Mutual Fund Transaction Costs*

Jeffrey A. Busse† Tarun Chordia‡ Lei Jiang§ Yuehua Tang**

May 2016

ABSTRACT

We examine institutional trade data matched to a sample of mutual funds to analyze the determinants of mutual fund trading costs. Larger funds realize lower transaction costs than smaller funds despite their larger trade sizes because they hold and trade bigger, more liquid stocks and turn over their portfolio less frequently. Smaller funds outperform larger funds on a net return basis primarily because they earn a premium by holding less liquid stocks. The two effects, transaction cost efficiency for large funds and the illiquidity premium for small funds, largely offset each other, leading to statistically indistinguishable four-factor performance.

Keywords: Mutual funds, transaction costs, fund size, fund performance

* 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.

† Jeffrey A. Busse, Goizueta Business School, Emory University, 1300 Clifton Road NE, Atlanta, GA 30322, USA; Tel: +1 404-727-0160; Email: jbusse@emory.edu.

‡ Tarun Chordia, Goizueta Business School, Emory University, 1300 Clifton Road NE, Atlanta, GA 30322, USA; Tel: +1 404-727-1620; Email: tarun.chordia@emory.edu.

§ Lei Jiang, School of Economics and Management, Tsinghua University, Beijing, 100084, China; Tel: +86 10-62797084; Email: jianglei@sem.tsinghua.edu.cn.

** Yuehua Tang, Lee Kong Chian School of Business, Singapore Management University, 50 Stamford Road #04-01, Singapore 178899; Tel. +65 6808-5475; Email yhtang@smu.edu.sg.

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.[1] This paper aims to fill this gap in the literature by analyzing mutual fund transaction costs.

The reason mutual fund transaction 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. 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 because funds worry that such information will reveal their trading strategies.

Most studies estimate mutual fund transaction costs using an algorithm provided by Keim and Madhavan (1997) (henceforth, KM). This approach, however, may not accurately reflect the trading costs over the more recent sample periods because the KM algorithm is based on a sample of 21 institutions over a short three-year sample period from 1991–1993,[2] 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.

This paper utilizes trade data from Abel Noser Solutions, a leading execution quality measurement service provider for institutional investors. The Abel Noser data span 1999–2011, a four times longer sample period than that of KM. The sample period 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 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

[1] 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."
[2] Chan and Lakonishok (1995) examine the transaction costs of 37 large investment managers over the 1986–1988 period.

transaction costs to 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 strategies vary with investment style and fund size.

We estimate transaction costs based on the difference between the executed stock price and four alternative benchmarks, including execution shortfall (Anand et al. (2012)), which uses the stock price at the time of order placement as a benchmark. These measures capture implicit trading costs associated with a fund's actual trades, including price impact and costs related to the bid-ask spread. We also use the explicit trading cost measures (commission and tax plus fee) and obtain total trading costs by summing the implicit and explicit trading cost measures.

Conditional on trading the same stock, large funds realize higher transaction costs than smaller funds because large funds transact larger dollar amounts and costs increase in trade size due to price impact. However, fund managers take transaction costs into consideration when they decide which stocks to hold in their portfolios. These considerations result in funds showing a preference for more liquid stocks as their asset base grows. Large funds hold larger, more liquid stocks, and smaller funds hold smaller, less liquid stocks. Funds in the largest TNA quintile hold stocks with a mean market capitalization (Amihud illiquidity measure) of $58.2 billion (0.29), whereas funds in the smallest TNA quintile hold stocks with a mean market capitalization (Amihud illiquidity measure) of $34.6 billion (0.33); both differences are statistically significant at the 1% level. Compared to funds with lower cash inflows, funds with higher cash inflows in a given month shift their portfolio holdings towards larger stocks over the subsequent 3, 6, 12, and 24 months. In other words, funds rebalance their portfolios towards bigger stocks as they grow. This result provides insight into the time-series dynamics of fund portfolios.

Furthermore, large funds alter their portfolios far less often than small funds, as illustrated by their lower annual turnover ratio (70%) compared to small funds (122%). By choosing stocks with greater liquidity and trading less often, larger funds experience lower transaction costs per dollar of TNA. When sorted on TNA, top quintile funds experience an annual performance drag due to total trading costs of 1.10% based on execution shortfall, whereas bottom quintile funds show an annual performance drag of 1.69%. In addition, the average annual expense ratio is 0.78% for top quintile funds and 1.51% for bottom quintile funds. Lower transaction costs and lower

expense ratios (due to economies of scale) provide large funds with a substantial cost advantage that amounts to more than 1.3% per year.

Despite these cost disadvantages, small funds outperform large funds on a net return basis (i.e., net of fund operating expenses and trading costs) because they hold smaller, less liquid stocks. The size and illiquidity premiums earned by smaller funds are larger, on average, than the cost efficiencies of larger funds. Presumably, if large funds emphasized in their portfolios the types of stocks held by smaller funds, the transaction costs would subsume any potential gain from the illiquidity premium. Even though small funds outperform large funds on a net return basis, controlling for risk or portfolio holding characteristics eliminates these advantages, such that large funds and small funds show roughly equal Carhart (1997) four-factor alphas and DGTW (Daniel et al. (1997)) benchmark-adjusted returns. This finding is consistent with Berk and Green (2004), who in equilibrium predict no relation between fund size and net alpha. Apparently, the universe of relatively illiquid stocks provides small funds the opportunity to generate just enough alpha to overcome their cost disadvantages relative to large funds. Our results thus offer insights into the specific forces underlying Berk and Green's (2004) model of active portfolio management. The illiquidity premium earned by small funds is entirely offset by larger exposures to factors and characteristics as well as higher expenses and transaction costs.

On a purely descriptive level, our precise estimates of transaction costs are interesting in their own right. At 1.57% per year on average, fund transaction costs are economically meaningful and greater than the average annual fund expense ratio of 1.17%. Furthermore, our analysis across fund style shows that growth-oriented funds realize greater transaction costs than value-oriented funds, suggesting that growth funds are more aggressive in their trades than value funds. Lastly, transaction costs are strongly persistent and negatively related to fund performance. When we sort funds into quintiles based on transaction cost estimates, the lowest transaction cost quintile shows a 1.8% to 3.7% higher annual four-factor alpha than the highest transaction 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), Bollen and Busse (2005)). Stated differently, an investor would do as well by buying low transaction cost funds as by buying funds with high past four-factor alpha. Despite these important performance implications, transaction costs are not transparent to investors. Funds

typically do not report transaction costs, and transaction costs themselves fall under far less regulatory scrutiny than expense ratios.

Prior work that studies the transaction costs of mutual funds is sparse. Wermers (2000) uses the KM algorithm to find average mutual fund transaction costs of 0.80% per year, roughly half our average estimate. 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. We find that the KM algorithm often produces negative transaction cost estimates over our sample of trades, especially for large cap stocks. 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 costs 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.[3] One common limitation of these four studies is their use of semi-annual or quarterly snapshots of portfolio holdings to infer trades when estimating fund transaction costs.

Two recent papers examine the transaction 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. 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. Frazzini, Israel, and Moskowitz (2015) analyze the trades of one large institution that operates both mutual funds and hedge funds. Consequently, they are unable to observe heterogeneity in costs across management firms or cross sectional relations between costs and fund attributes. Our paper contributes to the transaction cost literature by providing a comprehensive analysis of mutual fund transaction costs based on actual mutual fund trades. We also provide an algorithm for estimating mutual fund trading costs that incorporates both ticket- and fund-level variables.[4]

I. Data

A. Data Description

[3] 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. Lastly, Keim (1999) studies the trading costs of one DFA index fund.
[4] Other studies on trading costs of institutional investors include Chan and Lakonishok (1995), Jones and Lipson (2001), Conrad, Johnson, and Wahal (2001), Chiyachantana, Jain, Jiang, and Wood (2004), and Goldstein, Irvine, Kandel, and Weiner (2009).

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 the funds in the Morningstar and CRSP merged database of Pástor, Stambaugh, and Taylor (2015) (henceforth, PST).[5] We obtain fund investment styles (i.e., based on the three by three style box) from the Morningstar Direct database. Portfolio holdings are obtained from the Thomson Reuters Mutual Fund Holdings (formerly CDA/Spectrum S12) database, which provides portfolio holdings for all U.S. equity mutual funds, usually at a quarterly frequency.[6] 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.[7] 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 Pástor, Stambaugh, and Taylor (2015), 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.[8]

Mutual fund transactions data are obtained from Abel Noser Solutions, a leading execution quality measurement service provider for institutional investors.[9] We 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 as follows. For each manager X in the Abel Noser dataset and for each reporting period between two adjacent portfolio report dates for a manager M in the Thomson S12 data, we compute the change in

[5] 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.

[6] 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.

[7] 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).

[8] 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).

[9] 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), and Busse, Green, and Jegadeesh (2012), among others.

holdings (i.e., total trades with shares adjusted for splits and distributions) for manager X in each stock during the reporting period. We also compute split-adjusted changes in holdings by manager M for that reporting period. We then compare the change in holdings for 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 a manager name list disclosed by Abel Noser in 2011.[10]

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.

B. Variable Construction

B.1. Trading Cost Measures

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

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

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. We use four alternative prices for $Benchmark\ Price$: (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 (Frazzini, Israel, and Moskowitz (2015)), (iii) the closing price the day before the first share in the order ticket trades (KM and Frazzini, Israel, and Moskowitz (2015)), and (iv) the volume-weighted average price (i.e., VWAP) on the day after the last share in the order ticket trades. The first three cost estimates use a pre-ticket benchmark, and the last cost estimate uses a post-ticket benchmark. The latter indicates the

[10] See Agarwal, Tang, and Yang (2012) for more details on the matching procedure.

extent to which the stock price quickly reverses, as price pressure associated with the trade dissipates. The transaction cost measures capture implicit trading costs, including price impact and costs related to the bid-ask spread.

Following KM, we evaluate costs on the basis of tickets rather than individual trades. Fund managers transmit orders to the trading desk in the form of tickets. Tickets often encompass a number of individual trades, and evaluating transaction costs relative to individual trades, rather than the entire ticket, ignores the impact of the other legs of the ticket. For example, if a fund submits a ticket that executes via two separate trades over two days, evaluating the transaction cost of the second leg of the ticket relative to the beginning of the ticket, rather than the beginning of the second leg of the ticket, captures total price pressure over two days, rather than only over the second day.

We compute ticket level data as the value weighted average of the trade level data using trading volume as the weight on each trade. We stitch together trades by the same fund manager on the same stock and the same trade side that occur on consecutive trading days into tickets. We stitch a fund manager's same-side trades on a stock across consecutive days even when the trades involve more than one broker. Abel Noser groups trades into tickets only when they involve the same broker, and in many instances the data indicate separate tickets for trades that involve the same ticker, the same trade side, and the same broker but on different, but consecutive, trading days. Funds in our sample trade each stitched ticket in an average of 2.97 different trades compared to 1.26 trades per ticket based on Abel Noser's unstitched ticket definition.[11] Our approach directly impacts the price benchmark associated with a trade because all of the trades within a stitched ticket utilize the same price benchmark. In Appendix B, we examine how our stitched-ticket approach affects our main results.

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, prior-day close cost, or next-day VWAP 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 different cost measures by the dollar value of each

[11] For Abel Noser's ticket definition, as in Anand et al. (2012), we 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. See Appendix B for more details.

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. Total trading costs are obtained by adding 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.[12] 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).[13] We calculate

[12] 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.

[13] 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.

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.

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 previous month's market capitalization. We obtain book value from COMPUSTAT supplemented by book values from Ken French's website.[14] We winsorize the book-to-market ratio at the 0.5 and 99.5 percent 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 $t - 2$.[15] 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. Following Acharya and Pedersen (2005), we normalize the Amihud ratio and truncate it at 30 to eliminate the effect of outliers as follows:

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

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

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

Table I reports summary statistics of fund characteristics, holdings stock characteristics, and transaction cost measures. Panel A reports descriptive statistics by fund size quintile, where the portfolios are sorted based on the last month's TNA. Panel B reports a limited set of statistics by fund investment style, dividing funds in each style into two groups based on lagged TNA. 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

[14] See http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

[15] 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.

cross-sectional average each month across all of the funds in each fund size quintile (below/above median groups in Panel B) and then take the time-series mean of the cross-sectional averages.

[Insert Table I here]

The sample averages 198 funds per month. Sample funds average $3.0 billion in TNA, with large variation across the fund size portfolios. One concern is that mutual fund clients of Abel Noser are large and may not be representative of the universe of funds typically examined in the literature. For a point of comparison, 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. First, we find that the style composition of our sample is similar to the style composition of the PST sample (see Panel B of Table A in Appendix A). For instance, 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.

Although our fund sample does skew toward larger TNA funds, it nonetheless largely captures the heterogeneity in TNA of a standard CRSP-sourced sample, with underrepresentation among the very smallest funds and overrepresentation of large 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. Panel A of Table A in Appendix A provides a full set of the statistics that we report in this section (excluding trading costs) for the comparison sample based on the PST selection criteria.

Panel A of Table I shows that funds with larger TNA show both lower net monthly returns and lower gross monthly returns (computed by adding 1/12 of the expense ratio to net returns). The monthly average gross return (net return) declines from 0.645% (0.528%) for the smallest TNA quintile to 0.361% (0.296%) for the largest TNA quintile, with the difference significant at the 5% level. Holding return, which we compute using the most recently released quarter-end fund holdings assuming no change in holdings between quarter-end holdings releases, also declines

from an average of 0.542% per month for the smallest fund quintile to 0.326% per month for the largest fund quintile.

At first glance, the return difference between low and high TNA funds could be interpreted as being consistent with diseconomies of scale in the mutual fund industry (e.g., Chen et al. (2004) and Yan (2008)).[16] However, differences across the quintiles are mainly driven by differences in factor loadings, as the four-factor alpha decreases only mildly across the quintiles, from 0.002% for the smallest quintile to –0.019% per month for the largest quintile. The 0.021% difference in four-factor alpha across fund TNA quintiles represents less than one tenth the difference in gross or net returns (0.284% and 0.232%, respectively) and does not statistically significantly differ from zero.

We also 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. The DGTW benchmark portfolios capture roughly three quarters of the difference in returns (gross, net, or holdings-based) between small and large funds in Panel A of Table I, consistent with the idea that much of the return difference between small and large TNA funds is driven by differences in the types of stocks that they hold. Similar to the four-factor alpha difference, the 0.046% difference in DGTW-adjusted return across the quintiles is not statistically significant.

Overall, the pattern of return differences between small and large mutual funds in our sample confirms results in the prior literature that show a negative relation between fund performance and TNA, i.e., diseconomies of scale. However, the negative relation exists only before controlling for the types of stocks held by the funds, i.e., before controlling for factor or characteristic exposure.

We now examine how trading costs vary with fund size. All the implicit cost measures calculated using pre-ticket benchmark prices decrease with fund size in Panel A of Table I. Funds

[16] We note that one concern about these studies is an omitted variable bias in the relation between TNA and fund performance caused by omitting (the unknown) managerial skill, which is likely correlated with fund size as well as performance (see Pástor, Stambaugh, and Taylor (2015)). Further, since in the Berk and Green (2004) equilibrium there should be no difference in returns across small and large funds, PST advocate time series analysis to examine fund returns as a function of change in fund size.

in quintiles 1 to 5 incur annualized average transaction costs as measured by execution shortfall per TNA dollar of 1.27%, 1.52%, 1.19%, 1.43%, and 0.97%, respectively. A similar negative relation between TNA and cost exists for the open price and prior-day close cost benchmarks. Note, however, that much of the difference is driven by low costs in the largest quintile and that costs do not monotonically decrease across quintiles 1 to 4. The relation between trading costs and fund size is robust to controlling for fund styles. In Table IA.I of the Internet Appendix, we find similar patterns in trading costs across quintiles after subtracting the mean fund style statistics from the fund level statistics for each fund-month observation.

In addition, in Appendix B, we find a similar negative relation between trading costs per TNA dollar and fund size but much smaller transaction cost estimates based on Abel Noser's ticket definition, i.e., without stitching tickets. Given that each stitched ticket in our sample encompasses an average of 3.0 trades, whereas the average non-stitched ticket has 1.3 trades, it is not surprising that the transaction cost estimates in the analysis without stitching tickets are much smaller. Also note that trading costs per trade dollar in Panel A of Table B in Appendix B increase in fund size for stitched tickets but decrease in fund size for non-stitched tickets. This sharp contrast highlights that cost estimates based on non-stitched tickets are underestimated for larger, longer duration trades submitted mostly by large funds.

In Panel B of Table I, a similar negative relation between fund size and transaction costs exists across all large cap investment styles, which together comprise more than half of the fund sample and fund-month observations. The evidence is mixed among the more sparsely populated small and mid-cap styles, especially for small cap, blend, and value funds, where smaller funds have lower costs. Also note that value funds have lower transactions costs than growth funds across all size groups.

The post-ticket benchmark price is the volume-weighted average stock price the day following a ticket's last trade. Unlike the three cost measures based on pre-ticket price benchmarks, the VWAP cost measure implies a negative transaction cost, on average. An alternative interpretation, consistent with Frazzini, Israel, and Moskowitz (2015), who also briefly discuss post-trade price benchmarks, is that stock prices do not immediately revert, on average, after a fund completes its trade. This could happen if funds herd into stocks (Wermers (1999)) after the release of news, for example. That is, even when a sample fund finishes buying or selling a stock, another investor could subsequently buy or sell the same stock, causing a continuation in price.

Table I, Panel A also shows that larger funds are older, belong to larger fund families, and have lower expense and turnover ratios. The average expense ratio (annual fund operating expenses as a percentage of TNA, including management fee, administrative fee, 12b-1 fee, etc.) ranges from 1.51% for the smallest funds to 0.78% for the largest funds. The fact that larger funds have lower expenses, due to economies of scale, indicates that expenses do not explain the lower performance of larger funds. Thus, the driving force behind the lower net returns for larger funds is important enough to override the expense and transaction cost advantage of large TNA funds.

This paper is the first to provide precise estimates of mutual fund transaction 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. As an example of how our analysis captures differences in the evolution of transaction costs over time, based on the KM transaction cost algorithm, Wermers (2000) reports a mean annual transaction cost estimate of 0.80% for his sample of equity funds over 1975–1994. Over our 1999–2011 sample period, annualized transaction costs across all funds range from about 1.3% to 1.7%, depending on the pre-ticket price benchmark. After accounting for commissions, taxes, and fees, the total average annualized transaction costs range from 1.6% to 2.0%. These "hidden" costs, which typically are not reported to investors, are larger than the average annual expense ratio of 1.17%.

There are four important caveats to the interpretation of the transaction 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, the funds in our sample are those that use the services of Abel Noser to monitor trading costs and as such are likely to have costs that are lower than those of other funds. Third, some funds could have higher total transaction costs due to soft-dollar arrangements whereby research services are bundled with brokerage commissions.[17] Fourth, fund managers account for expected transaction costs when forming their portfolios. All things equal, managers prefer stocks with greater liquidity, since these stocks can be traded at lower cost. 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 transaction costs is endogenous to the fund

[17] See, e.g., Conrad, Johson, and Wahal (2001).

managers' decision to hold stocks that generate lower transaction costs, and this endogeneity likely relates to fund size.

Table I, Panel A shows that larger funds hold larger market capitalization stocks, more liquid stocks, and stocks with lower book-to-market ratios (i.e., growth stocks). Since it has been well documented that larger, more liquid, and lower book-to-market stocks are characterized by lower average returns, it is not surprising, then, to find that smaller funds show higher average returns than larger funds.[18] Consistent with this relation, note that a large fraction of the increase in stock size occurs between quintiles 4 and 5 in Panel A, which coincides with a large fraction of the difference in returns. The difference in gross returns between quintiles 1 and 4 is 0.069% while that between quintiles 4 and 5 is 0.215%. Trading costs are also not monotonic. The total execution shortfall is 1.691%, 1.673% and 1.103% across portfolio quintiles 1, 4, and 5, respectively. Thus, the large decline in trading costs and net returns coincides with a large increase in firm size between TNA quintiles 4 and 5.

Table IA.II in the Internet Appendix provides a full set of statistics for the style categories shown in Panel B of Table I. The main results in Table IA.II coincide with those noted above in Panel A of Table I. In particular, conditional on investment style, a positive relation exists between fund TNA and the mean market capitalization of stock holdings. In seven of nine investment styles, above median TNA funds show greater average portfolio holding market capitalization than funds with below median TNA, with the two exceptions in the small cap category. Second, on average, funds with larger TNA show both lower net monthly returns and lower gross monthly returns. Evidence of this pattern exists in six out of the nine fund investment styles, with value and blend (growth) categories showing lower returns for larger (smaller) TNA funds across all three market capitalization groups. Third, no statistically significant difference in four-factor alpha exists between small and large funds in any of the nine investment styles. Lastly, there is little evidence of a difference in the DGTW-adjusted return between small and large funds of the same investment style, with only low-TNA mid-cap blend funds showing statistically significant greater performance than high-TNA mid-cap blend funds. Given that large differences typically exist among the different fund styles in many of the statistics reported in Panel B of Table I and in Table IA.II, we utilize style dummy variables in our analysis.

[18] 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).

The explicit trading cost measures, including commissions, taxes, and fees per TNA dollar, are also lower for larger funds in Panel A of Table I and across most investment styles in Table IA.II. This is not surprising given that funds with higher trade volume would be able to negotiate lower per-share commissions. Thus, both the implicit and explicit trading costs decrease with TNA.

III. Results

In this section, we first use the Abel Noser trade data to more comprehensively analyze the determinants of mutual fund transaction costs. We study the effects of trade, stock, and fund characteristics on transaction costs first at the ticket level and then at the fund level. We then examine whether transaction costs affect fund performance. Lastly, we examine how fund flows affect the characteristics of stock holdings.

A. Transaction 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. In contrast to trading costs per TNA dollar, these per trade dollar costs increase with the size of the fund. Panel A of Table II shows that all three implicit cost estimates that utilize a pre-ticket benchmark price increase by approximately 16-18 basis points from funds in the smallest quintile to funds in the largest quintile. The increase in total costs, which includes commissions, taxes, and fees, is a bit smaller, ranging from 14-16 basis points. The reason why the results here contrast with the per TNA dollar results reported in Table I is because smaller funds show greater portfolio turnover than larger funds (122% per year compared to 70% per year), 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 advantage in trading costs per trade dollar results in the greater 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 three to four basis points on average. This suggests that there is 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, it is difficult to distinguish between these two explanations.

Larger funds exhibit higher transaction costs per trade dollar because their portfolio size leads to larger positions and larger stock trades. Panel A2 of Table II shows that the average ticket size of funds in the largest quintile ($6.1 million and 180,800 shares) is more than an order of magnitude larger than the average ticket size of funds in the smallest quintile ($264,000 and 9,900 shares). The mean TNA of funds in the largest quintile is more than 200 times greater than that of the smallest quintile ($13 billion vs. $46 million). Even though 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. We also see in Panel A2 that large funds take longer to trade their ticket than small funds (2.19 vs. 1.34 days). Finally, consistent with the evidence on the characteristics of stocks mutual funds hold in their portfolios, Panel A3 of Table II shows that large funds also trade larger and more liquid stocks than smaller funds. The average market capitalization of stocks traded by a quintile 5 fund ($40.0 billion) is considerably greater than the average market capitalization for a quintile 1 fund ($27.0 billion), as large funds pro-actively 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 overall transaction cost estimates in Table I and in Panel A of Table II. To control for this endogeneity between realized transaction costs and fund size, Panel B of Table II compares transaction costs of fund quintiles 1 and 5 conditional on funds in both quintiles (i.e., at least one fund) trading the same stock in a given month.[19] For each stock-month combination, we compute the ticket value-weighted trading costs for each fund quintile. Then, we average across all stocks each month and finally compute the time-series average across all sample months.[20] Since not all stocks are traded by both quintiles 1 and 5 in a given month, we utilize only 62.3% of the full sample of trade tickets (3,968,142 of them) in this analysis.

[19] 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) trade the same stock in a given month.

[20] 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

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 $4.5 million and 142,100 shares per ticket broken up into an average of 3.8 trades, while small funds average $190,000 and 6,800 shares per ticket broken up across an average of 2.1 trades. The large difference in ticket size results in a big difference in transaction cost estimates between small and large funds. Conditional on the stock traded, top TNA quintile funds experience a value-weighted execution shortfall (open price cost) of 0.61% (0.74%), which is significantly greater than the 0.25% (0.32%) execution shortfall for bottom quintile funds. The difference between the top and bottom quintiles in all three implicit cost estimates that utilize a pre-ticket benchmark price are approximately 37-50 basis points. The severe 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 II suggest that fund managers account for expected trading costs when deciding which stocks to include in their portfolios.

As further evidence that large funds incur greater transaction costs than small funds conditional on the stock traded, we report in Panel C of Table II the difference in implicit trading cost between small funds and large funds for quintiles of stocks based on market capitalization and the Amihud measure of illiquidity. This analysis examines cost differences conditional on a proxy for liquidity using the full sample of tickets, whereas the analysis in Panel B above conditions on trading the same stock using a subsample of tickets. Our goal is to assess whether stock liquidity impacts trading cost differences between large and small funds.

The negative difference across all market cap and illiquidity quintiles for the pre-ticket benchmark costs in Panel C of Table II indicates that, on average, small funds incur lower transaction costs than large funds when trading stocks of similar liquidity. Smaller funds appear to have higher transaction costs than large funds only based on the VWAP post-trade ticket benchmark cost and only for the most liquid stocks, likely because there is more continuation in prices following large trades of larger funds.

In sum, large funds incur higher trading costs on a per trade dollar basis, especially when conditioning on the liquidity of the underlying stock that is traded. However, recall from Table I that large funds realize lower overall transaction costs per TNA dollar than small funds. This

all funds in a quintile), then average across all stocks each month, and lastly average across all months.

difference in trading costs on a per trade dollar versus per TNA dollar basis obtains because (i) large funds hold and trade stocks that are less costly to trade, and (ii) they trade less.

B. Determinants of Ticket-Level Transaction Costs

We now examine how ticket-level transaction costs relate to characteristics of the stitched ticket, 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 data set allows us to analyze fund-level determinants of trading costs. The goal is to provide an algorithm for computing mutual fund transaction costs using variables at the ticket level and at the fund level.

To document how transaction costs change over calendar time, we first report estimates of execution shortfall and total costs (which include commissions, taxes, and fees) by year in Panel A of Table III. The results for the other cost estimates based on pre-ticket benchmarks, open price and prior-day close cost, are similar and are presented in Table IA.III in the Internet Appendix.[21] 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.

[Insert Table III here]

The overall average execution shortfall for all tickets amounts to 0.27%, and for buys (sells) it is 0.24% (0.30%). After accounting for commissions, taxes, and fees, the average total trading cost is 0.38%.[22] Trading costs vary somewhat by year and appear noticeably greater during periods of market uncertainty. Note, for example, the relatively large transaction costs during 2000, as the Nasdaq market initially reached its all-time high before selling off during the latter half of the year. Also note the increase in 2008, likely due to market dislocations during the financial crisis. During the heart of the financial crisis, September 2008 through March 2009, total transaction costs average 0.46%, more than two times as high as the 0.25% and 0.23% 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.[23] Note in particular the substantial increase in the cost to sell as liquidity dries up in 2000 and 2008.

[21] 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 with execution shortfall. The next-day VWAP cost does not appear to capture mean reversion in price impact.

[22] 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.

[23] See also Keim and Madhavan (1997), Anand et al. (2012), and Brennan et al. (2012).

Our transaction cost estimates at the ticket level are comparable to, but slightly larger than, 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. However, Anand et al. (2012) base their estimates on ticket identifiers provided by Abel Noser, which do not group same-stock trades that occur at the same time via different brokers. For instance, if one broker executes institution A's buy order for stock Z on one day, and another broker executes institution A's buy order for stock Z the following day, these two orders are treated as separate tickets in Abel Noser and in Anand et al. 's (2012) main results. By contrast, we stitch together all same-side trades (e.g., all buys) across brokers provided they occur on consecutive days, such that we apply the same benchmark price across all orders within the stitched ticket. Note that Anand et al. (2012) use this same procedure for aggregating into stitched tickets in robustness tests, but they do not report transaction cost statistics associated with this analysis. In Table IA.V of the Internet Appendix, we report equal-weighted average results based on Abel Noser's ticket definition, i.e., without stitching tickets. As expected, our transaction cost estimates for non-stitched tickets are smaller.

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

$$TradeCost_{i,j,k,t} = \alpha + \beta_1 TicketSize_{i,t} + \beta_2 \frac{1}{P_{k,t-1}} + \beta_3 LogMktCap_{k,t-1} + \beta_4 Nasdaq_{k,t} +$$

$$\beta_5 IVOL_{k,t-1} + \beta_6 side_{i,t} * market_t + \lambda Z_{j,t-1} + \zeta_{i,j,k,t}, \quad (4)$$

where $TradeCost_{i,j,k,t}$ is the ticket-level execution shortfall or total cost (which includes commissions, taxes, and fees) per trade dollar for stock *k* and fund *j* at time *t*, $TicketSize_{i,t}$ is the share volume of ticket *i* normalized by dividing by the average daily trading volume of the previous month,[24] $P_{k,t-1}$ 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

[24] 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.

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 during the ticket's execution, and $Z_{j,t-1}$ is a set of fund-level control variables at the end of the month prior to the ticket's first trade, including expense ratio, turnover, net flow, Log(fund age), Log(TNA), Log(family TNA), fund net return, and dummy variables to capture differences associated with fund style relative to large cap blend. We run the cross-sectional regression in (4) every month, and Panel B of Table III reports the time series average of the monthly coefficient estimates as in Fama-MacBeth (1973). Given that transaction costs persist, we adjust the Fama-MacBeth standard errors using the Newey-West (1987) correction with three lags.

Focusing first on the transaction level variables, we find that execution shortfall is strongly positively related to ticket size, the inverse of price, $IVOL$, and the stock market return and is negatively related to firm size. The strong relation between trade cost and ticket size is apparent in all of the alternative specifications for both buys and sells. Since large funds have bigger ticket sizes, they incur higher costs per trade dollar as shown in Panel A of Table II. The negative relation between trade cost and stock price is possibly a result of the higher proportional bid-ask spread amongst low price stocks. This negative relation is especially evident in the total cost results in columns (4)-(6). 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 $IVOL$ suggests that costs are higher, especially for sell transactions, for stocks with greater information uncertainty. Nasdaq stocks seem to have higher implicit trading costs but lower commissions and fees. 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, possibly due to an imperfect control for ticket size, given that larger funds trade larger tickets. Moreover, buying costs are higher for funds that belong to larger fund families, which could occur because funds in a family decide to buy stocks at the same time based on centralized research at the family level. The positive relation between costs and fund turnover obtains possibly because funds with greater turnover trade more aggressively. Costs are also higher for funds with higher expense ratios. The negative relation between fund age and costs suggests that funds are better able to manage trading costs over time.

The coefficients on the style dummies are consistent with value-oriented funds experiencing lower transaction costs than growth-oriented funds. This result is consistent with anecdotal evidence that suggests that value funds are patient, whereas growth funds are more aggressive in their trades. Large cap growth funds experience relatively high transaction costs, while small cap funds, and especially small cap value funds, realize lower transaction costs.

To assess economic significance, we focus on regression (4) of Panel B for the total cost of all trades. A one standard deviation increase in ticket size increases total trading cost by about 24.9 basis points. For stock characteristics, a one standard deviation increase in the price inverse (market capitalization) of the stock increases (decreases) total costs by 14.8 (3.5) basis points. For the fund level variables, a one standard deviation increase in Log(TNA) (fund turnover) increases total trading costs by 5.1 (4.1) basis points, while a one standard deviation increase in expense ratio (fund age) increases (decreases) cost by 5.5 (3.0) basis points. These numbers are significant in relation to the average total cost of 37.8 basis points (from Panel A of Table III).

C. Determinants of Fund-Level Transaction Costs

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

Panel A of Table IV presents fund-month level trading costs by year. We compute all of the alternative trading cost measures (execution shortfall, open-price cost, prior-day close cost, and next day VWAP cost) as before and aggregate into two measures for each fund-month: (i) per trade dollar and (ii) per TNA dollar, both unannualized. Then, we take the equally-weighted cross-sectional average across all fund-month observations in a year and report the averages by year. We

present results only for execution shortfall and report results based on the other benchmarks in Table IA.IV in the Internet Appendix. The trading cost pattern is similar to that in Panel A of Table III, with a large increase during 2000 and 2008 coinciding with periods of market uncertainty.[25]

[Insert Table IV here]

We now examine the relation between transaction costs and a number of fund level attributes in monthly Fama-MacBeth (1973) cross-sectional regressions as in equation (4), but excluding the ticket and stock level variables. Once again, we follow Newey-West (1987) to adjust the Fama-MacBeth (1973) standard errors with three lags.

Panel B of Table IV shows that larger funds realize higher transaction costs than smaller funds, as measured by execution shortfall per trade dollar. In all six specifications, the coefficient on fund TNA is positive and significant at the 1% level. By contrast, larger funds have lower transaction costs when measured by execution shortfall per TNA dollar in Panel C of Table IV. It could be argued that there is a mechanical relation between log(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. By cumulating costs across all fund trades, the results per TNA dollar account for the strong tendency of smaller funds to have higher turnover. Consistent with this argument, Panel C shows that the negative relation between fund size and transaction costs per TNA dollar disappears after controlling for turnover.

Both estimates of fund transaction costs are strongly positively correlated with the turnover ratio. This result once again suggests that high-turnover funds are less patient, and their trading aggressiveness leads to higher transaction costs. The expense ratio is positively correlated with execution shortfall per trade dollar (similar to what we find in Panel B of Table III) but negatively correlated with execution shortfall per TNA dollar, possibly because of the negative correlation between TNA and the expense ratio. Other fund specific characteristics, such as fund flow, age, family TNA, and lag fund return, show no significant relation to transaction costs. Transaction

[25] 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.

costs are highly persistent, as evidenced by the highly significant coefficient estimate on lagged trading cost and the increase in average adjusted-R^2 in the presence of lagged trading cost.

Examining the investment style dummies reveals two main effects. First, growth-oriented funds realize greater transaction costs than value-oriented funds, consistent with the results in Table III. For every market capitalization category (large cap, mid-cap, and small cap) and across all six specifications in both Panel B and Panel C, the coefficient on the growth dummy is greater than the coefficient on the value dummy. In general, the coefficient estimates on the growth (value) dummy are positive (negative) relative to the default group of large cap blend. The exception is the positive coefficient in Panel C for the small cap value category. Not surprisingly, the differences become smaller, on average, after controlling for fund level characteristics and lagged trading costs as in columns (3) and (6), since funds within particular styles often share similar characteristics. For example, small cap funds tend to have smaller TNA than large cap funds. Second, transaction costs per TNA dollar are greater for small cap styles than for large cap styles. For the growth and value categories, across all six specifications in Panel C, the coefficient on the small cap dummy is greater than the coefficient on the large cap dummy. Also, all of the coefficients on the small cap dummies are greater than zero.

D. Comparison to Keim and Madhavan (1997)

The results in Tables III and IV can be used to estimate mutual fund trading costs at the transaction level and at the fund-month level. The most commonly utilized approach for estimating fund transaction costs is based on the transaction level regressions of KM. We next compare the ticket- and fund-level transaction cost estimates based on KM with estimates based on the transaction level regression results reported in Table III. Appendix C provides the fitted regression model that we use to estimate transaction costs following KM.

Table V reports total transaction cost estimates based on the two alternative transaction cost algorithms. Panel A reports total transaction 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 0.12%, 0.59%, 2.06%, and 7.99% (i.e., the fraction of the average daily trading volume of the previous month). For market capitalization quintiles, the cutoff points are $0.88 billion, $2.40 billion, $6.76 billion, and $24.28 billion. Panel A1 reports estimates based

on KM (equations (C1) and (C2) in Appendix C). Panel A2 provides estimates of costs per trade dollar (execution shortfall) 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 B. Since KM utilize a pre-trade price benchmark (the stock's closing price the day before the first trade), we also base the transaction cost estimates that we use in Panel A2 on a pre-trade benchmark (the price at the time of order placement).[26]

[Insert Table V here]

The results in Panel A1 show multiple instances (five out of the 25 cases) where 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, the estimates of transaction cost per trade dollar increase nearly monotonically with ticket size and decrease monotonically with the market capitalization of the traded stock. In contrast, in four out of five stock size quintiles, the KM algorithm cost estimates decrease with ticket size.

Panel B reports total transaction cost estimates for funds sorted into quintiles based on TNA. Panel B1 again utilizes equations (C1) and (C2), and Panel B2 utilizes equation (4) and either ticket-level variables or both ticket- and fund-level variables. For both alternatives, 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 transaction costs across each month. Consistent with our results in Tables I and II, using the algorithm based on equation (4), per trade dollar cost estimates increase in fund TNA, and per TNA dollar cost estimates decrease in fund TNA. This is not the case with the KM algorithm, which gives a negative relation between per trade dollar cost estimates and fund TNA. Overall, our results in Table V highlight the limitations of the KM algorithm when applying it to a more recent sample period.

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 37 basis points.

[26] We obtain similar results in Panels A2 and B2 of Table V if we use the prior-day close cost measure as in KM.

E. Transaction Costs and Fund Performance

In this section, we study the impact of transaction costs on fund net performance (net of fund operating expenses and trading costs). We run monthly cross-sectional regressions of fund net returns on 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 transaction 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 Log(TNA), expense ratio, turnover, fund flow, Log(fund age), Log(family TNA), and dummy variables for fund investment styles.

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

[Insert Table VI here]

The coefficients on all four transaction cost measures are negative and significant at the 5% 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 –0.18 for implicit cost and –0.15 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 –0.38 to –0.15 in Table VI, suggest that fund managers are unable to fully recoup the cost of their transactions by moving into substantially better 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 due to private information possessed by mutual funds. If trading cost estimates reflect information,

then the coefficient estimates on trading costs should not be negative. Overall, transaction costs adversely affect fund risk-adjusted performance in the cross-section.[27]

Table VI, Panel B reports the difference in four-factor alpha between funds in the lowest transaction cost quintile and funds in the highest transaction cost quintile. For quintiles based on either implicit or total transaction costs, we find a statistically significant negative relation between transaction costs and performance regardless of the price benchmark. The negative relation between transaction 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 transaction costs is an important component of her 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 transaction cost quintile and the highest total transaction cost quintile ranges from 0.15% per month to 0.31% per month, or from 1.8% per year to 3.7% 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 transaction costs are not transparent, investors would be unable to exploit this strong relation.

Similar to evidence in prior studies (e.g., Chen et al. (2004) and Yan (2008)), the coefficient estimate on Log(Family TNA) in Panel A of Table VI is positive and significant, suggesting that funds belonging to larger fund families earn higher returns, possibly because larger fund families are able to nurture and develop their managers by providing exposure to many different kinds of funds. Consistent with results in Table I, Panel A, we find no evidence that funds in our sample show statistically significant diminishing returns to scale when examining risk-adjusted performance, as the coefficient on log(TNA) is negative but insignificant.

This lack of evidence for diseconomies of scale is significant because it is what we should find in equilibrium according to Berk and Green (2004). The Berk and Green model reconciles the

[27] 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 transaction 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.

puzzling behavior of performance chasing with the lack of superior mutual fund performance. They argue that fund managers have differential ability, which leads to the positive relation between past fund performance and cash inflows. One crucial assumption in the Berk and Green model is that mutual funds experience decreasing returns to scale. In equilibrium, funds grow to the point where managers, even with differential ability, are unable to outperform benchmarks. Thus, in equilibrium, we should find no evidence of differential performance across fund size, and we do not.

While the differential ability in Berk and Green (2004) refers to stock picking skill, it could also refer to skill in managing transactions costs. In such a model, funds with transaction costs that increase less with trade size would have a larger equilibrium size than funds that are subject to a more severe decreasing returns to scale trading cost function.[28] Further, in equilibrium there should be no difference in the risk adjusted returns of large and small funds. Our results are consistent with this alternative interpretation of the Berk and Green model. In our sample, larger funds have lower transactions costs per TNA dollar because they hold and trade larger, more liquid stocks and they trade far less than smaller funds. Moreover, there is no difference in four factor alpha or DGTW adjusted return between large and small funds.

F. Fund Flows and the Change in Holding Stock Size

Managing transaction costs could be particularly important for funds that increase in size over time. In this section, we examine the impact of fund flows on the type of stocks that funds choose to hold in their portfolios. The hypothesis is that as funds become bigger due to inflows, they tilt their portfolios towards larger stocks in order to manage their trading costs.

We do not need transactions cost data in this analysis and can utilize Thomson S12 data, which begin 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 monthly, 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

[28] We thank an anonymous referee for suggesting this interpretation.

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.

[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%). Further, 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,

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

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

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; $\widehat{\omega}_{i,j,t}$ 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,

$$\Delta StockSize_{i,t,t+k} = \alpha + \beta_1 \, Flow_{i,t-1,t} + \lambda \mathrm{X}_{i,t} + \epsilon_{i,t,t+k}, \tag{7}$$

and

$$\Delta StockSize_{i,t,t+k} = \alpha + \beta_1 \, PosFlow_{i,t-1,t} * Flow_{i,t-1,t} + \beta_2 \, NegFlow_{i,t-1,t} * Flow_{i,t-1,t} + \lambda \mathrm{X}_{i,t} + \epsilon_{i,t,t+k}, \tag{8}$$

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 $\mathrm{X}_{i,t}$ 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 with three lags.

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 flows and changes in the

market capitalization of holdings, which 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 $\widehat{\omega}_{i,j,t}$ 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 are positively correlated 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.

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 the initial investments quickly into smaller stocks, since, 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

Mutual fund transaction costs vary considerably as a function of trade size and the liquidity of the traded stock. We find that large funds underperform small funds because of their preference for large cap stocks and liquid stocks. 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 insight into the competitive equilibrium of 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 asset scale. Whereas new, small funds are unable to compete with big funds on expenses, they make up for the expense disadvantage by accessing an investment pool that, despite higher transaction costs, generates higher net returns. Nonetheless, on the basis of risk-adjusted performance, investing in less liquid stocks only allows small funds to offset their cost disadvantage relative to large cap funds, resulting in no statistically significant difference in four-factor alpha across TNA-quintiles, consistent with the prediction of Berk and Green (2004).

Beyond providing insight into Berk and Green (2004), our results shed light on the evolution of fund strategies as a function of assets under management. Small funds' preference for less-liquid holdings lead to relatively high estimates of CAPM alpha. Since fund investors are especially sensitive to CAPM alpha (Berk and van Binsbergen (2016)), funds that hold less liquid stocks increase in size because their strong CAPM alpha performance leads to cash inflows. 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, beyond predictions related to Berk and Green (2004), 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)

Table A, Panel A reports summary statistics for the comparison sample based on the selection criteria of Pástor, Stambaugh, and Taylor (2015). Pástor, Stambaugh, and Taylor (2015) 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.

Appendix B: Stitched vs. Non-Stitched Ticket Analysis

We base our analysis on stitched tickets, where we aggregate a fund's same-side trades that occur on consecutive days. Institutions commonly break up large orders into trades executed on different days and via different brokers. Our view is that stitching these trades into one ticket best captures the transaction costs associated with this practice. Nonetheless, other recent papers (e.g., Anand et al. (2012) and Frazzini, Israel, and Moskowitz (2015)) focus their analysis on transaction costs that are estimated from the trades that execute via one broker and typically over shorter periods of time. For instance, Anand et al. (2012) emphasize results based on an average of 2.1 trades per ticket, and Frazzini, Israel, and Moskowitz (2015), who don't indicate whether different brokers execute the trades of their large institutional investor, report a trade duration of 1.1 days in their sample. By contrast, our stitched ticket analysis averages 3.0 trades per ticket and a ticket duration of 1.7 days.

Here we examine whether our main findings are sensitive to our decision to utilize stitched tickets rather than using Abel Noser's (non-stitched) ticket definition, which does not aggregate into a single ticket a fund's trades when they execute via different brokers. For the non-stitched ticket definition, as in Anand et al. (2012), we 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. We find a 99.6% match of trades to tickets and discard the remaining 0.4%. Table B reports transaction cost estimates and trade statistics based on these two alternative ticket definitions. The

first five columns of statistics in the table utilize the stitched ticket definition that we use elsewhere in the paper, whereas the last five columns of statistics utilize the ticket definition of Abel Noser.

In Panel A, note that, as expected, the stitched-ticket transaction cost estimates are uniformly higher than the non-stitched ticket estimates. The differences are economically large, with the stitched ticket cost estimates approximately double the non-stitched estimates. For example, based on the stitched (non-stitched) ticket definition, the total execution shortfall estimate is 1.57% (0.78%). These differences highlight the sensitivity of cost estimates to these alternative methodologies. Panel B indicates that stitched tickets are approximately three times the size of non-stitched tickets, and they comprise more than twice as many trades (2.97 vs. 1.26, on average). The average trade duration is 1.7 days for stitched tickets and 1.0 days for non-stitched tickets.

Also note a slight difference in the relation between fund size and transaction costs that depends on the ticket definition. With stitched tickets, small funds realize a transaction cost advantage relative to large funds on a trade dollar basis. This effect is likely attributable to the smaller average ticket size of small funds, which is especially apparent when trades are aggregated into stitched tickets. When we use the alternative ticket definition provided by Abel Noser, ticket size drops more precipitously for large funds than for small funds, and small funds completely lose their per trade dollar transaction cost advantage. However, since the transaction cost per TNA dollar measures aggregate costs across trades, and small funds trade more frequently than large funds, the net effect of the reduction in ticket size is an even stronger overall transaction cost advantage for large funds compared to small funds under the alternative Abel Noser ticket definition. Thus, our key finding that large funds realize smaller transaction costs than small funds is robust to this important change in methodology.

We also use our alternative transaction cost estimates to examine determinants of transaction costs at the ticket level and at the fund level. We report the results of these analyses in the Internet Appendix in Tables IA.V-VI. All of the key relations described earlier (in particular, the positive relation between per trade dollar transaction cost and stock illiquidity and the negative relation between per TNA dollar transaction cost and fund size) remain statistically significant.

Finally, we repeat our cross-sectional analysis that examines the relation between fund performance and transaction costs. Table IA.VII in the Internet Appendix reports the results based on the Abel Noser definition of ticket. Our earlier finding that fund performance is negatively

related to transaction costs in the cross section remains statistically significant when utilizing transaction cost estimates based on non-stitched tickets.

Appendix C: Keim and Madhavan (1997) Transaction Cost Algorithm

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

$$C_{i,t}^{B} = 0.767 + 0.336D_{i,t}^{Nasdaq} + 0.092Trsize_{i,t} - 0.084Log\left(mcap_{i,t}\right) + 13.807\left(\frac{1}{P_{i,t}}\right) + 0.492D_{i,t}^{Tech} + 0.305D_{i,t}^{Index}, \quad \text{(C1)}$$

and

$$C_{i,t}^{S} = 0.505 + 0.058D_{i,t}^{Nasdaq} + 0.214Trsize_{i,t} - 0.059Log\left(mcap_{i,t}\right) + 6.537\left(\frac{1}{P_{i,t}}\right) + 0.718D_{i,t}^{Tech} + 0.432D_{i,t}^{Index}, \quad \text{(C2)}$$

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 Selection Criteria from Pástor, Stambaugh, and Taylor (2015)

Panel A of this table 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. The sample period is January 1999 through September 2011. We first sort the 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

		Mutual Fund Size Quintile						
Variables	All Funds	1 (Small)	2	3	4	5 (Large)	Diff:1-5	*t*-stat.
Number of funds	1,673	335	335	335	335	334		
TNA ($ million)	1,227	34	98	241	629	5,140	-5,106***	(-70.06)
Fund Return Breakdown								
Gross return (%)	0.518	0.649	0.565	0.511	0.485	0.379	0.270***	(4.82)
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)
Holdings-based return (%)	0.495	0.601	0.522	0.499	0.485	0.371	0.230***	(3.81)
DGTW benchmark return (%)	0.437	0.491	0.474	0.452	0.426	0.347	0.144***	(3.29)
DGTW adjusted return (%)	0.050	0.102	0.042	0.039	0.050	0.020	0.081*	(1.94)
Holdings Characteristics								
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)
Other Fund Characteristics								
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)
Fund flow (%)	0.871	2.756	0.820	0.470	0.290	0.014	2.742***	(20.95)
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)

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
PST Sample										
Number of fund-month obs.	53,136	46,420	38,209	32,098	16,873	18,135	24,207	14,912	12,046	25,6036
% 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
Abel Noser Sample										
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
% of Abel Noser Sample out of PST Sample										
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%

Table B: Fund Level Transaction Cost Comparison: Stitched vs. Non-Stitched Tickets

This table compares fund level trading costs and other trade statistics for costs estimated relative to the order ticket using two different ticket definitions. Non-stitched tickets use tickets defined in the Abel Noser database. Stitched tickets aggregate same-ticker, same side trades across consecutive days, regardless of the broker. We calculate the execution shortfall, open price cost, prior-day close cost, and next-day VWAP cost measures from the Abel Noser institutional trading data using equation (1). We aggregate the transaction costs into transaction costs per TNA dollar as described in Table I. We aggregate transaction costs into transaction costs per trade dollar and trade statistics as described in Table II. Statistical significance of one, five, and ten percent are indicated by ***, **, and * respectively.

Panel A: Transaction Costs

	Stitched Tickets					Non-Stitched Tickets				
	All	1 (Small)	5 (Large)	Diff: 1-5	*t*-stat	All	1 (Small)	5 (Large)	Diff: 1-5	*t*-stat
Fund Transaction Costs per TNA Dollar										
Execution shortfall (%)	1.277	1.273	0.970	0.303***	(5.23)	0.501	0.628	0.184	0.444***	(18.19)
Open price (%)	1.512	1.611	1.188	0.423***	(5.34)	0.661	0.887	0.335	0.552***	(13.23)
Prior-day close (%)	1.658	1.736	1.337	0.399***	(3.80)	0.813	1.045	0.453	0.591***	(8.98)
VWAP, t+1 (%)	-0.198	-0.243	-0.159	-0.083	(-1.31)	-0.184	-0.249	-0.129	-0.120**	(-2.52)
Total, exec. Shortfall (%)	1.571	1.691	1.103	0.588***	(9.29)	0.778	1.020	0.305	0.715***	(24.55)
Total, open price cost (%)	1.805	2.034	1.322	0.712***	(8.52)	0.936	1.280	0.455	0.825***	(18.32)
Total, prior-day close (%)	1.956	2.166	1.469	0.697***	(6.43)	1.088	1.443	0.573	0.870***	(12.71)
Total, VWAP, t+1 (%)	0.097	0.183	-0.027	0.210***	(3.25)	0.096	0.161	-0.009	0.170***	(3.56)
Fund Transaction Costs per Trade Dollar										
Execution shortfall (%)	0.407	0.295	0.453	-0.159***	(-7.51)	0.139	0.140	0.066	0.074***	(7.89)
Open price (%)	0.449	0.349	0.530	-0.181***	(-6.85)	0.165	0.177	0.120	0.057***	(3.93)
Prior-day close (%)	0.436	0.357	0.521	-0.163***	(-4.45)	0.157	0.197	0.093	0.104***	(4.11)
VWAP, t+1 (%)	-0.108	-0.097	-0.147	0.050*	(1.97)	-0.093	-0.085	-0.120	0.034*	(1.69)
Total, exec. Shortfall (%)	0.535	0.420	0.558	-0.138***	(-6.48)	0.266	0.265	0.169	0.096***	(10.11)
Total, open price cost (%)	0.577	0.474	0.634	-0.160***	(-6.01)	0.291	0.302	0.222	0.080***	(5.49)
Total, prior-day close (%)	0.564	0.483	0.624	-0.141***	(-3.84)	0.285	0.324	0.196	0.127***	(5.08)
Total, VWAP, t+1 (%)	0.020	0.029	-0.044	0.073***	(2.87)	0.034	0.041	-0.017	0.057***	(2.83)

Panel B: Trade Statistics

	Stitched Tickets					Non-Stitched Tickets				
	All	1 (Small)	5 (Large)	Diff: 1-5	*t*-stat	All	1 (Small)	5 (Large)	Diff: 1-5	*t*-stat
Tickets per fund month	129	92	166	-75***	(-18.80)	295	151	510	-359***	(-30.11)
Ticket size ($ thousands)	2,252	264	6,086	-5,822***	(-50.34)	893	179	2,061	-1,882***	(-62.29)
Ticket size (shares thousands)	71.4	9.9	180.8	-170.9***	(-56.81)	28.3	6.4	61.0	-54.6***	(-70.30)
Trades per ticket	2.97	2.05	4.09	-2.05***	(-24.23)	1.26	1.22	1.13	0.09***	(4.39)
Ticket duration (days)	1.66	1.34	2.19	-0.85***	(-39.67)	1.00	1.00	1.00	0.00	(0.00)

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 Singapore Management University.

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, 223–49.

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.

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 Relative Efficiency of Various Portfolios: Some Further Evidence: Discussion, *Journal of Financial Economics* 9, 3–18.

Berk, Jonathan and Richard Green, 2004, Mutual Fund Flows and Performance in Rational Markets, *Journal of Political Economy* 112, 1269–1295.

Berk, Jonathan and Jules van Binsbergen, 2016, Assessing Asset Pricing Models Using Revealed Perference, *Journal of Financial Economics* 119, 1–23.

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, 713–35.

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, 865–94.

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* 46, 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.

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 James MacBeth, 1973, Risk, Return, and Equilibrium: Empirical Tests, *Journal of Political Economy* 81, 607–636.

Ferson, 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 Mark Lipson, 2001, Sixteenths: Direct Evidence on Institutional Execution Costs, *Journal of Financial Economics* 59, 253–78.

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.

Puckett, Andy and Xuemin Yan, 2011, The Interim Trading Skills of Institutional Investors, *Journal of Finance* 66, 601–33.

Sirri, Erik and Peter Tufano, 1998, Costly Search and Mutual Fund Flows, *Journal of Finance* 53, 1589–1622.

Wermers, Russ, 1999, Mutual Fund Herding and the Impact on Stock Prices, *Journal of Finance* 54, 581–622.

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 transaction 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. In Panel A, we first sort the 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. In Panel B, we categorize funds by investment style. We first sort the 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. Number of funds is the average number of funds each month in each portfolio. TNA is the sum of assets under management across all share classes of a fund. Fund age is the age of the oldest share class in the fund. We compute gross return by adding one-twelfth of the annual expense ratio to the monthly net fund returns. 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-month and the factor returns during that month. Holding return is the value-weighted average return based on a fund's portfolio holdings from the Thomson S12 database. DGTW adjusted return and DGTW benchmark return are the Daniel et al. (1997, DGTW) benchmark-adjusted returns of a fund and its benchmark returns, respectively. 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, 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 are the value weighted averages across all share classes. Family TNA 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, prior-day close cost, and next-day VWAP 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 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 transaction 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: Sample Statistics by Quintile

Variables	All Funds	Mutual Fund Size Quintile 1 (Small)	2	3	4	5 (Large)	Diff:1-5	*t*-stat.
Number of funds	198	40	40	40	40	39		
TNA ($ million)	3,029	46	184	518	1,594	12,955	-12,909***	(-40.46)
Fund Return Breakdown								
Gross return (%)	0.540	0.645	0.539	0.576	0.576	0.361	0.284**	(2.53)
Net shareholder return (%)	0.445	0.528	0.430	0.480	0.489	0.296	0.232**	(2.13)
Four-factor alpha (%)	-0.009	0.002	-0.041	0.005	0.019	-0.019	0.021	(0.30)
Holdings-based return (%)	0.492	0.542	0.513	0.577	0.507	0.326	0.216	(1.53)
DGTW benchmark return (%)	0.403	0.460	0.423	0.441	0.403	0.287	0.174**	(2.33)
DGTW adjusted return (%)	0.074	0.075	0.068	0.111	0.089	0.029	0.046	(0.52)
Fund Transaction Costs per TNA Dollar								
Execution shortfall (%)	1.277	1.273	1.517	1.188	1.429	0.970	0.303***	(5.23)
Open price (%)	1.512	1.611	1.735	1.406	1.617	1.188	0.423***	(5.34)
Prior-day close (%)	1.658	1.736	1.898	1.493	1.819	1.337	0.399***	(3.80)
VWAP, t+1 (%)	-0.198	-0.243	-0.235	-0.137	-0.216	-0.159	-0.083	(-1.31)
Commission (%)	0.280	0.410	0.366	0.261	0.234	0.127	0.283***	(31.64)
Tax and fee (%)	0.006	0.006	0.012	0.006	0.004	0.002	0.004***	(7.15)
Total, execution shortfall (%)	1.571	1.691	1.913	1.458	1.673	1.103	0.588***	(9.29)
Total, open price cost (%)	1.805	2.034	2.127	1.676	1.858	1.322	0.712***	(8.52)
Total, prior-day close (%)	1.956	2.166	2.301	1.769	2.065	1.469	0.697***	(6.43)
Total, VWAP, t+1 (%)	0.097	0.183	0.159	0.137	0.029	-0.027	0.210***	(3.25)
Holdings Stock Characteristics								
Stock size ($ billion)	43.2	34.6	37.0	41.7	44.0	58.2	-23.7***	(-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)
Other Fund Characteristics								
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)
Fund flow (%)	0.689	2.072	0.843	0.353	0.265	-0.113	2.186***	(7.75)
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: Sample Statistics by Investment Style

	Growth				Blend				Value			
Variables	1 (Small)	2 (Large)	Diff: 1-2	*t*-stat.	1 (Small)	2 (Large)	Diff: 1-2	*t*-stat.	1 (Small)	2 (Large)	Diff: 1-2	*t*-stat.
					B1. Large Cap Funds							
TNA ($ million)	303	7,508	-7,205***	(-49.02)	258	9,995	-9,737***	(-21.93)	218	7,481	-7,263***	(-24.93)
Transaction Costs per TNA Dollar												
Total, exec. shortfall (%)	1.848	1.456	0.391***	(4.08)	1.624	1.051	0.572***	(5.99)	1.162	0.798	0.364***	(4.24)
Total, open price cost (%)	2.230	1.563	0.667***	(5.57)	2.202	1.411	0.791***	(6.48)	1.292	0.922	0.370***	(3.99)
Total, prior-day close (%)	2.677	1.867	0.809***	(4.83)	2.572	1.735	0.837***	(5.55)	1.329	0.905	0.424***	(3.55)
Total, VWAP, t+1 (%)	-0.042	-0.090	0.047	(0.67)	0.175	-0.042	0.217***	(2.71)	0.273	0.009	0.264***	(3.62)
					B2. Mid Cap Funds							
TNA ($ million)	198	2,863	-2,665***	(-33.09)	145	4,273	-4,129***	(-15.56)	114	2,591	-2,477***	(-21.34)
Transaction Costs per TNA Dollar												
Total, exec. shortfall (%)	2.139	2.244	-0.105	(-0.57)	1.982	1.164	0.819***	(4.67)	1.157	0.904	0.254**	(2.49)
Total, open price cost (%)	2.535	2.770	-0.235	(-0.98)	2.346	1.204	1.142***	(4.94)	0.921	0.922	-0.001	(-0.01)
Total, prior-day close (%)	2.925	2.986	-0.061	(-0.21)	2.161	0.924	1.237***	(4.14)	0.642	0.772	-0.129	(-0.71)
Total, VWAP, t+1 (%)	0.107	0.097	0.010	(0.09)	0.118	0.001	0.117	(0.77)	0.116	0.214	-0.098	(-0.83)
					B3. Small Cap Funds							
TNA ($ million)	235	2,401	-2,167***	(-38.64)	216	2,296	-2,080***	(-12.11)	161	1,740	-1,579***	(-19.77)
Transaction Costs per TNA Dollar												
Total, exec. shortfall (%)	4.113	2.712	1.401***	(4.76)	1.176	1.721	-0.545**	(-2.18)	1.872	2.319	-0.448*	(-1.74)
Total, open price cost (%)	4.967	2.912	2.055***	(5.58)	1.231	1.917	-0.686**	(-2.04)	1.450	2.152	-0.702**	(-2.13)
Total, prior-day close (%)	5.607	3.153	2.455***	(5.29)	1.166	1.735	-0.568	(-1.35)	0.459	2.028	-1.569***	(-3.24)
Total, VWAP, t+1 (%)	0.005	0.720	-0.715***	(-3.03)	0.183	0.210	-0.027	(-0.21)	0.391	0.446	-0.055	(-0.30)

Table II: Mutual Fund Trading Costs per Trade Dollar

Panel A of this table 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, prior-day close cost, and next-day VWAP 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, trades per ticket, and the total ticket duration. 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 all 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, trades per ticket, and the total ticket duration 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. Panel C reports implicit trading costs on a per trade dollar basis for tickets independently double sorted by previous month-end fund TNA and stock liquidity/illiquidity. We only report the differences between TNA quintiles 1 (small) and 5 (large) within each quintile, sorted based on stock market capitalization in Panel C1 or stock Amihud Illiquidity measure in Panel C2. Each month, we first compute the value-weighted trading costs across tickets from any fund in a fund quintile and on any stock in a liquidity quintile. We then take the difference between fund quintiles 1 and 5 for each liquidity quintile each month and lastly 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

		Mutual Fund Size Quintile						
Variables	All Funds	1 (Small)	2	3	4	5 (Large)	Diff:1-5	*t*-stat.
				A1. Trading Costs per trade dollar				
Execution shortfall (%)	0.407	0.295	0.401	0.384	0.501	0.453	-0.159***	(-7.51)
Open price (%)	0.449	0.349	0.435	0.425	0.510	0.530	-0.181***	(-6.85)
Prior-day close (%)	0.436	0.357	0.426	0.382	0.493	0.521	-0.163***	(-4.45)
VWAP, t+1 (%)	-0.108	-0.097	-0.102	-0.079	-0.116	-0.147	0.050*	(1.97)
Total, execution shortfall (%)	0.535	0.420	0.547	0.522	0.628	0.558	-0.138***	(-6.48)
Total, open price (%)	0.577	0.474	0.581	0.563	0.636	0.634	-0.160***	(-6.01)
Total, prior-day close (%)	0.564	0.483	0.572	0.522	0.620	0.624	-0.141***	(-3.84)
Total, VWAP, t+1 (%)	0.020	0.029	0.044	0.058	0.010	-0.044	0.073***	(2.87)
				A2. Trade Statistics				
Tickets per fund month	129	92	112	111	165	166	-75***	(-18.80)
Ticket size ($ thousands)	2,252	264	740	1,392	2,842	6,086	-5,822***	(-50.34)
Ticket size (shares thousands)	71.4	9.9	27.7	48.9	91.6	180.8	-170.9***	(-56.81)
Trades per ticket	2.97	2.05	2.33	2.69	3.70	4.09	-2.05***	(-24.23)
Ticket duration (days)	1.66	1.34	1.44	1.55	1.81	2.19	-0.85***	(-39.67)
				A3. Trading Stock Characteristics				
Stock size ($ billion)	31.7	27.0	26.9	31.6	33.2	40.0	-13.1***	(-15.52)
B/M ratio	0.463	0.493	0.480	0.483	0.439	0.420	0.073***	(10.07)
Momentum (%)	11.88	10.18	11.17	12.60	13.74	11.72	-1.54*	(-1.97)
Amihud illiquidity	0.315	0.317	0.345	0.316	0.314	0.284	0.033***	(5.63)

Panel B: Tickets Conditional on Trading Same Stock

Variables	Fund Size Quintile 1 (Small)	5 (Large)	Diff:1-5	*t*-stat.
B1. Trading Costs per Trade Dollar				
Execution shortfall (%)	0.247	0.614	-0.367***	(-21.24)
Open price (%)	0.321	0.744	-0.423***	(-18.33)
Prior-day close (%)	0.347	0.846	-0.500***	(-18.03)
VWAP, t+1 (%)	-0.059	-0.095	0.036*	(1.79)
Total, execution shortfall (%)	0.356	0.724	-0.368***	(-20.72)
Total, open price (%)	0.430	0.855	-0.425***	(-18.15)
Total, prior-day close (%)	0.455	0.957	-0.502***	(-17.86)
Total, VWAP, t+1 (%)	0.050	0.017	0.034*	(1.69)
B2. Trade Statistics				
Ticket size ($ thousands)	190	4,532	-4,342***	(-37.97)
Ticket size (shares thousands)	6.8	142.1	-135.3***	(-46.90)
Trades per ticket	2.08	3.81	-1.73***	(-20.60)
Ticket duration (days)	1.36	2.26	-0.90***	(-30.24)

Panel C: Tickets Sorted in Quintiles based on Stock Size or Amihud Illiquidity

	Transaction Cost Difference Between Small and Large Fund Quintiles				
	1 (Low)	2	3	4	5 (High)
C1. Stock Size					
Execution shortfall (%)	-0.438***	-0.791***	-0.735***	-0.527***	-0.340***
	(-3.57)	(-9.44)	(-9.20)	(-12.35)	(-9.32)
Open price (%)	-0.394**	-0.861***	-0.773***	-0.601***	-0.426***
	(-2.23)	(-7.54)	(-7.98)	(-10.00)	(-8.56)
Prior-day close (%)	-0.304	-0.926***	-0.809***	-0.678***	-0.522***
	(-1.47)	(-6.91)	(-7.22)	(-9.04)	(-7.49)
VWAP, t+1 (%)	-0.062	-0.003	-0.076	0.022	0.086***
	(-0.46)	(-0.03)	(-0.97)	(0.57)	(2.98)
C2. Amihud Illiquidity					
Execution shortfall (%)	-0.344***	-0.542***	-0.767***	-0.722***	-0.237*
	(-10.09)	(-10.56)	(-9.61)	(-7.08)	(-1.74)
Open price (%)	-0.429***	-0.606***	-0.790***	-0.815***	-0.227
	(-9.08)	(-8.99)	(-8.30)	(-5.65)	(-1.27)
Prior-day close (%)	-0.527***	-0.660***	-0.871***	-0.843***	-0.106
	(-7.83)	(-8.99)	(-7.52)	(-4.88)	(-0.49)
VWAP, t+1 (%)	0.076***	0.031	-0.019	0.045	-0.071
	(2.81)	(0.83)	(-0.26)	(0.47)	(-0.53)

Table III: Determinants of Ticket Level Transaction Costs

Panel A of this table 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 at the ticket level on the trade and fund level variables as shown in equation (4). Ticket Size is the share volume of a ticket normalized by dividing by the average daily trading volume of the previous month. Price inverse is defined as one over the closing price of the trading day prior to the order placement date. Log(mktcap) is the logarithm of market capitalization (in million dollars) of the traded stock at the previous month-end. Nasdaq is a dummy variable for stocks listed on Nasdaq stock exchange. All fund level independent variables are defined in Table I and lagged by one month. 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) with three lags. 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	170,956	0.517	0.609	83,042	0.443	0.533	87,914	0.588	0.681
2000	225,940	0.520	0.605	118,381	0.408	0.493	107,559	0.643	0.729
2001	243,305	0.418	0.531	138,845	0.372	0.484	104,460	0.478	0.592
2002	257,992	0.338	0.530	140,544	0.222	0.401	117,448	0.478	0.684
2003	318,754	0.279	0.457	177,851	0.321	0.491	140,903	0.225	0.413
2004	361,200	0.230	0.367	206,946	0.220	0.342	154,249	0.243	0.401
2005	415,077	0.206	0.328	216,843	0.200	0.307	198,234	0.212	0.351
2006	419,146	0.205	0.285	226,541	0.192	0.266	192,605	0.220	0.307
2007	381,593	0.174	0.249	200,721	0.124	0.193	180,872	0.229	0.311
2008	422,624	0.280	0.365	217,011	0.137	0.219	205,613	0.433	0.519
2009	426,122	0.212	0.327	208,142	0.269	0.380	217,980	0.158	0.276
2010	234,809	0.129	0.226	113,187	0.161	0.254	121,622	0.100	0.200
2011	105,420	0.113	0.196	53,976	0.113	0.191	51,444	0.114	0.202
2008m9-2009m3	287,916	0.348	0.461	144,473	0.154	0.264	143,443	0.542	0.661
All	3,982,938	0.265	0.378	2,102,030	0.235	0.341	1,880,903	0.300	0.419

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

	Implicit			Total		
	All	Buy	Sell	All	Buy	Sell
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Ticket size	1.632***	1.535***	1.643***	1.684***	1.589***	1.692***
	(22.16)	(17.80)	(16.96)	(23.05)	(18.39)	(17.49)
Price inverse	0.861***	0.571***	0.999***	2.813***	2.481***	2.995***
	(5.35)	(3.04)	(5.17)	(18.18)	(13.30)	(16.52)
Log(mktcap)	-0.019***	-0.036***	-0.001	-0.019***	-0.037***	0.000
	(-6.64)	(-9.11)	(-0.14)	(-6.42)	(-9.29)	(0.06)
Nasdaq	0.015*	0.020*	0.010	-0.020***	-0.013	-0.027**
	(1.76)	(1.95)	(0.75)	(-3.15)	(-1.24)	(-2.57)
IVOL	0.052***	0.027***	0.083***	0.056***	0.031***	0.089***
	(8.57)	(3.32)	(7.97)	(9.16)	(3.73)	(8.38)
Side*market	0.363***	0.381***	0.333***	0.363***	0.380***	0.334***
	(32.59)	(32.25)	(27.55)	(32.40)	(32.15)	(27.14)
Log(TNA)	0.024***	0.023***	0.025***	0.026***	0.025***	0.026***
	(5.49)	(4.62)	(5.60)	(5.63)	(4.93)	(5.49)
Expense ratio	0.107***	0.138***	0.066***	0.120***	0.149***	0.080***
	(6.79)	(6.49)	(3.46)	(7.68)	(7.00)	(4.21)
Fund turnover	0.063***	0.078***	0.044***	0.057***	0.076***	0.034***
	(6.18)	(6.63)	(4.13)	(5.12)	(5.98)	(2.96)
Fund flow	-0.001	-0.001	0.001	-0.001	-0.001	0.001
	(-1.50)	(-0.73)	(0.70)	(-1.31)	(-0.59)	(0.80)
Log(fund age)	-0.035***	-0.028***	-0.047***	-0.032***	-0.024***	-0.046***
	(-4.42)	(-3.31)	(-5.09)	(-3.80)	(-2.64)	(-4.75)
Log(family TNA)	0.012***	0.019***	0.005	0.002	0.011***	-0.006*
	(3.52)	(5.00)	(1.58)	(0.64)	(2.83)	(-1.84)
Lag fund return	-0.001	-0.000	-0.002	-0.001	-0.001	-0.003
	(-0.27)	(-0.10)	(-0.82)	(-0.37)	(-0.16)	(-0.93)
Large cap growth	0.043***	0.028	0.063***	0.046***	0.027	0.069***
	(2.65)	(1.63)	(3.39)	(2.86)	(1.61)	(3.79)
Large cap value	-0.050**	-0.057**	-0.047**	-0.060***	-0.062***	-0.061***
	(-2.57)	(-2.49)	(-2.19)	(-3.13)	(-2.82)	(-2.79)
Mid cap blend	-0.099**	-0.133***	-0.063	-0.115**	-0.143***	-0.084*
	(-2.13)	(-2.70)	(-1.26)	(-2.55)	(-3.01)	(-1.70)
Mid cap growth	-0.010	-0.049**	0.030	-0.010	-0.043*	0.024
	(-0.56)	(-2.16)	(1.36)	(-0.53)	(-1.82)	(1.13)
Mid cap value	-0.036*	-0.030	-0.030	-0.040*	-0.022	-0.044
	(-1.70)	(-1.21)	(-1.15)	(-1.75)	(-0.86)	(-1.58)
Small cap blend	-0.024	-0.052	0.010	-0.049*	-0.078**	-0.009
	(-0.77)	(-1.36)	(0.32)	(-1.66)	(-2.16)	(-0.28)
Small cap growth	-0.140***	-0.177***	-0.094***	-0.149***	-0.185***	-0.104***
	(-4.10)	(-4.03)	(-2.90)	(-4.49)	(-4.29)	(-3.19)
Small cap value	-0.209***	-0.222***	-0.189***	-0.235***	-0.240***	-0.227***
	(-6.16)	(-5.12)	(-5.54)	(-6.88)	(-5.38)	(-6.93)
Constant	-0.244***	-0.198**	-0.305***	-0.131*	-0.104	-0.165*
	(-3.33)	(-2.40)	(-3.57)	(-1.84)	(-1.31)	(-1.89)
Adj. R-squared	0.087	0.097	0.085	0.097	0.105	0.097
Observations	3,697,120	1,940,360	1,756,760	3,697,120	1,940,360	1,756,760
# of months	153	153	153	153	153	153

Table IV: Determinants of Fund Level Transaction Costs

Panel A reports the number of observations and the 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 the Fama-MacBeth (1973) coefficient estimates from monthly cross-sectional regressions of trading cost measures on fund attributes. The dependent variables are execution shortfall per trade dollar (in panel B) and execution shortfall per TNA Dollar (in panel C). Fund attributes (independent variables) are defined in Table I and lagged by one month. Fama-MacBeth (1973) *t*-statistics (in parenthesis) are corrected following Newey-West (1987) with three lags. Statistical significance of one, five, and ten percent are indicated by ***, **, and * respectively.

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

		Per Trade Dollar		Per TNA Dollar	
	# Obs.	Implicit	Total	Implicit	Total
1999	1,443	0.596	0.699	0.154	0.172
2000	1,665	0.688	0.778	0.198	0.219
2001	2,053	0.443	0.562	0.133	0.158
2002	2,388	0.404	0.597	0.111	0.148
2003	2,711	0.393	0.589	0.089	0.124
2004	2,563	0.381	0.545	0.075	0.103
2005	2,941	0.311	0.461	0.088	0.117
2006	2,977	0.364	0.467	0.088	0.107
2007	2,799	0.340	0.435	0.084	0.100
2008	2,853	0.483	0.582	0.138	0.162
2009	2,858	0.423	0.548	0.111	0.138
2010	1,990	0.252	0.367	0.055	0.075
2011	997	0.169	0.275	0.047	0.066
All	30,238	0.402	0.532	0.104	0.129

Panel B: Execution Shortfall per Trade Dollar (%)

	Implicit Trading Costs			Total Trading Costs		
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Log(TNA)	0.026***	0.054***	0.033***	0.024***	0.054***	0.033***
	(4.62)	(7.08)	(6.31)	(4.17)	(7.09)	(6.25)
Lag trade cost			0.402***			0.401***
			(33.48)			(34.81)
Expense ratio		0.099***	0.066***		0.110***	0.074***
		(4.77)	(4.19)		(5.33)	(4.67)
Fund turnover		0.173***	0.106***		0.168***	0.103***
		(15.13)	(12.68)		(14.62)	(12.55)
Fund flow		0.000	-0.000		-0.000	-0.001
		(0.01)	(-0.44)		(-0.02)	(-0.60)
Log(fund age)		-0.000	0.002		0.006	0.006
		(-0.03)	(0.36)		(0.62)	(0.98)
Log(family TNA)		-0.001	-0.003		-0.009*	-0.007**
		(-0.22)	(-0.85)		(-1.80)	(-2.25)
Lag fund return		-0.002	-0.002		-0.002	-0.003
		(-0.46)	(-0.56)		(-0.62)	(-0.72)
Large cap growth	0.173***	0.113***	0.074***	0.180***	0.116***	0.074***
	(8.17)	(5.23)	(4.64)	(8.60)	(5.46)	(4.68)
Large cap value	-0.164***	-0.080***	-0.039**	-0.157***	-0.078***	-0.040**
	(-4.70)	(-2.65)	(-2.00)	(-4.58)	(-2.63)	(-2.03)
Mid cap blend	-0.013	0.002	0.014	0.013	0.025	0.025
	(-0.33)	(0.05)	(0.44)	(0.32)	(0.59)	(0.78)
Mid cap growth	0.223***	0.148***	0.093***	0.244***	0.162***	0.101***
	(9.56)	(4.33)	(3.93)	(10.17)	(4.72)	(4.19)
Mid cap value	-0.103**	-0.025	0.004	-0.079*	-0.004	0.016
	(-2.52)	(-0.67)	(0.15)	(-1.87)	(-0.11)	(0.59)
Small cap blend	-0.076	0.011	0.023	-0.012	0.064	0.053
	(-1.45)	(0.21)	(0.56)	(-0.23)	(1.26)	(1.32)
Small cap growth	0.477***	0.381***	0.232***	0.541***	0.432***	0.261***
	(12.84)	(7.35)	(6.88)	(14.91)	(8.44)	(7.74)
Small cap value	-0.234***	-0.201**	-0.101**	-0.122*	-0.123	-0.057
	(-3.21)	(-2.61)	(-2.00)	(-1.67)	(-1.57)	(-1.10)
Constant	0.202***	-0.287***	-0.159***	0.322***	-0.115	-0.056
	(4.50)	(-3.82)	(-2.81)	(6.88)	(-1.42)	(-0.93)
Adj. R-squared	0.051	0.071	0.224	0.051	0.072	0.224
Observations	29,841	29,012	27,430	29,841	29,012	27,430
# of months	153	153	152	153	153	152

Panel C: Execution Shortfall per TNA Dollar (%)

	Implicit Trading Costs			Total Trading Costs		
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Log(TNA)	-0.005***	0.002	-0.000	-0.010***	-0.002	-0.002
	(-4.30)	(0.80)	(-0.03)	(-6.88)	(-0.78)	(-1.15)
Lag trade cost			0.495***			0.545***
			(21.42)			(25.05)
Expense ratio		-0.013**	-0.007*		-0.015***	-0.007*
		(-2.59)	(-1.94)		(-2.84)	(-1.96)
Fund turnover		0.068***	0.033***		0.078***	0.036***
		(10.73)	(7.34)		(11.59)	(7.49)
Fund flow		0.000	-0.000		0.000	-0.000
		(0.68)	(-0.53)		(0.53)	(-0.72)
Log(fund age)		-0.007**	-0.003		-0.006*	-0.003
		(-2.33)	(-1.63)		(-1.74)	(-1.30)
Log(family TNA)		-0.001	-0.000		-0.003**	-0.001
		(-1.16)	(-0.56)		(-2.19)	(-1.37)
Lag fund return		0.000	0.001		0.000	0.001
		(0.17)	(1.03)		(0.06)	(0.94)
Large cap growth	0.028***	0.010*	0.004	0.027***	0.007	0.002
	(3.52)	(1.85)	(1.00)	(3.19)	(1.25)	(0.40)
Large cap value	-0.031***	0.003	0.001	-0.033***	0.004	0.001
	(-4.20)	(0.42)	(0.15)	(-4.18)	(0.60)	(0.31)
Mid cap blend	0.011	0.016	0.008	0.013	0.019	0.008
	(1.10)	(1.44)	(1.13)	(1.15)	(1.54)	(1.18)
Mid cap growth	0.055***	0.037***	0.020***	0.064***	0.042***	0.021***
	(7.31)	(5.32)	(3.56)	(7.54)	(5.37)	(3.45)
Mid cap value	-0.037***	-0.007	0.000	-0.036***	-0.004	0.002
	(-5.41)	(-1.10)	(0.02)	(-4.97)	(-0.53)	(0.40)
Small cap blend	0.007	0.039***	0.017**	0.005	0.038**	0.015*
	(0.54)	(2.70)	(2.07)	(0.36)	(2.43)	(1.73)
Small cap growth	0.148***	0.111***	0.052***	0.168***	0.126***	0.054***
	(7.61)	(6.93)	(4.78)	(7.87)	(6.94)	(4.45)
Small cap value	0.034*	0.058***	0.028**	0.052**	0.074***	0.032***
	(1.79)	(2.99)	(2.48)	(2.46)	(3.39)	(2.64)
Constant	0.128***	0.048**	0.028*	0.175***	0.095***	0.049***
	(11.78)	(2.35)	(1.96)	(15.34)	(4.15)	(3.22)
Adj. R-squared	0.038	0.091	0.330	0.044	0.098	0.375
Observations	29,841	29,012	27,430	29,841	29,012	27,430
# of months	153	153	152	153	153	152

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

Panel A of this table 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 the 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 (C1) and (C2) in Appendix C. 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 of this table reports transaction cost estimates for funds sorted into quintiles based on TNA. Panel B1 again utilizes equations (C1) and (C2), and Panel B2 utilizes equation (4) (either with only ticket level variables 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 transaction costs across 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) Quintile		Ticket Size 1 (Small) ≤0.12%	2 0.12%–0.59%	3 0.59%–2.06%	4 2.06%–7.99%	5 (Large) >7.99%	Diff:1-5	*t*-stat.
A1. Keim and Madhavan (1997) Algorithm Transaction Cost Estimates								
1 (Small)	≤0.88	0.929***	0.901***	0.914***	0.946***	1.006***	-0.077***	(-5.98)
		(45.44)	(51.83)	(55.43)	(59.42)	(60.48)		
2	0.88–2.40	0.558***	0.551***	0.559***	0.568***	0.537***	0.021***	(3.46)
		(44.16)	(41.93)	(42.69)	(43.85)	(48.44)		
3	2.40–6.76	0.340***	0.344***	0.350***	0.348***	0.312***	0.027***	(4.99)
		(32.55)	(31.55)	(31.71)	(34.41)	(38.17)		
4	6.76–24.28	0.167***	0.175***	0.175***	0.165***	0.141***	0.026***	(5.34)
		(19.46)	(18.99)	(20.00)	(22.09)	(20.82)		
5 (Big)	>24.28	-0.017***	-0.011*	-0.018***	-0.042***	-0.032***	0.015***	(4.12)
		(-2.75)	(-1.76)	(-2.89)	(-8.28)	(-6.58)		
Diff: 1-5		0.946***	0.912***	0.932***	0.988***	1.038***		
		(56.61)	(65.15)	(70.60)	(76.87)	(80.39)		
A2. Equation (4) Algorithm Transaction Cost Estimates, Ticket and Fund Level Variables								
1 (Small)	≤0.88	0.356***	0.353***	0.377***	0.440***	1.201***	-0.845***	(-54.16)
		(25.96)	(28.70)	(31.56)	(35.83)	(77.13)		
2	0.88–2.40	0.263***	0.279***	0.300***	0.369***	0.927***	-0.664***	(-47.84)
		(25.60)	(24.38)	(28.30)	(30.63)	(52.23)		
3	2.40–6.76	0.250***	0.279***	0.302***	0.345***	0.762***	-0.512***	(-37.51)
		(20.81)	(23.49)	(26.24)	(29.00)	(41.35)		
4	6.76–24.28	0.213***	0.238***	0.258***	0.297***	0.582***	-0.369***	(-33.77)
		(19.56)	(24.80)	(26.82)	(29.52)	(34.49)		
5 (Big)	>24.28	0.131***	0.156***	0.169***	0.214***	0.431***	-0.300***	(-24.71)
		(16.19)	(20.11)	(20.27)	(22.83)	(26.30)		
Diff: 1-5		0.225***	0.197***	0.208***	0.226***	0.770***		
		(17.67)	(21.01)	(26.10)	(29.42)	(66.57)		

Panel B: Fund Level Transaction Costs by Fund Quintile

Variables	All Funds	Mutual Fund Size Quintile 1 (Small)	2	3	4	5 (Large)	Diff:1-5	*t*-stat.
B1. Keim and Madhavan (1997) Algorithm Transaction Cost Estimates								
Costs per Trade Dollar	0.298	0.327	0.349	0.311	0.298	0.206	0.121***	(22.51)
Costs Per TNA Dollar	0.690	1.074	0.945	0.642	0.553	0.225	0.849***	(28.67)
B2. Equation (4) Algorithm Transaction Cost Estimates								
Costs per Trade Dollar, algorithm with only ticket level variables	0.413	0.287	0.372	0.403	0.481	0.527	-0.240***	(-28.30)
Costs per Trade Dollar, algorithm with ticket and fund level variables	0.375	0.248	0.326	0.360	0.445	0.485	-0.238***	(-29.91)
Costs Per TNA Dollar, algorithm with only ticket level variables	1.005	1.153	1.281	0.999	1.013	0.572	0.582***	(16.58)
Costs Per TNA Dollar, algorithm with ticket and fund level variables	0.861	0.862	1.059	0.901	0.940	0.540	0.322***	(11.53)

Table VI: Transaction Costs and Fund Performance

Panel A reports the 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) with three lags. Panel B reports the difference in contemporaneous monthly four-factor alpha between funds in the lowest transaction cost quintile and funds in the highest transaction cost quintile. Statistical significance of one, five, and ten percent are indicated by ***, **, and * respectively.

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

	Execution Shortfall		Open Price Cost		Prior-day Close Cost		Next-day VWAP Cost	
VARIABLES	Implicit	Total	Implicit	Total	Implicit	Total	Implicit	Total
Trade cost	-0.175**	-0.153**	-0.191***	-0.172***	-0.201***	-0.189***	-0.378***	-0.353***
	(-2.27)	(-2.15)	(-3.10)	(-2.97)	(-4.31)	(-4.13)	(-3.87)	(-3.88)
Log(TNA)	-0.003	-0.004	-0.004	-0.005	-0.003	-0.004	-0.008	-0.009
	(-0.22)	(-0.26)	(-0.25)	(-0.30)	(-0.22)	(-0.27)	(-0.51)	(-0.57)
Lag fund return	0.009	0.009	0.010	0.010	0.010	0.010	0.010	0.010
	(0.48)	(0.48)	(0.52)	(0.51)	(0.55)	(0.54)	(0.53)	(0.55)
Expense ratio	-0.043	-0.044	-0.049	-0.049	-0.050	-0.051	-0.049	-0.049
	(-1.08)	(-1.09)	(-1.22)	(-1.23)	(-1.21)	(-1.24)	(-1.23)	(-1.24)
Fund turnover	0.003	0.002	0.005	0.005	0.010	0.010	-0.024	-0.020
	(0.10)	(0.08)	(0.18)	(0.18)	(0.36)	(0.39)	(-0.92)	(-0.77)
Fund flow	-0.003	-0.003	-0.003	-0.003	-0.003	-0.003	-0.004	-0.004
	(-0.68)	(-0.68)	(-0.68)	(-0.67)	(-0.68)	(-0.69)	(-0.87)	(-0.84)
Log(fund age)	-0.024	-0.023	-0.027	-0.026	-0.025	-0.024	-0.020	-0.020
	(-0.97)	(-0.93)	(-1.08)	(-1.04)	(-0.98)	(-0.96)	(-0.81)	(-0.81)
Log(family TNA)	0.018**	0.018**	0.017**	0.017**	0.017**	0.017**	0.016**	0.016**
	(2.60)	(2.59)	(2.36)	(2.34)	(2.36)	(2.33)	(2.22)	(2.17)
Constant	-0.073	-0.068	-0.034	-0.028	-0.046	-0.039	-0.016	-0.000
	(-0.52)	(-0.48)	(-0.24)	(-0.20)	(-0.30)	(-0.26)	(-0.12)	(-0.00)
Style fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R-squared	0.173	0.173	0.172	0.172	0.174	0.173	0.173	0.173
Observations	28,687	28,687	29,061	29,061	29,028	29,028	29,058	29,058
# of months	153	153	153	153	153	153	153	153

Panel B: Performance by Transaction Cost Quintile

	Trading Costs	
Cost Measure	Implicit	Total
Execution shortfall	0.161**	0.147**
	(2.34)	(2.13)
Open price	0.180**	0.188***
	(2.49)	(2.64)
Prior-day close	0.310***	0.309***
	(4.40)	(4.39)
VWAP, t+1	0.215***	0.226***
	(3.82)	(4.08)

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) with three lags. Statistical significance of one, five, and ten percent are indicated by ***, **, and * respectively.

Panel A: Summary Sample Statistics

		Mutual fund size quintile						
Variables	All funds	1 (small)	2	3	4	5 (large)	Diff:1-5	*t*-stat.
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:	
	1 (Small)	2	3	4	5 (Large)	1-5	*t*-stat.
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***		0.082***		0.169***		0.295***	
	(2.83)		(4.39)		(5.26)		(4.74)	
PosFlow* Flow		0.046**		0.081***		0.159***		0.258***
		(2.18)		(4.62)		(3.75)		(3.75)
NegFlow * Flow		0.092*		0.082		0.280**		0.543***
		(1.75)		(0.98)		(2.47)		(3.42)
Lag fund return	-0.117***	-0.117***	-0.090**	-0.087**	-0.075	-0.078	-0.027	-0.017
	(-3.73)	(-3.68)	(-2.38)	(-2.29)	(-1.13)	(-1.16)	(-0.26)	(-0.17)
Expense ratio	0.659**	0.643**	1.090**	1.109**	2.248**	2.392***	4.353***	4.363***
	(2.24)	(2.13)	(2.28)	(2.32)	(2.56)	(2.66)	(3.50)	(3.55)
Fund turnover	-0.009***	-0.009***	-0.014***	-0.014***	-0.021***	-0.021***	-0.019**	-0.018*
	(-3.73)	(-3.79)	(-3.24)	(-3.40)	(-3.28)	(-3.32)	(-2.00)	(-1.95)
Log(fund age)	0.143	0.174	0.154	0.113	0.021	0.010	-0.589	-0.642
	(0.83)	(1.07)	(0.67)	(0.47)	(0.05)	(0.02)	(-1.08)	(-1.14)
Log(family TNA)	0.042	0.041	0.005	0.015	0.004	0.017	-0.056	-0.049
	(0.92)	(0.89)	(0.07)	(0.22)	(0.03)	(0.14)	(-0.36)	(-0.32)
Constant	-0.932	-0.886	-1.175	-1.073	-1.534	-1.403	1.001	1.589
	(-1.31)	(-1.31)	(-1.28)	(-1.16)	(-1.04)	(-0.93)	(0.47)	(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 Transaction Costs"

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

Table IA.I: Summary Statistics by Quintile: Subtracting Style Mean

This table repeats the sorting analysis based on lagged TNA of Table I, Panel A except that we report summary statistics after subtracting the mean fund style statistics from the fund level statistics for each fund-month observation. It covers fund characteristics, holdings characteristics, and transaction 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. We first sort the funds each month into quintile portfolios and then compute the time-series averages of the monthly cross-sectional means for each mutual fund size quintile. All variables are defined in Table I. All trading cost measures are in percentage points. Statistical significance of one, five, and ten percent are indicated by ***, **, and * respectively.

	Mutual Fund Size Quintile						
Variables	1 (Small)	2	3	4	5 (Large)	Diff:1-5	*t*-stat.
Number of funds	40	40	40	40	39		
TNA ($ million)	46	184	518	1,594	12,955	-12,909***	(-40.46)
Fund Return Breakdown							
Gross return (%)	0.037	-0.009	0.025	0.011	-0.063	0.100	(1.17)
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)
Holdings-based return (%)	-0.016	0.002	0.066	0.007	-0.047	0.031	(0.35)
DGTW benchmark return (%)	0.010	-0.008	0.027	0.006	-0.033	0.043	(1.14)
DGTW adjusted return (%)	-0.015	0.003	0.032	-0.004	-0.007	-0.008	(-0.13)
Fund Transaction Costs per TNA Dollar							
Execution shortfall (%)	0.040	0.211	-0.068	0.056	-0.249	0.289***	(5.18)
Open price (%)	0.163	0.221	-0.064	-0.021	-0.304	0.467***	(6.07)
Prior-day close (%)	0.184	0.266	-0.092	0.003	-0.370	0.554***	(5.35)
VWAP, t+1 (%)	-0.039	-0.048	0.041	-0.003	0.047	-0.086	(-1.49)
Commission (%)	0.106	0.073	-0.017	-0.042	-0.122	0.229***	(26.94)
Tax and fee (%)	0.001	0.006	0.001	-0.002	-0.005	0.005***	(8.34)
Total, execution shortfall (%)	0.145	0.300	-0.088	0.010	-0.380	0.525***	(8.67)
Total, open price cost (%)	0.271	0.306	-0.084	-0.068	-0.433	0.704***	(8.69)
Total, prior-day close (%)	0.294	0.356	-0.110	-0.046	-0.504	0.799***	(7.47)
Total, VWAP, t+1 (%)	0.069	0.039	0.024	-0.051	-0.085	0.155***	(2.63)
Holdings Stock Characteristics							
Stock size ($ billion)	-2.4	-3.0	-1.7	1.7	5.2	-7.6***	(-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)
Other Fund Characteristics							
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 IA.II: Summary Statistics by Investment Style

The table reports summary statistics of fund characteristics, holdings characteristics, and transaction 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. We categorize funds by investment style. In particular, we first sort the 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. All variables are defined in Table I. All trading cost measures are in percentage point. Statistical significance of one, five, and ten percent are indicated by ***, **, and * respectively.

Panel A: Large Cap Funds

	Growth				Blend				Value			
Variables	1 (Small)	2 (Large)	Diff: 1-2	*t*-stat.	1 (Small)	2 (Large)	Diff: 1-2	*t*-stat.	1 (Small)	2 (Large)	Diff: 1-2	*t*-stat.
Num. of fund-month obs.	3,684	3,608			2,534	2,465			2,570	2,496		
TNA ($ million)	303	7,508	-7,205***	(-49.02)	258	9,995	-9,737***	(-21.93)	218	7,481	-7,263***	(-24.93)
Fund Return Breakdown												
Gross return (%)	0.327	0.430	-0.104	(-0.86)	0.485	0.302	0.183***	(2.71)	0.418	0.319	0.100	(1.26)
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)
Holdings-based return (%)	0.287	0.342	-0.055	(-0.44)	0.379	0.251	0.128*	(1.79)	0.313	0.323	-0.010	(-0.12)
DGTW benchmark ret (%)	0.273	0.240	0.033	(0.69)	0.330	0.256	0.074**	(2.15)	0.287	0.309	-0.022	(-0.64)
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)
Fund Transaction Costs per TNA Dollar												
Execution shortfall (%)	1.550	1.287	0.263***	(2.91)	1.294	0.898	0.396***	(4.54)	0.855	0.628	0.227***	(2.97)
Open price (%)	1.933	1.393	0.540***	(4.67)	1.865	1.258	0.607***	(5.28)	0.991	0.755	0.236***	(2.74)
Prior-day close (%)	2.373	1.696	0.677***	(4.15)	2.237	1.585	0.652***	(4.48)	1.023	0.735	0.288**	(2.53)
VWAP, t+1 (%)	-0.336	-0.263	-0.074	(-1.04)	-0.151	-0.194	0.044	(0.55)	-0.028	-0.161	0.133*	(1.77)
Commission (%)	0.276	0.157	0.119***	(15.51)	0.303	0.148	0.156***	(11.70)	0.292	0.169	0.123***	(9.30)
Tax and fee (%)	0.011	0.007	0.004***	(5.28)	0.015	0.002	0.013***	(8.50)	0.006	0.002	0.005***	(6.73)
Total, exec. shortfall (%)	1.848	1.456	0.391***	(4.08)	1.624	1.051	0.572***	(5.99)	1.162	0.798	0.364***	(4.24)
Total, open price cost (%)	2.230	1.563	0.667***	(5.57)	2.202	1.411	0.791***	(6.48)	1.292	0.922	0.370***	(3.99)
Total, prior-day close (%)	2.677	1.867	0.809***	(4.83)	2.572	1.735	0.837***	(5.55)	1.329	0.905	0.424***	(3.55)
Total, VWAP, t+1 (%)	-0.042	-0.090	0.047	(0.67)	0.175	-0.042	0.217***	(2.71)	0.273	0.009	0.264***	(3.62)
Holdings Stock Characteristics												
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)
Other Fund Characteristics												
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	0.916***	(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: Mid Cap Funds

	Growth				Blend				Value			
Variables	1 (Small)	2 (Large)	Diff: 1-2	*t*-stat.	1 (Small)	2 (Large)	Diff: 1-2	*t*-stat.	1 (Small)	2 (Large)	Diff: 1-2	*t*-stat.
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	-4,129***	(-15.56)	114	2,591	-2,477***	(-21.34)
Fund Return Breakdown												
Gross return (%)	0.668	0.729	-0.061	(-0.30)	1.029	0.779	0.250	(0.99)	0.841	0.721	0.121	(0.73)
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)
Holdings-based return (%)	0.601	0.687	-0.086	(-0.39)	1.104	0.599	0.505*	(1.72)	0.780	0.849	-0.088	(-0.44)
DGTW benchmark ret (%)	0.464	0.462	0.002	(0.02)	0.520	0.428	0.091	(0.92)	0.633	0.584	0.034	(0.66)
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)
Fund Transaction Costs per TNA Dollar												
Execution shortfall (%)	1.666	1.955	-0.289*	(-1.70)	1.562	0.975	0.587***	(3.66)	0.768	0.688	0.081	(0.88)
Open price (%)	2.068	2.485	-0.417*	(-1.81)	1.927	1.009	0.918***	(4.22)	0.530	0.718	-0.188	(-1.40)
Prior-day close (%)	2.439	2.691	-0.252	(-0.91)	1.716	0.728	0.988***	(3.43)	0.234	0.563	-0.329*	(-1.83)
VWAP, t+1 (%)	-0.385	-0.175	-0.210*	(-1.74)	-0.324	-0.215	-0.110	(-0.72)	-0.300	0.002	-0.302**	(-2.60)
Commission (%)	0.455	0.262	0.193***	(11.56)	0.423	0.187	0.236***	(9.86)	0.396	0.203	0.193***	(12.68)
Tax and fee (%)	0.011	0.002	0.010***	(7.20)	0.007	0.002	0.004***	(3.49)	0.004	0.001	0.003***	(13.36)
Total, exec. shortfall (%)	2.139	2.244	-0.105	(-0.57)	1.982	1.164	0.819***	(4.67)	1.157	0.904	0.254**	(2.49)
Total, open price cost (%)	2.535	2.770	-0.235	(-0.98)	2.346	1.204	1.142***	(4.94)	0.921	0.922	-0.001	(-0.01)
Total, prior-day close (%)	2.925	2.986	-0.061	(-0.21)	2.161	0.924	1.237***	(4.14)	0.642	0.772	-0.129	(-0.71)
Total, VWAP, t+1 (%)	0.107	0.097	0.010	(0.09)	0.118	0.001	0.117	(0.77)	0.116	0.214	-0.098	(-0.83)
Holdings Stock Characteristics												
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)
Other Fund Characteristics												
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 C: Small Cap Funds

	Growth				Blend				Value			
Variables	1 (Small)	2 (Large)	Diff: 1-2	*t*-stat.	1 (Small)	2 (Large)	Diff: 1-2	*t*-stat.	1 (Small)	2 (Large)	Diff: 1-2	*t*-stat.
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)
Fund Return Breakdown												
Gross return (%)	0.577	0.637	-0.060	(-0.30)	0.787	0.621	0.166	(0.96)	0.902	0.874	0.028	(0.24)
Net shareholder return (%)	0.464	0.546	-0.082	(-0.41)	0.683	0.540	0.143	(0.83)	0.788	0.771	0.0173	(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)
Holdings-based return (%)	0.479	0.634	-0.096	(-0.67)	0.667	0.640	0.027	(0.14)	0.961	0.804	0.157	(1.05)
DGTW benchmark ret (%)	0.531	0.630	-0.041	(-0.55)	0.689	0.699	-0.010	(-0.10)	0.790	0.750	0.040	(0.68)
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)
Fund Transaction Costs per TNA Dollar												
Execution shortfall (%)	3.477	2.324	1.153***	(4.22)	0.934	1.471	-0.537**	(-2.29)	1.347	1.837	-0.490**	(-2.05)
Open price (%)	4.327	2.523	1.804***	(5.13)	0.989	1.671	-0.682**	(-2.11)	0.924	1.690	-0.766**	(-2.39)
Prior-day close (%)	4.953	2.768	2.185***	(4.89)	0.919	1.482	-0.564	(-1.39)	-0.069	1.553	-1.622***	(-3.41)
VWAP, t+1 (%)	-0.604	0.344	-0.948***	(-4.22)	-0.058	-0.025	-0.033	(-0.26)	-0.136	-0.048	-0.089	(-0.49)
Commission (%)	0.578	0.345	0.233***	(8.04)	0.222	0.226	-0.004	(-0.20)	0.532	0.514	0.018	(0.65)
Tax and fee (%)	0.005	0.003	0.002**	(2.12)	0.011	0.001	0.010***	(6.41)	0.004	0.001	0.003***	(3.93)
Total, exec. shortfall (%)	4.113	2.712	1.401***	(4.76)	1.176	1.721	-0.545**	(-2.18)	1.872	2.319	-0.448*	(-1.74)
Total, open price cost (%)	4.967	2.912	2.055***	(5.58)	1.231	1.917	-0.686**	(-2.04)	1.450	2.152	-0.702**	(-2.13)
Total, prior-day close (%)	5.607	3.153	2.455***	(5.29)	1.166	1.735	-0.568	(-1.35)	0.459	2.028	-1.569***	(-3.24)
Total, VWAP, t+1 (%)	0.005	0.720	-0.715***	(-3.03)	0.183	0.210	-0.027	(-0.21)	0.391	0.446	-0.055	(-0.30)
Holdings Stock Characteristics												
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	0.095***	(3.12)	0.853	0.975	-0.123***	(-3.07)
Other Fund Characteristics												
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)

Table IA.III: Determinants of Ticket Level Transaction Costs

Panel A of this table reports the annual equal-weighted average of trading cost measures at the ticket level. Based on four alternative price benchmarks (execution shortfall, open price cost, prior close cost, and next day VWAP), 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. Panel B reports Fama-MacBeth (1973) coefficient estimates from the regression of mutual fund total transaction costs at the ticket level on the trade and fund level variables as shown in equation (4). Ticket Size is the share volume of a ticket normalized by dividing by the average daily trading volume of the previous month. Price inverse is defined as one over the closing price of the trading day prior to the order placement date. Log(mktcap) is the logarithm of market capitalization (in million dollars) of the traded stock at the previous month-end. Nasdaq is a dummy variable for stocks listed on Nasdaq stock exchange. All fund level independent variables are defined in Table I and lagged by one month. 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) with three lags. 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	VWAP	Tickets	Ex SF	Open	Pr. Close	VWAP	Tickets	Ex SF	Open	Pr. Close	VWAP
1999	170,956	0.609	0.687	0.839	-0.158	83,042	0.533	0.551	0.841	-0.296	87,914	0.681	0.816	0.837	-0.028
2000	225,940	0.605	0.733	0.919	-0.015	118,381	0.493	0.520	0.713	0.076	107,559	0.729	0.967	1.166	-0.115
2001	243,305	0.531	0.639	0.758	-0.013	138,845	0.484	0.539	0.555	0.060	104,460	0.592	0.773	1.030	-0.108
2002	257,992	0.530	0.613	0.722	0.051	140,544	0.401	0.387	0.432	0.236	117,448	0.684	0.882	1.072	-0.172
2003	318,754	0.457	0.515	0.572	0.046	177,851	0.491	0.543	0.618	-0.154	140,903	0.413	0.479	0.514	0.298
2004	361,200	0.367	0.386	0.424	0.113	206,946	0.342	0.340	0.390	0.044	154,249	0.401	0.449	0.470	0.205
2005	415,077	0.328	0.342	0.349	0.061	216,843	0.307	0.291	0.342	-0.001	198,234	0.351	0.397	0.357	0.129
2006	419,146	0.285	0.295	0.296	0.048	226,541	0.266	0.261	0.276	-0.016	192,605	0.307	0.335	0.320	0.124
2007	381,593	0.249	0.208	0.183	0.038	200,721	0.193	0.108	0.118	0.041	180,872	0.311	0.317	0.256	0.035
2008	422,624	0.365	0.323	0.349	-0.025	217,011	0.219	0.085	0.005	0.366	205,613	0.519	0.575	0.712	-0.437
2009	426,122	0.327	0.330	0.332	0.091	208,142	0.380	0.423	0.454	-0.070	217,980	0.276	0.242	0.216	0.244
2010	234,809	0.226	0.199	0.126	0.054	113,187	0.254	0.230	0.164	-0.036	121,622	0.200	0.169	0.091	0.138
2011	105,420	0.196	0.140	0.042	0.076	53,976	0.191	0.114	-0.019	0.308	51,444	0.202	0.167	0.106	-0.168
2008m9-2009m3	287,916	0.461	0.441	0.501	0.000	144,473	0.264	0.100	0.081	0.607	143,443	0.661	0.785	0.923	-0.609
All	3,982,938	0.378	0.398	0.430	0.036	2,102,030	0.341	0.326	0.360	0.042	1,880,903	0.419	0.477	0.509	0.029

Panel B: Determinants of Ticket Level Total Transaction Costs

	Open Price Cost			Prior-day Close Cost			Next Day VWAP Cost		
VARIABLES	All	Buy	Sell	All	Buy	Sell	All	Buy	Sell
Ticket size	1.785***	1.615***	1.853***	1.884***	1.498***	2.167***	-0.059	-0.194***	0.172***
	(22.20)	(18.31)	(17.36)	(21.70)	(16.68)	(17.96)	(-1.63)	(-3.90)	(3.02)
Price inverse	3.021***	2.701***	3.088***	3.163***	3.795***	2.490***	1.498***	0.774***	2.320***
	(14.88)	(10.08)	(13.04)	(16.06)	(10.96)	(9.76)	(10.47)	(2.74)	(9.61)
Log(mktcap)	-0.006	-0.034***	0.023***	0.013**	-0.018**	0.047***	0.015***	0.027***	-0.001
	(-1.33)	(-5.63)	(3.10)	(2.54)	(-2.42)	(5.18)	(3.61)	(3.19)	(-0.10)
Nasdaq	-0.027***	-0.009	-0.046**	-0.042***	-0.041**	-0.040**	-0.046***	-0.069**	-0.024
	(-3.86)	(-0.54)	(-2.41)	(-4.60)	(-2.18)	(-2.02)	(-4.31)	(-2.41)	(-0.96)
IVOL	0.068***	0.012	0.137***	0.092***	0.066***	0.127***	-0.006	0.060***	-0.083***
	(7.28)	(0.96)	(8.03)	(7.55)	(3.88)	(6.07)	(-1.09)	(2.98)	(-4.08)
Side*market	0.579***	0.591***	0.560***	0.815***	0.829***	0.790***	-0.988***	-0.953***	-0.954***
	(30.68)	(31.27)	(29.71)	(47.11)	(47.24)	(40.99)	(-50.22)	(-48.30)	(-44.69)
Log(TNA)	0.043***	0.043***	0.046***	0.063***	0.065***	0.067***	-0.014***	-0.016***	-0.017**
	(6.25)	(5.40)	(6.77)	(6.76)	(6.41)	(7.20)	(-2.87)	(-3.50)	(-2.56)
Expense ratio	0.102***	0.118***	0.066***	0.151***	0.175***	0.114***	-0.029*	-0.030	-0.010
	(4.43)	(4.37)	(2.84)	(5.49)	(5.79)	(3.73)	(-1.94)	(-1.38)	(-0.49)
Fund turnover	0.106***	0.126***	0.080***	0.129***	0.159***	0.098***	-0.005	-0.009	0.002
	(7.58)	(8.52)	(5.27)	(7.11)	(8.45)	(5.25)	(-0.67)	(-0.90)	(0.21)
Fund flow	-0.003**	-0.002	0.001	-0.003*	-0.002	0.002	0.002	0.003**	-0.001
	(-2.14)	(-1.26)	(0.49)	(-1.77)	(-1.39)	(1.11)	(1.64)	(2.15)	(-0.67)
Log(fund age)	-0.043***	-0.030***	-0.070***	-0.055***	-0.033**	-0.094***	0.014*	0.014	0.015**
	(-4.44)	(-2.69)	(-5.46)	(-4.53)	(-2.29)	(-5.26)	(1.94)	(1.48)	(2.15)
Log(fam TNA)	-0.001	0.003	-0.004	0.005	0.010*	-0.001	-0.009***	-0.005	-0.010***
	(-0.21)	(0.63)	(-0.91)	(0.79)	(1.71)	(-0.07)	(-3.20)	(-1.01)	(-2.76)
Lag fund return	-0.006	-0.001	-0.010**	-0.006	-0.003	-0.009	0.001	-0.004	0.004
	(-1.32)	(-0.12)	(-2.23)	(-1.07)	(-0.41)	(-1.65)	(0.37)	(-1.13)	(1.01)
Large cap growth	-0.028	-0.037	-0.020	-0.070*	-0.065*	-0.081*	0.052***	0.072***	0.026
	(-0.97)	(-1.30)	(-0.62)	(-1.78)	(-1.72)	(-1.86)	(4.21)	(4.35)	(1.22)
Large cap value	-0.113***	-0.106***	-0.123***	-0.203***	-0.178***	-0.234***	0.053***	0.093***	0.009
	(-4.51)	(-3.66)	(-4.66)	(-6.51)	(-5.02)	(-6.96)	(4.04)	(4.28)	(0.45)
Mid cap blend	-0.245***	-0.252***	-0.232***	-0.366***	-0.348***	-0.396***	0.051*	0.079**	-0.008
	(-4.35)	(-4.17)	(-3.80)	(-4.97)	(-4.46)	(-5.02)	(1.88)	(2.22)	(-0.22)
Mid cap growth	-0.050*	-0.098***	-0.002	-0.076**	-0.128***	-0.037	0.071***	0.080***	0.057**
	(-1.85)	(-2.98)	(-0.05)	(-2.10)	(-3.27)	(-0.85)	(4.13)	(3.74)	(2.01)
Mid cap value	-0.155***	-0.139***	-0.163***	-0.255***	-0.247***	-0.260***	0.015	0.039	-0.008

	(-4.40)	(-3.72)	(-4.06)	(-5.61)	(-5.18)	(-5.04)	(0.78)	(1.34)	(-0.26)
Small cap blend	-0.127***	-0.170***	-0.072	-0.196***	-0.223***	-0.178***	0.012	0.057	-0.030
	(-3.31)	(-3.80)	(-1.62)	(-4.13)	(-3.95)	(-3.36)	(0.39)	(1.43)	(-0.63)
Small cap growth	-0.234***	-0.267***	-0.190***	-0.287***	-0.336***	-0.235***	0.104***	0.141***	0.023
	(-5.77)	(-5.05)	(-4.69)	(-6.32)	(-5.56)	(-4.83)	(3.43)	(4.11)	(0.64)
Small cap value	-0.459***	-0.470***	-0.452***	-0.591***	-0.596***	-0.606***	-0.020	0.063	-0.099***
	(-9.71)	(-9.13)	(-8.76)	(-9.66)	(-9.57)	(-9.19)	(-0.51)	(1.38)	(-2.65)
Constant	-0.239**	-0.066	-0.428***	-0.625***	-0.594***	-0.677***	0.023	-0.225*	0.290**
	(-2.08)	(-0.56)	(-3.02)	(-4.08)	(-3.31)	(-4.07)	(0.30)	(-1.70)	(2.23)
Adj. R-squared	0.110	0.117	0.112	0.142	0.152	0.139	0.133	0.131	0.132
Observations.	3,743,410	1,963,119	1,780,291	3,743,426	1,963,121	1,780,305	3,717,707	1,950,023	1,767,684
# of months	153	153	153	153	153	153	153	153	153

Table IA.IV: Determinants of Fund Level Transaction Costs

Based on four alternative price benchmarks (execution shortfall, open price cost, prior close cost, and next day VWAP), 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 and C report the Fama-MacBeth (1973) coefficient estimates from monthly cross-sectional regressions of the total trading cost measures on fund attributes. The dependent variables are total transaction cost (execution shortfall, open price cost, prior close cost, or next day VWAP) per trade dollar (in panel B) and total transaction cost (execution shortfall, open price cost, prior close cost, or next day VWAP) per TNA Dollar (in panel C). Fund attributes (independent variables) are defined in Table I and lagged by one month. Fama-MacBeth (1973) *t*-statistics (in parenthesis) are corrected following Newey-West (1987) with three lags. 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 Transaction Costs by Year

		Per Trade Dollar				Per TNA Dollar			
	# Obs.	Ex SF	Open	Pr. Close	VWAP	Ex SF	Open	Pr. Close	VWAP
1999	1,443	0.699	0.782	0.863	-0.109	0.172	0.196	0.226	-0.026
2000	1,665	0.778	0.874	0.963	-0.060	0.219	0.251	0.278	0.002
2001	2,053	0.562	0.618	0.673	-0.017	0.158	0.183	0.209	0.005
2002	2,388	0.597	0.631	0.715	0.040	0.148	0.166	0.193	0.013
2003	2,711	0.589	0.617	0.658	0.024	0.124	0.134	0.148	0.007
2004	2,563	0.545	0.573	0.617	0.075	0.103	0.110	0.118	0.021
2005	2,941	0.461	0.511	0.505	0.079	0.117	0.139	0.150	0.019
2006	2,977	0.467	0.507	0.495	0.028	0.107	0.125	0.139	0.013
2007	2,799	0.435	0.452	0.356	0.037	0.100	0.109	0.106	0.006
2008	2,853	0.582	0.612	0.631	-0.048	0.162	0.183	0.217	-0.001
2009	2,858	0.548	0.612	0.551	0.024	0.138	0.175	0.184	0.013
2010	1,990	0.367	0.384	0.218	0.093	0.075	0.088	0.067	0.014
2011	997	0.275	0.279	-0.018	0.107	0.066	0.083	0.065	0.022
All	30,238	0.532	0.573	0.564	0.023	0.129	0.148	0.161	0.009

Panel B: Trading Costs per Trade Dollar

VARIABLES	Open Price Cost		Prior-day Close Cost		Next-day VWAP Cost	
Log(TNA)	0.055***	0.032***	0.055***	0.033***	-0.015**	-0.012*
	(5.57)	(5.35)	(4.25)	(3.63)	(-2.29)	(-1.85)
Lag trade cost		0.428***		0.404***		0.027**
		(33.89)		(25.51)		(2.29)
Expense ratio	0.076***	0.055***	0.159***	0.112***	-0.035	-0.023
	(3.46)	(3.78)	(4.36)	(4.29)	(-1.60)	(-1.06)
Fund turnover	0.251***	0.145***	0.325***	0.198***	-0.017	-0.014
	(14.04)	(13.23)	(11.68)	(11.27)	(-1.54)	(-1.25)
Fund flow	-0.001	-0.001	0.002	0.002	0.005***	0.004**
	(-0.45)	(-0.64)	(0.86)	(0.70)	(2.99)	(2.48)
Log(fund age)	0.014	0.011	0.037**	0.021	0.012	0.010
	(1.23)	(1.40)	(2.00)	(1.61)	(0.93)	(0.88)
Log(family TNA)	-0.013**	-0.010**	-0.013	-0.009	-0.016***	-0.014***
	(-2.09)	(-2.38)	(-1.51)	(-1.65)	(-3.83)	(-3.54)
Lag fund return	-0.004	-0.001	-0.009	-0.003	0.001	0.000
	(-0.67)	(-0.21)	(-1.31)	(-0.54)	(0.22)	(0.09)
Large cap growth	0.023	0.017	0.007	0.028	-0.032	-0.041*
	(0.72)	(0.80)	(0.13)	(0.84)	(-1.42)	(-1.84)
Large cap value	-0.162***	-0.077***	-0.332***	-0.178***	0.032	0.032
	(-4.62)	(-3.50)	(-6.60)	(-5.47)	(1.29)	(1.28)
Mid cap blend	-0.162***	-0.085**	-0.549***	-0.320***	-0.055	-0.073
	(-2.94)	(-2.26)	(-6.09)	(-5.54)	(-1.00)	(-1.40)
Mid cap growth	0.084*	0.053	-0.002	0.009	0.040	0.032
	(1.68)	(1.64)	(-0.03)	(0.18)	(1.33)	(0.96)
Mid cap value	-0.183***	-0.076**	-0.503***	-0.264***	0.005	0.006
	(-3.56)	(-2.13)	(-8.00)	(-5.69)	(0.18)	(0.21)
Small cap blend	-0.157**	-0.079	-0.534***	-0.257***	-0.022	-0.046
	(-2.39)	(-1.54)	(-5.81)	(-3.84)	(-0.51)	(-0.94)
Small cap growth	0.380***	0.217***	0.259***	0.147***	0.065	0.055
	(6.65)	(5.83)	(3.45)	(2.82)	(1.64)	(1.43)
Small cap value	-0.478***	-0.262***	-1.090***	-0.626***	0.090**	0.075*
	(-5.41)	(-4.55)	(-8.96)	(-8.26)	(2.17)	(1.89)
Constant	0.038	0.028	-0.036	-0.017	0.335***	0.281***
	(0.38)	(0.42)	(-0.24)	(-0.17)	(4.57)	(3.77)
Adj. R-squared	0.066	0.239	0.070	0.225	0.021	0.030
Observations	29,388	28,175	29,354	28,130	29,385	28,172
# of months	153	152	153	152	153	152

Panel C: Trading Costs per TNA Dollar

VARIABLES	Open Price Cost		Prior-day Close Cost		Next-day VWAP Cost	
Log(TNA)	-0.003	-0.002	-0.001	-0.001	-0.004***	-0.004***
	(-1.01)	(-1.33)	(-0.21)	(-0.29)	(-3.10)	(-2.90)
Lag trade cost		0.544***		0.502***		0.061***
		(32.55)		(25.15)		(3.18)
Expense ratio	-0.031***	-0.014***	-0.026**	-0.012*	-0.009**	-0.007*
	(-3.77)	(-2.94)	(-2.59)	(-1.95)	(-2.24)	(-1.72)
Fund turnover	0.105***	0.047***	0.127***	0.062***	-0.004	-0.004
	(12.51)	(8.82)	(11.06)	(8.99)	(-1.56)	(-1.36)
Fund flow	0.001	-0.000	0.001	0.000	0.001	0.001
	(0.96)	(-0.24)	(1.32)	(0.57)	(1.22)	(1.37)
Log(fund age)	-0.008*	-0.004	-0.010**	-0.005	0.003	0.003
	(-1.91)	(-1.55)	(-1.99)	(-1.55)	(1.43)	(1.47)
Log(family TNA)	-0.003**	-0.001	-0.001	-0.000	-0.003***	-0.003***
	(-2.06)	(-1.31)	(-0.79)	(-0.10)	(-3.18)	(-3.93)
Lag fund return	-0.001	0.001	-0.003*	0.001	-0.001	-0.000
	(-0.89)	(1.05)	(-1.90)	(0.57)	(-1.03)	(-0.57)
Large cap growth	-0.012	-0.008	-0.013	-0.007	-0.009*	-0.008**
	(-1.49)	(-1.56)	(-1.31)	(-1.10)	(-1.97)	(-2.09)
Large cap value	-0.015**	-0.007	-0.034***	-0.017***	-0.000	-0.001
	(-2.08)	(-1.51)	(-3.85)	(-2.73)	(-0.04)	(-0.12)
Mid cap blend	-0.007	-0.003	-0.059***	-0.028**	-0.001	-0.001
	(-0.44)	(-0.33)	(-2.77)	(-2.04)	(-0.13)	(-0.14)
Mid cap growth	0.041***	0.018***	0.034**	0.017*	-0.000	-0.002
	(4.55)	(2.82)	(2.55)	(1.80)	(-0.07)	(-0.30)
Mid cap value	-0.047***	-0.018***	-0.088***	-0.037***	0.004	0.004
	(-4.44)	(-2.76)	(-6.72)	(-4.36)	(0.68)	(0.81)
Small cap blend	0.024	0.009	0.003	0.003	0.000	0.000
	(1.31)	(0.82)	(0.14)	(0.19)	(0.04)	(0.00)
Small cap growth	0.125***	0.049***	0.129***	0.053***	0.021**	0.018*
	(6.31)	(3.98)	(5.41)	(3.28)	(2.24)	(1.86)
Small cap value	0.024	0.010	-0.036	-0.011	0.016*	0.009
	(1.05)	(0.77)	(-1.35)	(-0.65)	(1.71)	(0.95)
Constant	0.140***	0.068***	0.118***	0.052**	0.076***	0.076***
	(4.58)	(3.63)	(2.97)	(2.08)	(4.31)	(4.68)
Adj. R-squared	0.096	0.370	0.088	0.322	0.033	0.066
Observations	29,388	28,175	29,354	28,130	29,385	28,172
# of months	153	152	153	152	153	152

Table IA.V: Determinants of Ticket Level Execution Shortfall – Non-Stitched Tickets

Panel A of this table reports the annual equal-weighted average of trading cost measures at the ticket level based on non-stitched tickets. 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 at the ticket level (based on non-stitched tickets) on the trade and fund level variables as shown in equation (4). Ticket Size is the share volume of a ticket normalized by dividing by the average daily trading volume of the previous month. Price inverse is defined as one over the closing price of the trading day prior to the order placement date. Log(mktcap) is the logarithm of market capitalization (in million dollars) of the traded stock at the previous month-end. Nasdaq is a dummy variable for stocks listed on Nasdaq stock exchange. All fund level independent variables are defined in Table I and lagged by one month. 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) with three lags. 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 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 (%)

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

Table IA.VI: Execution Shortfall Costs – Non-Stitched Tickets

Panel A reports the 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, calculated based on non-stitched tickets. Panels B and C report the Fama-MacBeth (1973) coefficient estimates from monthly cross-sectional regressions of trading cost measures based on non-stitched tickets on fund attributes. The dependent variables are execution shortfall per trade dollar (in panel B) and execution shortfall per TNA Dollar (in Panel C). Fund attributes (independent variables) are defined in Table I and lagged by one month. Fama-MacBeth (1973) *t*-statistics (in parenthesis) are corrected following Newey-West (1987) with three lags. 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 Transaction Costs by Year - Execution Shortfall (%)

		Per Trade Dollar		Per TNA Dollar	
	# Obs.	Implicit	Total	Implicit	Total
1999	1,443	0.168	0.270	0.047	0.063
2000	1,665	0.165	0.254	0.057	0.076
2001	2,053	0.148	0.266	0.047	0.071
2002	2,388	0.145	0.337	0.041	0.077
2003	2,711	0.133	0.328	0.033	0.066
2004	2,563	0.127	0.292	0.032	0.058
2005	2,941	0.106	0.254	0.035	0.060
2006	2,977	0.122	0.224	0.038	0.057
2007	2,799	0.126	0.213	0.038	0.054
2008	2,853	0.206	0.304	0.068	0.091
2009	2,858	0.165	0.290	0.048	0.075
2010	1,990	0.112	0.227	0.029	0.047
2011	997	0.065	0.171	0.025	0.041
All	30,238	0.140	0.269	0.042	0.065

Panel B: Execution Shortfall per Trade Dollar (%)

	Implicit Trading Costs			Total Trading Costs		
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Log(TNA)	-0.017***	-0.001	-0.002	-0.020***	-0.001	-0.002
	(-6.01)	(-0.50)	(-0.75)	(-7.00)	(-0.51)	(-0.89)
Lag trade cost			0.402***			0.397***
			(29.71)			(29.62)
Expense ratio		0.031**	0.016		0.042***	0.023**
		(2.02)	(1.50)		(2.89)	(2.28)
Fund turnover		0.085***	0.055***		0.081***	0.052***
		(14.25)	(10.92)		(12.35)	(10.23)
Fund flow		-0.001	-0.001		-0.001	-0.001
		(-1.29)	(-1.39)		(-1.26)	(-1.40)
Log(fund age)		0.009*	0.008**		0.016***	0.013***
		(1.87)	(2.16)		(3.13)	(3.25)
Log(family TNA)		-0.015***	-0.009***		-0.023***	-0.014***
		(-4.13)	(-4.22)		(-6.19)	(-6.05)
Lag fund return		-0.002	-0.001		-0.002	-0.001
		(-0.96)	(-0.28)		(-1.05)	(-0.40)
Large cap growth	0.070***	0.033**	0.023**	0.075***	0.032**	0.021*
	(5.92)	(2.12)	(2.20)	(6.22)	(2.09)	(1.94)
Large cap value	-0.066***	-0.032**	-0.014	-0.060***	-0.031**	-0.014
	(-4.14)	(-2.03)	(-1.25)	(-3.78)	(-1.99)	(-1.28)
Mid cap blend	-0.027	-0.009	0.001	-0.002	0.013	0.013
	(-0.97)	(-0.32)	(0.06)	(-0.06)	(0.44)	(0.65)
Mid cap growth	0.102***	0.058**	0.037**	0.123***	0.071***	0.044***
	(5.76)	(2.36)	(2.40)	(6.56)	(2.82)	(2.77)
Mid cap value	-0.038*	0.005	0.004	-0.013	0.027	0.017
	(-1.93)	(0.27)	(0.38)	(-0.61)	(1.45)	(1.34)
Small cap blend	-0.080***	-0.061**	-0.028	-0.013	-0.006	0.003
	(-3.00)	(-2.24)	(-1.45)	(-0.51)	(-0.22)	(0.16)
Small cap growth	0.148***	0.099***	0.055***	0.210***	0.148***	0.085***
	(7.45)	(3.90)	(3.04)	(10.71)	(5.81)	(4.65)
Small cap value	-0.077**	-0.118**	-0.064**	0.032	-0.042	-0.019
	(-2.07)	(-2.60)	(-2.22)	(0.83)	(-0.89)	(-0.64)
Constant	0.230***	0.138***	0.090**	0.354***	0.307***	0.191***
	(8.70)	(2.71)	(2.54)	(12.37)	(5.53)	(4.89)
Adj. R-squared	0.028	0.059	0.217	0.035	0.071	0.224
Observations	29,860	29,030	27,456	29,860	29,030	27,456
# of months	153	153	152	153	153	152

Panel C: Execution Shortfall per TNA Dollar (%)

	Implicit Trading Costs			Total Trading Costs		
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Log(TNA)	-0.007***	-0.003***	-0.002***	-0.011***	-0.006***	-0.003***
	(-10.38)	(-4.31)	(-3.91)	(-14.39)	(-6.54)	(-5.28)
Lag trade cost			0.579***			0.627***
			(20.50)			(23.41)
Expense ratio		-0.009***	-0.004**		-0.011***	-0.005**
		(-3.04)	(-2.22)		(-3.46)	(-2.28)
Fund turnover		0.028***	0.011***		0.037***	0.013***
		(11.03)	(6.64)		(11.30)	(6.95)
Fund flow		-0.000	-0.000		-0.000	-0.000
		(-0.36)	(-0.70)		(-0.56)	(-0.91)
Log(fund age)		-0.003*	-0.001		-0.002	-0.000
		(-1.75)	(-0.52)		(-1.02)	(-0.16)
Log(family TNA)		-0.004***	-0.002***		-0.005***	-0.002***
		(-5.45)	(-4.32)		(-6.43)	(-4.74)
Lag fund return		-0.001**	-0.000		-0.001*	-0.001
		(-2.06)	(-0.62)		(-1.88)	(-0.93)
Large cap growth	0.012***	0.003	0.000	0.011***	0.001	-0.001
	(3.56)	(1.22)	(0.09)	(2.85)	(0.24)	(-0.69)
Large cap value	-0.010**	0.001	0.000	-0.012**	0.003	0.000
	(-2.53)	(0.37)	(0.09)	(-2.55)	(0.61)	(0.13)
Mid cap blend	0.005	0.009	0.002	0.007	0.012*	0.003
	(0.94)	(1.56)	(0.88)	(1.05)	(1.68)	(1.04)
Mid cap growth	0.026***	0.015***	0.008**	0.036***	0.021***	0.009***
	(7.59)	(3.11)	(2.51)	(7.88)	(3.70)	(2.79)
Mid cap value	-0.014***	-0.001	0.000	-0.014***	0.002	0.001
	(-4.23)	(-0.20)	(0.20)	(-3.60)	(0.39)	(0.66)
Small cap blend	-0.001	0.006	0.002	-0.003	0.005	0.001
	(-0.28)	(1.26)	(0.67)	(-0.59)	(0.92)	(0.31)
Small cap growth	0.044***	0.028***	0.011*	0.062***	0.041***	0.015**
	(5.06)	(3.16)	(1.73)	(6.09)	(3.97)	(2.04)
Small cap value	0.043***	0.040***	0.011*	0.061***	0.056***	0.014**
	(3.75)	(3.22)	(1.81)	(4.39)	(3.76)	(2.21)
Constant	0.079***	0.083***	0.041***	0.125***	0.127***	0.057***
	(12.48)	(7.96)	(5.85)	(17.57)	(10.15)	(6.48)
Adj. R-squared	0.035	0.078	0.413	0.050	0.099	0.477
Observations	29,860	29,030	27,456	29,860	29,030	27,456
# of months	153	153	152	153	153	152

Table IA.VII: Transaction Costs and Fund Performance – Non-Stitched Tickets

This table reports the Fama-MacBeth (1973) coefficients from monthly cross-sectional regressions of individual fund-level four-factor alphas on log(TNA), contemporaneous per TNA dollar execution shortfall or total trading costs (based on non-stitched tickets), and other fund attributes. 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) with three lags. Statistical significance of one, five, and ten percent are indicated by ***, **, and * respectively.

	Implicit Trading Costs		Total Trading Costs	
VARIABLES	(1)	(2)	(3)	(4)
Trade cost	-0.511***	-0.459***	-0.415***	-0.365***
	(-2.99)	(-2.78)	(-2.93)	(-2.69)
Log(TNA)		-0.022		-0.023
		(-1.34)		(-1.41)
Lag fund return		0.009		0.009
		(0.50)		(0.51)
Expense ratio		-0.053		-0.054
		(-1.15)		(-1.17)
Fund turnover		-0.024		-0.024
		(-0.77)		(-0.77)
Fund flow		-0.003		-0.003
		(-0.71)		(-0.70)
Log(fund age)		-0.011		-0.009
		(-0.44)		(-0.38)
Log(family TNA)		0.022***		0.022***
		(2.75)		(2.77)
Constant	0.010	0.084	0.014	0.089
	(0.16)	(0.52)	(0.23)	(0.54)
Adj. R-squared	0.003	0.109	0.003	0.109
Observations	28,903	28,705	28,903	28,705
# of months	153	153	153	153