0.156***<br>(4.79)                                   | 0.206***<br>(4.77)   | 0.035***<br>(2.53)   | 0.058<br>(1.29)    | 0.217<br>(0.53)    | 0.114***<br>(2.61)  | -0.273<br>(-1.23) | -0.007<br>(-0.19)  | 0.395<br>(1.21)    |
| Adj. R-squared  | 0.495  | 0.425                | 0.393                | 0.443              | 0.749              | 0.484               | 0.591             | 0.743              | 0.704              |
| Observations    | 6,551  | 4,405                | 4,504                | 3,309              | 1,422              | 2,186               | 1,595             | 1,449              | 1,322              |
| # of months     | 152  | 152                  | 152                  | 152                | 152                | 152                 | 152               | 152                | 152                |

### **Table V. Transaction Cost Estimate Comparison to Keim and Madhavan (1997)**

Panel A reports two sets of transaction cost estimates for tickets double sorted each month along the dimensions of ticket size (i.e., fraction of the average daily trading volume of the previous month) and market capitalization (\$ billion) of the traded stock. Panel A1 reports estimates of costs per trade dollar based on Keim and Madhavan (KM, 1997) using equations (B1) and (B2) in Appendix B. Panel A2 reports estimates of costs per trade dollar (execution shortfall) based on the equation (4) regression coefficients in columns (5) and (6) of Table III, Panel B for buys and sells, respectively. In both Panels A1 and A2, we first compute value-weighted averages of trading costs across all tickets for each portfolio-month combination and then calculate the time-series average across all sample months for each portfolio. Panel B reports trading cost estimates for funds sorted into quintiles based on TNA. Panel B1 again utilizes equations (B1) and (B2), and Panel B2 utilizes equation (4) with either ticket-level variables only or both ticket- and fund-level variables. For both Panels B1 and B2, we report fund-month level cost estimates both on the per trade dollar and on the per TNA dollar basis, where we aggregate each fund's trading costs across all transactions in each month by computing the value-weighted average. All trading cost measures are in percentage point. Statistical significance of one, five, and ten percent are indicated by \*\*\*, \*\*, and \* respectively.



Panel A: Ticket Level Transaction Costs Estimates by Ticket Size and Stock Market Capitalization

| Market Cap (\$ billion)<br>Quintile  |            | Ticket Size         |                     |                      |                      |                      | Diff:1-5  | t-stat.  |
|--|------------|---------------------|---------------------|----------------------|----------------------|----------------------|-----------|----------|
|  |            | 1 (Small)<br>≤0.09% | 2<br>0.09%–0.40%    | 3<br>0.40%–1.31%     | 4<br>1.31%–4.38%     | 5 (Large)<br>>4.38%  |           |          |
| A1. Keim and Madhavan (1997) Algorithm Transaction Cost Estimates                          |            |                     |                     |                      |                      |                      |           |          |
| 1 (Small)  | ≤0.82      | 1.092***<br>(38.71) | 1.016***<br>(45.26) | 1.018***<br>(47.85)  | 1.027***<br>(50.78)  | 1.033***<br>(54.81)  | 0.058***  | (3.92)   |
| 2  | 0.82–2.30  | 0.615***<br>(40.76) | 0.594***<br>(40.77) | 0.601***<br>(41.48)  | 0.597***<br>(43.64)  | 0.536***<br>(47.95)  | 0.079***  | (10.10)  |
| 3  | 2.30–6.35  | 0.387***<br>(27.93) | 0.385***<br>(29.15) | 0.391***<br>(30.45)  | 0.370***<br>(33.11)  | 0.313***<br>(35.81)  | 0.074***  | (8.45)   |
| 4  | 6.35–22.86 | 0.209***<br>(19.24) | 0.215***<br>(20.05) | 0.208***<br>(21.16)  | 0.178***<br>(22.25)  | 0.142***<br>(21.18)  | 0.066***  | (10.20)  |
| 5 (Big)  | >22.86     | -0.006<br>(-0.78)   | -0.007<br>(-1.13)   | -0.024***<br>(-4.19) | -0.039***<br>(-8.03) | -0.029***<br>(-5.84) | 0.023***  | (5.17)   |
| Diff: 1-5  |            | 1.097***<br>(46.13) | 1.023***<br>(54.95) | 1.042***<br>(59.49)  | 1.066***<br>(64.30)  | 1.062***<br>(70.10)  |           |          |
| A2. Equation (4) Algorithm Transaction Cost Estimates with Ticket and Fund Level Variables |            |                     |                     |                      |                      |                      |           |          |
| 1 (Small)  | ≤0.82      | 0.331***<br>(32.31) | 0.304***<br>(40.53) | 0.305***<br>(48.40)  | 0.321***<br>(55.77)  | 0.482***<br>(83.48)  | -0.151*** | (-17.66) |
| 2  | 0.82–2.30  | 0.224***<br>(42.78) | 0.217***<br>(43.75) | 0.218***<br>(51.24)  | 0.230***<br>(55.45)  | 0.336***<br>(66.91)  | -0.112*** | (-21.64) |
| 3  | 2.30–6.35  | 0.184***<br>(37.85) | 0.183***<br>(38.70) | 0.181***<br>(40.57)  | 0.188***<br>(47.14)  | 0.271***<br>(55.91)  | -0.087*** | (-21.15) |
| 4  | 6.35–22.86 | 0.147***<br>(37.46) | 0.144***<br>(38.25) | 0.143***<br>(41.27)  | 0.147***<br>(46.09)  | 0.207***<br>(49.15)  | -0.060*** | (-16.01) |
| 5 (Big)  | >22.86     | 0.082***<br>(23.44) | 0.081***<br>(26.89) | 0.084***<br>(28.24)  | 0.096***<br>(30.67)  | 0.145***<br>(30.21)  | -0.063*** | (-13.89) |
| Diff: 1-5  |            | 0.249***<br>(28.17) | 0.224***<br>(37.59) | 0.221***<br>(48.90)  | 0.225***<br>(52.09)  | 0.337***<br>(68.48)  |           |          |

Panel B: Fund Level Trading Costs by Fund Quintile

| Variables  | Mutual Fund Size Quintile |           |       |       |       | Diff:1-5 | t-stat.           |
|--|---------------------------|-----------|-------|-------|-------|----------|-------------------|
|  | All Funds                 | 1 (Small) | 2     | 3     | 4     |          |                   |
| B1. Keim and Madhavan (1997) Algorithm Transaction Cost Estimates      |                           |           |       |       |       |          |                   |
| Costs per Trade Dollar   | 0.298                     | 0.326     | 0.349 | 0.311 | 0.298 | 0.205    | 0.120*** (21.92)  |
| Costs Per TNA Dollar   | 0.653                     | 1.009     | 0.890 | 0.606 | 0.532 | 0.220    | 0.789*** (27.31)  |
| B2. Equation (4) Algorithm Transaction Cost Estimates                  |                           |           |       |       |       |          |                   |
| Costs per Trade Dollar, algorithm with only ticket level variables     | 0.222                     | 0.203     | 0.230 | 0.225 | 0.234 | 0.219    | -0.016*** (-5.90) |
| Costs per Trade Dollar, algorithm with ticket and fund level variables | 0.198                     | 0.199     | 0.215 | 0.201 | 0.206 | 0.169    | 0.030*** (10.21)  |
| Costs Per TNA Dollar, algorithm with only ticket level variables       | 0.510                     | 0.702     | 0.668 | 0.481 | 0.456 | 0.238    | 0.464*** (29.69)  |
| Costs Per TNA Dollar, algorithm with ticket and fund level variables   | 0.449                     | 0.619     | 0.587 | 0.433 | 0.409 | 0.195    | 0.424*** (29.55)  |

**Table VI: Trading Costs and Fund Performance**

Panel A reports Fama-MacBeth (1973) coefficients from monthly cross-sectional regressions of individual fund-level four-factor alphas on log(TNA), contemporaneous per TNA dollar implicit or total trading costs, other fund attributes, and dummies for fund investment styles. All variables (dependent and independent) are defined in Table I. All independent variables except trade cost are lagged by one month. Fama-MacBeth (1973) *t*-statistics (in parenthesis) are corrected following Newey-West (1987). Panel B reports the difference in contemporaneous monthly four-factor alpha between funds in the lowest trading cost quintile and funds in the highest trading cost quintile. Statistical significance of one, five, and ten percent are indicated by \*\*\*, \*\*, and \* respectively.

Panel A: Fama-MacBeth (1973) Cross-sectional Regressions

| VARIABLES           | Execution Shortfall  |                      | Open Price Cost      |                      | Prior-day Close Cost |                      |
|---------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
|                     | Implicit             | Total                | Implicit             | Total                | Implicit             | Total                |
| Trade cost          | -0.532***<br>(-3.06) | -0.401***<br>(-2.88) | -0.471***<br>(-3.73) | -0.407***<br>(-3.57) | -0.388***<br>(-5.31) | -0.354***<br>(-4.96) |
| Log(TNA)            | -0.008<br>(-0.48)    | -0.008<br>(-0.53)    | -0.006<br>(-0.39)    | -0.007<br>(-0.45)    | -0.007<br>(-0.42)    | -0.008<br>(-0.47)    |
| Lag fund return     | 0.009<br>(0.49)      | 0.009<br>(0.50)      | 0.009<br>(0.49)      | 0.009<br>(0.50)      | 0.010<br>(0.53)      | 0.010<br>(0.52)      |
| Expense ratio       | -0.042<br>(-1.03)    | -0.043<br>(-1.05)    | -0.053<br>(-1.32)    | -0.052<br>(-1.31)    | -0.054<br>(-1.35)    | -0.054<br>(-1.38)    |
| Fund turnover       | -0.001<br>(-0.03)    | -0.001<br>(-0.05)    | 0.009<br>(0.33)      | 0.010<br>(0.36)      | 0.008<br>(0.31)      | 0.010<br>(0.37)      |
| Fund flow           | -0.002<br>(-0.57)    | -0.003<br>(-0.57)    | -0.003<br>(-0.70)    | -0.003<br>(-0.70)    | -0.003<br>(-0.72)    | -0.003<br>(-0.73)    |
| Log(fund age)       | -0.020<br>(-0.81)    | -0.019<br>(-0.77)    | -0.026<br>(-1.06)    | -0.025<br>(-1.01)    | -0.023<br>(-0.90)    | -0.022<br>(-0.87)    |
| Log(family TNA)     | 0.016**<br>(2.35)    | 0.016**<br>(2.38)    | 0.015**<br>(2.14)    | 0.015**<br>(2.15)    | 0.016**<br>(2.24)    | 0.016**<br>(2.20)    |
| Constant            | -0.018<br>(-0.12)    | -0.015<br>(-0.11)    | 0.016<br>(0.12)      | 0.023<br>(0.16)      | -0.002<br>(-0.01)    | 0.007<br>(0.05)      |
| Style fixed effects | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  |
| Adj. R-squared      | 0.173                | 0.172                | 0.173                | 0.172                | 0.173                | 0.173                |
| Observations        | 28,704               | 28,704               | 29,078               | 29,078               | 29,045               | 29,045               |
| # of months         | 153                  | 153                  | 153                  | 153                  | 153                  | 153                  |

Panel B: Difference in Four-Factor Alpha between the Lowest and Highest Cost Quintile

| Cost Measure        | Trading Costs      |                    |
|---------------------|--------------------|--------------------|
|                     | Implicit           | Total              |
| Execution shortfall | 0.134**<br>(2.19)  | 0.142**<br>(2.11)  |
| Open price          | 0.215***<br>(3.04) | 0.190***<br>(2.79) |
| Prior-day close     | 0.279***<br>(4.16) | 0.295***<br>(4.47) |

**Table VII: Fund Flows and Holding Stock Market Capitalization**

Panel A presents summary statistics for the Thomson S12 sample. All variables reported in Panel A are defined in Table I. Panel B presents the distribution of stocks by firm size in the mutual fund quintile portfolios. Funds are sorted into quintiles based on their last month's TNA. Stock holdings are independently sorted into quintile portfolios based on their market capitalization (using NYSE breakpoints) from the previous quarter's holdings. Panel B reports the time-series average of the proportion of fund holdings in each firm size quintile. Note that the holdings of each fund quintile add up to one. The second to last column presents the difference in the fraction of holdings between the smallest and the largest fund size portfolios for a given firm size quintile. *t*-statistics in the last column are based on Newey-West corrected standard errors with twelve lags as the holdings are likely to be serially correlated. Panel C reports the Fama-MacBeth (1973) coefficient estimates from a regression of changes in the market capitalization of the fund-level holdings on cumulative fund flows and other fund-level control variables as shown in equations (7) and (8). PosFlow (NegFlow) is a dummy variable that takes a value of one for inflows (outflows) and is zero otherwise. The dependent variable, change in the market capitalization of the fund-level holdings, is computed over 3-, 6-, 12, or 24-month horizons (i.e., from quarter end *t* to quarter end *t*+1, *t*+2, *t*+4, or *t*+8) using equation (6), rolling by a quarter at a time, and we multiply it by 100 before including it in the regression. This measure is designed to capture only the changes in holding stock size caused by funds actively rebalancing their portfolios and takes a value of zero if a fund does not actively rebalance its portfolio holdings. Fund flows are computed as cumulative fund flows over the previous 3-month period (i.e., from quarter end *t*-1 to quarter end *t*) and exclude any increase in fund size due to capital gains or dividends. The other independent variables are defined in Table I. Fama-MacBeth (1973) *t*-statistics (in parenthesis) are corrected following Newey-West (1987). Statistical significance of one, five, and ten percent are indicated by \*\*\*, \*\*, and \* respectively.

Panel A: Summary Sample Statistics

| Variables               | All funds | Mutual fund size quintile |       |       |       |           | Diff:1-5  | <i>t</i> -stat. |
|-------------------------|-----------|---------------------------|-------|-------|-------|-----------|-----------|-----------------|
|                         |           | 1 (small)                 | 2     | 3     | 4     | 5 (large) |           |                 |
| Number of funds         | 764       | 153                       | 153   | 153   | 153   | 152       |           |                 |
| TNA (\$ million)        | 948       | 36                        | 99    | 233   | 578   | 3809      | -3,773*** | (-34.37)        |
| Stock size (\$ billion) | 22.24     | 20.71                     | 21.41 | 20.70 | 22.08 | 26.29     | -5.58***  | (-17.59)        |
| Amihud illiquidity      | 0.472     | 0.581                     | 0.495 | 0.497 | 0.423 | 0.363     | 0.218***  | (23.12)         |
| Expense ratio (%)       | 1.13      | 1.31                      | 1.22  | 1.15  | 1.05  | 0.91      | 0.40***   | (93.70)         |
| Turnover (%)            | 85.0      | 98.6                      | 96.4  | 88.8  | 77.2  | 64.4      | 34.2***   | (21.87)         |
| Fund flow (%)           | 0.853     | 1.948                     | 0.863 | 0.718 | 0.483 | 0.250     | 1.699***  | (20.94)         |

Panel B: Mutual Fund Holding Behavior across Stock Size

| Stock Market Cap Quintile | Mutual Fund Size Quintile |        |        |        |           | Difference:<br>1-5 | t-stat.  |
|---------------------------|---------------------------|--------|--------|--------|-----------|--------------------|----------|
|                           | 1 (Small)                 | 2      | 3      | 4      | 5 (Large) |                    |          |
| 1 (Small)                 | 0.0775                    | 0.0655 | 0.0571 | 0.0449 | 0.0180    | 0.0595***          | (16.03)  |
| 2                         | 0.1103                    | 0.1067 | 0.1101 | 0.0872 | 0.0413    | 0.0691***          | (19.56)  |
| 3                         | 0.1401                    | 0.1383 | 0.1488 | 0.1348 | 0.0798    | 0.0603***          | (15.45)  |
| 4                         | 0.1846                    | 0.1846 | 0.1954 | 0.2000 | 0.1708    | 0.0138**           | (2.41)   |
| 5 (Large)                 | 0.4874                    | 0.5050 | 0.4886 | 0.5331 | 0.6901    | -0.2027***         | (-19.02) |

Panel C: Fund Flows and Change in Fund Holding Stock Size

|                 | 3 Months             |                      | 6 Months             |                      | 12 Months            |                      | 24 Months           |                    |
|-----------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|---------------------|--------------------|
|                 | (1)                  | (2)                  | (3)                  | (4)                  | (5)                  | (6)                  | (7)                 | (8)                |
| Flow            | 0.047***<br>(2.83)   |                      | 0.082***<br>(4.39)   |                      | 0.169***<br>(5.26)   |                      | 0.295***<br>(4.74)  |                    |
| PosFlow* Flow   |                      | 0.046**<br>(2.18)    |                      | 0.081***<br>(4.62)   |                      | 0.159***<br>(3.75)   |                     | 0.258***<br>(3.75) |
| NegFlow * Flow  |                      | 0.092*<br>(1.75)     |                      | 0.082<br>(0.98)      |                      | 0.280**<br>(2.47)    |                     | 0.543***<br>(3.42) |
| Lag fund return | -0.117***<br>(-3.73) | -0.117***<br>(-3.68) | -0.090**<br>(-2.38)  | -0.087**<br>(-2.29)  | -0.075<br>(-1.13)    | -0.078<br>(-1.16)    | -0.027<br>(-0.26)   | -0.017<br>(-0.17)  |
| Expense ratio   | 0.659**<br>(2.24)    | 0.643**<br>(2.13)    | 1.090**<br>(2.28)    | 1.109**<br>(2.32)    | 2.248**<br>(2.56)    | 2.392***<br>(2.66)   | 4.353***<br>(3.50)  | 4.363***<br>(3.55) |
| Fund turnover   | -0.009***<br>(-3.73) | -0.009***<br>(-3.79) | -0.014***<br>(-3.24) | -0.014***<br>(-3.40) | -0.021***<br>(-3.28) | -0.021***<br>(-3.32) | -0.019**<br>(-2.00) | -0.018*<br>(-1.95) |
| Log(fund age)   | 0.143<br>(0.83)      | 0.174<br>(1.07)      | 0.154<br>(0.67)      | 0.113<br>(0.47)      | 0.021<br>(0.05)      | 0.010<br>(0.02)      | -0.589<br>(-1.08)   | -0.642<br>(-1.14)  |
| Log(family TNA) | 0.042<br>(0.92)      | 0.041<br>(0.89)      | 0.005<br>(0.07)      | 0.015<br>(0.22)      | 0.004<br>(0.03)      | 0.017<br>(0.14)      | -0.056<br>(-0.36)   | -0.049<br>(-0.32)  |
| Constant        | -0.932<br>(-1.31)    | -0.886<br>(-1.31)    | -1.175<br>(-1.28)    | -1.073<br>(-1.16)    | -1.534<br>(-1.04)    | -1.403<br>(-0.93)    | 1.001<br>(0.47)     | 1.589<br>(0.73)    |
| Observations    | 76,759               | 76,759               | 75,188               | 75,188               | 72,033               | 72,033               | 65,794              | 65,794             |
| Adj. R-squared  | 0.027                | 0.031                | 0.026                | 0.029                | 0.028                | 0.032                | 0.030               | 0.033              |
| # of Quarters   | 127                  | 127                  | 126                  | 126                  | 124                  | 124                  | 120                 | 120                |

## **Internet Appendix for**

## **“Mutual Fund Trading Costs”**

This Internet Appendix tabulates additional results for some of the empirical tests that are mentioned in the paper.

**Table IA.I: Determinants of Ticket Level Transaction Costs**

Panel A reports the annual equal-weighted average of trading cost measures at the ticket level. Based on three alternative price benchmarks (execution shortfall, open price cost, and prior close cost), the average total trading cost (i.e., implicit cost + commissions + taxes and fees) are reported for all tickets, buys, and sells separately. In Panel A, we also report the equal-weighted average across all tickets during the financial crisis period from September 2008 to March 2009. Panels B and C report Fama-MacBeth (1973) coefficient estimates from the regression of mutual fund total transaction costs (in percentage point) at the ticket level on trade and fund level variables as shown in equation (4). Results in Panels B1 and C1 are based on utilizing investment style dummy variables in (4); results in Panels B2 and C2 are based on estimating (4) separately for each investment style. Ticket Size is the share volume of a ticket normalized by dividing by the average daily trading volume of the previous month (in decimal number). Price inverse is defined as one over the closing price of the trading day prior to the order placement date (in decimal number). Log(mktcap) is the logarithm of market capitalization (in \$ million) of the traded stock at the previous month-end. Nasdaq is a dummy variable for stocks listed on Nasdaq stock exchange. Idiosyncratic volatility of a stock is the standard deviation of daily idiosyncratic returns of the month (in percentage point) based on the CAPM model. Return on value-weighted market portfolio is also in percentage point. All fund level independent variables are defined in Table I and lagged by one month with the same units except family TNA is in \$ million. We first estimate cross-sectional regressions each month and then report the time-series average of the monthly coefficients. Fama-MacBeth (1973) *t*-statistics (in parenthesis) are corrected following Newey-West (1987). All trading cost measures are in percentage point. Statistical significance of one, five, and ten percent are indicated by \*\*\*, \*\*, and \* respectively.

Panel A: Ticket Level Total Transaction Costs by Year

|               | All       |       |       |           | Buys      |       |       |           | Sells     |       |       |           |
|---------------|-----------|-------|-------|-----------|-----------|-------|-------|-----------|-----------|-------|-------|-----------|
|               | Tickets   | Ex SF | Open  | Pr. Close | Tickets   | Ex SF | Open  | Pr. Close | Tickets   | Ex SF | Open  | Pr. Close |
| 1999          | 408,585   | 0.278 | 0.360 | 0.422     | 205,279   | 0.202 | 0.207 | 0.435     | 203,306   | 0.356 | 0.515 | 0.408     |
| 2000          | 592,105   | 0.219 | 0.336 | 0.380     | 315,907   | 0.134 | 0.139 | 0.257     | 276,198   | 0.317 | 0.562 | 0.525     |
| 2001          | 585,018   | 0.248 | 0.305 | 0.331     | 325,943   | 0.222 | 0.214 | 0.157     | 259,075   | 0.281 | 0.420 | 0.551     |
| 2002          | 545,519   | 0.316 | 0.377 | 0.433     | 294,168   | 0.237 | 0.201 | 0.195     | 251,351   | 0.408 | 0.584 | 0.713     |
| 2003          | 627,080   | 0.308 | 0.350 | 0.387     | 350,952   | 0.310 | 0.337 | 0.399     | 276,128   | 0.305 | 0.367 | 0.373     |
| 2004          | 688,276   | 0.267 | 0.280 | 0.300     | 387,672   | 0.244 | 0.225 | 0.253     | 300,599   | 0.297 | 0.351 | 0.361     |
| 2005          | 827,614   | 0.239 | 0.250 | 0.259     | 436,709   | 0.212 | 0.195 | 0.243     | 390,905   | 0.268 | 0.313 | 0.277     |
| 2006          | 950,906   | 0.192 | 0.223 | 0.239     | 517,323   | 0.173 | 0.174 | 0.194     | 433,583   | 0.214 | 0.281 | 0.293     |
| 2007          | 1,033,545 | 0.195 | 0.179 | 0.154     | 562,291   | 0.157 | 0.101 | 0.093     | 471,254   | 0.239 | 0.272 | 0.227     |
| 2008          | 1,090,401 | 0.279 | 0.287 | 0.348     | 558,824   | 0.198 | 0.098 | 0.046     | 531,577   | 0.365 | 0.485 | 0.665     |
| 2009          | 1,085,285 | 0.235 | 0.368 | 0.383     | 556,389   | 0.236 | 0.411 | 0.456     | 528,896   | 0.233 | 0.323 | 0.307     |
| 2010          | 618,670   | 0.111 | 0.207 | 0.153     | 312,245   | 0.102 | 0.207 | 0.128     | 306,425   | 0.120 | 0.207 | 0.178     |
| 2011          | 166,191   | 0.156 | 0.131 | 0.054     | 86,653    | 0.142 | 0.097 | -0.001    | 795,38    | 0.172 | 0.168 | 0.115     |
| 2008m9-2009m3 | 762,746   | 0.338 | 0.425 | 0.501     | 391,932   | 0.226 | 0.153 | 0.164     | 370,814   | 0.453 | 0.711 | 0.860     |
| All           | 9,219,195 | 0.236 | 0.283 | 0.301     | 4,910,355 | 0.201 | 0.205 | 0.223     | 4,308,835 | 0.275 | 0.371 | 0.390     |



Panel B: Determinants of Ticket Level Total Transaction Costs – Open Price Cost

B1: Investment Style Dummy Variables

| VARIABLES        | Implicit             |                      |                       | Total                |                      |                       |
|------------------|----------------------|----------------------|-----------------------|----------------------|----------------------|-----------------------|
|                  | All<br>(1)           | Buy<br>(2)           | Sell<br>(3)           | All<br>(4)           | Buy<br>(5)           | Sell<br>(6)           |
| Ticket size      | 0.624***<br>(7.13)   | 0.420***<br>(4.85)   | 0.807***<br>(6.77)    | 0.841***<br>(9.12)   | 0.623***<br>(6.91)   | 1.034***<br>(8.33)    |
| Price inverse    | 0.967***<br>(4.29)   | 0.449**<br>(2.17)    | 1.041***<br>(4.09)    | 2.880***<br>(13.31)  | 2.335***<br>(11.40)  | 2.981***<br>(12.54)   |
| Log(mktcap)      | -0.000<br>(-0.08)    | -0.023***<br>(-5.29) | 0.026***<br>(4.65)    | -0.002<br>(-0.46)    | -0.026***<br>(-5.68) | 0.026***<br>(4.61)    |
| Nasdaq           | 0.023**<br>(2.55)    | 0.032***<br>(2.79)   | 0.010<br>(0.45)       | -0.012*<br>(-1.70)   | -0.000<br>(-0.02)    | -0.027<br>(-1.47)     |
| IVOL             | 0.032***<br>(3.59)   | -0.018*<br>(-1.87)   | 0.097***<br>(7.18)    | 0.036***<br>(4.20)   | -0.014<br>(-1.49)    | 0.102***<br>(7.63)    |
| Side*market      | 0.437***<br>(25.98)  | 0.439***<br>(26.94)  | -0.432***<br>(-25.80) | 0.437***<br>(25.93)  | 0.439***<br>(26.91)  | -0.432***<br>(-25.70) |
| Log(TNA)         | 0.028***<br>(4.67)   | 0.028***<br>(4.22)   | 0.027***<br>(4.69)    | 0.028***<br>(4.67)   | 0.028***<br>(4.33)   | 0.026***<br>(4.52)    |
| Expense ratio    | 0.060***<br>(3.49)   | 0.070***<br>(3.51)   | 0.034*<br>(1.93)      | 0.073***<br>(4.29)   | 0.083***<br>(4.22)   | 0.048**<br>(2.60)     |
| Fund turnover    | 0.084***<br>(10.74)  | 0.089***<br>(8.76)   | 0.071***<br>(8.66)    | 0.078***<br>(9.83)   | 0.086***<br>(8.38)   | 0.061***<br>(7.65)    |
| Fund flow        | -0.002**<br>(-2.61)  | -0.002*<br>(-1.78)   | 0.001<br>(0.79)       | -0.002***<br>(-2.74) | -0.002*<br>(-1.95)   | 0.001<br>(0.64)       |
| Log(fund age)    | -0.017***<br>(-2.78) | -0.011*<br>(-1.76)   | -0.032***<br>(-3.39)  | -0.016**<br>(-2.46)  | -0.008<br>(-1.20)    | -0.032***<br>(-3.38)  |
| Log(family TNA)  | 0.004<br>(0.90)      | 0.006<br>(1.37)      | 0.002<br>(0.54)       | -0.005<br>(-1.20)    | -0.002<br>(-0.55)    | -0.008*<br>(-1.77)    |
| Lag fund return  | -0.004<br>(-1.21)    | -0.000<br>(-0.11)    | -0.005<br>(-1.59)     | -0.004<br>(-1.27)    | -0.001<br>(-0.20)    | -0.005<br>(-1.54)     |
| Large-cap growth | -0.039*<br>(-1.81)   | -0.032<br>(-1.34)    | -0.050**<br>(-2.20)   | -0.037*<br>(-1.78)   | -0.030<br>(-1.30)    | -0.048**<br>(-2.17)   |
| Large-cap value  | -0.054***<br>(-2.76) | -0.039*<br>(-1.79)   | -0.073***<br>(-3.48)  | -0.061***<br>(-3.10) | -0.042*<br>(-1.89)   | -0.082***<br>(-3.99)  |
| Mid-cap blend    | -0.109***<br>(-3.00) | -0.093**<br>(-2.34)  | -0.104***<br>(-2.62)  | -0.129***<br>(-3.80) | -0.109***<br>(-2.84) | -0.128***<br>(-3.38)  |
| Mid-cap growth   | -0.027<br>(-1.15)    | -0.050*<br>(-1.85)   | 0.002<br>(0.05)       | -0.028<br>(-1.19)    | -0.046*<br>(-1.70)   | -0.004<br>(-0.14)     |
| Mid-cap value    | -0.062***<br>(-2.87) | -0.052**<br>(-2.13)  | -0.069***<br>(-2.63)  | -0.065***<br>(-2.98) | -0.048*<br>(-1.92)   | -0.080***<br>(-3.07)  |
| Small-cap blend  | -0.029<br>(-1.07)    | -0.039<br>(-1.20)    | -0.010<br>(-0.37)     | -0.054*<br>(-1.96)   | -0.063**<br>(-1.99)  | -0.033<br>(-1.12)     |
| Small-cap growth | -0.113***<br>(-4.09) | -0.112***<br>(-3.01) | -0.094***<br>(-3.52)  | -0.125***<br>(-4.62) | -0.122***<br>(-3.35) | -0.108***<br>(-4.02)  |
| Small-cap value  | -0.210***<br>(-5.67) | -0.191***<br>(-4.19) | -0.218***<br>(-5.62)  | -0.232***<br>(-5.89) | -0.208***<br>(-4.38) | -0.247***<br>(-5.93)  |
| Constant         | -0.252***<br>(-2.66) | -0.071<br>(-0.77)    | -0.436***<br>(-3.97)  | -0.120<br>(-1.26)    | 0.051<br>(0.55)      | -0.291**<br>(-2.59)   |
| Adj. R-squared   | 0.065                | 0.070                | 0.069                 | 0.071                | 0.074                | 0.077                 |
| Observations     | 8,743,159            | 4,618,412            | 4,124,747             | 8,743,159            | 4,618,412            | 4,124,747             |
| # of months      | 153                  | 153                  | 153                   | 153                  | 153                  | 153                   |

B2: Analysis by Investment Style

| VARIABLES       | Large Cap            |                      |                      | Mid Cap              |                     |                      | Small Cap           |                      |                      |
|-----------------|----------------------|----------------------|----------------------|----------------------|---------------------|----------------------|---------------------|----------------------|----------------------|
|                 | Growth               | Blend                | Value                | Growth               | Blend               | Value                | Growth              | Blend                | Value                |
| Ticket size     | 0.616***<br>(2.98)   | 0.870***<br>(5.71)   | 0.398**<br>(2.38)    | 0.419***<br>(3.51)   | 0.846***<br>(4.73)  | 0.813***<br>(4.01)   | 1.246***<br>(7.51)  | 0.625***<br>(4.63)   | 1.298***<br>(8.25)   |
| Price inverse   | 2.939***<br>(10.82)  | 2.475***<br>(9.08)   | 3.391***<br>(9.68)   | 3.172***<br>(13.83)  | 3.580***<br>(9.78)  | 3.634***<br>(10.13)  | 3.009***<br>(15.53) | 2.770***<br>(9.73)   | 2.938***<br>(9.22)   |
| Log(mktcap)     | -0.020***<br>(-5.01) | 0.011**<br>(2.02)    | -0.001<br>(-0.42)    | 0.007<br>(0.88)      | -0.021**<br>(-2.46) | -0.021**<br>(-2.13)  | -0.020<br>(-1.62)   | -0.044***<br>(-3.31) | -0.032***<br>(-2.66) |
| Nasdaq          | -0.022<br>(-1.65)    | 0.005<br>(0.30)      | -0.041**<br>(-2.36)  | -0.056***<br>(-3.72) | -0.013<br>(-0.55)   | -0.003<br>(-0.19)    | -0.022<br>(-1.52)   | -0.044*<br>(-1.92)   | -0.013<br>(-0.80)    |
| IVOL            | 0.026**<br>(2.59)    | 0.046***<br>(3.12)   | -0.001<br>(-0.07)    | 0.036***<br>(3.41)   | -0.011<br>(-1.04)   | -0.017<br>(-1.25)    | 0.012<br>(1.49)     | 0.007<br>(0.56)      | 0.059***<br>(2.94)   |
| Side*market     | 0.461***<br>(24.87)  | 0.433***<br>(26.81)  | 0.352***<br>(23.99)  | 0.478***<br>(19.48)  | 0.454***<br>(21.71) | 0.367***<br>(18.91)  | 0.454***<br>(21.22) | 0.437***<br>(18.91)  | 0.378***<br>(19.60)  |
| Log(TNA)        | 0.048***<br>(5.67)   | -0.049***<br>(-3.70) | 0.034***<br>(3.99)   | 0.031<br>(1.17)      | 0.081<br>(1.50)     | -0.009<br>(-0.61)    | -0.091**<br>(-2.17) | -0.049<br>(-1.25)    | 0.030<br>(0.38)      |
| Expense ratio   | 0.139***<br>(3.99)   | -0.033<br>(-0.83)    | 0.233***<br>(4.98)   | -0.165<br>(-1.59)    | 0.098<br>(0.58)     | -0.206***<br>(-3.00) | -0.138<br>(-0.84)   | 0.022<br>(0.40)      | 0.894<br>(1.41)      |
| Fund turnover   | 0.077***<br>(4.11)   | 0.080***<br>(3.41)   | 0.202***<br>(5.62)   | 0.103<br>(1.53)      | 0.195**<br>(2.02)   | 0.010<br>(0.21)      | -0.079<br>(-1.11)   | 0.221***<br>(3.46)   | -0.192<br>(-0.89)    |
| Fund flow       | 0.005<br>(1.20)      | -0.017***<br>(-3.94) | 0.003<br>(0.81)      | -0.004<br>(-0.72)    | -0.067<br>(-1.00)   | 0.011<br>(1.38)      | -0.001<br>(-0.06)   | -0.042**<br>(-2.43)  | 0.048<br>(1.53)      |
| Log(fund age)   | -0.001<br>(-0.03)    | 0.107***<br>(5.80)   | 0.081***<br>(4.41)   | -0.161***<br>(-3.36) | -0.053<br>(-0.55)   | -0.067<br>(-1.60)    | 0.021<br>(0.20)     | 0.046<br>(0.90)      | -0.047<br>(-0.45)    |
| Log(family TNA) | -0.049***<br>(-6.23) | -0.000<br>(-0.03)    | 0.015**<br>(2.27)    | -0.023*<br>(-1.88)   | 0.330<br>(0.75)     | 0.016<br>(1.51)      | -0.016<br>(-0.57)   | 0.021<br>(0.84)      | 0.061**<br>(2.07)    |
| Lag fund return | -0.008*<br>(-1.82)   | -0.004<br>(-0.43)    | 0.006<br>(0.78)      | -0.004<br>(-0.56)    | -0.042<br>(-1.32)   | 0.028<br>(0.98)      | 0.016<br>(0.54)     | 0.028<br>(0.98)      | 0.017<br>(0.24)      |
| Constant        | 0.412***<br>(2.73)   | -0.012<br>(-0.05)    | -0.870***<br>(-5.59) | 0.642*<br>(1.81)     | -5.115<br>(-0.84)   | 0.351<br>(1.60)      | 1.193***<br>(2.76)  | -0.026<br>(-0.08)    | -1.486<br>(-1.07)    |
| Adj. R-squared  | 0.081                | 0.085                | 0.089                | 0.085                | 0.099               | 0.084                | 0.075               | 0.088                | 0.091                |
| Observations    | 2,081,997            | 1,290,411            | 1,008,382            | 847,653              | 441,707             | 371,982              | 856,849             | 559,439              | 1,284,739            |
| # of months     | 153                  | 153                  | 153                  | 153                  | 153                 | 153                  | 153                 | 153                  | 153                  |

Panel C: Determinants of Ticket Level Total Transaction Costs – Prior-Day Close Cost

C1: Investment Style Dummy Variables

| VARIABLES        | Implicit             |                      |                       | Total                |                      |                       |
|------------------|----------------------|----------------------|-----------------------|----------------------|----------------------|-----------------------|
|                  | All<br>(1)           | Buy<br>(2)           | Sell<br>(3)           | All<br>(4)           | Buy<br>(5)           | Sell<br>(6)           |
| Ticket size      | 0.795***<br>(8.88)   | 0.242**<br>(2.45)    | 1.303***<br>(9.63)    | 1.010***<br>(10.80)  | 0.442***<br>(4.38)   | 1.528***<br>(10.83)   |
| Price inverse    | 0.643***<br>(3.39)   | 1.243***<br>(4.51)   | 0.059<br>(0.26)       | 2.582***<br>(14.40)  | 3.132***<br>(11.54)  | 2.038***<br>(9.55)    |
| Log(mktcap)      | 0.023***<br>(5.25)   | -0.004<br>(-0.65)    | 0.053***<br>(7.10)    | 0.022***<br>(4.73)   | -0.007<br>(-1.01)    | 0.053***<br>(7.08)    |
| Nasdaq           | 0.001<br>(0.09)      | -0.004<br>(-0.25)    | 0.007<br>(0.36)       | -0.034***<br>(-2.97) | -0.037**<br>(-2.07)  | -0.029<br>(-1.40)     |
| IVOL             | 0.057***<br>(4.57)   | 0.035**<br>(2.39)    | 0.088***<br>(4.69)    | 0.061***<br>(5.01)   | 0.038***<br>(2.67)   | 0.093***<br>(5.00)    |
| Side*market      | 0.712***<br>(40.95)  | 0.712***<br>(41.65)  | -0.705***<br>(-37.55) | 0.712***<br>(41.02)  | 0.712***<br>(41.65)  | -0.706***<br>(-37.65) |
| Log(TNA)         | 0.039***<br>(4.58)   | 0.040***<br>(4.84)   | 0.042***<br>(4.66)    | 0.039***<br>(4.61)   | 0.041***<br>(4.98)   | 0.041***<br>(4.56)    |
| Expense ratio    | 0.099***<br>(4.18)   | 0.113***<br>(4.45)   | 0.077***<br>(2.86)    | 0.112***<br>(4.82)   | 0.125***<br>(5.16)   | 0.090***<br>(3.29)    |
| Fund turnover    | 0.110***<br>(8.84)   | 0.122***<br>(8.80)   | 0.093***<br>(7.44)    | 0.104***<br>(8.30)   | 0.119***<br>(8.52)   | 0.084***<br>(6.72)    |
| Fund flow        | -0.003**<br>(-2.56)  | -0.003**<br>(-2.50)  | 0.001<br>(0.67)       | -0.003***<br>(-2.64) | -0.003**<br>(-2.61)  | 0.001<br>(0.55)       |
| Log(fund age)    | -0.020**<br>(-2.02)  | -0.006<br>(-0.66)    | -0.046***<br>(-3.03)  | -0.019*<br>(-1.84)   | -0.003<br>(-0.30)    | -0.046***<br>(-3.03)  |
| Log(family TNA)  | 0.009<br>(1.48)      | 0.013*<br>(1.94)     | 0.006<br>(1.01)       | -0.000<br>(-0.04)    | 0.004<br>(0.61)      | -0.004<br>(-0.68)     |
| Lag fund return  | -0.003<br>(-0.70)    | -0.001<br>(-0.26)    | -0.004<br>(-0.89)     | -0.003<br>(-0.74)    | -0.002<br>(-0.33)    | -0.004<br>(-0.84)     |
| Large-cap growth | -0.109***<br>(-3.35) | -0.083***<br>(-2.64) | -0.141***<br>(-4.02)  | -0.107***<br>(-3.33) | -0.082***<br>(-2.63) | -0.137***<br>(-4.00)  |
| Large-cap value  | -0.137***<br>(-5.01) | -0.094***<br>(-3.19) | -0.188***<br>(-6.12)  | -0.143***<br>(-5.24) | -0.096***<br>(-3.27) | -0.198***<br>(-6.47)  |
| Mid-cap blend    | -0.214***<br>(-4.16) | -0.170***<br>(-3.19) | -0.259***<br>(-4.71)  | -0.234***<br>(-4.77) | -0.186***<br>(-3.61) | -0.281***<br>(-5.37)  |
| Mid-cap growth   | -0.074**<br>(-2.09)  | -0.093***<br>(-2.70) | -0.063<br>(-1.55)     | -0.075**<br>(-2.13)  | -0.089**<br>(-2.58)  | -0.068*<br>(-1.72)    |
| Mid-cap value    | -0.134***<br>(-4.26) | -0.101***<br>(-3.00) | -0.163***<br>(-4.49)  | -0.138***<br>(-4.33) | -0.098***<br>(-2.87) | -0.175***<br>(-4.84)  |
| Small-cap blend  | -0.079**<br>(-2.28)  | -0.073*<br>(-1.92)   | -0.097***<br>(-2.67)  | -0.105***<br>(-3.02) | -0.098***<br>(-2.63) | -0.121***<br>(-3.17)  |
| Small-cap growth | -0.156***<br>(-4.36) | -0.160***<br>(-3.73) | -0.144***<br>(-3.57)  | -0.168***<br>(-4.71) | -0.170***<br>(-4.02) | -0.158***<br>(-3.90)  |
| Small-cap value  | -0.297***<br>(-5.72) | -0.257***<br>(-4.94) | -0.337***<br>(-5.76)  | -0.320***<br>(-5.88) | -0.274***<br>(-5.10) | -0.367***<br>(-5.92)  |
| Constant         | -0.608***<br>(-4.48) | -0.561***<br>(-3.37) | -0.680***<br>(-5.22)  | -0.476***<br>(-3.48) | -0.439***<br>(-2.66) | -0.535***<br>(-3.99)  |
| Adj. R-squared   | 0.110                | 0.117                | 0.109                 | 0.113                | 0.121                | 0.111                 |
| Observations     | 8,743,184            | 4,618,417            | 4,124,767             | 8,743,184            | 4,618,417            | 4,124,767             |
| # of months      | 153                  | 153                  | 153                   | 153                  | 153                  | 153                   |

C2: Analysis by Investment Style

| VARIABLES       | Large Cap            |                      |                      | Mid Cap              |                     |                      | Small Cap            |                      |                     |
|-----------------|----------------------|----------------------|----------------------|----------------------|---------------------|----------------------|----------------------|----------------------|---------------------|
|                 | Growth               | Blend                | Value                | Growth               | Blend               | Value                | Growth               | Blend                | Value               |
| Ticket size     | 1.132***<br>(5.11)   | 1.077***<br>(5.08)   | -0.002<br>(-0.01)    | 0.586***<br>(3.84)   | 0.587***<br>(2.63)  | 0.335<br>(1.03)      | 1.525***<br>(8.10)   | 0.724***<br>(4.02)   | 1.250***<br>(6.14)  |
| Price inverse   | 2.521***<br>(10.66)  | 2.428***<br>(8.51)   | 3.441***<br>(9.70)   | 2.844***<br>(13.59)  | 3.750***<br>(8.66)  | 3.930***<br>(8.61)   | 2.644***<br>(14.64)  | 2.629***<br>(9.74)   | 2.793***<br>(7.87)  |
| Log(mktcap)     | 0.007<br>(1.23)      | 0.066***<br>(8.00)   | 0.001<br>(0.22)      | 0.034***<br>(2.97)   | -0.026**<br>(-2.18) | -0.022<br>(-1.50)    | -0.014<br>(-1.09)    | -0.030*<br>(-1.79)   | -0.032**<br>(-2.08) |
| Nasdaq          | -0.044**<br>(-2.27)  | -0.003<br>(-0.15)    | -0.073***<br>(-3.54) | -0.101***<br>(-4.31) | -0.039<br>(-1.24)   | -0.044**<br>(-2.20)  | -0.059***<br>(-2.64) | -0.079***<br>(-2.74) | -0.027<br>(-1.32)   |
| IVOL            | 0.048***<br>(3.25)   | 0.100***<br>(4.50)   | -0.006<br>(-0.35)    | 0.060***<br>(4.38)   | -0.018<br>(-1.33)   | -0.033<br>(-1.40)    | 0.021**<br>(2.16)    | 0.010<br>(0.68)      | 0.085***<br>(2.89)  |
| Side*market     | 0.777***<br>(37.59)  | 0.723***<br>(42.09)  | 0.601***<br>(30.21)  | 0.757***<br>(32.66)  | 0.726***<br>(27.00) | 0.608***<br>(20.93)  | 0.702***<br>(29.43)  | 0.667***<br>(23.25)  | 0.592***<br>(20.65) |
| Log(TNA)        | 0.061***<br>(5.13)   | -0.073***<br>(-3.37) | 0.053***<br>(5.16)   | 0.019<br>(0.57)      | -0.010<br>(-0.11)   | -0.009<br>(-0.40)    | -0.125*<br>(-1.90)   | -0.095*<br>(-1.86)   | 0.143<br>(1.14)     |
| Expense ratio   | 0.221***<br>(4.85)   | -0.014<br>(-0.28)    | 0.332***<br>(5.69)   | -0.260**<br>(-1.98)  | -0.625<br>(-1.19)   | -0.267***<br>(-3.12) | -0.129<br>(-0.46)    | 0.024<br>(0.33)      | 1.367<br>(1.56)     |
| Fund turnover   | 0.090***<br>(2.99)   | 0.119***<br>(3.89)   | 0.310***<br>(6.23)   | 0.158*<br>(1.89)     | 0.324*<br>(1.96)    | 0.049<br>(1.15)      | -0.095<br>(-0.87)    | 0.256***<br>(3.45)   | -0.173<br>(-0.76)   |
| Fund flow       | 0.008<br>(1.42)      | -0.026***<br>(-3.84) | 0.006<br>(0.85)      | -0.007<br>(-1.33)    | -0.138<br>(-1.19)   | 0.007<br>(0.68)      | -0.000<br>(-0.01)    | -0.045**<br>(-2.18)  | 0.046<br>(1.21)     |
| Log(fund age)   | -0.007<br>(-0.24)    | 0.186***<br>(5.90)   | 0.081***<br>(3.20)   | -0.231***<br>(-3.79) | 0.046<br>(0.33)     | -0.082<br>(-1.63)    | 0.110<br>(0.62)      | 0.063<br>(1.01)      | -0.045<br>(-0.22)   |
| Log(family TNA) | -0.052***<br>(-4.98) | 0.029*<br>(1.69)     | 0.037***<br>(3.76)   | -0.036**<br>(-2.34)  | 0.607<br>(0.75)     | 0.025<br>(1.58)      | -0.034<br>(-0.83)    | 0.026<br>(1.00)      | 0.089***<br>(2.80)  |
| Lag fund return | -0.005<br>(-0.79)    | -0.007<br>(-0.63)    | -0.000<br>(-0.05)    | -0.008<br>(-0.95)    | 0.003<br>(0.05)     | 0.024<br>(0.90)      | 0.011<br>(0.23)      | 0.029<br>(0.87)      | 0.033<br>(0.41)     |
| Constant        | 0.043<br>(0.19)      | -1.035***<br>(-2.81) | -1.439***<br>(-7.01) | 0.834*<br>(1.84)     | -8.149<br>(-0.72)   | 0.351<br>(1.25)      | 1.636**<br>(2.22)    | -0.042<br>(-0.10)    | -3.040*<br>(-1.66)  |
| Adj. R-squared  | 0.128                | 0.136                | 0.140                | 0.123                | 0.143               | 0.126                | 0.110                | 0.123                | 0.120               |
| Observations    | 2,082,002            | 1,290,414            | 1,008,398            | 847,653              | 441,707             | 371,982              | 856,849              | 559,439              | 1,284,740           |
| # of months     | 153                  | 153                  | 153                  | 153                  | 153                 | 153                  | 153                  | 153                  | 153                 |

**Table IA.II: Determinants of Fund Level Trading Costs**

Based on three alternative price benchmarks (execution shortfall, open price cost, and prior close cost), Panel A reports the number of observations and summary statistics for total trading cost (i.e., implicit cost + commissions + taxes and fees) per trade dollar or per TNA dollar each year. Panels B, C, D, and E report the Fama-MacBeth (1973) coefficient estimates from monthly cross-sectional regressions of the total trading cost measures (in percentage point) on fund attributes. The dependent variables are total transaction cost (open price cost or prior close cost) per trade dollar (in Panels B and C) and total transaction cost (open price cost or prior close cost) per TNA Dollar (in Panels C, D, and E). Results in Panels B1, C1, D1, and E1 are based on utilizing investment style dummy variables in (4); results in Panels B2, C2, D2, and E2 are based on estimating (4) separately for each investment style. Fund attributes (independent variables) are defined in Table I and lagged by one month with the same unit except family TNA is in \$ million. Fama-MacBeth (1973) *t*-statistics (in parenthesis) are corrected following Newey-West (1987). All trading cost measures are in percentage point. Statistical significance of one, five, and ten percent are indicated by \*\*\*, \*\*, and \* respectively.

Panel A: Fund Level Trading Costs by Year

|      | # Obs. | Per Trade Dollar |       |           | Per TNA Dollar |       |           |
|------|--------|------------------|-------|-----------|----------------|-------|-----------|
|      |        | Ex SF            | Open  | Pr. Close | Ex SF          | Open  | Pr. Close |
| 1999 | 1,443  | 0.267            | 0.312 | 0.396     | 0.063          | 0.077 | 0.101     |
| 2000 | 1,665  | 0.241            | 0.299 | 0.348     | 0.072          | 0.088 | 0.107     |
| 2001 | 2,053  | 0.252            | 0.268 | 0.312     | 0.069          | 0.082 | 0.102     |
| 2002 | 2,388  | 0.331            | 0.333 | 0.389     | 0.075          | 0.085 | 0.105     |
| 2003 | 2,711  | 0.323            | 0.323 | 0.346     | 0.064          | 0.068 | 0.078     |
| 2004 | 2,563  | 0.285            | 0.288 | 0.287     | 0.056          | 0.056 | 0.060     |
| 2005 | 2,941  | 0.251            | 0.267 | 0.261     | 0.058          | 0.063 | 0.069     |
| 2006 | 2,977  | 0.221            | 0.254 | 0.246     | 0.055          | 0.069 | 0.081     |
| 2007 | 2,799  | 0.210            | 0.230 | 0.166     | 0.051          | 0.059 | 0.059     |
| 2008 | 2,853  | 0.302            | 0.360 | 0.410     | 0.088          | 0.106 | 0.137     |
| 2009 | 2,858  | 0.282            | 0.355 | 0.300     | 0.072          | 0.101 | 0.104     |
| 2010 | 1,990  | 0.224            | 0.242 | 0.133     | 0.045          | 0.052 | 0.040     |
| 2011 | 997    | 0.168            | 0.155 | -0.020    | 0.038          | 0.051 | 0.050     |
| All  | 30,238 | 0.264            | 0.290 | 0.285     | 0.063          | 0.075 | 0.085     |

Panel B: Open Price Cost per Trade Dollar (%)

B1: Investment Style Dummy Variables

| VARIABLES        | Implicit Trading Costs |                      |                      | Total Trading Costs  |                      |                      |
|------------------|------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
|                  | (1)                    | (2)                  | (3)                  | (4)                  | (5)                  | (6)                  |
| Log(TNA)         | -0.021***<br>(-4.71)   | -0.004<br>(-0.84)    | -0.003<br>(-0.83)    | -0.024***<br>(-5.41) | -0.004<br>(-0.84)    | -0.003<br>(-0.90)    |
| Lag trade cost   |                        |                      | 0.420***<br>(28.66)  |                      |                      | 0.415***<br>(27.76)  |
| Expense ratio    |                        | -0.011<br>(-0.65)    | -0.003<br>(-0.26)    |                      | 0.000<br>(0.02)      | 0.004<br>(0.42)      |
| Fund turnover    |                        | 0.158***<br>(17.96)  | 0.094***<br>(14.78)  |                      | 0.154***<br>(18.07)  | 0.093***<br>(15.05)  |
| Fund flow        |                        | -0.002**<br>(-2.54)  | -0.002*<br>(-1.83)   |                      | -0.002**<br>(-2.45)  | -0.002*<br>(-1.86)   |
| Log(fund age)    |                        | 0.010<br>(1.32)      | 0.007<br>(1.30)      |                      | 0.016**<br>(2.37)    | 0.011**<br>(2.31)    |
| Log(family TNA)  |                        | -0.017***<br>(-3.67) | -0.011***<br>(-3.50) |                      | -0.025***<br>(-5.09) | -0.015***<br>(-4.81) |
| Lag fund return  |                        | -0.002<br>(-0.72)    | 0.001<br>(0.42)      |                      | -0.003<br>(-0.83)    | 0.001<br>(0.27)      |
| Large-cap growth | -0.025<br>(-1.09)      | -0.065**<br>(-2.41)  | -0.033**<br>(-2.04)  | -0.022<br>(-0.92)    | -0.066**<br>(-2.44)  | -0.035**<br>(-2.19)  |
| Large-cap value  | -0.173***<br>(-7.26)   | -0.115***<br>(-5.14) | -0.055***<br>(-3.98) | -0.167***<br>(-7.24) | -0.113***<br>(-5.19) | -0.056***<br>(-4.04) |
| Mid-cap blend    | -0.190***<br>(-5.23)   | -0.169***<br>(-4.48) | -0.098***<br>(-3.84) | -0.166***<br>(-4.51) | -0.147***<br>(-3.87) | -0.088***<br>(-3.41) |
| Mid-cap growth   | -0.004<br>(-0.12)      | -0.046<br>(-1.21)    | -0.026<br>(-1.15)    | 0.017<br>(0.52)      | -0.033<br>(-0.85)    | -0.019<br>(-0.84)    |
| Mid-cap value    | -0.228***<br>(-8.01)   | -0.171***<br>(-6.09) | -0.083***<br>(-4.28) | -0.203***<br>(-7.01) | -0.149***<br>(-5.20) | -0.072***<br>(-3.58) |
| Small-cap blend  | -0.282***<br>(-7.47)   | -0.218***<br>(-5.79) | -0.118***<br>(-4.23) | -0.217***<br>(-5.70) | -0.165***<br>(-4.38) | -0.091***<br>(-3.20) |
| Small-cap growth | 0.071**<br>(2.17)      | 0.012<br>(0.36)      | -0.007<br>(-0.31)    | 0.133***<br>(4.03)   | 0.059*<br>(1.80)     | 0.022<br>(0.95)      |
| Small-cap value  | -0.398***<br>(-10.08)  | -0.413***<br>(-8.20) | -0.231***<br>(-7.67) | -0.289***<br>(-7.15) | -0.336***<br>(-6.53) | -0.187***<br>(-5.97) |
| Constant         | 0.384***<br>(11.23)    | 0.302***<br>(4.29)   | 0.171***<br>(3.76)   | 0.506***<br>(14.55)  | 0.467***<br>(6.07)   | 0.267***<br>(5.45)   |
| Adj. R-squared   | 0.034                  | 0.062                | 0.231                | 0.031                | 0.060                | 0.227                |
| Observations     | 30,237                 | 29,405               | 28,200               | 30,237               | 29,405               | 28,200               |
| # of months      | 153                    | 153                  | 152                  | 153                  | 153                  | 152                  |

B2. Analysis by Investment Style

| VARIABLES       | Large Cap                         |                      |                    | Mid Cap              |                      |                     | Small Cap            |                     |                   |
|-----------------|-----------------------------------|----------------------|--------------------|----------------------|----------------------|---------------------|----------------------|---------------------|-------------------|
|                 | Growth                            | Blend                | Value              | Growth               | Blend                | Value               | Growth               | Blend               | Value             |
|                 | Cost vs. Fund Size                |                      |                    |                      |                      |                     |                      |                     |                   |
| Log(TNA)        | -0.039***<br>(-3.72)              | -0.025***<br>(-3.60) | -0.005<br>(-0.79)  | 0.003<br>(0.15)      | -0.050***<br>(-3.31) | 0.018<br>(1.62)     | -0.114***<br>(-5.43) | -0.069<br>(-1.02)   | -0.028<br>(-1.58) |
| Constant        | 0.598***<br>(8.27)                | 0.520***<br>(11.67)  | 0.232***<br>(5.51) | 0.331**<br>(2.30)    | 0.500***<br>(5.93)   | 0.101*<br>(1.67)    | 1.172***<br>(7.31)   | 0.595<br>(1.41)     | 0.239**<br>(2.21) |
| Adj. R-squared  | 0.019                             | 0.009                | -0.005             | 0.013                | -0.023               | 0.006               | 0.013                | 0.058               | -0.032            |
| Observations    | 7,292                             | 4,999                | 5,066              | 3,853                | 1,729                | 2,504               | 1,746                | 1,605               | 1,443             |
| # of months     | 153                               | 153                  | 153                | 153                  | 153                  | 153                 | 153                  | 153                 | 153               |
|                 | Cost vs. All Fund Level Variables |                      |                    |                      |                      |                     |                      |                     |                   |
| Log(TNA)        | 0.006<br>(0.55)                   | -0.032**<br>(-2.22)  | -0.011<br>(-0.98)  | 0.016<br>(0.59)      | 0.040<br>(0.71)      | 0.025<br>(1.15)     | -0.035<br>(-0.78)    | -0.098**<br>(-2.21) | -0.051<br>(-0.64) |
| Expense ratio   | 0.184***<br>(3.89)                | -0.032<br>(-0.75)    | 0.082<br>(1.46)    | -0.139<br>(-1.19)    | 0.215<br>(0.75)      | -0.192**<br>(-2.04) | 0.044<br>(0.19)      | 0.042<br>(0.48)     | 0.217<br>(0.33)   |
| Fund turnover   | 0.132***<br>(6.13)                | 0.192***<br>(6.96)   | 0.122***<br>(3.18) | 0.248***<br>(5.66)   | -0.002<br>(-0.02)    | 0.075*<br>(1.66)    | 0.228***<br>(2.78)   | 0.340***<br>(4.20)  | -0.269<br>(-0.94) |
| Fund flow       | 0.003<br>(0.70)                   | -0.003<br>(-0.80)    | 0.001<br>(0.25)    | -0.005<br>(-0.74)    | -0.024<br>(-0.65)    | 0.030**<br>(2.45)   | -0.028<br>(-1.04)    | -0.016<br>(-0.82)   | 0.074<br>(1.20)   |
| Log(fund age)   | 0.098***<br>(4.02)                | 0.119***<br>(6.38)   | 0.070***<br>(4.06) | -0.072<br>(-1.24)    | 0.027<br>(0.15)      | -0.079*<br>(-1.71)  | 0.101<br>(0.68)      | 0.096<br>(1.48)     | 0.035<br>(0.22)   |
| Log(family TNA) | -0.085***<br>(-6.47)              | -0.039***<br>(-2.70) | 0.012<br>(1.62)    | -0.069***<br>(-4.39) | 0.434<br>(1.14)      | -0.020<br>(-1.53)   | -0.055<br>(-1.32)    | 0.024<br>(1.03)     | 0.042<br>(1.08)   |
| Lag fund return | -0.001<br>(-0.07)                 | 0.000<br>(0.00)      | 0.019**<br>(2.48)  | -0.001<br>(-0.17)    | -0.017<br>(-0.35)    | 0.043<br>(1.62)     | -0.002<br>(-0.05)    | 0.029<br>(0.69)     | 0.028<br>(0.26)   |
| Constant        | 0.749***<br>(3.58)                | 0.537***<br>(2.80)   | -0.182<br>(-1.44)  | 1.219***<br>(2.69)   | -6.455<br>(-1.21)    | 0.540*<br>(1.79)    | 1.087**<br>(2.15)    | -0.321<br>(-0.88)   | 0.285<br>(0.21)   |
| Adj. R-squared  | 0.131                             | 0.086                | 0.013              | 0.100                | 0.152                | 0.008               | 0.057                | -0.042              | 0.048             |
| Observations    | 7,204                             | 4,874                | 4,878              | 3,680                | 1,693                | 2,423               | 1,701                | 1,549               | 1,403             |
| # of months     | 153                               | 153                  | 153                | 153                  | 153                  | 153                 | 153                  | 153                 | 153               |

Panel B2 continued.

| VARIABLES  | Large Cap            |                     |                     | Mid Cap              |                    |                     | Small Cap          |                    |                     |
|--|----------------------|---------------------|---------------------|----------------------|--------------------|---------------------|--------------------|--------------------|---------------------|
|  | Growth               | Blend               | Value               | Growth               | Blend              | Value               | Growth             | Blend              | Value               |
| Cost vs. All Fund Level Variables and Lag Trade Cost |                      |                     |                     |                      |                    |                     |                    |                    |                     |
| Log(TNA)   | 0.003<br>(0.32)      | -0.018*<br>(-1.83)  | -0.014*<br>(-1.87)  | -0.005<br>(-0.23)    | -0.047<br>(-0.68)  | 0.057<br>(0.79)     | -0.014<br>(-0.39)  | -0.071*<br>(-1.79) | 0.230<br>(0.84)     |
| Lag trade cost                                       | 0.414***<br>(12.62)  | 0.525***<br>(19.83) | 0.384***<br>(11.93) | 0.469***<br>(9.25)   | 0.424***<br>(4.87) | 0.197**<br>(2.00)   | 0.362***<br>(5.08) | 0.457***<br>(4.86) | 0.713***<br>(2.66)  |
| Expense ratio  | 0.116***<br>(2.79)   | -0.005<br>(-0.18)   | 0.042<br>(1.12)     | -0.059<br>(-0.70)    | 0.005<br>(0.04)    | -0.266**<br>(-2.57) | 0.100<br>(0.56)    | -0.022<br>(-0.40)  | 1.686<br>(0.89)     |
| Fund turnover  | 0.078***<br>(3.91)   | 0.092***<br>(6.43)  | 0.076***<br>(2.62)  | 0.190***<br>(3.95)   | -0.115<br>(-0.75)  | -0.196<br>(-0.80)   | -0.009<br>(-0.05)  | 0.049<br>(0.86)    | -0.173<br>(-0.74)   |
| Fund flow  | 0.005<br>(1.02)      | -0.006<br>(-1.42)   | -0.001<br>(-0.31)   | -0.003<br>(-0.45)    | -0.041<br>(-1.18)  | 0.012<br>(0.95)     | -0.083<br>(-1.52)  | -0.002<br>(-0.13)  | -0.074**<br>(-2.52) |
| Log(fund age)  | 0.060**<br>(2.57)    | 0.063***<br>(5.09)  | 0.049***<br>(3.50)  | -0.082<br>(-1.49)    | -0.184<br>(-1.34)  | -0.128<br>(-1.37)   | 0.164<br>(1.00)    | 0.097<br>(1.33)    | -0.141<br>(-0.55)   |
| Log(family TNA)                                      | -0.044***<br>(-5.40) | -0.021**<br>(-2.33) | 0.006<br>(0.93)     | -0.041***<br>(-3.33) | -0.234<br>(-0.73)  | -0.062<br>(-1.30)   | -0.030<br>(-1.52)  | -0.020<br>(-0.70)  | -0.007<br>(-0.13)   |
| Lag fund return                                      | 0.007<br>(0.81)      | 0.000<br>(0.03)     | 0.022**<br>(2.47)   | 0.010<br>(1.05)      | 0.011<br>(0.34)    | 0.022<br>(1.31)     | 0.065<br>(1.12)    | 0.002<br>(0.04)    | 0.057<br>(0.45)     |
| Constant   | 0.362**<br>(2.57)    | 0.326***<br>(2.72)  | -0.042<br>(-0.39)   | 0.813**<br>(2.16)    | 4.418<br>(1.13)    | 1.019*<br>(1.78)    | -0.018<br>(-0.03)  | 0.140<br>(0.34)    | -2.898<br>(-0.72)   |
| Adj. R-squared                                       | 0.300                | 0.336               | 0.171               | 0.350                | 0.267              | 0.133               | 0.241              | 0.156              | -0.066              |
| Observations   | 6,796                | 4,539               | 4,586               | 3,419                | 1,478              | 2,243               | 1,615              | 1,461              | 1,322               |
| # of months  | 152                  | 152                 | 152                 | 152                  | 152                | 152                 | 152                | 152                | 152                 |



Panel C: Prior Close Cost per Trade Dollar (%)

C1: Investment Style Dummy Variables

| VARIABLES        | Implicit Trading Costs |                       |                       | Total Trading Costs   |                      |                      |
|------------------|------------------------|-----------------------|-----------------------|-----------------------|----------------------|----------------------|
|                  | (1)                    | (2)                   | (3)                   | (4)                   | (5)                  | (6)                  |
| Log(TNA)         | -0.039***<br>(-5.64)   | -0.012<br>(-1.61)     | -0.006<br>(-1.20)     | -0.042***<br>(-6.14)  | -0.012<br>(-1.63)    | -0.006<br>(-1.24)    |
| Lag trade cost   |                        |                       | 0.402***<br>(23.80)   |                       |                      | 0.397***<br>(22.94)  |
| Expense ratio    |                        | 0.037<br>(1.37)       | 0.035*<br>(1.89)      |                       | 0.049*<br>(1.90)     | 0.043**<br>(2.37)    |
| Fund turnover    |                        | 0.220***<br>(12.08)   | 0.135***<br>(10.65)   |                       | 0.216***<br>(11.88)  | 0.133***<br>(10.47)  |
| Fund flow        |                        | -0.002<br>(-1.22)     | -0.001<br>(-0.72)     |                       | -0.002<br>(-1.13)    | -0.001<br>(-0.78)    |
| Log(fund age)    |                        | 0.037***<br>(3.01)    | 0.022**<br>(2.60)     |                       | 0.043***<br>(3.58)   | 0.027***<br>(3.22)   |
| Log(family TNA)  |                        | -0.019**<br>(-2.53)   | -0.012**<br>(-2.57)   |                       | -0.027***<br>(-3.48) | -0.016***<br>(-3.50) |
| Lag fund return  |                        | -0.005<br>(-0.86)     | 0.003<br>(0.56)       |                       | -0.005<br>(-0.93)    | 0.002<br>(0.41)      |
| Large-cap growth | -0.053<br>(-1.52)      | -0.108***<br>(-2.71)  | -0.049*<br>(-1.86)    | -0.049<br>(-1.38)     | -0.108***<br>(-2.70) | -0.051*<br>(-1.96)   |
| Large-cap value  | -0.360***<br>(-9.21)   | -0.285***<br>(-7.93)  | -0.163***<br>(-7.25)  | -0.354***<br>(-9.30)  | -0.285***<br>(-8.07) | -0.165***<br>(-7.38) |
| Mid-cap blend    | -0.465***<br>(-7.83)   | -0.450***<br>(-7.40)  | -0.270***<br>(-7.29)  | -0.440***<br>(-7.27)  | -0.427***<br>(-6.90) | -0.261***<br>(-6.92) |
| Mid-cap growth   | -0.076<br>(-1.49)      | -0.130**<br>(-2.26)   | -0.065*<br>(-1.75)    | -0.056<br>(-1.07)     | -0.118**<br>(-2.02)  | -0.058<br>(-1.54)    |
| Mid-cap value    | -0.506***<br>(-11.23)  | -0.433***<br>(-9.71)  | -0.248***<br>(-8.92)  | -0.482***<br>(-10.64) | -0.413***<br>(-9.17) | -0.238***<br>(-8.33) |
| Small-cap blend  | -0.595***<br>(-10.83)  | -0.486***<br>(-8.53)  | -0.255***<br>(-6.10)  | -0.530***<br>(-9.61)  | -0.434***<br>(-7.59) | -0.229***<br>(-5.39) |
| Small-cap growth | 0.005<br>(0.08)        | -0.051<br>(-0.91)     | -0.056<br>(-1.52)     | 0.064<br>(1.08)       | -0.005<br>(-0.10)    | -0.030<br>(-0.80)    |
| Small-cap value  | -0.873***<br>(-14.43)  | -0.879***<br>(-10.89) | -0.515***<br>(-10.27) | -0.767***<br>(-12.58) | -0.807***<br>(-9.93) | -0.475***<br>(-9.27) |
| Constant         | 0.622***<br>(10.84)    | 0.333***<br>(2.76)    | 0.173**<br>(2.32)     | 0.746***<br>(13.11)   | 0.502***<br>(3.96)   | 0.271***<br>(3.51)   |
| Adj. R-squared   | 0.047                  | 0.069                 | 0.223                 | 0.043                 | 0.065                | 0.218                |
| Observations     | 30,203                 | 29,371                | 28,158                | 30,203                | 29,371               | 28,158               |
| # of months      | 153                    | 153                   | 152                   | 153                   | 153                  | 152                  |

C2: Analysis by Investment Style

| VARIABLES       | Large Cap                         |                     |                      | Mid Cap              |                      |                     | Small Cap            |                      |                     |
|-----------------|-----------------------------------|---------------------|----------------------|----------------------|----------------------|---------------------|----------------------|----------------------|---------------------|
|                 | Growth                            | Blend               | Value                | Growth               | Blend                | Value               | Growth               | Blend                | Value               |
|                 | Cost vs. Fund Size                |                     |                      |                      |                      |                     |                      |                      |                     |
| Log(TNA)        | -0.071***<br>(-4.23)              | -0.030**<br>(-2.15) | -0.013<br>(-1.29)    | -0.012<br>(-0.41)    | -0.109***<br>(-4.24) | 0.011<br>(0.66)     | -0.170***<br>(-4.71) | -0.169<br>(-1.61)    | -0.062**<br>(-2.12) |
| Constant        | 0.901***<br>(7.72)                | 0.665***<br>(8.15)  | 0.220***<br>(3.02)   | 0.469**<br>(2.38)    | 0.709***<br>(4.46)   | -0.002<br>(-0.03)   | 1.573***<br>(5.76)   | 1.006<br>(1.54)      | 0.075<br>(0.44)     |
| Adj. R-squared  | 0.019                             | 0.010               | -0.006               | 0.010                | 0.019                | -0.003              | 0.008                | 0.054                | -0.021              |
| Observations    | 7,292                             | 4,999               | 5,065                | 3,853                | 1,725                | 2,480               | 1,745                | 1,605                | 1,439               |
| # of months     | 153                               | 153                 | 153                  | 153                  | 153                  | 153                 | 153                  | 153                  | 153                 |
|                 | Cost vs. All Fund Level Variables |                     |                      |                      |                      |                     |                      |                      |                     |
| Log(TNA)        | 0.004<br>(0.21)                   | -0.056**<br>(-2.05) | -0.028<br>(-1.62)    | 0.025<br>(0.53)      | -0.117<br>(-1.27)    | 0.032<br>(0.79)     | -0.035<br>(-0.47)    | -0.211***<br>(-2.81) | 0.173<br>(1.32)     |
| Expense ratio   | 0.324***<br>(4.18)                | -0.016<br>(-0.26)   | 0.178**<br>(2.21)    | -0.212<br>(-1.32)    | -0.081<br>(-0.21)    | -0.303**<br>(-2.01) | 0.144<br>(0.38)      | -0.088<br>(-0.85)    | 0.450<br>(0.45)     |
| Fund turnover   | 0.189***<br>(5.36)                | 0.316***<br>(6.70)  | 0.172***<br>(2.62)   | 0.345***<br>(3.85)   | -0.018<br>(-0.08)    | 0.085<br>(1.40)     | 0.272<br>(1.58)      | 0.318***<br>(2.87)   | -0.086<br>(-0.26)   |
| Fund flow       | 0.010<br>(1.33)                   | -0.009<br>(-1.31)   | 0.001<br>(0.11)      | -0.016<br>(-1.39)    | -0.046<br>(-0.92)    | 0.054**<br>(2.30)   | -0.048<br>(-1.11)    | -0.046*<br>(-1.89)   | 0.050<br>(0.87)     |
| Log(fund age)   | 0.128***<br>(3.64)                | 0.263***<br>(6.48)  | 0.108***<br>(3.37)   | -0.112<br>(-1.29)    | 0.123<br>(0.52)      | -0.109<br>(-0.96)   | 0.180<br>(0.69)      | 0.117<br>(1.12)      | -0.137<br>(-0.53)   |
| Log(family TNA) | -0.123***<br>(-6.76)              | -0.023<br>(-1.11)   | 0.039***<br>(3.44)   | -0.090***<br>(-4.66) | 0.563<br>(1.11)      | -0.046*<br>(-1.81)  | -0.080<br>(-1.34)    | 0.039<br>(1.40)      | 0.129***<br>(2.70)  |
| Lag fund return | -0.010<br>(-0.85)                 | -0.002<br>(-0.18)   | 0.004<br>(0.33)      | 0.005<br>(0.40)      | -0.027<br>(-0.42)    | 0.042<br>(0.88)     | 0.031<br>(0.31)      | -0.002<br>(-0.02)    | 0.033<br>(0.23)     |
| Constant        | 1.045***<br>(3.17)                | 0.142<br>(0.48)     | -0.674***<br>(-2.72) | 1.551***<br>(3.00)   | -7.415<br>(-1.04)    | 1.044*<br>(1.69)    | 1.491*<br>(1.77)     | -0.010<br>(-0.02)    | -2.316<br>(-1.02)   |
| Adj. R-squared  | 0.110                             | 0.104               | 0.031                | 0.030                | 0.169                | -0.028              | 0.089                | -0.104               | -0.017              |
| Observations    | 7,204                             | 4,874               | 4,877                | 3,680                | 1,689                | 2,399               | 1,700                | 1,549                | 1,399               |
| # of months     | 153                               | 153                 | 153                  | 153                  | 153                  | 153                 | 153                  | 153                  | 153                 |

Panel C2 continued.

| VARIABLES  | Large Cap            |                     |                     | Mid Cap             |                    |                      | Small Cap          |                     |                   |
|--|----------------------|---------------------|---------------------|---------------------|--------------------|----------------------|--------------------|---------------------|-------------------|
|  | Growth               | Blend               | Value               | Growth              | Blend              | Value                | Growth             | Blend               | Value             |
| Cost vs. All Fund Level Variables and Lag Trade Cost |                      |                     |                     |                     |                    |                      |                    |                     |                   |
| Log(TNA)   | 0.011<br>(0.72)      | -0.034*<br>(-1.92)  | -0.016*<br>(-1.73)  | 0.095<br>(1.37)     | -0.069<br>(-0.99)  | 0.039<br>(1.02)      | -0.038<br>(-0.37)  | -0.094**<br>(-2.19) | 0.040<br>(0.21)   |
| Lag trade cost                                       | 0.433***<br>(14.62)  | 0.506***<br>(19.27) | 0.423***<br>(13.23) | 0.541***<br>(10.48) | 0.397***<br>(3.84) | 0.236***<br>(3.64)   | 0.535***<br>(2.69) | 0.351***<br>(4.55)  | 0.258<br>(0.49)   |
| Expense ratio  | 0.200***<br>(2.83)   | -0.022<br>(-0.39)   | 0.106**<br>(2.07)   | 0.160<br>(0.74)     | -0.189<br>(-1.18)  | -0.182<br>(-1.50)    | -0.471<br>(-0.53)  | -0.045<br>(-0.45)   | 0.962*<br>(1.85)  |
| Fund turnover  | 0.110***<br>(4.00)   | 0.155***<br>(4.76)  | 0.091*<br>(1.90)    | 0.420***<br>(2.69)  | 0.230<br>(1.16)    | 0.126*<br>(1.69)     | -0.147<br>(-0.60)  | 0.154<br>(1.43)     | -0.355<br>(-0.75) |
| Fund flow  | 0.012<br>(1.35)      | -0.004<br>(-0.62)   | -0.003<br>(-0.42)   | -0.035<br>(-1.55)   | -0.019<br>(-0.32)  | 0.035*<br>(1.91)     | -0.155<br>(-1.60)  | -0.030<br>(-1.22)   | 0.066<br>(0.59)   |
| Log(fund age)  | 0.069*<br>(1.94)     | 0.139***<br>(5.09)  | 0.042*<br>(1.71)    | -0.201**<br>(-2.04) | -0.213<br>(-0.94)  | 0.006<br>(0.09)      | -0.052<br>(-0.13)  | 0.043<br>(0.47)     | 0.682<br>(1.58)   |
| Log(family TNA)                                      | -0.066***<br>(-5.96) | -0.016<br>(-1.09)   | 0.024***<br>(2.64)  | -0.048**<br>(-1.98) | 0.131<br>(0.63)    | -0.056***<br>(-3.04) | 0.044<br>(0.46)    | 0.042<br>(1.61)     | 0.242<br>(0.77)   |
| Lag fund return                                      | -0.003<br>(-0.26)    | -0.004<br>(-0.26)   | 0.009<br>(0.56)     | 0.037<br>(1.64)     | -0.055<br>(-0.84)  | 0.033<br>(1.21)      | -0.165<br>(-0.79)  | -0.084<br>(-1.05)   | 0.558<br>(1.07)   |
| Constant   | 0.475**<br>(2.07)    | 0.247<br>(1.03)     | -0.360*<br>(-1.92)  | -0.017<br>(-0.02)   | -0.516<br>(-0.19)  | 0.459<br>(1.27)      | -0.828<br>(-0.43)  | -0.074<br>(-0.15)   | -7.825<br>(-1.31) |
| Adj. R-squared                                       | 0.314                | 0.322               | 0.200               | 0.301               | 0.312              | 0.113                | 0.204              | 0.157               | 0.078             |
| Observations   | 6,796                | 4,539               | 4,584               | 3,419               | 1,470              | 2,219                | 1,613              | 1,461               | 1,318             |
| # of months  | 152                  | 152                 | 152                 | 152                 | 152                | 152                  | 152                | 152                 | 152               |

Panel D: Open Price Cost per TNA Dollar

D1: Investment Style Dummy Variables

| VARIABLES        | Implicit Trading Costs |                      |                      | Total Trading Costs   |                      |                      |
|------------------|------------------------|----------------------|----------------------|-----------------------|----------------------|----------------------|
|                  | (1)                    | (2)                  | (3)                  | (4)                   | (5)                  | (6)                  |
| Log(TNA)         | -0.010***<br>(-9.50)   | -0.005***<br>(-4.49) | -0.003***<br>(-3.85) | -0.014***<br>(-12.44) | -0.008***<br>(-6.41) | -0.004***<br>(-4.99) |
| Lag trade cost   |                        |                      | 0.555***<br>(31.31)  |                       |                      | 0.584***<br>(31.60)  |
| Expense ratio    |                        | -0.022***<br>(-5.07) | -0.011***<br>(-3.36) |                       | -0.024***<br>(-5.24) | -0.011***<br>(-3.38) |
| Fund turnover    |                        | 0.049***<br>(13.13)  | 0.022***<br>(9.56)   |                       | 0.059***<br>(14.20)  | 0.024***<br>(9.86)   |
| Fund flow        |                        | -0.000<br>(-0.37)    | -0.000<br>(-0.60)    |                       | -0.000<br>(-0.48)    | -0.000<br>(-0.61)    |
| Log(fund age)    |                        | -0.005**<br>(-2.39)  | -0.002<br>(-1.28)    |                       | -0.004*<br>(-1.79)   | -0.001<br>(-0.88)    |
| Log(family TNA)  |                        | -0.003***<br>(-4.61) | -0.001***<br>(-3.53) |                       | -0.005***<br>(-6.03) | -0.002***<br>(-4.30) |
| Lag fund return  |                        | -0.001*<br>(-1.86)   | -0.000<br>(-0.20)    |                       | -0.001*<br>(-1.97)   | -0.000<br>(-0.47)    |
| Large-cap growth | -0.008*<br>(-1.69)     | -0.017***<br>(-3.65) | -0.008***<br>(-2.69) | -0.009*<br>(-1.86)    | -0.020***<br>(-4.28) | -0.010***<br>(-3.23) |
| Large-cap value  | -0.036***<br>(-7.32)   | -0.017***<br>(-4.46) | -0.008***<br>(-3.26) | -0.039***<br>(-7.91)  | -0.017***<br>(-4.17) | -0.008***<br>(-3.05) |
| Mid-cap blend    | -0.018**<br>(-2.06)    | -0.014<br>(-1.54)    | -0.006<br>(-1.24)    | -0.016*<br>(-1.67)    | -0.011<br>(-1.13)    | -0.005<br>(-1.06)    |
| Mid-cap growth   | 0.009<br>(1.52)        | -0.001<br>(-0.18)    | -0.001<br>(-0.19)    | 0.017**<br>(2.54)     | 0.003<br>(0.44)      | 0.001<br>(0.26)      |
| Mid-cap value    | -0.055***<br>(-7.41)   | -0.037***<br>(-5.29) | -0.015***<br>(-3.66) | -0.056***<br>(-7.33)  | -0.036***<br>(-4.70) | -0.014***<br>(-3.30) |
| Small-cap blend  | -0.027***<br>(-3.43)   | -0.003<br>(-0.38)    | -0.003<br>(-0.51)    | -0.030***<br>(-3.49)  | -0.005<br>(-0.54)    | -0.004<br>(-0.76)    |
| Small-cap growth | 0.035***<br>(3.53)     | 0.016*<br>(1.93)     | 0.002<br>(0.37)      | 0.055***<br>(4.60)    | 0.031***<br>(3.05)   | 0.007<br>(1.13)      |
| Small-cap value  | -0.025**<br>(-2.33)    | -0.013<br>(-1.22)    | -0.006<br>(-0.97)    | -0.008<br>(-0.64)     | 0.003<br>(0.21)      | -0.001<br>(-0.19)    |
| Constant         | 0.126***<br>(12.51)    | 0.118***<br>(7.59)   | 0.060***<br>(5.45)   | 0.172***<br>(16.14)   | 0.164***<br>(9.36)   | 0.079***<br>(6.28)   |
| Adj. R-squared   | 0.027                  | 0.072                | 0.362                | 0.038                 | 0.090                | 0.406                |
| Observations     | 30,237                 | 29,405               | 28,200               | 30,237                | 29,405               | 28,200               |
| # of months      | 153                    | 153                  | 152                  | 153                   | 153                  | 152                  |

D2: Analysis by Investment Style

| VARIABLES                         | Large Cap            |                      |                      | Mid Cap              |                      |                      | Small Cap            |                     |                      |
|-----------------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|---------------------|----------------------|
|                                   | Growth               | Blend                | Value                | Growth               | Blend                | Value                | Growth               | Blend               | Value                |
| Cost vs. Fund Size                |                      |                      |                      |                      |                      |                      |                      |                     |                      |
| Log(TNA)                          | -0.019***<br>(-6.17) | -0.020***<br>(-7.31) | -0.008***<br>(-6.94) | -0.015***<br>(-3.12) | -0.020***<br>(-5.33) | 0.000<br>(0.07)      | -0.041***<br>(-3.03) | 0.009<br>(0.79)     | 0.022**<br>(2.16)    |
| Constant                          | 0.201***<br>(7.72)   | 0.211***<br>(10.18)  | 0.096***<br>(10.33)  | 0.188***<br>(5.63)   | 0.191***<br>(7.15)   | 0.046***<br>(2.89)   | 0.364***<br>(3.72)   | 0.012<br>(0.17)     | -0.042<br>(-0.78)    |
| Adj. R-squared                    | 0.048                | 0.032                | 0.008                | 0.024                | -0.016               | 0.035                | 0.076                | -0.014              | -0.004               |
| Observations                      | 7,292                | 4,999                | 5,066                | 3,853                | 1,729                | 2,504                | 1,746                | 1,605               | 1,443                |
| # of months                       | 153                  | 153                  | 153                  | 153                  | 153                  | 153                  | 153                  | 153                 | 153                  |
| Cost vs. All Fund Level Variables |                      |                      |                      |                      |                      |                      |                      |                     |                      |
| Log(TNA)                          | -0.012***<br>(-6.04) | -0.028***<br>(-4.49) | -0.008***<br>(-3.79) | -0.004<br>(-0.60)    | -0.041***<br>(-2.85) | -0.001<br>(-0.31)    | -0.032***<br>(-2.74) | -0.011<br>(-0.88)   | 0.096***<br>(3.83)   |
| Expense ratio                     | -0.043***<br>(-3.45) | -0.102***<br>(-5.54) | -0.002<br>(-0.25)    | -0.018<br>(-0.66)    | -0.052<br>(-0.76)    | -0.050***<br>(-2.72) | 0.087<br>(1.38)      | 0.029*<br>(1.87)    | 0.070<br>(0.67)      |
| Fund turnover                     | 0.051***<br>(8.81)   | 0.049***<br>(3.65)   | 0.016<br>(1.57)      | 0.082***<br>(5.66)   | -0.050*<br>(-1.84)   | 0.033***<br>(3.08)   | 0.082***<br>(4.11)   | 0.112***<br>(6.49)  | 0.216***<br>(2.65)   |
| Fund flow                         | 0.000<br>(0.27)      | -0.002<br>(-1.54)    | 0.000<br>(0.19)      | 0.002<br>(1.13)      | -0.002<br>(-0.54)    | -0.000<br>(-0.23)    | -0.006<br>(-0.99)    | -0.007<br>(-1.08)   | 0.000<br>(0.01)      |
| Log(fund age)                     | 0.002<br>(0.35)      | 0.010<br>(1.56)      | 0.004<br>(0.87)      | -0.018<br>(-1.15)    | 0.035<br>(0.78)      | -0.009<br>(-1.13)    | 0.070<br>(1.65)      | 0.006<br>(0.57)     | -0.123***<br>(-2.79) |
| Log(family TNA)                   | -0.015***<br>(-7.56) | -0.015***<br>(-4.08) | 0.001<br>(0.80)      | -0.014***<br>(-4.64) | 0.081<br>(1.11)      | -0.008***<br>(-3.01) | 0.003<br>(0.38)      | 0.012**<br>(2.01)   | -0.011<br>(-1.15)    |
| Lag fund return                   | 0.001<br>(0.76)      | -0.002<br>(-0.67)    | -0.000<br>(-0.09)    | -0.003<br>(-1.18)    | 0.003<br>(0.57)      | 0.002<br>(0.90)      | -0.006<br>(-0.52)    | -0.001<br>(-0.11)   | -0.012<br>(-0.49)    |
| Constant                          | 0.313***<br>(6.42)   | 0.460***<br>(6.49)   | 0.067**<br>(2.51)    | 0.289***<br>(2.81)   | -0.729<br>(-0.71)    | 0.180***<br>(2.80)   | -0.058<br>(-0.52)    | -0.169**<br>(-2.24) | -0.191<br>(-0.80)    |
| Adj. R-squared                    | 0.169                | 0.175                | 0.056                | 0.124                | 0.135                | 0.153                | 0.165                | 0.053               | 0.002                |
| Observations                      | 7,204                | 4,874                | 4,878                | 3,680                | 1,693                | 2,423                | 1,701                | 1,549               | 1,403                |
| # of months                       | 153                  | 153                  | 153                  | 153                  | 153                  | 153                  | 153                  | 153                 | 153                  |

Panel D2 continued.

| VARIABLES  | Large Cap            |                      |                      | Mid Cap             |                     |                     | Small Cap           |                    |                   |
|--|----------------------|----------------------|----------------------|---------------------|---------------------|---------------------|---------------------|--------------------|-------------------|
|  | Growth               | Blend                | Value                | Growth              | Blend               | Value               | Growth              | Blend              | Value             |
| Cost vs. All Fund Level Variables and Lag Trade Cost |                      |                      |                      |                     |                     |                     |                     |                    |                   |
| Log(TNA)   | -0.007***<br>(-4.74) | -0.013***<br>(-3.31) | -0.004***<br>(-2.67) | -0.003<br>(-0.44)   | -0.025*<br>(-1.91)  | 0.001<br>(0.25)     | -0.019**<br>(-2.34) | -0.014<br>(-1.21)  | 0.155<br>(0.95)   |
| Lag trade cost                                       | 0.518***<br>(16.46)  | 0.591***<br>(14.60)  | 0.528***<br>(14.15)  | 0.606***<br>(11.64) | 0.642***<br>(2.85)  | 0.348***<br>(5.02)  | 0.506***<br>(6.23)  | 0.489***<br>(6.26) | 1.814<br>(1.37)   |
| Expense ratio  | -0.026***<br>(-2.98) | -0.037***<br>(-3.73) | 0.002<br>(0.45)      | -0.010<br>(-0.43)   | -0.053**<br>(-1.99) | -0.018<br>(-1.20)   | 0.017<br>(0.52)     | 0.005<br>(0.33)    | 0.616<br>(1.11)   |
| Fund turnover  | 0.024***<br>(6.59)   | 0.014**<br>(2.29)    | 0.007<br>(0.94)      | 0.036***<br>(3.26)  | -0.035<br>(-1.12)   | 0.014*<br>(1.70)    | 0.004<br>(0.24)     | 0.046**<br>(2.54)  | 0.128<br>(0.69)   |
| Fund flow  | 0.000<br>(0.38)      | -0.001<br>(-0.70)    | 0.000<br>(0.47)      | 0.001<br>(0.82)     | -0.003<br>(-0.88)   | 0.001<br>(0.93)     | -0.007<br>(-1.20)   | -0.005<br>(-0.98)  | -0.010<br>(-0.49) |
| Log(fund age)  | -0.001<br>(-0.36)    | 0.004<br>(1.05)      | 0.001<br>(0.39)      | -0.001<br>(-0.08)   | -0.007<br>(-0.34)   | -0.005<br>(-0.84)   | 0.044*<br>(1.75)    | 0.009<br>(0.96)    | -0.346<br>(-1.08) |
| Log(family TNA)                                      | -0.008***<br>(-5.02) | -0.005**<br>(-2.11)  | 0.001<br>(1.00)      | -0.008**<br>(-1.98) | -0.049<br>(-0.34)   | -0.005**<br>(-2.28) | 0.004<br>(1.41)     | 0.005<br>(1.03)    | -0.001<br>(-0.11) |
| Lag fund return                                      | 0.001<br>(0.50)      | -0.001<br>(-0.31)    | 0.001<br>(0.78)      | 0.001<br>(0.33)     | -0.007<br>(-1.35)   | 0.001<br>(0.47)     | 0.007<br>(1.00)     | 0.003<br>(0.65)    | 0.055**<br>(2.01) |
| Constant   | 0.183***<br>(4.96)   | 0.190***<br>(4.22)   | 0.028<br>(1.54)      | 0.140<br>(1.39)     | 0.948<br>(0.48)     | 0.085**<br>(2.01)   | -0.120<br>(-0.98)   | 0.011<br>(0.16)    | -0.991<br>(-0.87) |
| Adj. R-squared                                       | 0.396                | 0.466                | 0.315                | 0.440               | 0.659               | 0.377               | 0.600               | 0.684              | 0.562             |
| Observations   | 6,796                | 4,539                | 4,586                | 3,419               | 1,478               | 2,243               | 1,615               | 1,461              | 1,322             |
| # of months  | 152                  | 152                  | 152                  | 152                 | 152                 | 152                 | 152                 | 152                | 152               |

Panel E: Prior Close Cost per TNA Dollar

E1: Investment Style Dummy Variables

| VARIABLES        | Implicit Trading Costs |                      |                      | Total Trading Costs  |                      |                      |
|------------------|------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
|                  | (1)                    | (2)                  | (3)                  | (4)                  | (5)                  | (6)                  |
| Log(TNA)         | -0.012***<br>(-7.08)   | -0.004**<br>(-2.56)  | -0.002**<br>(-2.14)  | -0.016***<br>(-9.35) | -0.007***<br>(-4.25) | -0.004***<br>(-3.39) |
| Lag trade cost   |                        |                      | 0.507***<br>(21.49)  |                      |                      | 0.519***<br>(22.36)  |
| Expense ratio    |                        | -0.019***<br>(-3.41) | -0.010**<br>(-2.53)  |                      | -0.023***<br>(-3.75) | -0.012***<br>(-2.88) |
| Fund turnover    |                        | 0.066***<br>(10.33)  | 0.032***<br>(8.31)   |                      | 0.076***<br>(11.27)  | 0.036***<br>(8.84)   |
| Fund flow        |                        | 0.000<br>(0.19)      | -0.000<br>(-0.09)    |                      | 0.000<br>(0.08)      | -0.000<br>(-0.17)    |
| Log(fund age)    |                        | -0.007**<br>(-2.22)  | -0.002<br>(-1.25)    |                      | -0.006*<br>(-1.84)   | -0.002<br>(-0.88)    |
| Log(family TNA)  |                        | -0.002*<br>(-1.72)   | -0.001<br>(-1.18)    |                      | -0.003***<br>(-3.22) | -0.002**<br>(-2.52)  |
| Lag fund return  |                        | -0.002*<br>(-1.91)   | 0.000<br>(0.12)      |                      | -0.002**<br>(-2.06)  | -0.000<br>(-0.04)    |
| Large-cap growth | -0.013*<br>(-1.69)     | -0.024***<br>(-3.17) | -0.011**<br>(-2.13)  | -0.014*<br>(-1.82)   | -0.027***<br>(-3.62) | -0.013**<br>(-2.53)  |
| Large-cap value  | -0.063***<br>(-8.25)   | -0.037***<br>(-6.07) | -0.019***<br>(-4.71) | -0.065***<br>(-8.71) | -0.036***<br>(-6.01) | -0.019***<br>(-4.61) |
| Mid-cap blend    | -0.052***<br>(-3.79)   | -0.050***<br>(-3.65) | -0.024***<br>(-3.02) | -0.049***<br>(-3.37) | -0.046***<br>(-3.18) | -0.021**<br>(-2.58)  |
| Mid-cap growth   | 0.001<br>(0.12)        | -0.012<br>(-1.06)    | -0.003<br>(-0.46)    | 0.010<br>(0.93)      | -0.007<br>(-0.58)    | -0.001<br>(-0.12)    |
| Mid-cap value    | -0.097***<br>(-9.15)   | -0.073***<br>(-7.19) | -0.032***<br>(-5.30) | -0.097***<br>(-9.26) | -0.070***<br>(-6.83) | -0.030***<br>(-4.93) |
| Small-cap blend  | -0.054***<br>(-4.54)   | -0.015<br>(-1.15)    | -0.005<br>(-0.69)    | -0.056***<br>(-4.49) | -0.017<br>(-1.15)    | -0.007<br>(-0.79)    |
| Small-cap growth | 0.048***<br>(3.07)     | 0.027**<br>(2.26)    | 0.008<br>(0.98)      | 0.065***<br>(3.81)   | 0.040***<br>(2.95)   | 0.013<br>(1.46)      |
| Small-cap value  | -0.086***<br>(-5.32)   | -0.059***<br>(-3.72) | -0.025***<br>(-2.70) | -0.068***<br>(-4.05) | -0.044***<br>(-2.64) | -0.018*<br>(-1.92)   |
| Constant         | 0.165***<br>(10.44)    | 0.105***<br>(4.59)   | 0.050***<br>(3.63)   | 0.211***<br>(13.26)  | 0.155***<br>(6.45)   | 0.077***<br>(5.27)   |
| Adj. R-squared   | 0.026                  | 0.064                | 0.311                | 0.032                | 0.076                | 0.332                |
| Observations     | 30,203                 | 29,371               | 28,158               | 30,203               | 29,371               | 28,158               |
| # of months      | 153                    | 153                  | 152                  | 153                  | 153                  | 152                  |

E2: Analysis by Investment Style

| VARIABLES       | Large Cap                         |                      |                      | Mid Cap              |                      |                    | Small Cap            |                    |                     |
|-----------------|-----------------------------------|----------------------|----------------------|----------------------|----------------------|--------------------|----------------------|--------------------|---------------------|
|                 | Growth                            | Blend                | Value                | Growth               | Blend                | Value              | Growth               | Blend              | Value               |
|                 | Cost vs. Fund Size                |                      |                      |                      |                      |                    |                      |                    |                     |
| Log(TNA)        | -0.023***<br>(-5.35)              | -0.023***<br>(-6.84) | -0.007***<br>(-4.20) | -0.020***<br>(-3.25) | -0.023***<br>(-4.15) | 0.006<br>(1.65)    | -0.061***<br>(-3.91) | 0.009<br>(0.61)    | 0.040***<br>(2.69)  |
| Constant        | 0.246***<br>(7.13)                | 0.255***<br>(9.97)   | 0.090***<br>(6.34)   | 0.239***<br>(5.42)   | 0.202***<br>(4.89)   | 0.002<br>(0.09)    | 0.518***<br>(4.57)   | 0.016<br>(0.19)    | -0.177**<br>(-2.23) |
| Adj. R-squared  | 0.039                             | 0.019                | 0.001                | 0.014                | -0.006               | 0.035              | 0.065                | -0.015             | -0.011              |
| Observations    | 7,292                             | 4,999                | 5,065                | 3,853                | 1,725                | 2,480              | 1,745                | 1,605              | 1,439               |
| # of months     | 153                               | 153                  | 153                  | 153                  | 153                  | 153                | 153                  | 153                | 153                 |
|                 | Cost vs. All Fund Level Variables |                      |                      |                      |                      |                    |                      |                    |                     |
| Log(TNA)        | -0.014***<br>(-4.50)              | -0.031***<br>(-4.14) | -0.008***<br>(-2.72) | -0.012<br>(-0.73)    | -0.053***<br>(-3.00) | 0.007<br>(1.12)    | -0.030*<br>(-1.73)   | -0.022<br>(-1.34)  | 0.153***<br>(4.60)  |
| Expense ratio   | -0.038***<br>(-2.79)              | -0.130***<br>(-5.20) | 0.009<br>(0.60)      | -0.064<br>(-1.17)    | -0.071<br>(-1.24)    | -0.051*<br>(-1.84) | 0.122<br>(1.22)      | 0.025<br>(1.14)    | 0.046<br>(0.29)     |
| Fund turnover   | 0.063***<br>(6.85)                | 0.086***<br>(4.42)   | 0.021*<br>(1.79)     | 0.092***<br>(3.25)   | -0.071<br>(-1.61)    | 0.034**<br>(2.23)  | 0.094***<br>(2.63)   | 0.122***<br>(6.29) | 0.218*<br>(1.96)    |
| Fund flow       | 0.003*<br>(1.91)                  | -0.005***<br>(-2.79) | -0.000<br>(-0.00)    | 0.002<br>(0.60)      | -0.001<br>(-0.15)    | 0.004*<br>(1.86)   | -0.010<br>(-1.12)    | -0.009<br>(-1.19)  | -0.006<br>(-0.45)   |
| Log(fund age)   | 0.007<br>(1.00)                   | 0.020**<br>(2.40)    | 0.004<br>(0.76)      | -0.022<br>(-0.92)    | 0.004<br>(0.09)      | -0.010<br>(-1.06)  | 0.068<br>(1.00)      | 0.008<br>(0.49)    | -0.165**<br>(-2.58) |
| Log(family TNA) | -0.019***<br>(-6.77)              | -0.017***<br>(-3.32) | 0.004**<br>(2.27)    | -0.018***<br>(-4.50) | 0.114<br>(1.05)      | -0.005<br>(-1.24)  | -0.002<br>(-0.20)    | 0.015*<br>(1.90)   | 0.006<br>(0.39)     |
| Lag fund return | 0.000<br>(0.17)                   | 0.002<br>(0.60)      | -0.002<br>(-0.81)    | -0.001<br>(-0.29)    | 0.006<br>(0.71)      | -0.001<br>(-0.20)  | -0.011<br>(-0.63)    | -0.003<br>(-0.40)  | -0.016<br>(-0.45)   |
| Constant        | 0.367***<br>(6.94)                | 0.496***<br>(4.61)   | 0.007<br>(0.17)      | 0.474***<br>(2.89)   | -1.049<br>(-0.70)    | 0.095<br>(1.11)    | 0.068<br>(0.38)      | -0.116<br>(-1.08)  | -0.555<br>(-1.49)   |
| Adj. R-squared  | 0.162                             | 0.176                | 0.048                | 0.048                | 0.170                | 0.157              | 0.199                | 0.020              | 0.070               |
| Observations    | 7,204                             | 4,874                | 4,877                | 3,680                | 1,689                | 2,399              | 1,700                | 1,549              | 1,399               |
| # of months     | 153                               | 153                  | 153                  | 153                  | 153                  | 153                | 153                  | 153                | 153                 |



Panel E2 continued.

| VARIABLES  | Large Cap            |                      |                    | Mid Cap            |                   |                    | Small Cap          |                    |                   |
|--|----------------------|----------------------|--------------------|--------------------|-------------------|--------------------|--------------------|--------------------|-------------------|
|  | Growth               | Blend                | Value              | Growth             | Blend             | Value              | Growth             | Blend              | Value             |
| Cost vs. All Fund Level Variables and Lag Trade Cost |                      |                      |                    |                    |                   |                    |                    |                    |                   |
| Log(TNA)   | -0.007***<br>(-3.59) | -0.015***<br>(-2.75) | -0.003<br>(-1.49)  | 0.024<br>(1.16)    | -0.010<br>(-0.69) | 0.010<br>(1.54)    | -0.011<br>(-0.74)  | -0.027*<br>(-1.72) | -0.131<br>(-1.15) |
| Lag trade cost                                       | 0.473***<br>(13.42)  | 0.544***<br>(10.74)  | 0.449***<br>(9.61) | 0.724***<br>(5.47) | 0.246**<br>(2.13) | 0.348***<br>(4.46) | 0.393***<br>(4.35) | 0.280*<br>(1.68)   | 0.680**<br>(2.11) |
| Expense ratio  | -0.031**<br>(-2.30)  | -0.060***<br>(-3.28) | 0.008<br>(0.76)    | 0.074<br>(1.09)    | -0.030<br>(-0.86) | -0.027<br>(-1.25)  | 0.077<br>(0.99)    | -0.003<br>(-0.11)  | -0.017<br>(-0.14) |
| Fund turnover  | 0.035***<br>(5.43)   | 0.042***<br>(3.63)   | 0.017**<br>(2.30)  | 0.061<br>(1.35)    | 0.003<br>(0.06)   | 0.013<br>(1.06)    | -0.025<br>(-0.68)  | 0.080**<br>(2.56)  | 0.198<br>(1.22)   |
| Fund flow  | 0.002*<br>(1.74)     | -0.002<br>(-1.19)    | 0.001<br>(0.67)    | -0.011*<br>(-1.74) | -0.003<br>(-0.57) | 0.005***<br>(3.34) | -0.021<br>(-1.17)  | -0.007<br>(-0.91)  | 0.010<br>(0.85)   |
| Log(fund age)  | -0.001<br>(-0.26)    | 0.011**<br>(2.08)    | 0.001<br>(0.31)    | 0.014<br>(0.44)    | -0.030<br>(-1.09) | -0.018*<br>(-1.69) | 0.087<br>(1.28)    | 0.016<br>(1.24)    | 0.379<br>(1.38)   |
| Log(family TNA)                                      | -0.011***<br>(-5.00) | -0.007*<br>(-1.71)   | 0.002*<br>(1.71)   | -0.003<br>(-0.39)  | 0.014<br>(0.27)   | -0.005<br>(-1.09)  | -0.005<br>(-0.74)  | 0.010<br>(1.53)    | 0.034*<br>(1.87)  |
| Lag fund return                                      | -0.001<br>(-0.39)    | 0.002<br>(0.72)      | 0.000<br>(0.13)    | 0.023<br>(1.46)    | -0.009<br>(-0.67) | -0.001<br>(-0.33)  | 0.010<br>(0.89)    | 0.001<br>(0.13)    | 0.016<br>(0.26)   |
| Constant   | 0.223***<br>(4.45)   | 0.235***<br>(2.86)   | -0.001<br>(-0.03)  | -0.473<br>(-1.08)  | 0.074<br>(0.11)   | 0.056<br>(0.81)    | -0.208<br>(-0.64)  | 0.021<br>(0.20)    | -0.364<br>(-0.89) |
| Adj. R-squared                                       | 0.389                | 0.433                | 0.299              | 0.348              | 0.525             | 0.359              | 0.532              | 0.558              | 0.491             |
| Observations   | 6,796                | 4,539                | 4,584              | 3,419              | 1,470             | 2,219              | 1,613              | 1,461              | 1,318             |
| # of months  | 152                  | 152                  | 152                | 152                | 152               | 152                | 152                | 152                | 152               |

**Table IA.III: Robustness Tests on Trading Costs and Fund Performance**

The table repeats the analysis in Panel A of Table VI except that we control for additional variables used in Table VI of Pollet and Wilson (2008), including interaction terms with TNA. Variables cap2 through cap5 are indicator variables for the quintile of fund value-weighted holding stock size, with cap5 representing the largest quintile. In Panel B, we further control for 1/S, the reciprocal of the number of stocks held by a fund. All independent variables except trade cost are lagged by one month. Fama-MacBeth (1973) *t*-statistics (in parenthesis) are corrected following Newey-West (1987). Statistical significance of one, five, and ten percent are indicated by \*\*\*, \*\*, and \* respectively.

Panel A: Holding Stock Size

| VARIABLES       | Execution Shortfall  |                      | Open Price Cost      |                      | Prior-day Close Cost |                      |
|-----------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
|                 | Implicit             | Total                | Implicit             | Total                | Implicit             | Total                |
| Trade cost      | -0.549***<br>(-3.57) | -0.429***<br>(-3.43) | -0.468***<br>(-4.12) | -0.417***<br>(-4.17) | -0.394***<br>(-6.19) | -0.362***<br>(-5.75) |
| cap2            | 0.456*<br>(1.96)     | 0.442*<br>(1.90)     | 0.467*<br>(1.96)     | 0.455*<br>(1.93)     | 0.452*<br>(1.91)     | 0.447*<br>(1.91)     |
| cap3            | -0.054<br>(-0.27)    | -0.058<br>(-0.28)    | -0.030<br>(-0.15)    | -0.038<br>(-0.19)    | -0.005<br>(-0.03)    | -0.012<br>(-0.06)    |
| cap4            | -0.256<br>(-1.26)    | -0.261<br>(-1.29)    | -0.204<br>(-1.02)    | -0.210<br>(-1.06)    | -0.168<br>(-0.82)    | -0.173<br>(-0.85)    |
| cap5            | -0.195<br>(-1.17)    | -0.202<br>(-1.20)    | -0.212<br>(-1.29)    | -0.219<br>(-1.32)    | -0.163<br>(-0.91)    | -0.170<br>(-0.95)    |
| log(TNA)*cap2   | -0.047<br>(-1.31)    | -0.044<br>(-1.25)    | -0.048<br>(-1.33)    | -0.046<br>(-1.29)    | -0.046<br>(-1.28)    | -0.045<br>(-1.26)    |
| log(TNA)*cap3   | 0.018<br>(0.61)      | 0.019<br>(0.64)      | 0.015<br>(0.52)      | 0.016<br>(0.55)      | 0.011<br>(0.38)      | 0.012<br>(0.41)      |
| log(TNA)*cap4   | 0.023<br>(0.81)      | 0.024<br>(0.85)      | 0.017<br>(0.62)      | 0.017<br>(0.64)      | 0.013<br>(0.45)      | 0.013<br>(0.47)      |
| log(TNA)*cap5   | 0.000<br>(0.01)      | 0.001<br>(0.05)      | 0.003<br>(0.13)      | 0.003<br>(0.15)      | -0.002<br>(-0.09)    | -0.002<br>(-0.06)    |
| Log(TNA)        | -0.008<br>(-0.28)    | -0.010<br>(-0.36)    | -0.003<br>(-0.10)    | -0.005<br>(-0.17)    | -0.001<br>(-0.02)    | -0.002<br>(-0.08)    |
| Lag fund return | 0.005<br>(0.27)      | 0.005<br>(0.27)      | 0.006<br>(0.31)      | 0.006<br>(0.31)      | 0.007<br>(0.34)      | 0.006<br>(0.33)      |
| Expense ratio   | -0.072<br>(-1.52)    | -0.072<br>(-1.53)    | -0.083*<br>(-1.78)   | -0.082*<br>(-1.78)   | -0.080*<br>(-1.68)   | -0.080*<br>(-1.69)   |
| Fund turnover   | -0.031<br>(-0.98)    | -0.031<br>(-1.00)    | -0.015<br>(-0.49)    | -0.014<br>(-0.44)    | -0.012<br>(-0.43)    | -0.011<br>(-0.38)    |
| Fund flow       | -0.002<br>(-0.55)    | -0.002<br>(-0.56)    | -0.003<br>(-0.66)    | -0.003<br>(-0.68)    | -0.003<br>(-0.75)    | -0.003<br>(-0.77)    |
| Log(fund age)   | -0.029<br>(-1.08)    | -0.028<br>(-1.03)    | -0.035<br>(-1.27)    | -0.034<br>(-1.22)    | -0.030<br>(-1.09)    | -0.029<br>(-1.07)    |
| Log(family TNA) | 0.016**<br>(2.43)    | 0.017**<br>(2.48)    | 0.015**<br>(2.19)    | 0.015**<br>(2.19)    | 0.018**<br>(2.32)    | 0.017**<br>(2.30)    |
| Constant        | 0.180<br>(0.84)      | 0.190<br>(0.88)      | 0.167<br>(0.80)      | 0.185<br>(0.88)      | 0.098<br>(0.43)      | 0.115<br>(0.50)      |
| Adj. R-squared  | 0.143                | 0.143                | 0.145                | 0.144                | 0.145                | 0.145                |
| Observations    | 28,704               | 28,704               | 29,078               | 29,078               | 29,045               | 29,045               |
| # of month      | 153                  | 153                  | 153                  | 153                  | 153                  | 153                  |

Panel B: Holding Stock Size and Number of Stocks

| VARIABLES       | Execution Shortfall  |                     | Open Price Cost      |                      | Prior-day Close Cost |                      |
|-----------------|----------------------|---------------------|----------------------|----------------------|----------------------|----------------------|
|                 | Implicit             | Total               | Implicit             | Total                | Implicit             | Total                |
| Trade cost      | -0.516***<br>(-2.66) | -0.344**<br>(-2.03) | -0.449***<br>(-3.60) | -0.369***<br>(-3.31) | -0.379***<br>(-5.46) | -0.333***<br>(-4.85) |
| cap2            | 0.687*<br>(1.76)     | 0.703*<br>(1.76)    | 0.622<br>(1.59)      | 0.626<br>(1.59)      | 0.625<br>(1.58)      | 0.632<br>(1.61)      |
| cap3            | 0.445<br>(1.06)      | 0.472<br>(1.10)     | 0.393<br>(0.98)      | 0.397<br>(0.98)      | 0.442<br>(1.07)      | 0.437<br>(1.05)      |
| cap4            | 0.237<br>(0.76)      | 0.266<br>(0.83)     | 0.180<br>(0.56)      | 0.183<br>(0.58)      | 0.248<br>(0.74)      | 0.245<br>(0.74)      |
| cap5            | 0.468<br>(1.52)      | 0.496<br>(1.59)     | 0.301<br>(0.96)      | 0.310<br>(1.00)      | 0.435<br>(1.31)      | 0.431<br>(1.31)      |
| log(TNA)*cap2   | -0.072<br>(-1.51)    | -0.073<br>(-1.51)   | -0.062<br>(-1.29)    | -0.063<br>(-1.30)    | -0.063<br>(-1.31)    | -0.064<br>(-1.33)    |
| log(TNA)*cap3   | -0.038<br>(-0.89)    | -0.041<br>(-0.94)   | -0.031<br>(-0.75)    | -0.032<br>(-0.76)    | -0.037<br>(-0.86)    | -0.036<br>(-0.86)    |
| log(TNA)*cap4   | -0.032<br>(-0.91)    | -0.035<br>(-0.98)   | -0.025<br>(-0.70)    | -0.026<br>(-0.73)    | -0.032<br>(-0.85)    | -0.032<br>(-0.86)    |
| log(TNA)*cap5   | -0.063*<br>(-1.79)   | -0.066*<br>(-1.85)  | -0.044<br>(-1.24)    | -0.046<br>(-1.29)    | -0.056<br>(-1.49)    | -0.057<br>(-1.50)    |
| 1/S             | 9.317<br>(1.21)      | 10.064<br>(1.28)    | 6.833<br>(0.92)      | 7.051<br>(0.94)      | 8.358<br>(1.06)      | 8.396<br>(1.06)      |
| (1/S)*cap2      | -1.296<br>(-0.12)    | -1.996<br>(-0.19)   | -0.153<br>(-0.01)    | -0.268<br>(-0.03)    | -1.111<br>(-0.11)    | -1.315<br>(-0.13)    |
| (1/S)*cap3      | -7.173<br>(-0.56)    | -7.799<br>(-0.59)   | -5.563<br>(-0.45)    | -5.603<br>(-0.45)    | -7.053<br>(-0.55)    | -6.853<br>(-0.53)    |
| (1/S)*cap4      | -8.054<br>(-0.83)    | -8.702<br>(-0.89)   | -5.444<br>(-0.56)    | -5.402<br>(-0.56)    | -7.259<br>(-0.71)    | -7.101<br>(-0.69)    |
| (1/S)*cap5      | -15.040*<br>(-1.69)  | -16.125*<br>(-1.74) | -11.052<br>(-1.31)   | -11.350<br>(-1.33)   | -14.410<br>(-1.62)   | -14.345<br>(-1.60)   |
| Log(TNA)        | 0.057*<br>(1.67)     | 0.059*<br>(1.69)    | 0.047<br>(1.41)      | 0.048<br>(1.42)      | 0.052<br>(1.45)      | 0.051<br>(1.44)      |
| Lag fund return | 0.013<br>(0.65)      | 0.013<br>(0.65)     | 0.014<br>(0.68)      | 0.013<br>(0.67)      | 0.014<br>(0.67)      | 0.013<br>(0.66)      |
| Expense ratio   | -0.039<br>(-0.77)    | -0.037<br>(-0.74)   | -0.052<br>(-1.06)    | -0.051<br>(-1.04)    | -0.056<br>(-1.16)    | -0.056<br>(-1.17)    |
| Fund turnover   | -0.012<br>(-0.37)    | -0.014<br>(-0.44)   | 0.003<br>(0.10)      | 0.003<br>(0.08)      | 0.003<br>(0.10)      | 0.003<br>(0.11)      |
| Fund flow       | -0.003<br>(-0.62)    | -0.003<br>(-0.60)   | -0.003<br>(-0.70)    | -0.003<br>(-0.72)    | -0.003<br>(-0.75)    | -0.003<br>(-0.77)    |
| Log(fund age)   | -0.035<br>(-1.36)    | -0.034<br>(-1.30)   | -0.039<br>(-1.52)    | -0.038<br>(-1.48)    | -0.038<br>(-1.43)    | -0.037<br>(-1.40)    |
| Log(family TNA) | 0.018**<br>(2.34)    | 0.018**<br>(2.40)   | 0.016**<br>(2.13)    | 0.016**<br>(2.15)    | 0.016**<br>(2.08)    | 0.016**<br>(2.06)    |
| Constant        | -0.454<br>(-1.36)    | -0.484<br>(-1.43)   | -0.337<br>(-1.04)    | -0.339<br>(-1.05)    | -0.385<br>(-1.16)    | -0.376<br>(-1.13)    |
| Adj. R-squared  | 0.162                | 0.162               | 0.165                | 0.164                | 0.165                | 0.164                |
| Observations    | 26,402               | 26,402              | 26,755               | 26,755               | 26,750               | 26,750               |
| # of month      | 153                  | 153                 | 153                  | 153                  | 153                  | 153                  |