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Transactions costs and investment style: an inter-exchange analysis of institutional equity trades

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Abstract

This paper examines the magnitude and determinants of transactions costs for a sample of institutional traders with different investment styles. Using order-level data for recent equity transactions totaling $83 billion, we find that trading costs are economically significant and increase with trade difficulty. In addition, costs vary with trader-specific factors such as investment style and order submission strategy, as well as stock-specific factors such as exchange listing. We find evidence that institutional trades in exchange-listed stocks have lower costs than in comparable Nasdaq stocks.

Keywords: Exchange listing; Institutional investor; Investment style; Microstructure; Transactions costs

JEL classification: G11; G23

1. Introduction

Investment performance reflects two factors: (1) the portfolio manager's investment strategy or style, and (2) the trading costs incurred in implementing this investment strategy. The components of investment strategy, or style, include the selection of securities to buy or sell, and the timing of these transactions. Trading costs can substantially reduce the notional, or 'paper,' return to an investment strategy. Consequently, there is considerable interest in assessing the magnitude of trading costs. Since transactions costs may vary

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significantly across different trading styles, any analysis of the magnitude and determinants of these costs must be made in relation to the trader's underlying investment strategy. Although there are an increasing number of papers that study equity trading costs, little attention is focused on the investment strategy generating these costs.[1] This paper analyzes empirically the relation between transactions costs and investment style for a sample of institutional equity trades.

Differences in investment style result in substantially different demands for immediacy of trade, and the resulting differences in order submission strategies likely cause differences in trading costs. For example, indexers, whose objective is to construct a portfolio that closely mimics the behavior of a specific stock index, and technical traders, whose trades try to capture short-term price movements, have a strong demand for immediacy. Technical traders seek to capture short-term price movements, and indexers seek to insure transactions at the market closing price used to compute their benchmarks. This desire to trade quickly will result in higher trading costs. On the other hand, value traders, whose trades are motivated by considerations of long-term fundamental value, may incur lower costs because of more patient trading strategies involving limit or working orders. If investment style affects trading costs, cost estimates that represent averages across institutions with different investment strategies may obscure interesting and important information in cross-sectional distributions of trade costs. Our analysis attempts to capture the effects of subtle differences in trader aggressiveness or strategy that may be manifested in cost differences across trade direction and style.

The magnitude of trading costs might also be influenced by the market on which a stock trades. This issue has attracted considerable attention following the study by Christie and Schultz (1994) concluding that dealers on the Nasdaq National Market implicitly collude to widen bid–ask spreads.[2] Recent inquiries

[1] See, e.g., Beebower and Priest (1980), Berkowitz et al. (1988), Chan and Lakonishok (1993), Perold and Sirri (1993), Wagner and Edwards (1993) and Chan and Lakonishok (1997). An exception is Chan and Lakonishok (1995), which examines differences in costs between value and growth stock portfolio managers.

[2] Christie and Schultz (1994) document an absence of odd-eighth quotes for Nasdaq stocks. Christie et al. (1994) find a significant drop in spreads following the disclosure of the findings of Christie and Schultz (1994). Dutta and Madhavan (1997) provide a theoretical model of a dealer market and demonstrate conditions under which implicit collusion is sustainable. Barclay (1996) finds that stocks that trade with spreads of a quarter point on Nasdaq subsequently trade with spreads of an eighth of a point after they list on exchanges. Huang and Stoll (1996) document significantly higher bid–ask spreads for Nasdaq stocks than for comparable exchange stocks. However, Chan and Lakonishok (1997) find little difference in trade costs between Nasdaq and exchange stocks for a sample of institutional traders. See also Blume and Goldstein (1992), Fama et al. (1993), Shapiro (1993), Christie and Huang (1994), and Chan et al. (1995) for additional evidence on the returns and costs of trading Nasdaq stocks.

by the Department of Justice and the Securities and Exchange Commission conclude that there was evidence of collusive pricing behavior among dealers. However, these findings relate to quoted spreads. While small, retail traders transact at the quoted bid and ask prices, large institutional traders typically negotiate prices directly with dealers. Thus, institutional traders may avoid the economic costs arising from the alleged collusive behavior, necessitating a comparison of the actual cost of transacting across markets.

A comparison of costs across markets may also shed light on broader questions regarding the relative merits of alternative trading designs. In particular, trading in exchange-listed stocks takes place through an auction mechanism, whereas the Nasdaq market operates as a dealer market. These differences may have important implications for institutional traders. For example, in an auction market a trader can use limit orders to reduce transaction costs, whereas in a dealer market, such passive trading strategies have limited applicability because orders typically are not exposed to the public. The Nasdaq Stock Market, however, recently implemented a program to provide for greater exposure of public limit orders in select stocks. Our analysis of actual transaction costs addresses these issues, and complements recent studies of intermarket cost comparisons by Huang and Stoll (1996) and Chan and Lakonishok (1997).

Finally, we focus on the total execution costs associated with filling the order quantity. There are two major components to trading costs: explicit costs consisting primarily of commission costs, and implicit costs, consisting primarily of the price impact of a trade.[3] Most previous studies (see, e.g., Kraus and Stoll, 1972; Holthausen et al., 1987; Keim and Madhavan, 1996) focus on the measurement of price impacts, often of large (block) trades. Important exceptions include Berkowitz et al. (1988), Chan and Lakonishok (1995) and Perold and Sirri (1993) who examine the total costs of equity trades.

It is crucial to examine both cost components jointly because they may be systematically related. For example, when trading an illiquid stock it may be optimal to pay higher broker commissions to execute the order slowly to obtain better execution, whereas in a liquid stock less attention might be required. This point is especially important for intermarket cost comparisons because commissions for institutions are often embodied in the bid–ask spread for Nasdaq stocks, whereas this is not the case for exchange-listed stocks. Focusing only on implicit costs, which include the bid–ask spread, may thus overstate the true cost of trading on Nasdaq relative to exchanges.

We investigate these issues using data on recent equity transactions by 21 institutional traders totalling $83 billion. Institutional traders are of special

[3] There are other transaction costs, such as taxes, clearance and settlement fees which we ignore, but these costs are relatively insensitive to the choice of trading strategy.

interest because they account for a significant fraction of equity ownership and trading volume. The data cover over 62,000 equity orders, each typically resulting in more than one trade, placed by institutions that differ in their investment objectives and trading styles. The data are unique in that they provide a complete record of all the individual trades generated by a particular indicated desire to trade. This is important because an order for a certain number of shares might result in several distinct trades spanning many different and not necessarily adjacent days. With our data, we can measure the total costs associated with a particular strategy involving multiple trades as opposed to the costs of an individual trade. There may be significant differences in the overall costs measured in the aggregate versus individually. In their analysis of institutional trading costs, Chan and Lakonishok (1995) have data on individual transactions, and aggregate to the order, or trade package, level by combining trades in a particular stock that occur on adjacent days. Thus, where our orders are ex ante expressions of desired trade quantity, the orders in Chan and Lakonishok (1995) are ex post approximations of desired trade quantity.

The data also include information about whether the initiated trade is a buy or a sell action. In particular, the institutions in our sample indicate, at a particular date, a specific desire to initiate a program to either buy or sell a stated quantity of shares of a stock to adjust their portfolio composition. Since a trader who approaches the market with a clear desire to buy shares will be met with a different market response than if she were to sell shares, it is important to separate the sample according to this distinction. The great majority of trades, both unweighted and weighted by the value of the trade, in our sample are executed using market orders, so this classification closely resembles one based on the active side of the market, i.e., by whether immediacy is demanded or supplied. In most available databases, e.g., the data provided by the Institute for the Study of Security Markets, volumes are not signed and the trade initiation must be inferred indirectly using time-stamped quotation data, a manipulation that possibly induces biases in estimated transaction costs.

Our analysis yields the following findings. Transactions costs are substantial, and both explicit and implicit trading costs are positively related to measures of trade difficulty. We find that trades in Nasdaq stocks are generally more costly than for comparable trades in exchange-listed stocks, particularly for buyer-initiated trades. We also find that buys, especially in small stocks, are generally more costly than equivalent sells. Our results are consistent with Chan and Lakonishok (1995) in that we document substantial variation in trading costs across institutions. This variation reflects differences in investment style and trade difficulty. However, even within a particular investment style, there is considerable heterogeneity in the costs across institutions, possibly arising from differences in trading skill. Indeed, some institutions in our sample have significant positive excess costs that cannot be explained by their order characteristics or by the stocks they traded.

The paper proceeds as follows. Section 2 describes the data. Section 3 reports estimates of trading costs and examines their determinants. Section 4 examines the relation between trading costs and trading styles, and Section 5 concludes.

2. Data

The data contain complete information on the equity transactions of 21 institutions during 1991 to 1993. These data were compiled by the Plexus Group as part of their advisory services for their institutional clients. Three types of institutional investment strategies are identified by Plexus as being represented in the data. Fundamental value managers are managers whose investment strategy is based on assessment of fundamental value with a decidedly longer-term perspective. Technical managers are managers whose strategy is based primarily on capturing short-term price movements. Index managers seek to mimic the returns of a particular stock index. Thus, the manager's investment strategy dictates the trading strategy and, thereby, motivates the classification used by Plexus. Each of the institutions in our sample represents an individual portfolio manager, not a larger umbrella organization comprising many managers with possibly very different investment styles. Consequently, even though institutions often offer several different investment products, our classifications are mutually exclusive. Further, these categorizations do not necessarily correspond to popular institutional classifications or styles, like value and growth. Indeed, growth managers, for example, could conceivably appear in both the fundamental value and technical classifications used here. Note that although Plexus identified the investment strategy type of the institutions in our sample, the identity of the institutions was not revealed. The institutions represented here vary in size. For example, the mean dollar value of assets under management is \$4.8 billion for value managers, ranging from a low of \$0.7 billion to a high of \$12.9 billion. The corresponding mean figures for the index and technical managers in our sample are \$3.2 billion and \$5.3 billion, respectively.

For each order, the data include the following information:

1. the identity of the stock to be traded and the date when the trading decision was made;
2. the desired number of shares to be traded, determined before trade begins, and an indication as to whether the trade is a buy or a sell;
3. the closing price on the day before the decision to trade is made;
4. the dates and the individual components of the order released to the broker;
5. the volume-weighted average trade price, number of shares traded, and date(s) associated with the trade(s) executed by the broker within a specific order; and
6. the commissions per share.

It is worth emphasizing that these data are unique because they enable us to identify the individual trades corresponding to an expressed intention to buy or sell, and that we also know the duration over which these trades took place. Further, the data provide some indications as to the motivation for the trade, because the institution's investment strategy or style is known, and the manner in which the trade was executed. Regarding the broker information, institutions typically receive only one aggregated report of a broker's trading activity per day which includes the total number of shares traded and the average execution price of those shares. Thus, even though several trades may have been executed during the day by a broker in a particular stock, institutions may obtain only one report for price and volume for that stock for that day. Of course, a single, aggregate report for the day does not mean that institutions, typically with their own trading desks, do not monitor the trading process closely and follow every trade that is executed.

We eliminate transactions corresponding to trades of under 100 shares, stocks trading under $1.00, and orders that took more than 21 calendar days to execute. These filters were imposed to eliminate records with potential errors or unrepresentative trades. We used data from the Center on Research in Security Prices (CRSP) to verify these data and obtain additional information on market capitalization, exchange listing, and the closing prices on days around the trade.

2.1. Descriptive statistics

Table 1 presents descriptive statistics on the trades in our sample for quintiles of NYSE market capitalization. The table is intended to provide background information on the nature of the transactions that produce the cost estimates examined below. The statistics for buys and sells are reported separately. The unit of observation in the table is the trade order, i.e., the number of shares of stock the institution decides to buy or sell. The table highlights several results of interest.

First, the trading activity of the 21 institutions was substantial during the period January 1991 to March 1993, when a total of 62,333 orders with a market value of approximately $83 billion took place. Second, it is apparent that the largest trades, measured in terms of dollar value, take place in the most liquid stocks, as measured by market capitalization. Third, there are roughly two broker releases per order, suggesting a high demand for immediacy. On average, both buy and sell orders were completed rapidly, at a rate of 1.80 days for buys and 1.65 days for sells, and most orders were filled entirely. By contrast, the managers studied by Chan and Lakonishok (1995) are more patient. It is also worth noting that the high demand for immediacy may reflect the fact that our orders are, for the most part, not large when compared to some other institutional trades. Fourth, seller-initiated trades in our sample tend to be larger and take place in more liquid stocks than the buys. The median market

Table 1
Summary statistics for institutional equity trades

Summary statistics for buyer- and seller-initiated common stock trades by 21 institutional investors from January 1991 to March 1993. The sample is partitioned by market capitalization, with cutoffs determined by NYSE quintile break points at December 1991, and ordered from largest quintile to smallest quintile.

Market cap (Quintiles)	Median market cap ($ Billions)	Orders in listed stocks (% of Total)	Median value of order ($ Thousands)	Mean number of releases to brokers	Number of orders	Percentage of number of orders by investment strategy		
						Value	Technical	Index
A. Buyer-initiated trades								
Quintile 1	6.176	90	421.5	2.32	12,120	26	49	25
Quintile 2	1.213	81	67.2	2.03	9,924	14	36	50
Quintile 3	0.470	58	103.4	1.99	7,075	11	49	40
Quintile 4	0.168	44	81.5	1.93	4,848	19	46	35
Quintile 5	0.063	32	27.9	1.71	2,634	18	43	39
Overall	1.061	71	138.1	2.08	36,601	19	45	36
B. Seller-initiated trades								
Quintile 1	6.908	92	564.1	2.04	11,867	34	54	12
Quintile 2	1.261	85	436.9	1.97	5,592	26	59	15
Quintile 3	0.460	59	339.3	2.15	3,871	18	74	8
Quintile 4	0.170	41	246.4	2.21	2,725	27	69	4
Quintile 5	0.059	34	81.6	2.11	1,677	33	61	6
Overall	1.825	76	385.9	2.07	25,732	30	60	10

capitalization of the stocks being traded is \$1.06 billion for the buys and \$1.83 billion for the sells, and the median trade value is \$138,100 for the buys and \$385,900 for the sells. Note that these results are driven in part by one index manager of small stocks that was almost exclusively a buyer during the period of analysis. We replicated all our results excluding this institution, but found that this had little impact on the estimates of costs reported below. Thus, the reported results reflect all 21 institutions. Fifth, the percentage of orders in exchange-listed stocks increases with market capitalization. This figure ranges from 32% in the smallest quintile to 90% in the largest quintile for buys and from 34% to 92%, respectively, for sells. Overall, the percentage of orders in exchange-listed stocks is 71% for buys and 76% for sells.

3. The magnitude of trading costs

Trading costs consist of explicit and implicit costs. While explicit costs such as broker commission costs are, in general, easy to quantify, this is not the case for implicit costs. The major implicit trading cost is the price impact of the trade, i.e., the deviation of the transaction price from the unperturbed price that would prevail had the trade not occurred. The price impact of a trade can be negative if, for example, a trader buys at a price below the unperturbed price. Presumably, liquidity providers will enjoy negative costs while liquidity demanders will face positive costs.

Different specifications for the unperturbed price give rise to different measures of implicit costs. Berkowitz et al. (1988) suggest using a weighted average of transaction prices surrounding the trade as a proxy for the unperturbed price because it is an unbiased estimate of the prices facing a non-strategic trader. Different weights, however, produce different measures of the price impact. For example, the Abel-Noser Corporation uses a volume-weighted average of all transaction prices on the trade day, including the analyzed transaction price, to estimate this notional price. Alternatively, Beebower and Priest (1980) propose comparing the trade price to the closing price on the day following the trade, since any liquidity effects arising from the trade would be dissipated in a day. Perold (1988) measures trading costs as the difference in the performance between a portfolio based on the trades actually made and a hypothetical 'paper' portfolio whose returns are computed assuming the transactions are executed at prices observed at the time of the trading decision.

Since our data include the date and price at the time of the trading decision, we use Perold's (1988) approach to measure trading costs. For a buyer-initiated order, the implicit cost is given by the ratio of the volume-weighted average price of the component trades in the order to the decision price, i.e., the closing price the day before the decision to trade is made, less one. The implicit cost for a seller-initiated trade is measured as the negative of this return. In contrast to some other measures of trade costs, we do not adjust the costs reported below for market-wide price movements. There are two reasons for this. First, the orders in our sample have short duration, typically less than two days. By comparison, the average daily return for the S&P 500 for our sample period is 0.046%, which is small relative to the approximate 0.50% average trade cost for our sample. Subtracting market movements does not have a significant effect on our results. Second, on a more philosophical basis, the institution's trading desk is concerned with the total costs associated with the trade. These total costs include the so-called timing costs that arise from a failure to execute the order in a timely manner (Wagner and Edwards, 1993). Timing costs typically occur when the market is moving against the trader during the execution of the order. For example, timing costs can occur when the market is rising when the trader is trying to buy, or vice versa. Thus, subtracting the market movements over the duration of the order would understate the implicit costs associated with a failure to execute an order in a timely manner. In theory, institutions could control for market exposure using futures contracts. However, in practice, this seems unlikely given the short duration of the typical order.

The explicit cost for a trade is measured in percentage form as the ratio of the dollar value of the commissions paid for the trade to the total dollar value of the order at the time of the decision to trade. Unlike Perold (1988), we do not assign a cost to that portion of the desired order, if any, that is not executed. However, in our sample, on average, approximately 95% of the order is filled, so the effect of including this cost is very small. Perold and Sirri (1993) find comparable fill rates using different data from an institutional trader.

3.1. *Trade costs and investment style*

Table 2 presents estimates of execution costs associated with institutional equity trades by investment style and trade direction. The table reports the total, explicit, and implicit costs for exchange-listed stocks. Since commissions for Nasdaq stocks are customarily built into the transaction price paid for the stock by institutional traders, we report only total transaction costs for Nasdaq trades. It is worth noting that this method of accounting for commissions does not affect our estimates of total trading costs. In addition, the table reports the percentage of the total value of our sample of trades by order type. Our data identify four order classifications. A market order is an order submitted for quick execution at the prevailing market price. A working order is an order in which the broker is instructed to trade patiently to obtain execution at a better price than the current market price. A cross is a transaction between a buyer and a seller at a mutually-agreed price, typically without the intervention of a broker. A limit order sets a limit on the price at which an order can execute. Price limits for buy orders are set at or below current market prices, and price limits for sell orders are set at or above current market prices.

Table 2

Average trading costs by investment style for common stock trades for 21 institutions for the period January 1991 to March 1993

Implict trading cost are defined $(P^a/P_d) - 1$, where P^a is the average price of all the executed trades in the order and P_d is the closing price for the stock on the day before the decision to trade the stock. Explict trading cost is defined as (Commissions per Share$/P_d$). The sample is partitioned by investment style. Three styles are represented in the data: value- or fundamentals-based traders (7 institutions), technical or momentum traders (11 institutions), and index traders (3 institutions). Our data identify four order classifications. A market order is an order submitted for quick execution at the prevailing market price. A working order is an order in which the broker is instructed to trade patiently to obtain execution at a better price than the current marker price. A cross is a transaction between a buyer and a seller at a mutually agreed price, typically without the intervention of a broker. A limit order sets a limit on the price at which an order can execute. Price limits for buy orders are set at or below current market prices, and price limits for sell orders are set at or above current market prices. Costs are reported in percent. Standard errors are in parentheses.

Investment style	Exchange-listed stocks				Nasdaq stocks		Percentage of total trade value by order type			
	Total	Implicit	Explicit	*n*	Total	*n*	Market	Working	Crossing	Limit
A. Buyer-initiated traders										
Value	0.30	0.12	0.18	5,610	0.37	1,201	76.2	11.3	0.1	12.4
	(0.04)	(0.04)	(0.00)		(0.13)					
Technical	0.71	0.48	0.23	10,922	1.39	5,373	97.2	1.1	0.4	1.3
	(0.03)	(0.03)	(0.00)		(0.07)					
Index	0.37	0.23	0.14	9,693	1.27	4,025	88.8	11.2	0.0	0.0
	(0.02)	(0.02)	(0.00)		(0.06)					
All	0.49	0.31	0.18	26,225	1.23	10,599	87.8	8.9	1.5	1.8
	(0.02)	(0.02)	(0.00)		(0.05)					
B. Seller-initiated traders										
Value	0.08	−0.10	0.18	6,388	0.61	1,052	77.6	12.2	0.1	10.1
	(0.03)	(0.03)	(0.00)		(0.13)					
Technical	0.87	0.61	0.25	10,876	1.68	4,624	96.4	1.2	0.2	2.2
	(0.03)	(0.03)	(0.00)		(0.09)					
Index	0.38	0.25	0.13	2,296	0.79	412	88.9	11.1	0.0	0.0
	(0.06)	(0.06)	(0.00)		(0.28)					
All	0.55	0.34	0.22	19,560	1.43	6,088	85.1	11.8	0.5	2.7
	(0.02)	(0.02)	(0.00)		(0.07)					

The magnitude of execution costs is significant. The average total cost of a buy order is 0.49% and the average total cost of a sell order is 0.55% for exchange-listed stocks. The average total cost of buy orders is 1.23% and for sell orders it is 1.43% for Nasdaq stocks. There is considerable variation in costs between markets and across investment styles. In general, value traders have lower costs than index traders, who in turn have lower costs than technical traders. The choice of order type is consistent with this finding. Indeed, the technical traders in our sample have the greatest demand for immediacy, with market orders accounting for about 97% of the value of their buy orders. By contrast, value traders use market orders the least and rely the most on limit orders. This may explain why implicit costs are negative 10 basis points for value traders selling exchange-listed stocks. Across markets, it appears at first glance that total trading costs in exchange-listed stocks are considerably lower than Nasdaq stocks. However, these differences may be explained by other factors, such as trade difficulty and market liquidity, necessitating a more detailed analysis.

It is also clear from Table 2 that both implicit and explicit costs are significant for the institutions in our sample. The relation between the two components of costs is of interest since it provides insights into the nature of the order submission process. On one hand, a portfolio manager may be willing to trade higher commissions for better execution and lower price impacts. On the other hand, it may be necessary to pay higher commissions to execute more difficult trades that naturally result in higher impacts. Computed for our entire exchange sample, the correlation coefficients between explicit and implicit trade costs are positive, standing at 0.14 and 0.07 for sells and buys, respectively. Further, the estimated correlations decline with increasing market capitalization, representing decreasing trade difficulty. An interpretation of this finding is that if the institutions had not paid the higher commissions to induce the broker to execute the more difficult trades with greater care, the relation between trade difficulty and price impact would be steeper. Commissions paid to soft dollar brokers might also influence the relation between explicit and implicit costs (see, e.g., Blume, 1993). Since very few of the trades in our sample are identified as soft dollar transactions, reliable tests of their influence are not possible. We turn now to a more detailed analysis of the determinants of execution costs.

3.2. *Trade costs and trade difficulty*

We hypothesize that trading costs should increase with trade difficulty, as measured by trade size and market capitalization. Intuitively, price impacts are likely to be smaller in more liquid stocks with larger market capitalization, where trades can be executed quickly without significant price concessions. Also, larger trades should require larger price concessions to induce a counter-party to take the other side of the trade.[4] Further, bid–ask spreads are lower on a percentage basis for more liquid stocks (see, e.g., Keim, 1989; Huang and Stoll, 1996).

Table 3 reports the total trading costs for buyer-initiated trades separately for exchange and non-exchange stocks. Table 4 reports the corresponding figures for seller-initiated trades. The separate exchange and non-exchange stocks are further partitioned by independent rankings on market capitalization and trade size. Market capitalization cutoffs are determined by NYSE quintile break points determined at December 1991. Trade size is defined as the number of shares traded divided by total outstanding shares, with quartile cutoffs determined separately for buy and sell transactions. These numbers provide a first glimpse at the determinants of trade costs, which we model below in Section 4, and, importantly, provide some perspective on the economic magnitude of institutional trade costs.

The costs reported in Tables 3 and 4 are significant in both economic and statistical terms, and vary over a wide range. For exchange-listed stocks, for example, the average total cost for buyer-initiated trades ranges from 0.31% for the smallest trades in the largest market capitalization category to 2.35% for the largest trades in the smallest market capitalization category. A number of interesting results emerge from the data along several dimensions of the determinants of trade costs.

First, we expect total costs to rise with trade size within each quintile of market capitalization. However, we find that the hypothesized relation holds only in the smaller quintiles of market capitalization. The relation between trade size and cost is also much attenuated for Nasdaq stocks, possibly because of factors unique to the multiple dealer structure of the Nasdaq Stock Market.

Second, we expect total costs to be inversely related to market capitalization in each trade-size quintile. We observe this pattern generally, the only exceptions being in the smallest trade-size quintiles. This is true for both buys and sells and for both exchange-listed and Nasdaq stocks.

Third, the total costs for seller-initiated trades in our sample are generally larger than those for buyer-initiated trades. However, this finding may be attributable to the larger order quantities for the sell transactions in our sample, as discussed below. Traders may also be more patient on the buy side (Keim and Madhavan, 1995). It is therefore not clear from the average results reported here whether trade initiation affects costs after controlling for other factors, including order submission strategy.

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[4] See, e.g., Loeb (1983), Wagner and Edwards (1993), Keim and Madhavan (1996), and Chan and Lakonishok (1997) for evidence on the relation between trade costs and both market capitalization and trade size.

Finally, comparing costs across markets within comparable quintiles of trade size and capitalization, we find that trades in Nasdaq stocks are generally more costly than in exchange-listed stocks, especially for buyer-initiated orders. The only exceptions are for the largest trades in the largest market capitalization category with the most liquid stocks, where Nasdaq trades tend to have lower costs than corresponding trades in exchange-listed stocks. This finding may reflect the influence of factors other than trade size and market capitalization that affect execution costs. In particular, market capitalization is an imperfect measure of liquidity, especially for the largest stocks. Further, orders for Nasdaq stocks in the largest capitalization quintile are concentrated in a few, very active stocks, such as Microsoft or Intel, which are more liquid than the typical exchange-listed stock in that quintile. This may explain the low trading costs for trades in Nasdaq stocks in the highest quintile of market capitalization.

4. An analysis of trade costs

The large dispersion in the trading costs reported above motivates a more formal analysis of the determinants of trading costs, especially since factors other than order size and market capitalization are likely to affect costs. In this section, we estimate a regression model to jointly analyze the various factors affecting trading costs.

As shown above, measures of trade difficulty or market liquidity, such as order size and market capitalization, explain some of the variation in execution costs. In addition, the previous literature suggests that the price impact of a trade, usually the most significant implicit cost, has two components: (i) a component related to trade size, and (ii) a component independent of trade size related to the bid–ask spread.[5] A lower bound on the bid–ask spread is placed by the minimum price variation, which is generally one-eighth for exchange-listed stocks. As a result, the percentage spread is directly related to the inverse stock price, suggesting its inclusion as an additional explanatory variable (Harris, 1994). Our analysis also indicates considerable differences in costs across investment styles, perhaps reflecting differences in the amount of immediacy demanded by these traders. To control for these effects, we include dummy variables for investment style. Finally, we include a dummy variable for Nasdaq versus exchange listing to account for the evidence suggesting that trade costs vary across markets.

[5] See, e.g., Glosten and Harris (1988) or Madhavan and Smidt (1991) who decompose trading costs into these two components.

Table 3
Average trading costs by market capitalization quintile and trade size for common stock buy trades for 21 institutions for the period January 1991 to March 1993

Total trading costs are the sum of implicit costs, defined as $(P^a/P_d) - 1$, and explict costs, defined as Commissions per Share $/P_d$, where P^a is the average price of all the executed trades in the order and P_d is the closing price for the stock on the day before the decision to trade the stock. The sample is partitioned by independent rankings on market capitalization and trade size. Market capitalization cutoffs are determined by NYSE quintile break points determined at December 1991. Trade size is defined as the number of shares traded divided by total outstanding shares, with quartile cutoffs determined separately for buy and sell transactions. Standard errors are in parentheses. The bottom entry in each cell is the number of observations.

Trade size (Quartiles)[a]	Market capitalization (Quintiles)[b]				
	$mc > 2{,}271$	$2{,}271 \geqslant mc > 721$	$721 \geqslant mc > 270$	$270 \geqslant mc > 98$	$98 \geqslant mc$
A. NYSE & AMEX buy trades					
$S \leqslant 0.0016$	0.31	0.23	0.37	0.36	0.39
	(0.03)	(0.03)	(0.08)	(0.31)	(0.10)
	3,306	2,545	609	73	3
$0.0016 < S \leqslant 0.0087$	0.36	0.26	0.28	0.48	1.13
	(0.04)	(0.06)	(0.08)	(0.10)	(0.25)
	3,033	1,808	1,053	544	110
$0.0087 < S \leqslant 0.0566$	0.32	0.61	0.53	0.69	1.35
	(0.04)	(0.08)	(0.11)	(0.14)	(0.16)
	2,993	1,712	980	537	343
$0.0566 < S$	0.16	0.67	1.08	1.51	2.35
	(0.07)	(0.09)	(0.11)	(0.14)	(0.21)
	1,720	1,970	1,537	971	378

B. Nasdaq buy trades

$S \leqslant 0.0016$	0.60	0.55	1.21	1.34	1.75
	(0.19)	(0.07)	(0.14)	(0.27)	(0.81)
	317	715	314	77	12
$0.0016 < S \leqslant 0.0087$	0.68	0.60	0.90	1.04	1.79
	(0.18)	(0.16)	(0.11)	(0.12)	(0.26)
	314	473	748	647	307
$0.0087 < S \leqslant 0.0566$	0.27	0.57	0.51	0.92	2.68
	(0.20)	(0.25)	(0.17)	(0.17)	(0.19)
	305	352	714	673	635
$0.0566 < S$	−0.95	0.20	1.06	1.92	3.34
	(0.28)	(0.29)	(0.16)	(0.17)	(0.22)
	226	398	1,151	1,355	866

[a] Trade size, S, is expressed in percent.
[b] Market capitalization, mc, is in millions of dollars.

Table 4
Average trading costs by market capitalization quintile and trade size for common stock sell trades for 21 institutions for the period January 1991 to March 1993

Total trading costs are the sum of implicit costs, defined as $(P^a/P_d) - 1$, and explict costs, defined as Commissions per Share $/P_d$, where P^a is the average price of all the executed trades in the order and P_d is the closing price for the stock on the day before the decision to trade the stock. The sample is partitioned by independent rankings on market capitalization and trade size. Market capitalization cutoffs are determined by NYSE quintile break points determined at December 1991. Trade size is defined as the number of shares traded divided by total outstanding shares, with quartile cutoffs determined separately for buy and sell transactions. Standard errors are in parentheses. The bottom entry in each cell is the number of observations.

Trade size (Quartiles)[a]	Market capitalization (Quintiles)[b]				
	$mc > 2{,}271$	$2{,}271 \geq mc > 721$	$721 \geq mc > 270$	$270 \geq mc > 98$	$98 \geq mc$
A. NYSE & AMEX sell trades					
$S \leq 0.0032$	0.26	0.47	0.91	1.03	0.75
	(0.03)	(0.09)	(0.35)	(0.82)	(0.67)
	4,067	652	109	40	16
$0.0032 < S \leq 0.0169$	0.27	0.34	0.61	0.67	1.39
	(0.03)	(0.08)	(0.15)	(0.62)	(1.76)
	3,177	1,130	450	107	32
$0.0169 < S \leq 0.0775$	0.22	0.49	0.54	0.70	0.67
	(0.05)	(0.07)	(0.12)	(0.27)	(0.33)
	2,397	1,427	656	267	141
$0.0775 < S$	0.29	1.05	1.49	1.67	2.68
	(0.10)	(0.11)	(0.16)	(0.20)	(0.28)
	1,223	1,513	1,080	696	380

B. Nasdaq sell trades					
$S \leqslant 0.0032$	0.33	0.41	0.24	0.46	− 0.02
	(0.18)	(0.28)	(0.32)	(0.50)	(0.50)
	251	96	82	66	71
$0.0032 < S \leqslant 0.0169$	0.25	0.23	0.87	1.68	1.10
	(0.19)	(0.23)	(0.19)	(0.21)	(0.45)
	278	183	219	194	104
$0.0169 < S \leqslant 0.0775$	0.29	0.32	0.56	0.73	0.88
	(0.26)	(0.33)	(0.18)	(0.19)	(0.47)
	261	248	442	320	205
$0.0775 < S$	− 0.42	1.69	1.66	2.33	4.08
	(0.33)	(0.35)	(0.20)	(0.21)	(0.31)
	170	322	825	1,029	722

[a] Trade size, S, is expressed in percent.
[b] Market capitalization, mc, is in millions of dollars.

Following the discussion above, we model trading costs as:

$$C_i = \beta_0 + \beta_1 D_i^{\mathrm{NASDAQ}} + \beta_2 Trsize_i + \beta_3 Logmcap_i + \beta_4 \frac{1}{P_1} + \beta_5 D_i^{\mathrm{TECH}} + \beta_6 D_i^{\mathrm{INDEX}} + \varepsilon_i, \tag{1}$$

where for order i, C_i is the total cost, stated in percentage form, D_i^{NASDAQ} equals one if the stock being traded is Nasdaq and zero otherwise, $Trsize_i$ is the ratio of the order value to market capitalization of the traded stock, $Logmcap_i$ is the log of the market capitalization of the traded stock, P_i is the price of the traded stock, D_i^{TECH} and D_i^{INDEX} are dummy variables for technical and index managers, respectively, and ε_i is the error term.

The Nasdaq dummy captures any exchange-specific effects on trading costs that are unrelated to market capitalization or trading behavior. For example, if exchanges provide better execution through the auction process the costs for comparable Nasdaq trades should be higher (see, e.g., Blume and Goldstein, 1992). Conversely, the ability of institutions to negotiate large trades directly with dealers may induce lower costs on Nasdaq, after controlling for other factors. The coefficient β_1 captures such effects. Larger orders should imply, other things being equal, higher costs, so that we expect β_2 to be greater than zero. Market capitalization is included as a proxy for liquidity, and we hypothesize that β_3 will be less than zero. We expect proportional fixed costs, or the percentage bid–ask spreads, to decrease with price, so that β_4 is expected to be greater than zero. Finally, the coefficients β_5 and β_6 capture the effects on cost of any differences in the style of the managers, relative to the benchmark of a value trader. The style dummy variables capture the effects of subtle differences in trader aggressiveness or strategy that may be manifested in cost differences across trade direction and style. Index managers, whose objective is to construct a portfolio that closely mimics the behavior of a specific stock index, and technical managers, whose trades try to capture short-term price movements, are more likely to demand immediacy than fundamental value managers, whose trades are motivated by considerations of long-term value. Hence, we expect that technical and index styles will incur higher execution costs relative to value traders, so we expect both β_5 and β_6 to be greater than zero.

We estimate Eq. (1) for the entire 1991–1993 sample period for all trades, and separately for buys and sells to capture possible differences related to trade initiation. Table 5 reports coefficient estimates of Eq. (1), along with heteroskedasticity-consistent standard errors. Although the adjusted R^2 values are relatively low, the coefficient estimates are statistically significant and are consistent with our predictions. The use of robust standard errors corrects for possible heteroskedasticity arising from the diversity among the sample institutions. Nevertheless, it is possible that the standard errors may be understated if

Table 5
Regression analysis of total trading costs for 21 institutional traders

The table presents, for 21 institutions in the period January 1991 to March 1993, the estimated coefficients of the regression model:

$$C_i = \beta_0 + \beta_1 D_i^{\mathrm{NASDAQ}} + \beta_2 Trsize_i + \beta_3 Logmcap_i + \beta_4 \tfrac{1}{P_i} + \beta_5 D_i^{\mathrm{TECH}} + \beta_6 D_i^{\mathrm{INDEX}},$$

where, for order i, C_i is the total trading cost in percent, D_i^{NASDAQ} is a dummy variable for Nasdaq stocks, $Logmcap_i$ is the log of the market capitalization of stock traded, where firm size is measured in thousands of dollars, $Trsize_i$ is the size of the trade, measured by order size divided by shares outstanding, P_i is the price per share of the stock traded, and D_i^{TECH} and D_i^{INDEX} are dummy variables for technical and index managers, respectively. Standard errors are heteroskedasticity-consistent estimates.

Variable	Buyer-initiated orders		Seller-initiated orders		All orders	
	Estimate	Standard error	Estimate	Standard error	Estimate	Standard error
Intercept	0.767	0.325	0.505	0.449	0.687	0.269
D^{NASDAQ}	0.336	0.052	0.058	0.085	0.239	0.045
Trsize	0.092	0.016	0.214	0.030	0.165	0.005
Logmcap	– 0.084	0.019	– 0.059	0.027	– 0.076	0.016
$1/P_i$	13.807	1.356	6.537	1.482	9.924	1.029
D^{TECH}	0.492	0.050	0.718	0.049	0.607	0.035
D^{INDEX}	0.305	0.049	0.432	0.074	0.451	0.040
Adjusted R^2	0.046		0.086		0.060	

the observations are not independent across institutions.[6] This understatement may occur if institutions engage in herding behavior, buying or selling the same stocks at roughly the same times. Two factors tend to mitigate this concern. First, we find little evidence of temporal correlations in the institutional trades in our sample, suggesting that this understatement may not be a serious problem. Second, as a test of the robustness of our results, we estimated Eq. (1) separately for two 13-month subperiods comprising the first and second halves of our sample period and obtained very similar results to those reported here. The estimated coefficients appear to be stable across different sub-periods. We also estimated Eq. (1) without sample institution 2, a small-capitalization manager that was primarily buying during the period, likely in response to a cash infusion, to ascertain whether that behavior unduly influenced our results. The results from that estimation are qualitatively the same as those reported in Table 5.

[6] Of course, the same caveat applies to other studies using high-frequency observations across individual stocks.

Turning now to the interpretation of the results, the coefficient on trade size is positive and significant for both buys and sells, indicating that larger order sizes are associated with higher costs. This suggests that liquidity is an important determinant of trading costs. As hypothesized, the log of market capitalization has a strong negative impact on costs, indicating that stocks trading in less liquid markets are more costly to trade. Similarly, the coefficient of the price inverse is positive and significant, consistent with higher percentage spreads in low-priced stocks.

Consistent with the findings in Table 2, the dummy variables for technical and index traders are positive and statistically significant for all trades and separately for buys and sells. The magnitudes of the dummy coefficients imply economically significant differences in the predicted trading costs across investment styles, while holding constant the other factors relating to exchanges and trade difficulty. Across all trades, technical and index traders incur execution costs that are 0.61 and 0.45% higher than value traders, respectively.

When estimated across all trades, the coefficient on the Nasdaq dummy variable, β_1, is positive and significant. Controlling for trade difficulty and firm size, a one-way transaction on Nasdaq was 0.24% more expensive than an equivalent trade in an exchange listed stock. When estimated separately by trade direction, β_1 is positive and significant for buys, and is positive but not significant for sells. Eq. (1) implicitly assumes the same functional form for the relation between trade costs and the determinants of those costs for both Nasdaq and exchange-listed trades. We also estimated a variant of Eq. (1) that allowed the slope coefficients, as well as the intercept, to be different for Nasdaq and exchange-listed trades. In this alternative estimation for the overall period, we find that the coefficient on the Nasdaq dummy variable is again positive, at 2.21%, and significant when estimated over all trades. This coefficient is also positive for both buys and sells, but is significant only for buys. Interestingly, the absolute value of each slope coefficient is significantly larger for Nasdaq trades than for exchange-listed trades.

The results indicate that for our sample of institutional traders, costs on Nasdaq are higher after controlling for other determinants of trade costs. It is possible that these findings reflect greater patience by traders on the buy side. If assets are substitutable, it is difficult to conceive of non-information motivations for a large purchase, suggesting that traders will exercise more care in taking large positions. Trading exchange-listed stocks allows patient traders to reduce their execution costs by using passive trading strategies. For example, a trader can acquire a position slowly by placing limit orders or by instructing a broker to execute the order slowly to avoid a large price impact. By contrast, the Nasdaq market does not provide similar opportunities for passive trading. Alternative explanations may lie in unobserved subtleties of the trading process, such as the relationships between managers and large dealers, or the investment styles represented here. Indeed, Chan and Lakonishok (1997) find little evidence of differences in costs across markets.

4.1. Predicted trading costs

The estimated regression Eq. (1) allows us to estimate the expected costs associated with hypothetical trading strategies. Many previous studies simply report aggregate cost estimates, without controlling for factors that may affect costs. Such results may be misleading. For example, suppose that a trader following a technical trading strategy incurs execution costs of 2% of the value of orders placed. This figure may appear large, but if similarly sized orders in identical market capitalization stocks typically incur costs of, say, 3%, the trader's performance was better than average. Thus, cost comparisons, either across or within investment styles, must control for the difficulty of the trade and the trade venue. By doing so, we can identify those traders with below-average execution costs, relative to a benchmark determined by trade difficulty. Such an identification is important for performance analysis.

4.1.1. Predicted costs by investment style

Fig. 1 plots the one-way average trading costs for the three investment styles as a function of market capitalization for a hypothetical trade. The computations assume an order size of 35,000 shares on a base of 30 million outstanding shares in a Nasdaq stock for market capitalizations ranging from \$0.25–2.50 billion. These values are typical for our sample. The figure is based on the estimates of the total trading costs in Eq. (1) using data on all orders, both buys and sells, by the 21 institutions in the sample. For all three styles, trading costs decrease as a function of market capitalization. The decline in costs is especially dramatic for firm sizes below \$1 billion. This finding reflects the non-linear transformations of both the price and market capitalization variables in Eq. (1). This specification provided a substantially better fit than a simple linear regression, possibly because the inverse price proxies for the percentage bid–ask spread, while the log transformation of market capitalization adjusts for the right-skewed distribution of firm size.

The predicted execution costs of technical and index traders in Fig. 1 are uniformly higher than those of value traders. Since the total round-trip costs are twice the one-way costs shown in Fig. 1, these differences are economically significant. The differences in predicted costs reflect the styles of the managers. Index and technical managers use active strategies to demand immediate execution and, as a result, may incur high execution costs. By contrast, value managers use passive trading strategies to reduce their trading costs. Indeed, to the extent that such managers supply liquidity through the use of limit orders, they may even enjoy negative trading costs.

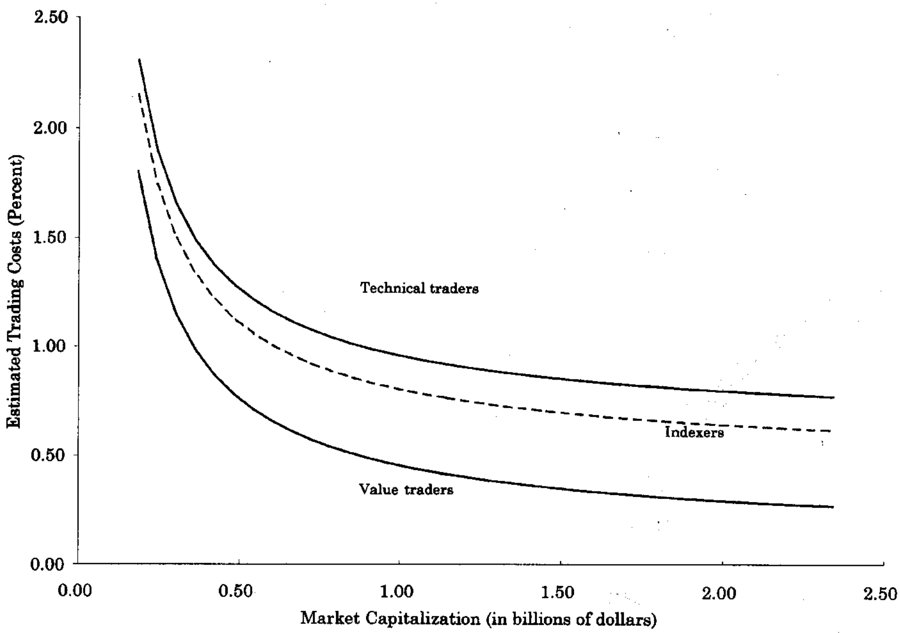

Fig. 1. Estimated one-way trading costs by investment style for a hypothetical trade in a Nasdaq stock.

The figure is based on estimates of the following regression model

$$C_i = \beta_0 + \beta_1 D_i^{\mathrm{NASDAQ}} + \beta_2 Trsize_i + \beta_3 Logmcap_i + \beta_4 \tfrac{1}{P_i} + \beta_5 D_i^{\mathrm{TECH}} + \beta_6 D_i^{\mathrm{INDEX}} + \varepsilon_i,$$

where for order i, C_i is the total cost, stated in percentage form, D_i^{NASDAQ} equals one if the stock being traded is Nasdaq and zero otherwise, $Trsize_i$ is the ratio of the order value to market capitalization of the traded stock, $Logmcap_i$ is the log of the market capitalization of the traded stock, P_i is the price of the traded stock, D_i^{TECH} and D_i^{INDEX} are dummy variables for technical and index managers, respectively, and ε_i is the error term. The estimation uses data on all orders, both buys and sells, by the 21 institutions in the sample. The computations assume an order size of 35,000 shares on a base of 30 million outstanding shares in a Nasdaq stock for market capitalization values ranging from \$0.25 billion to \$2.50 billion. These values are typical for our sample.

4.1.2. Predicted costs by trade direction

The differences in the regression estimates for buys and sells suggest that there may be important differences in trading costs by trade direction. Fig. 2 shows the one-way predicted trade costs for buys and sells as a function of market capitalization. The computations assume an order size of 35,000 shares placed by a value trader in a Nasdaq stock with 30 million outstanding shares. The predicted costs are based on the two sets of coefficient estimates for Eq. (1) for buy and sell orders for all 21 institutions in the sample. The predicted costs for both buys and sells decrease in market capitalization. Interestingly, in this

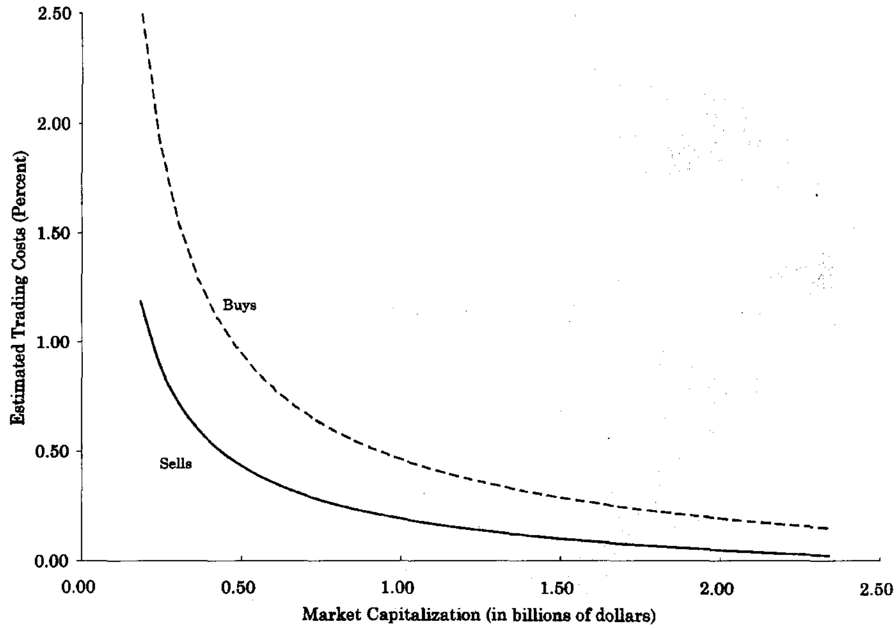

Fig. 2. Estimated one-way trading costs for buy and sell orders for a hypothetical trade in a Nasdaq stock.

The figure is based on estimates of the following regression model

$$C_i = \beta_0 + \beta_1 D_i^{\mathrm{NASDAQ}} + \beta_2 Trsize_i + \beta_3 Logmcap_i + \beta_4 \tfrac{1}{P_i} + \beta_5 D_i^{\mathrm{TECH}} + \beta_6 D_i^{\mathrm{INDEX}} + \varepsilon_i,$$

where for order i, C_i is the total cost, stated in percentage form, D_i^{NASDAQ} equals one if the stock being traded is Nasdaq and zero otherwise, $Trsize_i$ is the ratio of the order value to market capitalization of the traded stock, $Logmcap_i$ is the log of the market capitalization of the traded stock, P_i is the price of the traded stock, D_i^{TECH} and D_i^{INDEX} are dummy variables for technical and index managers, respectively, and ε_i is the error term. The predicted costs are based on two sets of coefficient estimates for buyer- and seller-initiated transactions using data for the 21 institutions in the sample. The computations assume an order size of 35,000 shares on a base of 30 million outstanding shares in a Nasdaq stock for market capitalization values ranging from $0.25 billion to $2.50 billion. These values are typical for our sample.

example, the one-way costs for a buyer-initiated trade exceed that of a seller-initiated trade, even though the trades are identical in terms of order characteristics. This pattern holds for a wide range of order sizes, and is consistent with the asymmetry between buyer and seller behavior noted by Keim and Madhavan (1995). They report that traders are more patient on the buy side than on the sell side, other things being equal. In turn, this behavior may arise because the information content of a large buy order is perceived to be greater than that of an equivalent sell order. Indeed, while there are many possible non-informational motives for a block sale, there are few plausible liquidity motives for a block purchase. Chan and Lakonishok (1995) also find that buys are more expensive than sells for their sample of institutions.

It is important to note that the realized costs for the institutions in our sample, as reflected in Table 2, do not exhibit the asymmetry indicated in the regression analysis. This result is because order sizes for seller-initiated trades are generally larger than for buyer-initiated trades in our sample, and hence have higher average costs. Finally, it is worth noting that the higher costs facing a buyer decrease with market capitalization. The reason for this effect is unclear. It is possible, for example, that there is a greater perception of information asymmetry for buyer-initiated trades in small stocks because potential buyers can split their trades among many other substitute stocks with similar characteristics. Alternatively, information asymmetries for large stocks, which are typically widely held and followed by many analysts, may simply be less important than for small stocks, implying smaller differentials by type of trade initiation.

4.2. *Institution-specific effects*

A natural extension of the previous analysis is to examine the variation in trading costs across individual traders. Accordingly, we estimate the following regression equation for all trades, and separately for buyer- and seller-initiated trades:

$$C_i = \beta_1 D_i^{\mathrm{NASDAQ}} + \beta_2 Trsize_i + \beta_3 Logmcap_i + \beta_4 \frac{1}{P_i} + \sum_{j=1}^{21} \gamma_j D_{i,j}^s + \varepsilon_i, \qquad (2)$$

where $D_{i,j}^s$ is an institution specific dummy variable taking the value 1 if institution j with style s initiated order i and zero otherwise. The model is estimated without an intercept to facilitate the interpretation of the institution-specific dummy variables. As such, the estimated coefficients, γ_j, of the institution-specific dummy variables in Eq. (2) are interpreted as the average base-level, or trader-specific, cost of execution, correcting for trade difficulty and market-specific factors.

Table 6 reports the estimates of Eq. (2) for all trades, and separately for buys and sells. In all three regressions, there are large differences in the estimated base-level costs across institutions, even correcting for variation in trading behavior and stock-specific factors. The differences between institutional styles noted above are statistically significant, since an F-test rejects the null hypothesis that all the base-level costs represented by the dummy variables have the same value.

While there are clear differences in costs across styles, it is apparent in Table 6 that even within investment styles, different approaches to filling an order can significantly affect overall execution costs. Consider, for example, institutions 8 and 9, both of which are technical traders. The estimated model suggests that

Table 6
Regression analysis of total trading costs for 21 institutional traders
The table presents, for 21 institutions in the period January 1991 to March 1993, the estimated coefficients of the regression model:

$$C_i \beta_1 D_i^{\mathrm{NASDAQ}} + \beta_2 Trsize_i + \beta_3 Logmcap_i + \beta_4 \tfrac{1}{P_i} + \sum_{j=1}^{21} \gamma_j D_{i,j}^s$$

where, for order i, C_i is the total trading cost in percent, D_i^{NASDAQ} is a dummy variable for Nasdaq stocks, $Logmcap_i$ is the log of the market capitalization of stock traded, where market capitalization is measured in thousands of dollars, P_i is the price per share of the trade stock. $Trize_i$ is the size of the trade, measured by order size divided by shares outstanding, and $D_{i,j}^s$ is a dummy variable for institution j and style $s \in \{V, T, I\}$. The model is estimated without an intercept for all orders and separately for 33,876 buyer-initiated orders and 23,136 seller-initiated orders. Standard errors are heteroskedasticity-consistent estimates.

Variable	Buyer-initiated orders		Seller-initiated orders		All orders	
	Estimate	Standard error	Estimate	Standard error	Estimate	Standard error
D^{NASDAQ}	0.297	0.052	− 0.081	0.083	0.162	0.045
Trsize	0.102	0.016	0.207	0.030	0.168	0.017
Logmcap	− 0.028	0.020	− 0.008	0.026	− 0.015	0.016
$1/P_i$	12.784	1.285	6.758	1.487	9.688	1.003
d_1^T	2.240	0.452	− 0.125	0.554	1.092	0.358
d_2^I	0.319	0.322	0.648	0.450	0.339	0.261
d_3^V	0.131	0.375	− 0.073	0.319	− 0.022	0.241
d_4^V	0.192	0.387	− 0.220	0.465	− 0.110	0.304
d_5^V	− 0.722	0.346	− 1.070	0.443	− 1.000	0.283
d_6^V	− 0.992	0.689	2.358	0.877	0.496	0.581
d_7^T	− 0.039	0.365	0.229	0.586	− 0.043	0.306
d_8^T	− 0.406	0.398	0.567	0.471	− 0.013	0.310
d_9^T	4.379	0.425	2.634	0.556	3.577	0.349
d_{10}^V	1.082	0.398	0.631	0.673	0.776	0.422
d_{11}^V	0.261	0.337	− 0.343	0.436	− 0.100	0.277
d_{12}^I	0.269	0.344	0.168	0.431	0.167	0.277
d_{13}^I	1.408	0.449	− 0.353	0.525	0.579	0.349
d_{14}^T	0.242	0.343	− 0.095	0.432	− 0.063	0.280
d_{15}^T	0.660	0.354	0.546	0.435	0.539	0.281
d_{16}^T	0.392	0.377	0.047	0.463	0.126	0.298
d_{17}^T	− 0.239	0.369	0.181	0.467	− 0.151	0.301
d_{18}^T	1.047	0.332	1.590	0.466	1.199	0.279
d_{19}^V	0.084	0.350	0.148	0.441	0.051	0.282
d_{20}^T	− 0.123	0.352	0.236	0.448	− 0.011	0.287
d_{21}^T	− 1.067	0.610	0.166	0.626	− 0.569	0.452
Adjusted R^2	0.116		0.137		0.117	
F_1[a]	10.756		19.436		25.533	
F_2	115.037		36.858		124.395	
F_3	30.184		10.322		5.836	

[a] The F-statistics test, respectively, the equality of the institutional dummy coefficients within the Value (F_1), Technical (F_2), and Index (F_3) investment-style categories.

relative to institution 8 (and to all other technical traders), institution 9 has significantly large positive excess costs. For institution 9, the estimated dummy coefficient is, on average, almost 3.7% higher than that of institution 8. We performed F-tests on the equality of base-level costs within each investment style. These are reported in the bottom three rows in Table 6. Based on these tests, it is clear that the differences in individual costs within a particular investment style are statistically significant, a result that complements similar findings in Chan and Lakonishok (1995). The diversity in the estimated institution-specific dummy variables reflect differences in the skills or trading ability of the managers.

Our results highlight the importance of analyzing the transaction costs associated with implementing a given investment strategy. The unconditional observed cost is not the appropriate measure of a trader's ability. Rather, what matters is whether the trader systematically incurs trade costs that differ from a benchmark measure of cost, given the investment strategy to be implemented.

5. Conclusions

The realized return to a given investment strategy is the notional investment return from stock selection and timing less the associated transactions costs. Consequently, there is considerable interest in the magnitudes and determinants of transaction costs. This paper examines this issue using order-level data for equity transactions by a sample of institutional traders totalling $83 billion.

Total transactions costs are economically significant and are systematically related to trade difficulty and market liquidity. In addition, other factors, such as trade initiation and exchange listing, also affect trade costs. We find substantial variation in trading costs across institutions, reflecting differences in trading ability and investment style. In particular, value traders enjoy substantially lower trading costs than traders whose trading strategies demand more immediacy. However, even within a particular investment style, there is considerable heterogeneity in the costs across institutions.

Our study complements recent analyses of institutional trading by Chan and Lakonishok (1993), Chan and Lakonishok (1995). Our findings affirm the importance of understanding transaction costs in formulating and assessing an investment strategy. Further, our results suggest that transaction costs cannot be studied in isolation but must be analyzed with respect to the trader's underlying investment strategy.

Our results suggest several directions for future research. First, the differences in trading costs across markets requires further analysis. It is not clear whether our results reflect differences in market structure or whether they arise from the behavior of traders and dealers. This question is important because differences in costs may shed light on the merits of alternative trading designs. Second, the apparent differences in cost by trade initiation are intriguing. These differences may simply reflect subtleties of the trading process that are not captured here, but may also reflect information asymmetries. Finally, the variation in costs across institutions, even after controlling for trade difficulty and investment style, may indicate real differences in trading ability.

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