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

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Execution Costs and Investment Performance: An Empirical Analysis of Institutional Equity Trades

Abstract

We examine the magnitude and determinants of execution costs associated with institutional equity trades and their effect on investment performance. Using detailed information on over $83 billion of recent equity transactions by 21 institutions, we analyze the major components of execution costs, including explicit and implicit costs. We find that execution costs are significantly related to trade size, exchange listing, and the traded stock's market capitalization. We also find that buyer-initiated trades are more costly than equivalent seller-initiated trades. Our results indicate that execution costs have a significant effect on performance over short horizons, and there is significant 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

Investment performance is a fundamental concern for equity traders and portfolio managers. Performance reflects two factors: (1) The manager'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. The measurement, analysis, and prediction of execution costs is thus crucial in assessing investment performance and in developing new trading strategies.

This paper examines the magnitude and determinants of execution costs associated with institutional equity trades and the relation between these costs and investment performance using data on $83 billion of equity transactions by 21 institutions in the period 1991-1993. Our analysis differs from previous work in several important respects. First, we focus on the total execution costs associated with filling a desired order. 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.[1] 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.[2]

Second, our analysis recognizes that trading costs depend on strategic choices (such as order type and the duration over which the order is filled) as well as stock-specific attributes beyond the control of the trader. Previous studies that report figures on transaction costs do not make any allowance for the fact that different strategies may result in very different

[1]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.

[2]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 (1994b)) 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.

transaction costs, especially if duration is a choice variable. Without controls for order size, type, difficulty, and duration, such cost comparisons are difficult to interpret and use.

Third, the data we use are ideally suited to examining the price impacts associated with institutional trades. We have 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.[3] 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.

Fourth, our data are extensive and enable a detailed analysis of the determinants of trading costs and investment performance for 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. Institutional traders are of particular interest because although their trades are relatively large and frequent, little is known about their execution costs and investment performance.[4]

We use these data to measure the total costs (both implicit and explicit) of trading. The results provide a way to assess various trading strategies and to form benchmarks to evaluate portfolio managers. We find that the implicit and explicit components of total trading costs are positively related, possibly because more difficult trades are sent to full service brokers.

[3]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.

[4]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 (1994a) examine various aspects of institutional trading behavior.

Both components of total cost are affected by traders' decisions regarding order size and the trading horizon, as well as stock specific characteristics such as firm size and exchange listing. Execution costs are inversely related to measures of liquidity. However, we show that buyer-initiated trades are significantly more costly than equivalent seller-initiated trades. We also document significant variation in trading costs and performance across institutions. 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. Finally, we show that execution costs can have a significant effect on performance over short horizons.

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 execution costs and investment performance; and Section 7 concludes.

2 Trading Costs and Investment Performance

In this section, we discuss alternative approaches to measuring trading costs developed in the previous literature, and the approach taken in this paper.

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.

[5] The treatment of commissions for non- exchange listed stocks presents a problem, and we discuss this issue later.

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. This measure has several potential problems. First, 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, i.e., the measure can be gamed. Similar remarks apply to other variants of this approach using averages of pre-trade prices to construct the price benchmark. An additional shortcoming arises when a trade represents a large portion of the daily volume in the stock, in which case the benchmark price against which the trade is compared is largely a reflection of the trade itself. This is particularly troublesome for stocks that trade in illiquid markets. Further, it is not clear that using past transaction prices is a good measure of the unperturbed price since these prices may reflect information that is stale.

Beebower and Priest (1980) propose an alternative measure (also known as the SEI approach) that avoids these problems. 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. Further, the use of the next day's closing price avoids the problem found with thinly traded stocks where the trade whose impact is being assessed is the last trade of the day. Since the yardstick is not known at the time of the trade, it is difficult to manipulate this measure.

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 resembles that of Perold (1988), although there are some important differences. 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 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

[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.

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

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

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 yardstick and form benchmarks to evaluate performance.

[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.

3 The 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. Keim and Madhavan (1994a) 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 on market momentum as well as fundamental factors), 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.

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

[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.

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.

Table 1 presents descriptive statistics on the trades in our sample for quintiles of NYSE market capitalization, separately for buys and sells. The unit of observation in this table is the trade order, the number of shares of stock the institution decides to buy or sell. 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. 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. 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. The percentage of orders in exchange-listed stocks decreases with market capitalization; overall, it is 71% for buys and 76% for sells.

Total, implicit, and explicit transaction costs can be computed from the data in a straightforward manner since they record the date of the trading decision and the details of the transactions used to fill the order. A potential problem arises from the treatment of commissions for Nasdaq-NMS stocks, because commissions are customarily built into the transaction price paid by the stock. Consequently, we do not report separate commission costs for Nasdaq stocks. The innability to directly measure commissions for Nasdaq stocks does not affect, however, our estimates of total trading costs. For example, suppose that 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 percent. 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 breakdown the total cost into its components.

4 The Magnitude of Trading Costs

We turn now to an empirical analysis of trade costs. As indicated above, we are interested in the relation between trade costs and trade difficulty. Loeb (1983), Edwards and Wagner (1993), and Keim and Madhavan (1994b) find that trade size and market capitalization serve well as proxies for trade difficulty. Accordingly, we report estimates of trading cost for separate categories of market capitalization and trade size.

4.1 Market Capitalization and Trade Costs

Table 2 presents estimates of execution costs associated with institutional equity trades by trade direction and market for five categories of market capitalization (a measure of market liquidity) determined by NYSE quintiles as of December 1991. There is considerable variation in costs between markets and across firm size categories. However, there are several consistent relations that are apparent in the table. As hypothesized, total costs are inversely related to market capitalization. This result holds for both buyer- and seller-initiated trades and for both exchange-listed and Nasdaq-NMS stocks. Further, for exchange-listed stocks, both implicit and explicit costs decrease with firm size. 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.

Overall, these costs are significant in both economic and statistical terms. For exchange-listed stocks, for example, the total cost for buyer-initiated trades ranges from 0.31% in the largest market cap category to 1.78% 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 are more patient on the buy side.

Further, across firm size categories, it is clear that Nasdaq-NMS stocks have higher total execution costs than exchange-listed stocks. For example, for seller-initiated trades, the average total cost in the smallest market capitalization category is 2.91% for Nasdaq-NMS stocks, but only 2.03% for exchange-listed stocks. Note that the cutoffs for the market cap categories are the same for both markets, so that this comparison is valid.

Finally, for exchange-listed stocks, explicit costs represent only a portion of the total cost. In general, implicit costs are larger than explicit costs. The difference is greatest in the smaller market capitalization quintiles because commission costs are relatively constant in per share terms, whereas implicit costs decrease rapidly with market capitalization.

4.2 Order Size and Trading Costs

Table 3 presents the estimates of the trading costs associated with institutional equity trades by trade direction and market, partitioned by trade size quartile. The trade size (defined as the ratio of the desired order size in shares to the shares outstanding) quartiles are determined separately for buy and sell transactions.

Again, as expected, total costs increase monotonically with order size category, a proxy for trade difficulty. This is true for both buyer- and seller-initiated trades and for both exchange-listed and Nasdaq-NMS stocks. For exchange-listed stocks, both implicit and explicit costs generally increase with order size.

For comparable order size categories, Nasdaq-NMS stocks have higher total execution costs than exchange-listed stocks. For example, for seller-initiated trades, the average total cost in the largest order size category is 2.63% for Nasdaq-NMS stocks but only 1.42% for exchange-listed stocks. Interestingly, for exchange-listed stocks, implicit costs are larger than explicit costs for buyer-initiated transactions, but there is no such relation for seller-initiated transactions.

5 An Analysis of Trade Costs

The dispersion in the trading costs reported above motivates a more formal analysis of their determinants. As shown above, trade difficulty (proxied for by order size and market capitalization) and exchange-listing may explain some of the variation in execution costs, but there may be other relevant factors. In particular, active strategies (using market orders) or strategies requiring a high degree of immediacy (short durations) may be costlier than more patient strategies involving passive (limit) orders taking many days to execute. In addition, there may be differences in execution costs across different institutions. Identifying traders who obtain below-average execution costs (relative to a benchmark determined by trade difficulty etc.) is important for performance analysis.

Many previous studies simply report aggregate cost estimates, without controlling for factors that may affect costs. For example, suppose that the trading costs associated with a particular order were, say, 2 percent of the value of the order. This figure may appear large, but if orders of a similar size and duration, executed in identical market capitalization stocks using the same order type, typically incur costs of, say, 3 percent, the order strategy in question actually performed well. To identify systematic differences in performance, we must control for the investment strategy of the institution initiating the trade, as well as the difficulty of the trade.

5.1 Regression Analysis

Trading costs are a function of investment strategy. In this section, we estimate this relation, i.e., $C(S)$. As noted above, the relevant strategy variables include the liquidity of the stocks to be traded (measured by market capitalization and exchange listing) and trade difficulty (measured by the trade duration and order size). Accordingly, we estimate the following regression equation separately for buyer- and seller-initiated trades:

$$C_i = \beta_1 D_i^{OTC} + \beta_2 Logmcap_i + \beta_3 Duration_i + \beta_4 Size_i + \sum_{j=1}^{21} \gamma_j D_{i,j} + \epsilon_i, \qquad (6)$$

where for order i, C_i is the total cost (stated in percentage form), D_i^{OTC} equals one if the stock being traded is Nasdaq-NMS and zero otherwise, $Logmcap_i$ is the log of the market capitalization of the stock being traded, $Duration_i$ is the number of days over which the order is filled, $Size_i$ represents the ratio of the order quantity to total shares outstanding, $D_{i,j}$ is a dummy variable taking the value 1 if order i was executed by client j, and ϵ_i is an error term.

The OTC 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 $\beta_1 > 0$. Market capitalization is included as a proxy for liquidity, and the discussion above suggests that $\beta_2 < 0$. Duration and size are included because they capture trade difficulty. We expect an inverse relation between duration and cost since traders must pay a premium for immediacy. Thus, we hypothesize that $\beta_3 < 0$. Similarly, larger orders should imply, other things equal, higher costs, so that $\beta_4 > 0$. Finally, the dummy variables capture the base-level trading cost of each institution. As the dummy variables sum to one, no intercept is estimated. This facilitates the evaluation of individual traders, as we explain below.

Table 4 presents coefficient estimates of equation (6) separately for buyer- and seller-initiated trades. Although the adjusted R^2 values are relatively low (0.107 for buys and 0.134 for sells), the coefficient estimates are significant and consistent with our predictions. The Nasdaq-NMS dummy is positive and significant for buys, but is not significant for sells. Holding constant market capitalization, trade duration, and trade difficulty, buyer-initiated trades are costlier for Nasdaq stocks. The magnitude of this effect is 0.24%. As hypothesized, costs are significantly related to proxies for liquidity and trade difficulty. The coefficient on market capitalization is negative and the coefficient on order size is positive, and both variables are significant for both buyer- and seller-initiated trades. Duration is significant only for sell orders, but has the expected negative sign in both cases. This may reflect the fact that traders are more patient on the buy side (see, e.g., Keim and Madhavan (1994a)), and optimally choose the level of order fragmentation to minimize the impact on transaction costs. We return to this issue later.

5.2 Predicted Trading Costs

The estimated regression equation (6) allows us to estimate the expected costs associated with hypothetical trading strategies and to compare the execution costs of different managers using an equivalent trade. Figure 1 shows the predicted trade costs for buys and sells as a function of market capitalization for a hypothetical trade in a Nasdaq stock with duration one day and trade size 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 1 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 1 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 (1994a). 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 do not exhibit this asymmetry because trading volumes for seller-initiated trades are generally larger than for buyer-initiated trades.

Figure 2 shows a similar plot of trade costs for buyer-initiated trades, broken down by type of institution. It is clear that there is little difference in the execution costs of index and technical traders, who use active strategies to obtain rapid execution. However, value traders have significantly lower predicted trading costs over the entire range of market capitalization. Further, the difference in the predicted costs becomes even more pronounced as market capitalization increases. This may reflect the fact that value traders may be more active in such stocks because they find the use of passive strategies difficult to employ in thin markets. Index and technical traders may also be more cautious when trading in illiquid markets, producing less of a discrepancy. Some evidence in favor of this hypothesis can be found in Keim and Madhavan (1994a).

5.3 Institution-Specific Effects

The variation in trading costs across institutions, although informative, cannot be used to assess a particular trader's ability unless we control for differences in investment strategy. The estimated coefficients on the institution-specific dummy variables in equation (6) provide such a control. For each institution, the dummy represents the trader-specific cost of execution, correcting for endogenous choices over order type and duration, and exogenous factors such as market liquidity and exchange listing. 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 $C_i - C(S_i)$.

In both regressions, the dummy variables are significantly positive, indicating that all 21 institutions bear non-zero execution costs. Figure 3 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 (6). It is apparent that there are large differences in the total execution 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.

Some of these differences potentially reflect the trading style of the institutions. To investigate this possibility, we re-estimated equation (6) replacing the institution-specific dummy variables with style-specific dummy variables. 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 implicit costs because they tend to trade quickly, whereas value traders (whose trades are motivated by considerations of long-term value) may incur low costs. However, the pattern with commission costs may be quite different because index strategies are quite simple to execute in relation to value strategies. Taken together, the estimated implicit costs outweigh the exlicit costs in determining the differences in total costs across investment styles — both index and technical traders have higher costs than value traders, for both buyer- and seller-initiated transactions. For example, the regression model that includes investment style dummy variables yields estimated coefficients (standard errors) for buy transactions of 3.966 (0.198) for the value managers, 4.459 (0.195) for the technical traders, and 4.191 (0.187) for the index managers.

Nevertheless, the estimates of equation (6) in table 4 detect significant differences in the institution specific cost components even within a given style, so that trading ability appears to be an important determinant of the overall execution costs. Consider, for example, institutions 8 and 9, who are both 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 495 $(= 754 - 259)$ basis points higher than that of institution 8 for buyer-initiated transactions. This abnormal cost is statistically significant; it is almost 20 standard deviations from zero. 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.[10] 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

[10]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.

associated with price movements during the trading process that may produce a misleading 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 5 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. In particular, 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.

The table also shows that the costs of these trades were 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 4, 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.

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 Common Stock Trades for 21 Institutions for the Period January 1991 to March 1993

Size Quintile	Median Market Cap ($ Billions)	Number of Orders	Median Value of Order ($ Thousands)	Orders in Listed Stocks (% of Total)	Mean Duration (Days)
Buyer-Initiated Trades					
Largest	6.176	12,120	421.5	90	1.84
2	1.213	9,924	67.2	81	2.01
3	0.470	7.075	103.4	58	1.62
4	0.168	4.848	81.5	44	1.60
Smallest	0.063	2,634	27.9	32	1.73
Overall	1.061	36,601	138.1	71	1.80
Seller-Initiated Trades					
Largest	6.908	11,867	564.1	92	1.71
2	1.261	5.592	436.9	85	1.67
3	0.460	3,871	339.3	59	1.56
4	0.170	2.725	246.4	41	1.55
Smallest	0.059	1,677	81.6	34	1.52
Overall	1.825	25.732	385.9	76	1.65

Table 2

Average Trading Costs by Market Capitalization Quintile 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 market capitalization with cutoffs determined by NYSE quintile break points at December 1991. Costs are reported in percent. Standard errors are in parentheses.

Market Cap Quintile	Exchange-Listed Stocks				NASDAQ/NMS Stocks	
	Total	Implicit	Explicit	n	Total	n
Buyer-Initiated Trades						
Largest	0.31	0.17	0.13	10,960	0.24	1,155
	(0.02)	(0.02)	(0.00)		(0.11)	
2	0.43	0.28	0.17	7,989	0.51	1,934
	(0.03)	(0.03)	(0.00)		(0.09)	
3	0.64	0.41	0.24	4,137	0.92	2,929
	(0.06)	(0.06)	(0.00)		(0.08)	
4	1.00	0.70	0.30	2,115	1.52	2,720
	(0.07)	(0.08)	(0.00)		(0.09)	
Smallest	1.78	1.35	0.42	834	2.85	1,801
	(0.12)	(0.12)	(0.01)		(0.13)	
Seller-Initiated Trades						
Largest	0.26	0.11	0.15	10,901	0.16	960
	(0.02)	(0.02)	(0.00)		(0.12)	
2	0.63	0.41	0.23	4,738	0.85	853
	(0.04)	(0.05)	(0.00)		(0.18)	
3	1.02	0.72	0.30	2,296	1.18	1,517
	(0.09)	(0.09)	(0.00)		(0.12)	
4	1.33	0.92	0.41	1,112	1.73	1,613
	(0.16)	(0.15)	(0.01)		(0.15)	
Smallest	2.03	1.36	0.67	568	2.91	1,106
	(0.23)	(0.23)	(0.02)		(0.23)	

Table 3

Average Trading Costs by Trade Size Quartile 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 trade size quartile defined as number of shares traded divided by total outstanding shares, with quartile cutoffs determined separately for buy and sell transactions. Costs are reported in percent. Standard errors are in parentheses.

Trade Size Quartile	Exchange-Listed Stocks				NASDAQ/NMS Stocks	
	Total	Implicit	Explicit	n	Total	n
Buyer-Initiated Trades						
Smallest	0.31	0.18	0.13	7,392	0.76	1,755
	(0.02)	(0.02)	(0.00)		(0.06)	
2	0.36	0.19	0.17	6,577	1.01	2,571
	(0.03)	(0.03)	(0.00)		(0.07)	
3	0.53	0.32	0.21	6,503	1.08	2,645
	(0.04)	(0.04)	(0.00)		(0.09)	
Largest	0.90	0.65	0.25	5,570	1.80	3,577
	(0.05)	(0.05)	(0.00)		(0.10)	
Seller-Initiated Trades						
Smallest	0.33	0.15	0.18	5,736	0.29	696
	(0.03)	(0.03)	(0.00)		(0.12)	
2	0.31	0.11	0.20	5,291	0.50	1,142
	(0.04)	(0.03)	(0.00)		(0.11)	
3	0.38	0.17	0.21	4,766	0.71	1,666
	(0.04)	(0.04)	(0.00)		(0.11)	
Largest	1.42	1.13	0.29	3,830	2.63	2,602
	(0.08)	(0.08)	(0.00)		(0.14)	

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 the regression model:

$$C_i = \beta_1 D_i^{OTC} + \beta_2 Logmcap_i + \beta_3 Duration_i + \beta_4 Trsize_i + \sum_{j=1}^{21} \gamma_j D_{i,j}$$

where, for order i, C_i is the total trading cost (in percent), D_i^{OTC} 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, $Duration_i$ is the number of days taken to fill the order, $Trsize_i$ 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.

Variable	Buyer-Initiated Orders Estimate	Buyer-Initiated Orders Std Error	Seller-Initiated Orders Estimate	Seller-Initiated Orders Std Error
D^{OTC}	0.236	0.046	−0.111	0.067
Logmcap	−0.204	0.014	−0.112	0.017
Duration	−0.009	0.007	−0.071	0.012
Trsize	0.105	0.007	0.213	0.006
D_1	5.314	0.273	1.602	0.327
D_2	3.297	0.203	2.460	0.290
D_3	1.596	0.361	0.828	0.370
D_4	3.258	0.321	1.619	0.344
D_5	2.329	0.245	0.791	0.283
D_6	2.109	0.528	4.116	0.624
D_7	2.932	0.233	1.962	0.346
D_8	2.591	0.268	2.343	0.315
D_9	7.543	0.250	4.479	0.308
D_{10}	4.122	0.680	2.379	0.643
D_{11}	3.360	0.209	1.510	0.255
D_{12}	3.392	0.239	1.993	0.284
D_{13}	4.655	0.257	1.552	0.308
D_{14}	3.211	0.271	1.648	0.293
D_{15}	3.770	0.235	2.421	0.274
D_{16}	3.667	0.257	1.933	0.284
D_{17}	2.879	0.233	1.983	0.275
D_{18}	4.093	0.208	3.353	0.257
D_{19}	3.187	0.234	2.049	0.278
D_{20}	2.983	0.231	2.073	0.272
D_{21}	2.126	0.701	1.940	0.871
Adj. R^2	0.107		0.134	
F-Statistic	163.967		144.288	

Table 5

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
21	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
17	1.02*	−0.05	0.31	581	0.78*	−0.17	0.33	923
19	0.53*	0.30	2.97*	1,141	0.94*	0.62*	2.68*	1,062
20	1.80*	0.55*	0.95*	3,634	2.72*	0.63*	1.94*	2,427
22	0.13*	0.37*	0.18	4,678	0.64*	−0.04	−0.78*	5,640
23	−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.

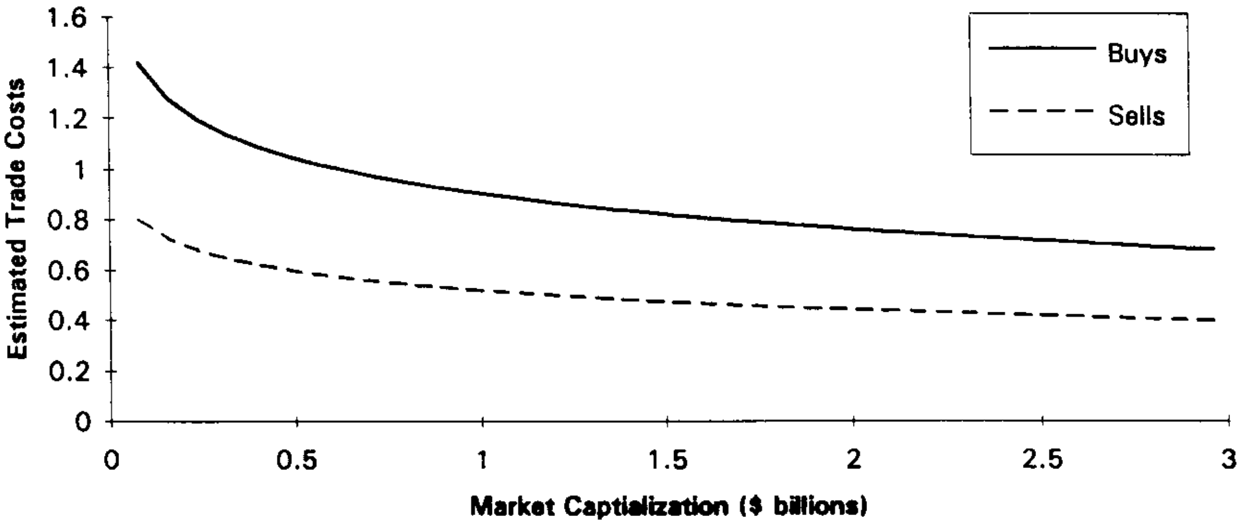


fig. 1. Predicted trade costs for buy and sell transactions as a function of market capitalization for a hypothetical trade in a Nasdaq stock with duration one day and trade size equal to the median for the sample. The predicted costs are based on the coefficient estimates from equation (6) using data for all 21 institutions. Estimation is for the period January 1991 to March 1993.

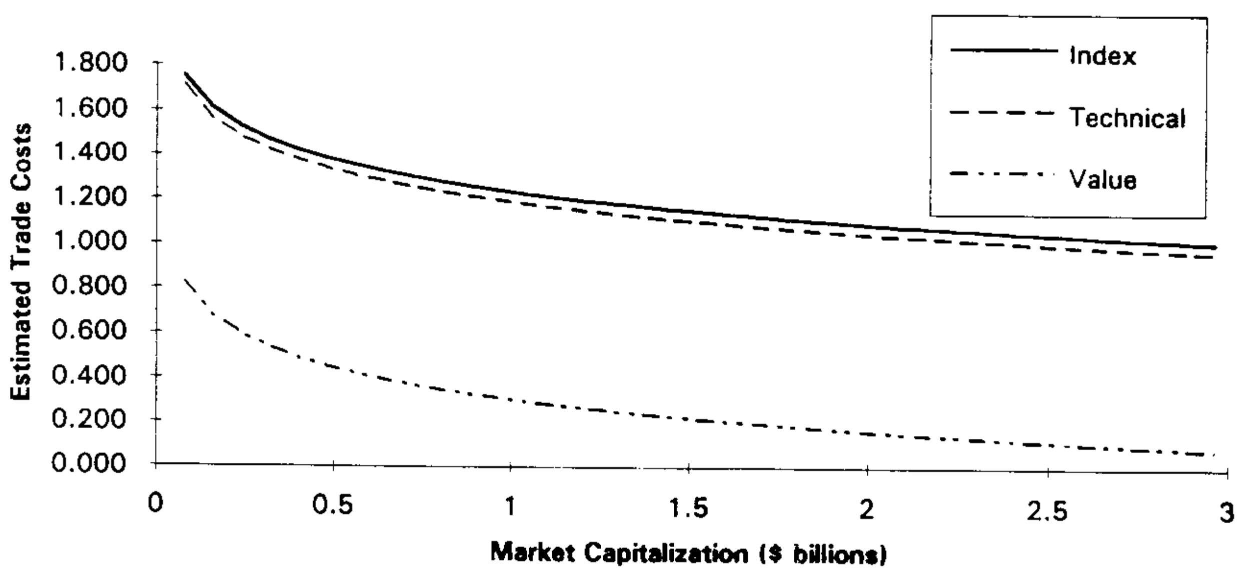


fig. 2. Predicted trade costs (for buys) for the three institution types as a function of market capitalization for a hypothetical trade in a Nasdaq stock with duration one day and trade size equal to the median for the sample. The predicted costs are based on the coefficient estimates from equation (6) using data for all 21 institutions. Estimation is for the period January 1991 to March 1993.

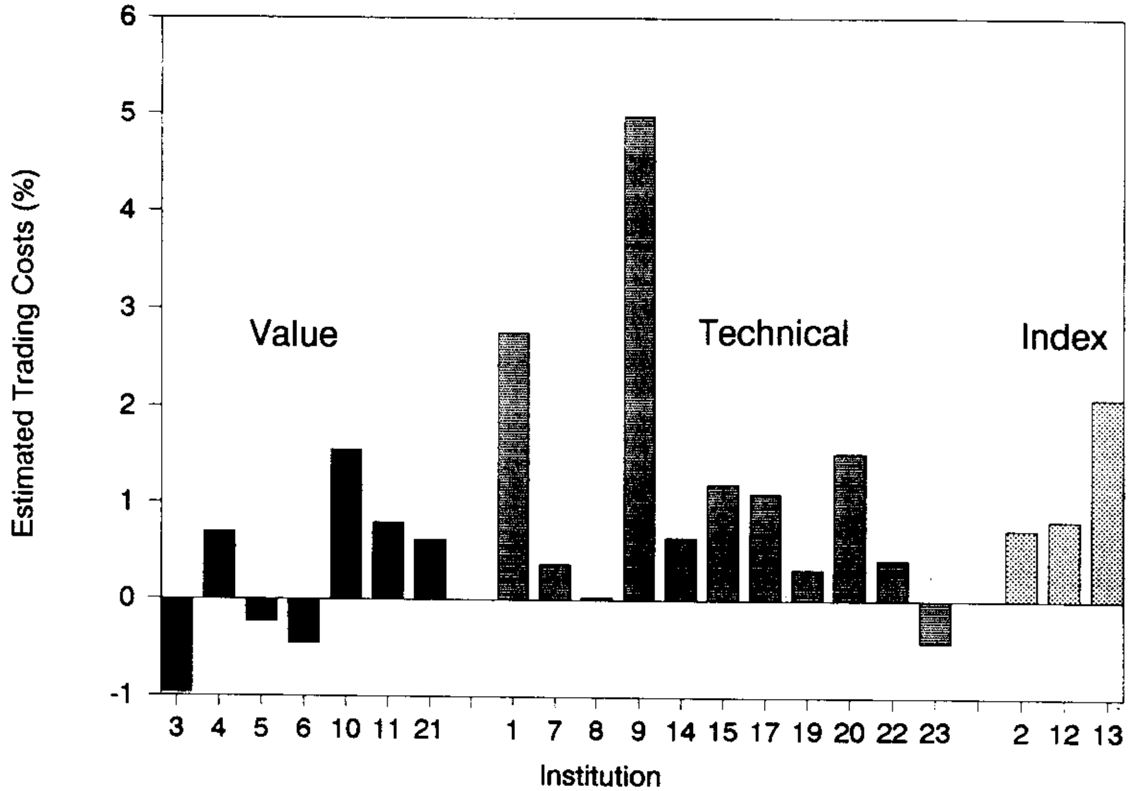


fig. 3a. Estimated base-level trade costs (buy transactions) for each institution in our sample, grouped by investment style, based on estimates in equation (6) and using median values for the independent variables. Estimation is for the period January 1991 to March 1993.

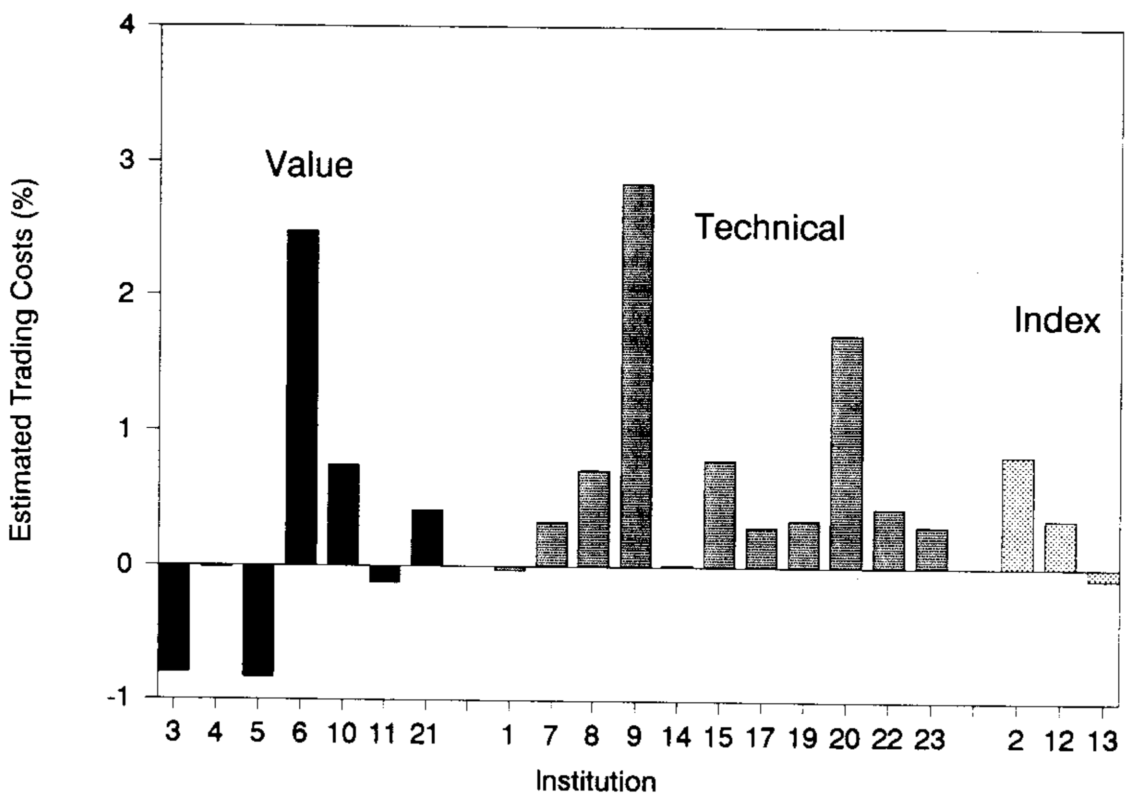
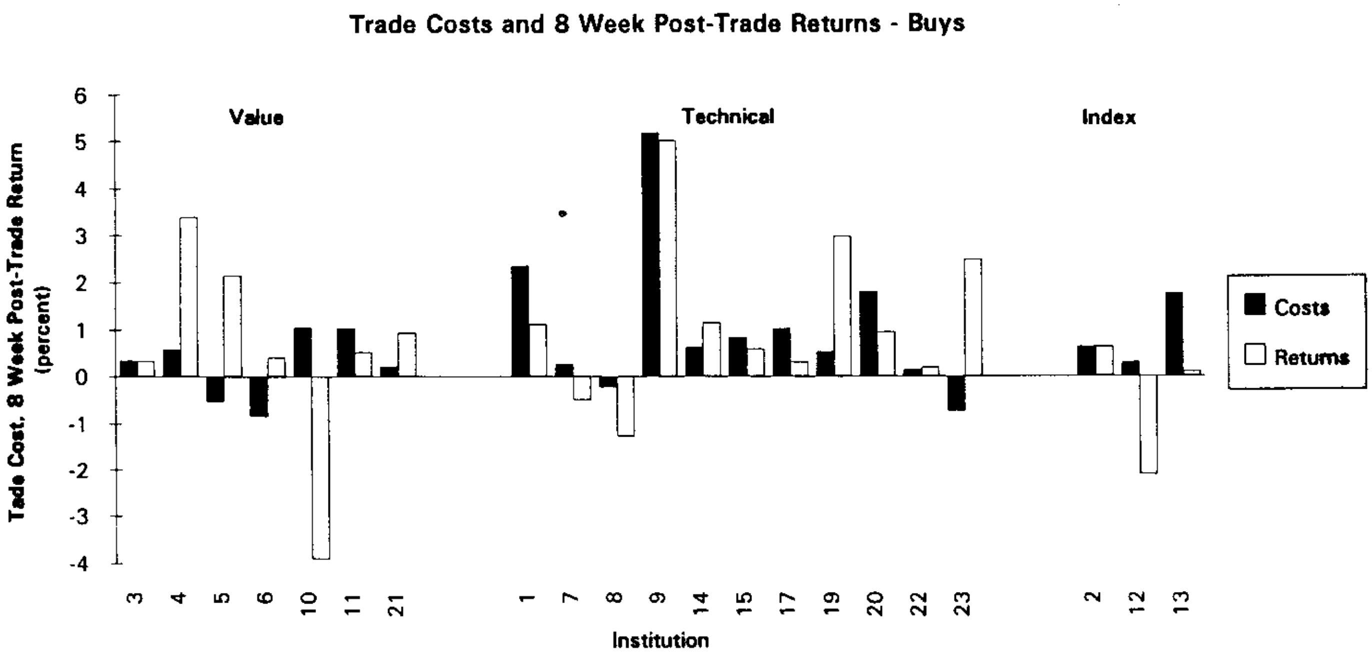


fig. 3b. Estimated base-level trade costs (sell transactions) for each institution in our sample, grouped by investment style, based on estimates in equation (6) and using median values for the independent variables. Estimation is for the period January 1991 to March 1993.



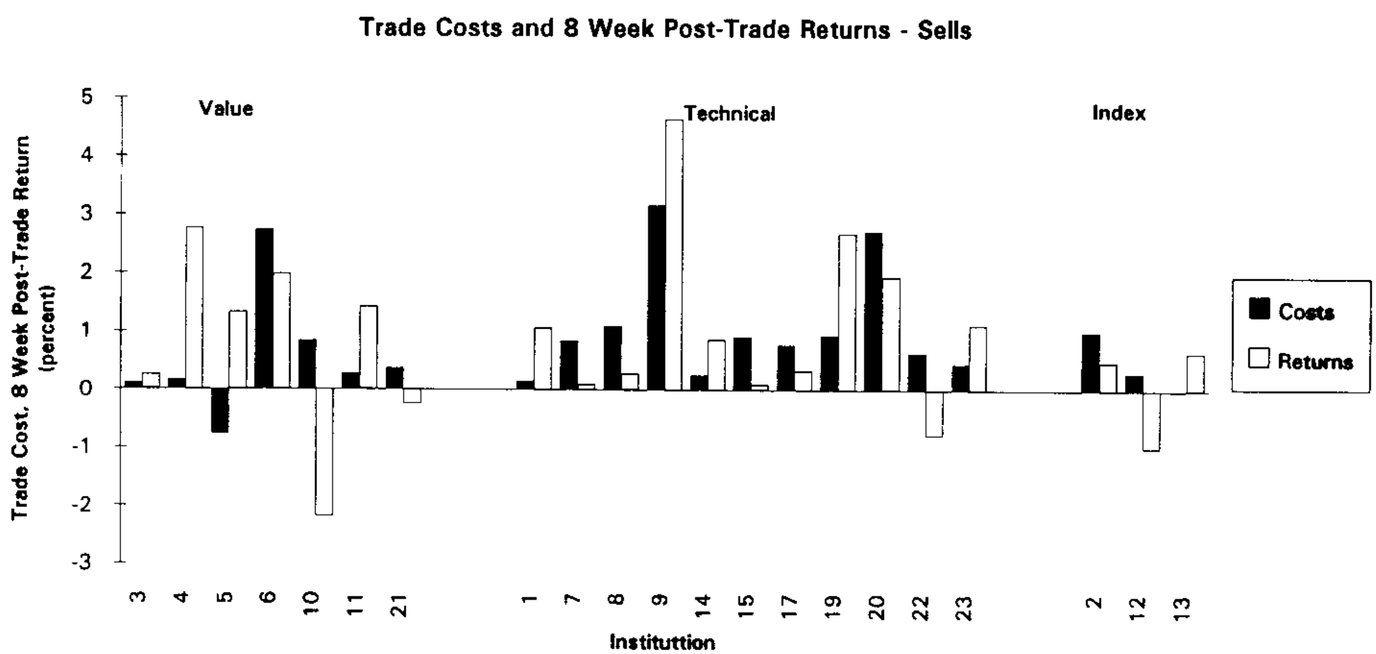


fig. 4. Trade cost and performance of common stock trades initiated by 21 institutions from 1991 to 1993.

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 5, and the values plotted are 8-week performance estimates from that table.