EXECUTION COSTS AND INVESTMENT PERFORMANCE: AN EMPIRICAL ANALYSIS OF INSTITUTIONAL EQUITY TRADES

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Abstract

This paper examines the execution costs and investment performance of $83 billion of recent equity transactions by 21 institutional traders. These trades are of particular interest because we have detailed information on the order submission strategy adopted by traders with different investment styles. We analyze the major components of execution costs, including explicit and implicit costs. Execution costs are substantial relative to investment performance and are positively related to measures of trade difficulty. Trading systems differ in their ability to accommodate large trades; orders in exchange-listed stocks generally have a lower price impact than in comparable NASDAQ stocks. There is substantial variation in trading costs and performance across institutions, reflecting differences in trading ability and style. The results provide a way to assess various trading strategies and to form benchmarks to evaluate portfolio managers.

1 Introduction

This paper analyzes empirically the relation between execution costs and investment performance of institutional equity traders. Investment performance reflects two factors: (1) the trader's strategy, i.e., the choice of securities to buy or sell, and the timing of these transactions, and (2) the costs incurred in implementing these investment ideas through trading. Execution costs can substantially reduce or possibly even outweigh the expected value created by an investment strategy. Consequently, it is important to better understand the relation between trading costs, performance, and the underlying trading strategy.

Interest in this area is motivated by several factors. First, assessing the magnitude and determinants of execution costs, and evaluating these costs in the light of subsequent investment performance, has immediate practical value for investors, portfolio managers, and traders. Specifically, such an analysis can be used to predict execution costs for various trading strategies and to form benchmarks to evaluate the *ex post* performance of equity traders. Institutional traders are of special interest because they account for a significant fraction of equity ownership and trading volume. Although their trades are relatively large and frequent, little is known about their execution costs and investment performance.[1]

Second, a comparison of execution costs across markets can shed light on the relative merits of auction and dealer systems. This issue has attracted considerable attention after Christie and Schultz (1994) concluded that dealers on the NASDAQ National Market implicitly collude to widen bid-ask spreads.[2] Although there is evidence to suggest that quoted spreads on NASDAQ stocks may be wider than comparable exchange-listed stocks,

[1]Schwartz and Shapiro (1992) discuss the impact of institutional trading. They report that in 1990, U.S. institutional equity holdings were approximately 50% of total New York Stock Exchange (NYSE) capitalization, and institutional trades were 72% of NYSE share volume. Lakonishok, Shleifer, and Vishny (1992), Chan and Lakonishok (1993a, 1993b), and Keim and Madhavan (1995a) examine various aspects of institutional trading behavior.

[2]Christie and Schultz (1994) document an absence of odd-eighth quotes for NASDAQ stocks, implying that spreads are at least a quarter for the largest stocks; Christie, Harris, and Schultz (1994) find a significant drop in spreads following the disclosure of the findings of Christie and Schultz (1994); Dutta and Madhavan (1995) provide a theoretical model of a dealer market and demonstrate conditions under which implicit collusion is sustainable. See Stoll (1976), Reinganum (1990), Blume and Goldstein (1992), Chan, Christie, and Schultz (1993), Fama, French, Booth, and Sinquefield (1993), Shapiro (1993), and Christie and Huang (1994) for additional evidence on the returns and costs of trading NASDAQ stocks.

large traders (typically institutions) negotiate prices within the quoted spread. To the extent such price "discounting" occurs, it would mitigate the economic effects of any elevation in quoted bid-ask spreads. Thus, a comparison of the trading costs of institutonal traders across markets may provide new insights into this issue.

We investigate these issues using data on $83 billion of recent equity transactions by 21 institutional traders. 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 aggregate versus individually. In their analysis of institutional trading costs, Chan and Lakonishok (1993a) have data on individual transactions, and aggregate to the order (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 are *ex post* approximations of desired trade quantity. The data also identify the trade as buyer- or seller-initiated. In most available databases, e.g., the ISSM data, volumes are not signed and the trade initiation must be inferred indirectly using time-stamped quotation data, possibly inducing severe biases in estimated transaction costs.

Our analysis contributes to the literature in three ways. First, we examine trading costs in the context of the strategic choices made by the trader (such as order type and the number of component trades to fill the order) as well as stock-specific attributes beyond the control of the trader. Previous studies typically do not make any allowance for the fact that different strategies may result in very different transaction costs, possibly biasing their results.

Second, we examine the relation between trading costs and the investment style of the institution. Differences in investment style may have significant effects on subtle attributes of trader behavior, which may translate into non-trivial differences in cost. For example, a technical or momentum-based trader may instruct brokers to execute trades within an hour while a fundamental (value) based trader may allow several days. Both orders are recorded as working orders, but differ considerably in their degree of aggressiveness.

Finally, we focus on the *total* execution costs associated with filling the *order* quantity. There are two major components to trading costs: *explicit costs*, primarily commission costs, and *implicit costs*, which include the price impact of a trade and the opportunity costs associated with failing to execute a trade in a timely manner.[3] It is important to consider both costs because the two cost components may be systematically related. For example, when trading an illiquid stock it may be optimal to pay higher broker commissions to slowly 'work' the order to obtain better execution, whereas in a liquid stock it may be less costly to use market orders and hence pay lower commissions.[4]

Our analysis provides several new findings. Execution costs are substantial relative to investment performance. As expected, both explicit and implicit trading costs are positively related to measures of trade difficulty. Interestingly, 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 document substantial variation in trading costs and performance across institutions, reflecting differences in trading ability and style. However, even within a particular investment style, there is considerable heterogeneity across institutions. These differences may reflect either real differences in trading ability, or may arise because of differences in the demand for immediacy.

The paper proceeds as follows: Section 2 discusses the measurement of implicit and explicit costs; Section 3 describes the data; Section 4 reports estimates of execution costs; Section 5 examines the determinants of these costs; Section 6 analyzes the relation between

[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.

[4]Most previous studies (see, e.g., Kraus and Stoll (1972), Dann, Mayers, and Raab (1977), Holthausen, Leftwich, and Mayers (1987), Ball and Finn (1989), and Keim and Madhavan (1995b)) focus on the measurement of price impacts, often of large (block) trades. Important exceptions include Berkowitz, Logue, and Noser (1988), Chan and Lakonishok (1993b) and Perold and Sirri (1993) who examine the total costs of equity trades.

execution costs and investment performance; and Section 7 concludes.

2 Trading Costs and Investment Performance

2.1 Measures of Trading Costs

Trading costs consist of explicit and implicit costs. The major explicit costs are broker commission costs and are, in general, easy to quantify.[5] This is not the case for implicit costs. The major implicit trading cost is the *price impact* of the trade. This cost is a liquidity cost – it represents the deviation of the transaction price from the "unperturbed price," i.e., the price that would prevail without the trade. 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. Popular approaches to measuring implicit costs differ in their specification of the unperturbed or equilibrium price.

Berkowitz, Logue, and Noser (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 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.

The problem with using pre-trade prices to form the price benchmark is that the measure can be gamed. A trader who has enough latitude concerning the time of the trade could achieve negative trading costs as measured by Abel-Noser since he or she knows the benchmark against which the trade will be evaluated at the time the trade is initiated. Beebower and Priest (1980) propose an alternative measure (also known as the SEI approach) that avoids this problem. They advocate 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.

[5] The treatment of commissions for NASDAQ stocks presents a problem, and we discuss this issue below.

Perold (1988) suggests an alternative measure of 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.* This approach has the advantage that it cannot be manipulated by traders and accounts for the implicit costs arising from failing to fill the order completely, i.e., the "implementation shortfall." Perold and Sirri (1993) use this approach to quantify execution costs in international markets.

2.2 The Conceptual Framework

Our approach closely resembles that of Perold (1988). Consider an order which is filled on $n \geq 1$ different days with (average) transaction prices and associated volumes denoted by $(p_1, v_1), \ldots, (p_n, v_n)$.[6] Let p^a denote the average volume-weighted trade price for the order, defined formally by

$$p^a = \frac{\sum_{i=1}^n p_i v_i}{\sum_i^n v_i}. \tag{1}$$

Let p_{n+k+1} denote the closing price $k+1$ days after the day of the last trade associated with the order and let p_d denote the closing price on the day before the decision to trade. Finally, let ψ denote the (average) commission per share. Then, the total (dollar) k-period profit per share for a purchase is $\pi_k = (p_{n+k+1} - p^a - \psi)$. (The analysis for a sale is symmetric.) This profit can be decomposed as follows:

$$\pi_k = (p_{n+k+1} - p_d) - [(p^a - p_d) + \psi]. \tag{2}$$

Equation (2) shows that trade performance, measured by $(p_{n+k+1} - p^a)$, is the difference between two terms: (1) The notional (or paper) return from stock selection and timing, measured by $(p_{n+k+1} - p_d)$, and (2) total implicit and explicit execution costs, $[(p^a - p_d) + \psi]$.

Our measure of implicit execution costs takes into account both the price impact of the trade and the costs from failing to execute in a timely manner. To see this, let p_0 represent the opening price on the day of the first trade associated with the order. Then, our measure

[6]There may be multiple fills on any given day, in which case the price for that day is the average transaction price and the volume is the total volume for all trades associated with that order for that day.

of implicit execution costs, $(p^a - p_d)$, can be expressed as the sum of two components: the overall price impact, measured by $(p^a - p_0)$, and the opportunity costs of failing to execute in a timely manner, measured by $(p_0 - p_d)$. 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, approximately 95% of the order is filled on average, so the effect of including this cost is very small.[7]

Equation (2) also illustrates the relation between our approach to cost and performance measurement and the approach advocated by Beebower and Priest (1980) (BP). For short horizons (e.g., low k), the BP measure of costs is $p^a - p_{n+k+1}$, i.e., the deviation of the average trade price from the notional value of the stock. It is clear that the BP measure of costs is the negative of our performance measure if k is small and the stock selection component is negligible.

Let C denote the total execution cost of the order, in return form. Formally, $C = C^{imp} + C^{exp}$, where C^{imp} denotes the implicit cost and C^{exp} denotes the explicit cost, defined as follows. For a buyer-initiated order, the implicit cost is:

$$C^{imp} = \frac{p^a}{p_d} - 1. \tag{3}$$

(The cost for a seller-initiated trade is measured as the negative of this return.) The explicit cost is defined as

$$C^{exp} = \frac{\psi}{p_d}, \tag{4}$$

i.e., the ratio of the dollar value of the commissions paid for trade to the total dollar value of the order at the time of the decision to trade.

Then, multiplying equation (2) by the total volume of shares traded $\sum_i v_i$ and dividing through by the initial value of the order at the decision date, $\sum_i p_d v_i$, we obtain, for a buy:

$$r_k = r_k^0 - C \tag{5}$$

where $r_k = \pi_k / p_d$ is the k-period investment return (the ratio of the net profit from executing the order to the value of the order at the decision date), $r_k^0 = p_{n+k+1}/p_d - 1$ is the notional

[7] Perold and Sirri (1993) find comparable fill rates using different data from an institutional trader.

k-period return from stock selection and timing, and C is the total execution cost of the order, in return form.

Equation (5) is a tautology, but serves to illustrate the relation between investment performance and execution costs. Investment performance, measured by r_k, is the notional return to stock timing and selection less total execution costs. This representation shows that an investment strategy cannot be evaluated without considering the associated implementation costs. To formalize this further, observe that the notional performance, r_k^0, and execution costs, C, are functions of the investment strategy. The strategy, denoted by S, dictates the securities to be traded, the magnitude and timing of the trades, the way in which the order is presented to the market given the liquidity of the stock and trade difficulty, and so on.[8] The objective of the manager is to maximize $r_k(S) = r_k^0(S) - C(S)$. It is clear that this objective does not necessarily imply that transaction costs should be minimized or that the *ex ante* expected return should be maximized. Thus, costs and performance must be considered together when evaluating a particular investment strategy.

There is another important issue to be considered here. In the previous literature, measures of transaction costs have not considered the underlying investment strategy. As a result, it is difficult to use the estimated costs to evaluate a trader or to predict trading costs in real time. For example, a trader who must implement a momentum-based strategy in thinly traded stocks will generally have higher costs than a trader who has the discretion to trade passively in liquid stocks. Thus, the realized execution cost is not the appropriate measure of a trader's ability. Rather, what matters is whether the trader systematically incurs execution costs that differ from the norm, *given the investment strategy to be implemented.*

Given a sample of trades from different institutions with different strategies, we can estimate a common function, $C(S)$, relating execution costs to a vector of strategy variables. For trader i, our measure of costs is the *difference* between the actual execution costs incurred by the trader, C_i, and the predicted costs for the strategy adopted S_i, i.e., $C_i - E[C(S_i)]$. Unlike previous approaches, this method allows us to compare traders using a common

[8]In our notation, S includes both control variables (such as order size) and stock-specific variables (such as market liquidity); for notational simplicity we do not distinguish between the two.

yardstick and form benchmarks to evaluate performance.

3 The Data

3.1 Order-Level Information

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. Keim and Madhavan (1995a) use these data to analyze the trading decision. Three types of institutions are represented in the data: value managers (who trade stocks based on their assessment of fundamental value), technical or momentum traders (whose strategy is based primarily on market momentum), and index traders (who seek to mimic the returns of a particular stock index.) 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 and an indication as to whether the trade is a buy or a sell;

(3) the price at the time of the decision to trade;

(4) the dates and the individual components of the order released to the broker[9] ;

(5) the average trade price, number of shares traded, and date(s) associated with the trade(s) executed by the broker within a specific release;

(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 purchase 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 strategy or style is known), and the manner in which the trade was executed.

[9]Institutions 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 are provided with only one price and volume for that stock for that day.

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.

3.2 Descriptive Statistics

Table 1 presents descriptive statistics on the trades in our sample for quintiles of NYSE market capitalization. The statistics are reported separately for buys and sells. The unit of observation in this 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 – a total of 62,333 orders with a market value of approximately $83 billion. 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.[10] For buyer-initiated trades, the number of releases increases with market cap, but this is not the case for seller-initiated trades. Most orders originate from technical (momentum) traders, although there are considerable differences across buys and sells. Seller-initiated trades tended to be larger and take place in more liquid stocks: the median market 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 buyer-initiated trades and $385,900 for the seller-initiated trades.[11] Finally, the percentage of orders in exchange-listed stocks decreases with market capitalization; overall, it is 71% for buys and 76% for sells.

[10]On average, both buy and sell orders were completed rapidly (1.80 days for buys and 1.65 days for sells) and most orders were filled entirely.

[11]These results are driven in part by one index manager of small stocks. We replicated all our results excluding this institution, but found that this had little impact on our estimates. The reported results in Table 1 reflect all 21 institutions.

4 The Magnitude of Trading Costs

4.1 Execution Costs Across Investment Styles

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, 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.[12] In addition, the table reports the percentage, by order type, of the total value of our sample of trades.

The magnitude of execution costs is significant: the average buyer-initiated (seller-initiated) total trade cost is 0.49% (0.55%) for exchange-listed shocks and 1.23% (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, technical traders have the greatest demand for immediacy, with market orders accounting for about 97% of the value of their 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 that total trading costs in exchange-listed stocks are considerably lower than NASDAQ stocks, but these differences may be explained by other factors such as trade difficulty, which we discuss in the next section.

It is also clear from Table 2 that both implicit and explicit costs are significant for the institutions in our sample. One hypothesis suggests a negative relation between the two components of costs—a portfolio manager may be willing to pay the broker a larger commission

[12] For example, suppose a trader decides to buy 10,000 shares of a stock currently trading at \$20. The purchase pushes the price up, so that the trader pays, say, \$202,000 to buy the shares. In addition, the trader pays a commission of \$0.05 per share, for a total of \$500. Then, our measure of total costs is 1.25%. If the commission is built into the price, the reported average price would be \$20.25, and the total cost is the same as before, but it is not possible to break down the total cost into its components.

for more difficult trades so that the broker expends effort to minimize the expectedly-higher price impacts associated with those trades (see section 4.2). On the other hand, it may be the case that the price impact–trade difficulty relation has such a steep positive slope that the trader can only hope to lower (but not eliminate) the positive slope by being more willing to pay higher commissions for more difficult trades. In this case, we would observe a positive relation between explicit and implicit costs, which is what the data reveal. Computed for the entire NYSE-AMEX sample, the correlation coefficients between explicit and implicit trade costs are 0.14 and 0.07 for seller- and buyer-initiated trades, respectively. Further, the estimated correlations decline with increasing market cap (decreasing trade difficulty).

4.2 Execution Costs and Trade Difficulty

We hypothesize that execution costs should increase with trade difficulty, as measured by trade size and market capitalization.[13] Intuitively, both price impacts and opportunity costs are likely to be smaller in more active issues, where trades can be executed quickly without significant price concessions. Further, commissions are lower on a percentage basis in more liquid stocks, although they may increase on a per share basis because market capitalization and price are strongly positively correlated.

Table 3a reports the total trading costs for buyer-initiated trades separately for exchange and non-exchange stocks. Table 3b 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 quintile cutoffs determined separately for buy and sell transactions.

These costs in table 3 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 cap category

[13] See, e.g., Loeb (1983), Edwards and Wagner (1993), and Keim and Madhavan (1995b).

to 2.35% for the largest trades in the smallest market cap category. The total costs for seller-initiated trades are generally larger than those of buyer-initiated trades, possibly because the order quantities are larger on the sell side and also because traders tend to be more patient on the buy side. 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 buyer- and seller-initiated trades and for both exchange-listed and NASDAQ-NMS stocks.

We also expect that, within each quintile of market capitalization, costs would rise with trade size. However, we find that the hypothesized relation holds true only in the smaller quintiles of market capitalization. The relation between trade size and cost is much attenuated for NASDAQ stocks. 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 cap (most liquid) stocks where NASDAQ trades tend to have lower costs than corresponding trades in exchange-listed stocks.

How can these results be explained? Clearly, there are other factors that may explain the variation in execution costs in addition to trade size and market capitalization. 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 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.

4.3 Price Behavior Associated with Component Trades

Another issue of interest is the relation between trade breakup and costs within a particular order. Keim and Madhavan (1995a) find that trade duration and breakup are positively related to order size, which is consistent with traders strategically fragmenting their orders to reduce price impacts. In this section, we investigate this aspect of trader behavior in more detail.

Specifically, we are interested in whether there are systematic differences between the costs of the component trades. There are several reasons why the pattern of price impacts may vary across different trades within the same order. First, traders may vary the pattern of volume within the order, i.e., trading small amounts in the initial trades and subsequently trading larger volumes, or vice versa. Such patterns may arise because of differences in immediacy or to avoid revealing information to other market participants. Second, even if volumes are approximately constant across component trades, there may be differences in their associated price impacts. In particular, price impacts may rise over trades in the component order if market participants view the trades as part of a much larger position adjustment. Alternatively, price impacts may decline over component trades as the initial price movements induce a greater supply of liquidity by market makers, floor traders, and limit order traders. Finally, with anonymous trading, the price impacts of the various components, per unit volume, should be approximately equal.

Figures 1a and 1b illustrate the price behavior associated with the individual component trades for the buyer- and seller-initiated transactions in our sample, respectively. The lines in each figure represent the price impacts associated with orders broken into 2, 3, 4, 5, and 6 or more trades, respectively. Focusing on orders broken into 6 or more trades, it is evident from the figures that the price paths are convex. That is, the price effects associated with the component trades are declining over time. This pattern is also evident for orders broken-up into smaller numbers of trades.

There is evidence to suggest that these price patterns do not reflect the effect of differences in volume. For example, consider a sell order that is executed in two trades. Although the average volume on the first and second trades are roughly equal (21,404 and 22,365 shares, respectively), the price impacts associated with these component trades, i.e., -0.42% and -0.21%, are not. This is by no means atypical; while orders are often broken-up into equal trades, the absolute price impacts for the last trades are smaller than the first trades of an order.

This evidence is suggestive that the market reaction to a sequence of orders is not linear; rather, the cumulative pattern of trades affects the subsequent price impacts. As noted above, this is consistent with the idea that the initial price movements induce the provision of liquidity that mitigates the costs associated with subsequent trades. This is a topic for future research, but one that lies beyond the scope of this paper.

5 An Analysis of Trade Costs

5.1 A Regression Model

The dispersion in the trading costs reported above motivates a more formal analysis of their determinants. In this section, we estimate a regression model to analyze jointly the various factors affecting trading costs. As shown above, there are considerable differences in costs across investment styles, perhaps reflecting differences in the amount of immediacy demanded by these traders. Further, there are substantial differences by trade initiation. Measures of trade difficulty (e.g., order size and market capitalization) explain some of the variation in execution costs, as do market-specific factors such as exchange-listing.

In addition to the variables described above, the previous literature suggests the inclusion of several other variables. Implicit trading costs have two components: (i) a variable component, which is related to trade size, and (ii) a fixed component, in the form of the bid-ask spread.[14] 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.

There is considerable evidence to suggest that trade costs vary across markets, so we include a dummy variable for NASDAQ stocks. Further, there are differences in the way large trades are accommodated between exchange- and non-exchange-listed stocks. Trading in exchange-listed stocks takes place through an auction mechanism whereas the NASDAQ market operates as a dealer market. Thus, there may be several different traders taking the opposite side of a large trade in an exchange-listed stock. By contrast, there will typically be

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

one dealer on the opposite side of a transaction in a NASDAQ stock. While a single dealer may demand greater price concessions to accommodate a large order than the "crowd" in a continuous auction, the dealer may also be willing to execute the trade within the quoted spread for preferred customers or known liquidity traders. These differences suggest modeling the effect of trade size differently for exchange and non-exchange listed stocks.

Following the discussion above, we model trading costs as:

$$C_i = \beta_0 + \beta_1 D_i^{NASDAQ} + \beta_2 Trsize_i + \beta_3 Trsize_i D_i^{NASDAQ} + \beta_4 Logmcap_i + \beta_5 \frac{1}{P_i} + \epsilon_i, \quad (6)$$

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-NMS and zero otherwise, $Trsize_i$ is the ratio of the order value to market capitalization, $Logmcap_i$ is the log of the market capitalization of the stock being traded, P_i is the price of the traded stock, 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. If exchanges provide better execution through the auction process (see, e.g., Blume and Goldstein (1992)) the costs for comparable NASDAQ-NMS trades should be higher and $\beta_1 > 0$. Larger orders should imply, other things equal, higher costs, so that $\beta_2 > 0$; the interaction coefficient β_3 captures any differences in the liquidity of auction and dealer markets. Market capitalization is included as a proxy for liquidity, and we hypothesize that $\beta_4 < 0$. Finally, we expect that costs (percentage bid-ask spreads) increase with the price inverse, so that $\beta_5 > 0$.

Given the systematic differences in costs across investment styles and trade initiation, we estimate equation (6) separately for buyer- and seller-initiated trades, and across investment styles. By doing so, we capture the effects of subtle differences in trader aggressiveness or strategy that may be manifested in cost differences across trade direction and style. We expect that 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 market momentum) will incur high trading costs because they tend to trade quickly, whereas value traders (whose trades are motivated by considerations of long-term value) may incur lower costs because of more patient trading strategies.

Table 4 presents coefficient estimates of equation (6), with heteroskedasticity-consistent standard errors in parentheses. Although the adjusted R^2 values are relatively low, the coefficient estimates are significant and consistent with our predictions. There is considerable variation in the coefficient estimates across investment styles and trade initiation.

The regression intercept β_0 reflects variation in base-level trading costs across investment styles. Consistent with our earlier findings, the intercept for technical (momentum) traders is higher than those of value traders for both buys and sells. This variation implies large differences in the predicted trading costs for hypothetical trades.

Interestingly, the NASDAQ-NMS dummy is positive and significant for buys, but is not significant for sells. Other things equal, exchange-listing allows traders to obtain lower costs (by about 31 basis points) for buyer-initiated trades. One explanation for this finding is that traders are more patient 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. Exchange-listing 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 slowly work the order to avoid a large price impact. By contrast, the NASDAQ market does not provide similar opportunities for passive trading. This difference may explain why the NASDAQ dummy variable is positive and significant only on the buy side.

Large order sizes are associated with higher costs for both buys and sells, and across investment styles. The only exception is for value traders on the buy side, possibly because these traders are more patient in filling buy orders. The coefficient of the interaction variable, β_3, is positive and significant for both buys and sells; other things equal, there is lower liquidity or depth for NASDAQ stocks, possibly reflecting the operation of the dealer mechanism. As expected, the market capitalization variable has a negative impact on costs. Finally, the coefficient of price inverse is positive and significant.

5.2 Predicted Trading Costs

The estimated regression equation (6) 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. For example, suppose that a trader following a technical trading strategy incurs execution costs of, say, 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 above average. Thus, any cost comparisons across investment styles must control for the difficulty of the trade. 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. In addition, an analysis of predicted execution costs across exchange and non-exchange listed stocks for equivalent trades can shed light on the differences in trading costs across market structures.

Figure 2 shows the predicted trade costs for buys and sells as a function of market capitalization for a hypothetical trade in a NASDAQ stock with trade size and share price equal to the median for the sample. The predicted costs are based on the coefficient estimates from equation (6) using data for all 21 institutions.

It is clear from figure 2 that expected trading costs decrease as a function of market capitalization. Further, most of this decline occurs below $1 billion, after which trading costs are relatively insensitive to market capitalization. Interestingly, figure 2 shows that predicted costs are higher for buys than for sells for the particular parameter values chosen. Indeed, this result holds for a wide range of plausible parameter values; buys have lower costs than sells for only the largest transactions. This fact provides an explanation for the asymmetry between buyer and seller behavior noted by Keim and Madhavan (1995a). They report that traders are more patient on the buy side than on the sell side, other things equal. This behavior is consistent with the asymmetry in costs. It is important to note, however, that the realized costs (tables 2 and 3) do not exhibit this asymmetry because trading volumes for seller-initiated trades are generally larger than for buyer-initiated trades in our sample.

Figure 3 shows a similar plot of trade costs for buyer-initiated trades, broken down by type of institution. It is clear that the execution costs of technical traders, who use active strategies to obtain rapid execution, are the highest among the firms in our sample. Value traders, on the other hand, have the lowest predicted trading costs of the institutions in our sample, due to their use of more passive trading strategies. Index managers, whose trading strategies are a blend of active and passive, displayed costs that correspondingly lie between the two extremes.

5.3 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 separately for buyer- and seller-initiated trades:

$$C_i = \beta_1 D_i^{NASDAQ} + \beta_2 Trsize_i + \beta_3 Trsize_i D_i^{NASDAQ} + \beta_4 Logmcap_i + \beta_5 \frac{1}{P_i} + \sum_{j=1}^{21} \gamma_j D_{i,j} + \epsilon_i, \quad (7)$$

where $D_{i,j}$ is an institution specific dummy variable taking the value 1 if institution j initiated order i and zero otherwise. The model is estimated without an intercept so that the estimated coefficients, γ_j, on the institution-specific dummy variables in equation (7) represent the trader-specific cost of execution, correcting for trade difficulty and market-specific factors. In terms of our theoretical framework, the dummy variable for a particular institution captures the average (over all trades placed by that trader) of the deviation $C_i - C(S_i)$.

Table 5 reports the estimates of equation (7) for buys and sells. In both regressions, there are large differences in the estimated base-level costs across institutions, even correcting for variation in trading behavior and stock-specific factors. These differences are statistically significant, since an F-test rejects the null hypothesis that all the base-level costs (i.e., the dummy variables) have the same value. In addition, we performed F-tests on the equality of coefficients by style; it is clear that the differences in individual costs, *within a particular investment style*, are statistically significant.

Figure 4 shows the estimated trading costs for each institution, grouped by style, for a hypothetical strategy based on the median values of the independent variables in equation (7). Correcting for differences in investment style and in trade difficulty, there are large differences in the total execution costs across institutions. These differences are statistically significant, since an F-test rejects the null hypothesis that all the base-level costs (i.e., the dummy variables) have the same value.

Thus, trading ability is an important determinant of the overall execution costs. Consider, for example, institutions 8 and 9, both of whom are technical traders. The estimated model suggests that relative to institution 8 (and indeed to all other technical traders), institution 9 has significantly large positive excess costs. For institution 9, the estimated dummy coefficient is 477 basis points higher than that of institution 8 for buyer-initiated transactions. This abnormal cost is statistically significant. Similar remarks apply to the sell side as well. However, as noted above, both the costs *and* the returns generated by an investment strategy must be considered jointly to assess the overall performance of the strategy.

6 Performance Evaluation

The economic importance of the cost of a trade is difficult to assess without reference to the actual performance of the trade. The conceptual framework described earlier shows that execution costs and investment performance are two sides of the same coin; a percentage point reduction in transaction costs improves the investment return by one percentage point. An important question, then, concerns the relative magnitudes of execution costs and investment returns.

In measuring performance, we focus on the market-adjusted return from the close on the day following the last trade associated with the order to the close eight weeks later.[15] This measure represents the return from taking a position in the stock and has some advantages over the return defined in equation (5). In particular, this measure excludes the returns associated with price movements during the trading process that may produce a misleading

[15]Market adjusted returns are computed by subtracting from the post-trade return the CRSP value-weighted return for NYSE and AMEX stocks and the CRSP NASDAQ index for NASDAQ-NMS stocks.

measure of investment performance. To motivate this approach, note that the dollar payoff per share is $p_{n+k+1} - p^a = (p_{n+k} - p_{n+1}) + (p_{n+1} - p^a)$, i.e., is the sum of the price movement from the close following the last day of trading to the price at the investment horizon and the price movement from the average price to the closing price on the day after the last trading day. The latter movement, i.e., $(p_{n+1} - p^a)$, may reflect the actions of the trader (especially for a thinly traded stock). Accordingly, we measure investment performance over the periods $n + 1$ to $n + k + 1$.

Table 6 presents the mean trade costs and mean market-adjusted returns for one- and eight-week post-trade periods for buyer- and seller-initiated trades for the 21 institutions, grouped by investment style. The costs exhibit a wide range of variation across institutions and across styles. Overall, technical traders bear the highest costs, perhaps because their trading takes place over short-horizons in stocks with significant market momentum. Similarly, the performance numbers exhibit a wide range of variation across institutions, styles, and trade initiation.

A striking aspect of the performance and cost figures reported in table 6 is the difference in performance between the buy and sell side. The mean 8-week post-trade *excess return* for all institutions on the buy side is 0.61% and 0.41% on the sell side.[16] Good performance on the buy side is associated with positive returns while the opposite is true of the sell side. Thus, while most institutions made profitable purchases, their sales were in general not followed by negative returns. The exception were the index traders, who in general were profitable on the sell side. It is worth emphasizing that this asymmetry is not simply due to a rising market since the returns in question are adjusted for market movements.

The most likely explanation for the difference in performance on the buy and sell side is that some institutions have relatively short holding periods, leading to frequent turnover. For example, institution 9 bought 282 different stocks (i.e., names) and sold 255 stocks in the sample period, with 123 stocks in common. These 123 names accounted for 50.5% of the value of sells and 55.2% of the value of buys for that institution. Similarly, institution 12

[16] Both these figures are statistically significant at the 1% level.

bought 294 names, and sold 308 names, of which 233 were in common. The value of these intersection trades as a percentage of the value of all institution 12's trades was over 80%. Given this high turnover in stocks traded, it is perhaps not surprising that good performance on one side of the market is associated with poor performance on the other side, at least over short horizons.

Table 6 also shows that trading costs are relatively large compared to the subsequent post-trade performance, even on the buy side. For example, for buyer-initiated trades, the overall post-trade eight week market-adjusted return was 0.61% but the trade costs amounted to 0.72%. On the sell side, the average trade cost was 0.76%, but the excess return was significantly positive. These numbers suggest that relatively small reductions in execution costs may have a significant impact on investment performance. This fact is most apparent in figure 5, which juxtaposes performance and costs. Indeed, institution 9, which incurred abnormally large trading costs, also obtained abnormally large returns on the buy side. Thus, for this particular institution, at least some of the costs incurred are justified in terms of *ex post* performance. In summary, trading costs are a crucial element in determining the overall return to an investment strategy. Efforts aimed at reducing these costs may greatly increase the total portfolio return.

7 Conclusions

Despite the magnitude of equity transactions initiated by institutional traders, relatively little is known about their trading strategies and investment returns. This paper uses data on the equity transactions of 21 institutions from 1991-1993 to measure and evaluate the trading costs and investment performance associated with various trading strategies. In doing so, we hope to contribute to the growing academic literature on institutional trading behavior as well as provide practical insights into how these traders might be evaluated and their strategies improved.

Unlike much of the previous literature, we examine both explicit costs, such as commissions, and implicit costs, such as the price impact of a trade and the opportunity costs associated with failing to execute a trade in a timely manner. We also impose controls for choice variables (e.g., trade size, difficulty, and duration) to facilitate cost comparisons across institutions and evaluate portfolio managers. Finally, we use the unique structure of our data to assess the economic significance of these costs in relation to post-trade investment performance.

Trading costs are positively related to measures of trade difficulty such as order size. In addition, traders' decisions regarding order type and the trading horizon, and stock specific characteristics, such as exchange listing, are also important determinants of execution costs. Controlling for these factors, we find strong evidence of differences in trading costs across institutions. Some of these cost differentials are related to the trading style of the institution, but others may reflect differences in trading ability. Indeed, some institutions have significantly positive excess costs that cannot be explained by their order characteristics or by the stocks they traded. The analysis provides one way to assess various trading strategies and to form benchmarks for portfolio managers.

Finally, we examine the post-trade market-adjusted returns following institutional trades. Again, there is considerable heterogeneity in performance across institutions and by trade initiation. The institutions in our sample were relatively poor performers in terms of their stock timing and selection abilities. We find that relatively small reductions in execution costs can have a significant effect on performance over short horizons.

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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.

Market Cap Quintile	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								
Largest	6.176	90	421.5	2.32	12,120	26	49	25
2	1.213	81	67.2	2.03	9,924	14	36	50
3	0.470	58	103.4	1.99	7,075	11	49	40
4	0.168	44	81.5	1.93	4,848	19	46	35
Smallest	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								
Largest	6.908	92	564.1	2.04	11,867	34	54	12
2	1.261	85	436.9	1.97	5,592	26	59	15
3	0.460	59	339.3	2.15	3,871	18	74	8
4	0.170	41	246.4	2.21	2,725	27	69	4
Smallest	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

Table 2

Average Trading Costs by Investment Style for Common Stock Trades for 21 Institutions for the Period January 1991 to March 1993

Implicit trading costs are defined as $(P^a/P_d) - 1$ 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. Explicit 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). Costs are reported in percent. Standard errors are in parentheses.

Investment Style	Exchange-Listed Stocks				NASDAQ/NMS Stocks		Percentage of Total Trade Value by Order Type			
	Total	Implicit	Explicit	n	Total	n	Market	Working	Crossing	Limit
A. Buyer-Initiated Trades										
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 Trades										
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)					

Table 3a

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, $(P^a/P_d) - 1$, and explicit costs, 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 Quartile[1]	Quintile of Market Capitalization[2]				
	$mc > 2{,}271$	$2{,}271 \geq mc > 721$	$721 \geq mc > 270$	$270 \geq mc > 98$	$98 \geq mc$
A. NYSE & AMEX Buy Trades					
$S \leq 0.0016$	0.31 (0.03) 3,306	0.23 (0.03) 2,545	0.37 (0.08) 609	0.36 (0.31) 73	0.39 (0.10) 3
$0.0016 < S \leq 0.0087$	0.36 (0.04) 3,033	0.26 (0.06) 1,808	0.28 (0.08) 1,053	0.48 (0.10) 544	1.13 (0.25) 110
$0.0087 < S \leq 0.0566$	0.32 (0.04) 2,993	0.61 (0.08) 1,712	0.53 (0.11) 980	0.69 (0.14) 537	1.35 (0.16) 343
$0.0566 < S$	0.16 (0.07) 1,720	0.67 (0.09) 1,970	1.08 (0.11) 1,537	1.51 (0.14) 971	2.35 (0.21) 378
B. NASDAQ Buy Trades					
$S \leq 0.0016$	0.60 (0.19) 317	0.55 (0.07) 715	1.21 (0.14) 314	1.34 (0.27) 77	1.75 (0.81) 12
$0.0016 < S \leq 0.0087$	0.68 (0.18) 314	0.60 (0.16) 473	0.90 (0.11) 748	1.04 (0.12) 647	1.79 (0.26) 307
$0.0087 < S \leq 0.0566$	0.27 (0.20) 305	0.57 (0.25) 352	0.51 (0.17) 714	0.92 (0.17) 673	2.68 (0.19) 635
$0.0566 < S$	−0.95 (0.28) 226	0.20 (0.29) 398	1.06 (0.16) 1,151	1.92 (0.17) 1,355	3.34 (0.22) 866

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

Table 3b

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, $(P^a/P_d) - 1$, and explicit costs, 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 Quartile[1]	Quintile of Market Capitalization[2]				
	$mc > 2{,}271$	$2{,}271 \geq mc > 721$	$721 \geq mc > 270$	$270 \geq mc > 98$	$98 \geq mc$
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					
$S \leq 0.0032$	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
$0.0032 < S \leq 0.0169$	0.25	0.23	0.87	0.68	1.10
	(0.19)	(0.23)	(0.19)	(0.21)	(0.45)
	278	183	219	194	104
$0.0169 < S \leq 0.0775$	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

[1]Trade size, S, is expressed in percent.

[2]Market capitalization, mc, is in millions of dollars.

Table 4

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 a regression model:

$$C_i = \beta_0 + \beta_1 D_i^{\text{NASDAQ}} + \beta_2 \, Trsize_i + \beta_3 \, Trsize_i * D_i^{\text{NASDAQ}} + \beta_4 \, Logmcap_i + \beta_5 \frac{1}{P_i}$$

where, for order i, C_i is the total trading cost (in percent), D_i^{NASDAQ} is a dummy variable for NASDAQ-NMS stocks, $Logmcap_i$ is the log of the market capitalization (where firm size is measured in thousands) of the stock traded, $Trsize_i$ is the size of the trade (measured by order size divided by shares outstanding), and P_i is the price per share of the stock traded. Heteroskedasticity-consistent standard errors are in parentheses.

	Intercept	D^{NASDAQ}	*Trsize*	*Trsize* * D^{NASDAQ}	*Logmcap*	$\frac{1}{P}$	Adjusted R^2	Number of Observations
A. *Buyer-Initiated Trades*								
Value	1.2936	0.2759	−0.0231	−0.1217	−0.0996	11.7591	0.038	6,104
	(0.5272)	(0.1435)	(0.0307)	(0.0505)	(0.0312)	(2.1327)		
Technical	2.2321	−0.2514	0.0540	0.1166	−0.1499	16.2747	0.059	14,537
	(0.5074)	(0.1002)	(0.0222)	(0.0342)	(0.0299)	(2.0848)		
Index	0.9956	0.6265	0.4498	0.8592	−0.0702	7.3931	0.049	13,459
	(0.3960)	(0.0678)	(0.1367)	(0.3244)	(0.0250)	(1.5633)		
All	1.1311	0.3085	0.0613	0.0614	−0.0856	13.8419	0.044	34,102
	(0.3064)	(0.0559)	(0.0176)	(0.0295)	(0.0182)	(1.3500)		
B. *Seller-Initiated Trades*								
Value	−1.1351	−0.0855	0.0632	0.1607	0.0585	7.7132	0.021	6,652
	(0.7579)	(0.2212)	(0.0311)	(0.1123)	(0.0441)	(3.0062)		
Technical	2.7884	−0.3644	0.1351	0.1523	−0.1548	4.7423	0.099	13,704
	(0.5747)	(0.1237)	(0.0411)	(0.0479)	(0.0341)	(1.7779)		
Index	2.0157	−0.4126	0.3278	0.3119	−0.1414	9.7719	0.048	2,712
	(1.5947)	(0.3193)	(0.1653)	(0.3364)	(0.0959)	(4.9647)		
All	1.4309	−0.1778	0.1370	0.1545	−0.0851	6.2689	0.087	23,070
	(0.4535)	(0.1007)	(0.0374)	(0.0445)	(0.0267)	(1.4822)		

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:

$$C_i = \beta_1 D_i^{\mathrm{NASDAQ}} + \beta_2\ Trsize_i + \beta_3\ Trsize_i * D_i^{\mathrm{NASDAQ}} + \beta_4\ Logmcap_i + \beta_5 \frac{1}{P_i} + \sum_{j=1}^{21} \gamma_j D_{i,j}$$

where, for order i, C_i is the total trading cost (in percent), D_i^{NASDAQ} is a dummy variable for NASDAQ-NMS stocks, $Logmcap_i$ is the log of the market capitalization (where market cap is measured in thousands of dollars) of the stock traded, P_i is the price per share of the traded stock, $Trsize_i$ is the size of the trade (measured by order size divided by shares outstanding), and $D_{i,1}, \ldots, D_{i,21}$ are institution-specific dummy variables. The model is estimated separately (without an intercept) 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	
	Estimate	Standard Error	Estimate	Standard Error
D^{NASDAQ}	0.240	0.055	−0.399	0.103
$Trsize$	0.077	0.018	0.131	0.036
$Trsize * D^{\mathrm{NASDAQ}}$	0.046	0.029	0.144	0.043
$Logmcap$	−0.033	0.020	−0.032	0.026
$1/P_i$	12.723	1.284	6.481	1.487
d_1	2.339	0.449	0.320	0.559
d_2	0.404	0.320	1.104	0.460
d_3	0.173	0.375	0.147	0.323
d_4	0.302	0.383	0.207	0.470
d_5	−0.619	0.344	−0.629	0.451
d_6	−0.891	0.689	2.828	0.884
d_7	0.049	0.362	0.661	0.585
d_8	−0.311	0.395	1.001	0.477
d_9	4.462	0.424	3.089	0.565
d_{10}	1.171	0.396	1.068	0.677
d_{11}	0.355	0.334	0.093	0.443
d_{12}	0.394	0.342	0.568	0.437
d_{13}	1.492	0.448	0.064	0.530
d_{14}	0.341	0.339	0.334	0.438
d_{15}	0.742	0.352	0.971	0.444
d_{16}	0.501	0.373	0.535	0.471
d_{17}	−0.147	0.365	0.635	0.470
d_{18}	1.131	0.329	1.962	0.460
d_{19}	0.172	0.348	0.568	0.447
d_{20}	−0.028	0.349	0.689	0.456
d_{21}	−0.969	0.607	0.592	0.628
Adjusted R^2	0.117		0.143	
F_1[1]	10.527		19.059	
F_2	114.357		34.571	
F_3	30.232		11.382	

[1]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.

Table 6

Trade Cost and Performance of Common Stock Trades Initiated by 21 Institutions from January 1991 to December 1992

This table presents mean trade costs and mean market adjusted returns for buyer- and seller-initiated trades for 21 institutions. Trade cost is defined as (Commission per Share/P_d) + $[(P^a/P_d) - 1]$ when 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. Post-trade performance is computed as $(P_n/P_p) - 1$ where P_n is the closing price for the traded stock n weeks after the last day of the trade, and P_p is the closing price on the day after the last trade in the order. The value weighted CRSP NYSE-AMEX market index is used to adjust the post-trade returns for NYSE and AMEX stock trades, and the CRSP NASDAQ index is used to adjust the post-trade returns of the NASDAQ trades. All costs and returns are reported in percent.

	Buyer-Initiated Trades				Seller-Initiated Trades			
	Trade Cost	1-Week Performance	8-Week Performance	n	Trade Cost	1-Week Performance	8-Week Performance	n
Value								
3	0.34	−0.70	0.33	25	0.10	1.29	0.25	30
4	0.57*	0.28	3.39*	249	0.16	0.16	2.77	339
5	−0.54*	1.07*	2.14*	1,005	−0.77*	−0.56*	1.33*	1,251
6	−0.84	−0.75	0.40	52	2.73*	−0.35	1.98	45
10	1.05*	−0.58	−3.91	29	0.84	0.55	−2.18	42
11	1.04*	0.01	0.51	1,872	0.27*	−0.06	1.43*	1,829
19	0.20*	0.47*	0.93*	2,938	0.36*	0.04	−0.25	3,232
Value Mean	0.35*	0.40*	1.07*	6,170	0.13*	−0.09	0.65*	6,768
Technical								
1	2.34*	0.20	1.11	496	0.14	0.11	1.06	428
7	0.25	−0.24	−0.50	1,020	0.85	0.87	0.09	247
8	−0.24	−0.31	−1.27	603	1.10*	−0.31	0.28	486
9	5.17*	0.64	5.00*	540	3.17*	0.97*	4.64*	404
14	0.61*	0.85*	1.15	452	0.25*	0.13	0.87	726
15	0.83*	0.18	0.58	1,305	0.91*	−0.08	0.09	1,639
16	1.02*	−0.05	0.31	581	0.78*	−0.17	0.33	923
17	0.53*	0.30	2.97*	1,141	0.94*	0.62*	2.68*	1,062
18	1.80*	0.55*	0.95*	3,634	2.72*	0.63*	1.94*	2,427
20	0.13*	0.37*	0.18	4,678	0.64*	−0.04	−0.78*	5,640
21	−0.75	0.55	2.46	26	0.44	0.14	1.12	21
Technical Mean	0.95*	0.05	0.77*	14,476	1.12*	0.16*	0.47*	14,003
Index								
2	0.63*	0.20*	0.62*	11,077	1.00*	0.70*	0.48	744
12	0.29*	0.11	−2.10*	1,755	0.29*	−0.11	−0.99*	1,492
13	1.75*	0.15	0.10	627	−0.02	0.12	−0.65	472
Index Mean	0.65*	0.19*	0.24	13,389	0.43*	0.15	−0.53	2,708
Overall	0.72*	0.16*	0.61*	34,035	0.76*	0.09*	0.41*	23,479

*significant at better than the .01 level.

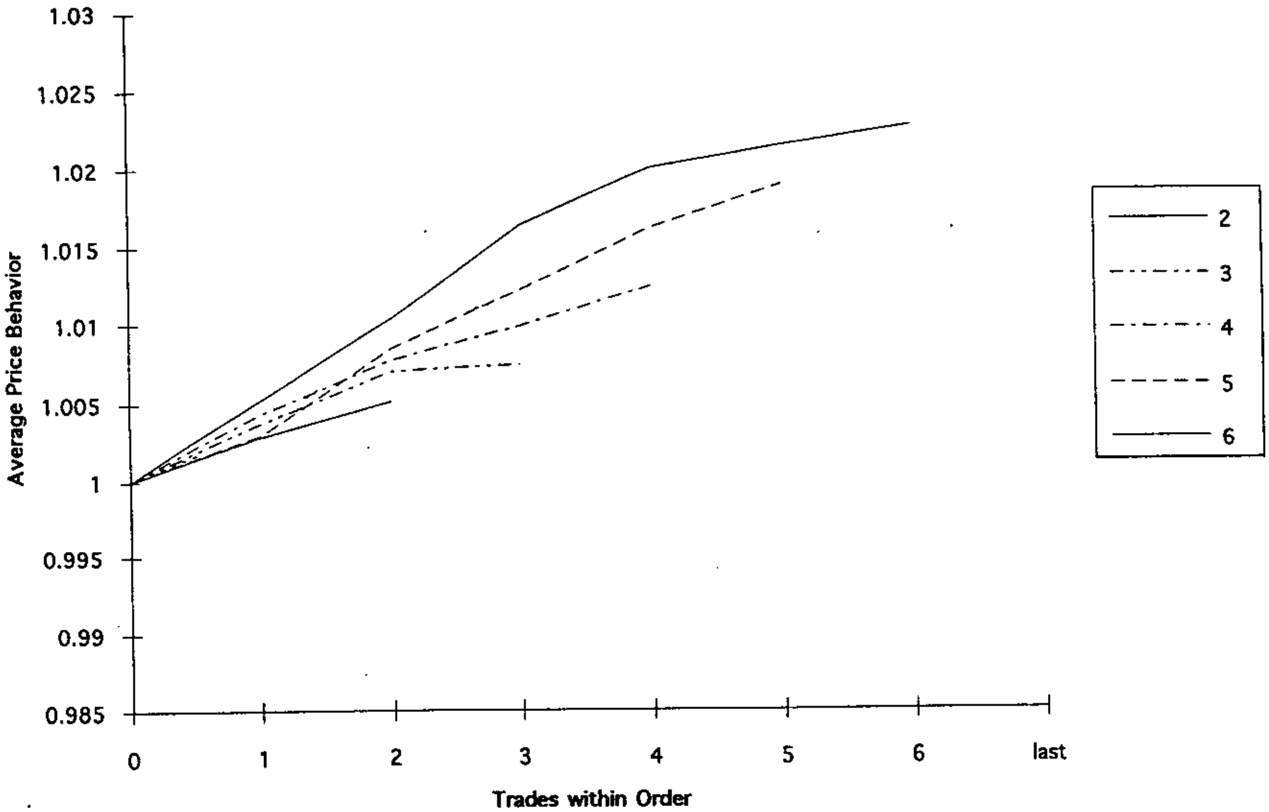


fig. 1a. Intra-order price behavior associated with the individual component trades for buyer-initiated orders. The data are for 21 institutions for the period January 1991 to March 1993.

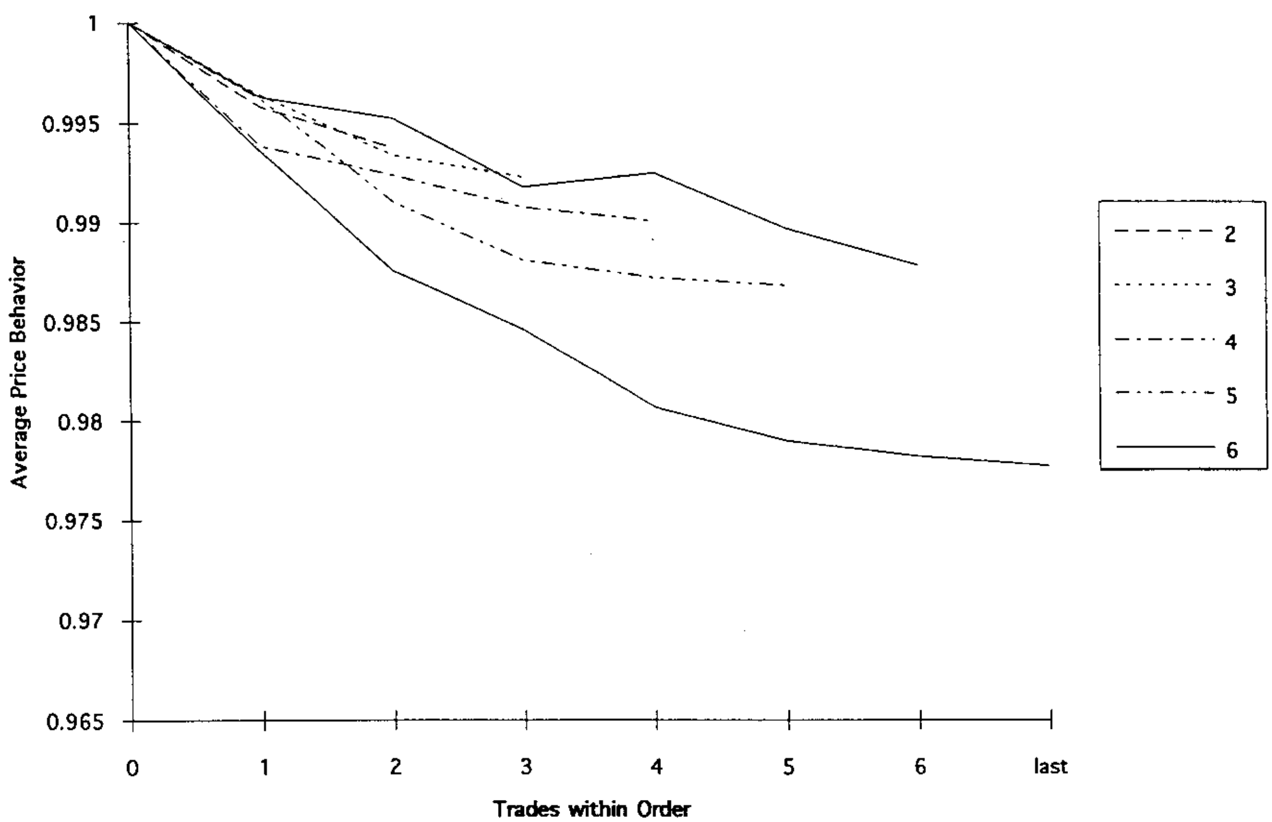


fig. 1b. Intra-order price behavior associated with the individual component trades for seller-initiated orders. The data are for 21 institutions for the period January 1991 to March 1993.

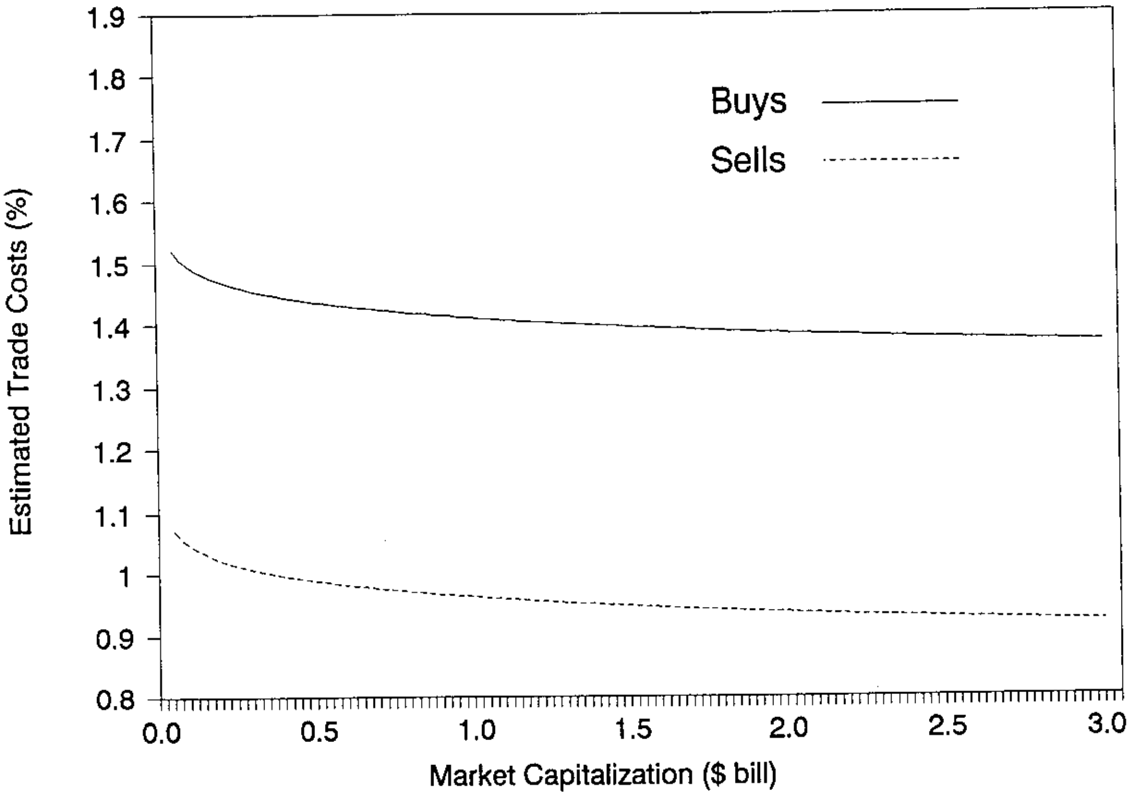


fig. 2. Predicted trade costs for buy and sell transactions as a function of market capitalization for a hypothetical trade in a Nasdaq stock with trade size and share price equal to the median values for the sample. The predicted costs are based on the coefficient estimates from equation (6) using data for all 21 institutions. Estimation is for the period January 1991 to March 1993.

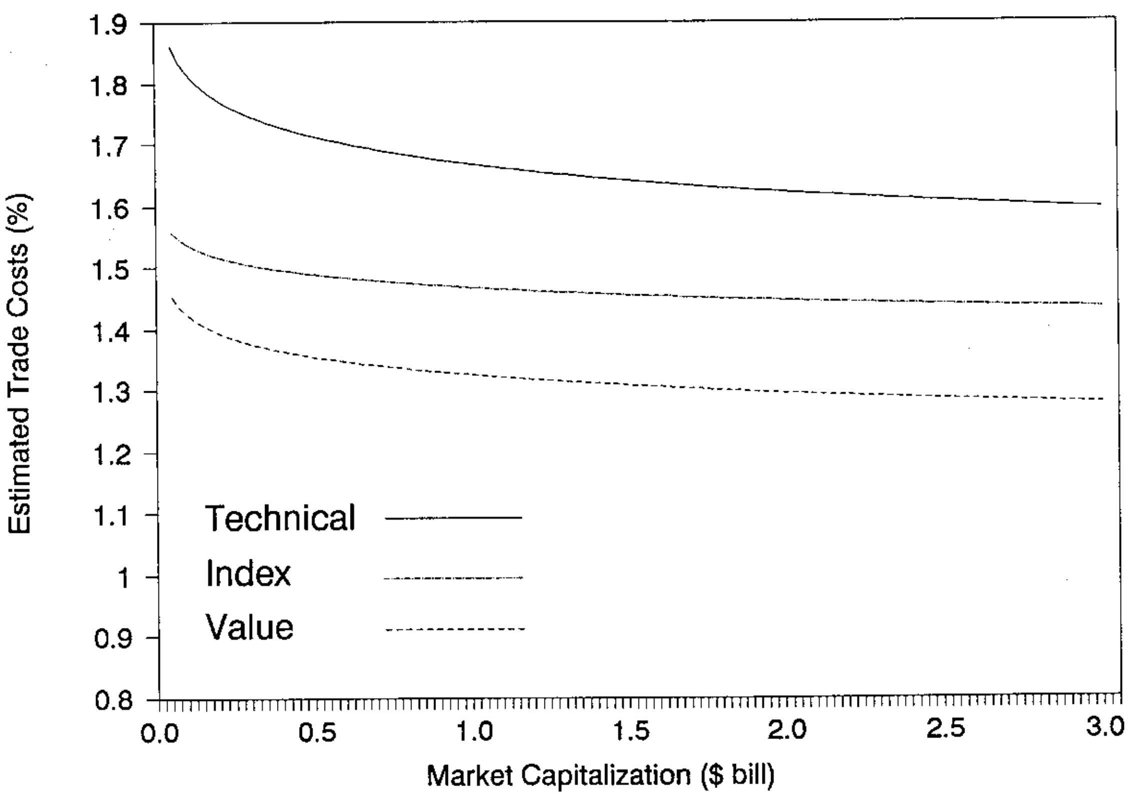


fig. 3. Predicted trade costs (for buys) for the three institution types as a function of market capitalization for a hypothetical trade in a Nasdaq stock with trade size and share price equal to the median values for the sample. The predicted costs are based on the coefficient estimates from equation (6) using data for all 21 institutions. Estimation is for the period January 1991 to March 1993.

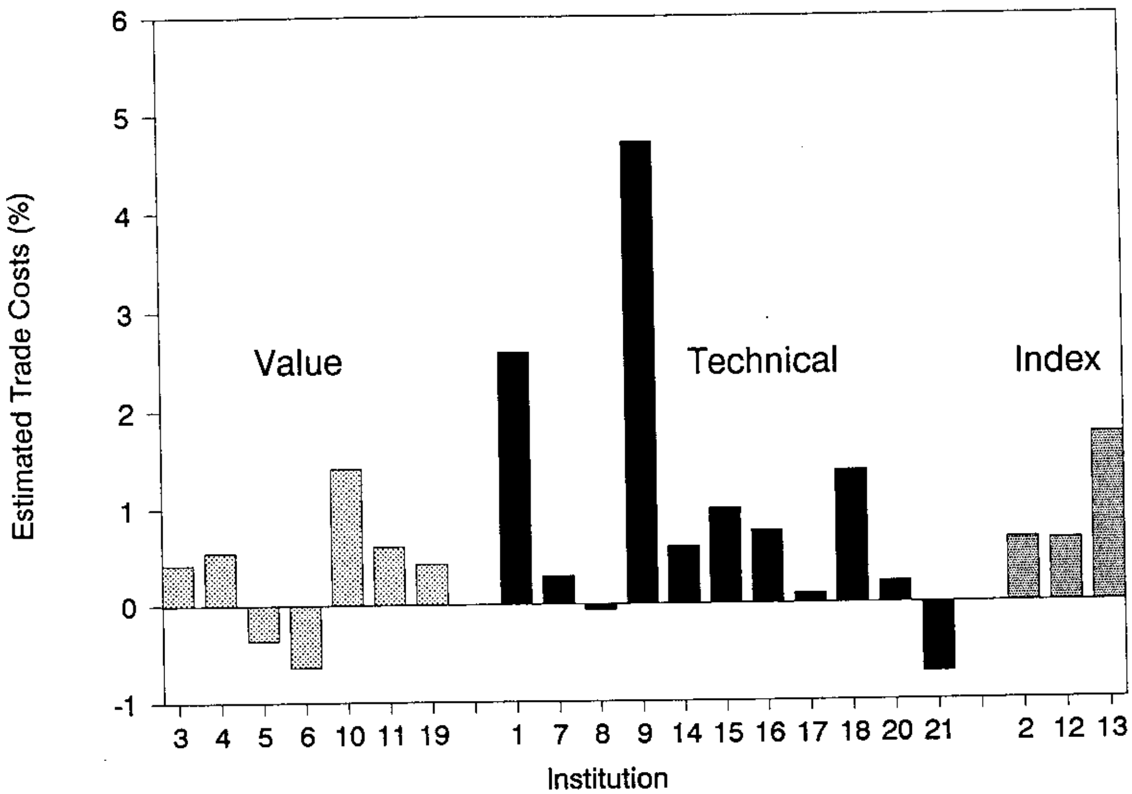


fig. 4a. Estimated base-level trade costs (Listed buy transactions) for each institution in our sample, grouped by investment style, based on estimates in equation (6) and using median values for the independent variables. Estimation is for the period January 1991 to March 1993.

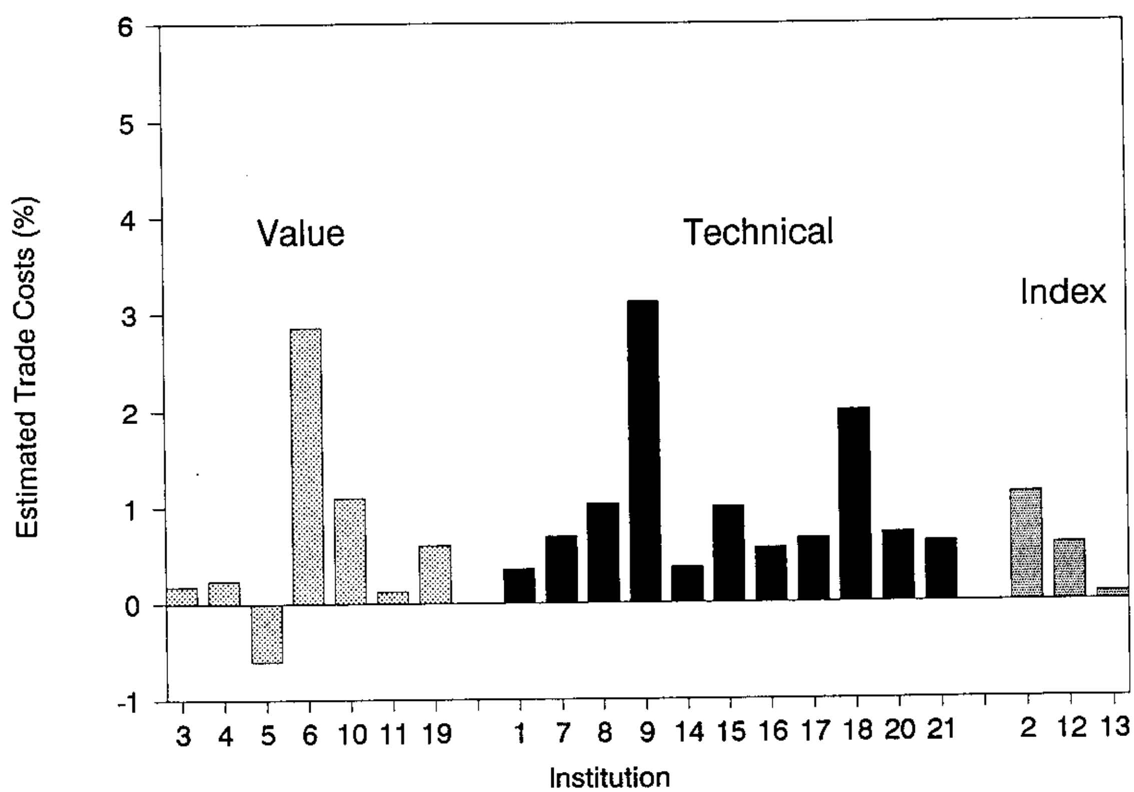
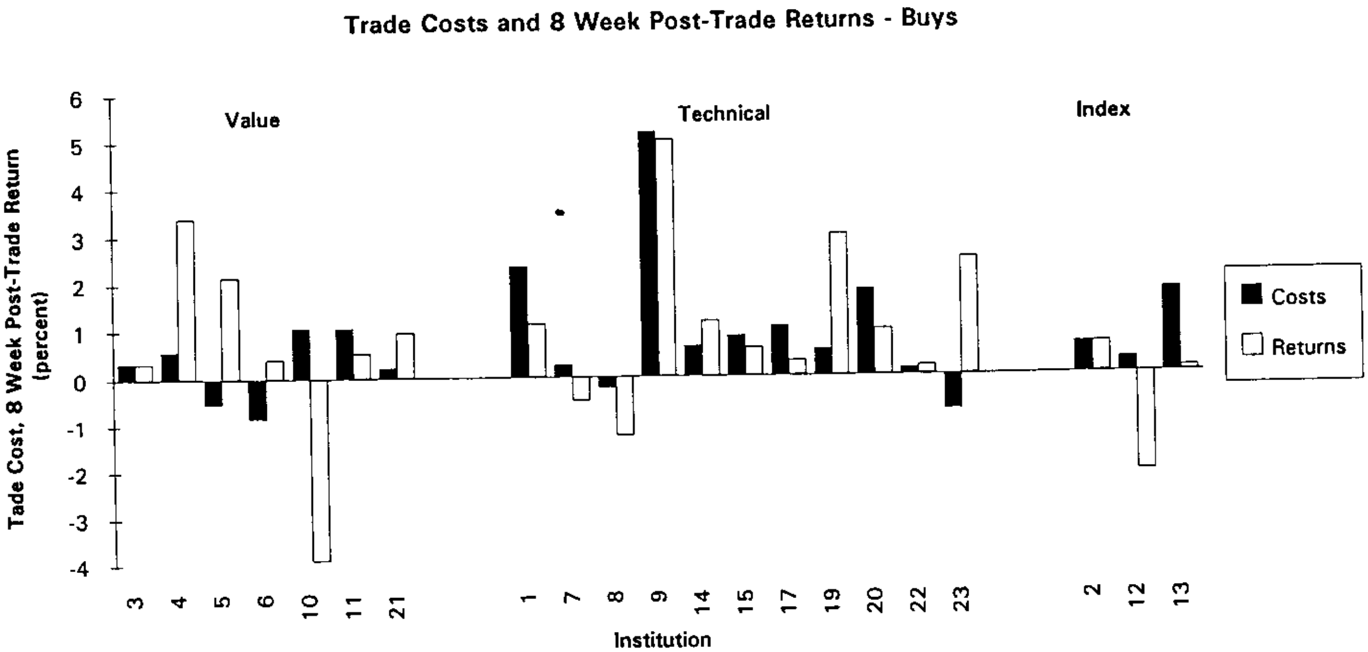


fig. 4b. Estimated base-level trade costs (Listed sell transactions) for each institution in our sample, grouped by investment style, based on estimates in equation (6) and using median values for the independent variables. Estimation is for the period January 1991 to March 1993.



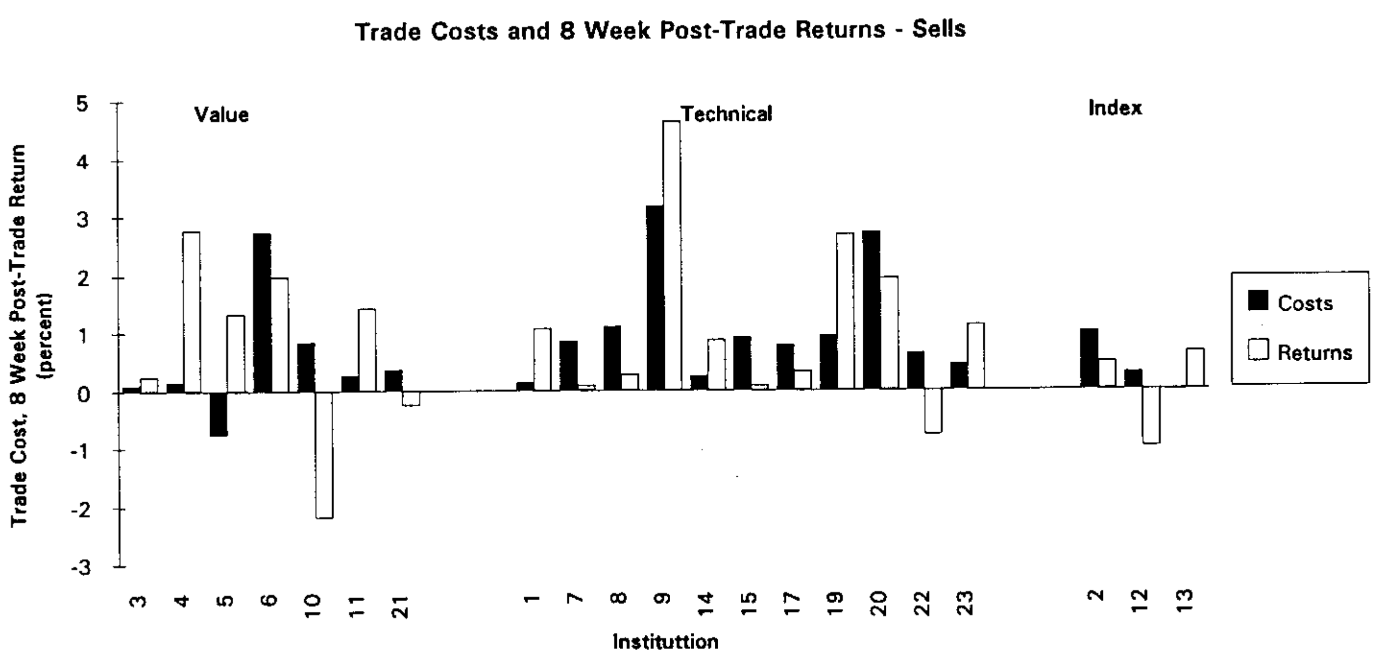


fig. 5. Trade cost and performance of common stock trades initiated by 21 institutions from 1991 to 1993.

The figure presents mean total trade costs and mean market-adjusted returns for buyer- and seller-initiated trades for the 21 institutions. Trade costs and returns are defined as in Table 6, and the values plotted are 8-week performance estimates from that table.