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# Execution Costs of Institutional Equity Orders*

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We compare institutional execution costs across the major U.S. exchanges using a sample of institutional equity orders in firms that switch exchanges. Execution costs including commissions are essentially indistinguishable across these exchanges. We also find the fraction of trading volume from momentum traders is greater on the NYSE than on either the Nasdaq or AMEX and that orders are more likely to be worked by an institution's trading desk on the NYSE than on the Nasdaq. These results suggest that institutions actively manage execution strategies, taking into account characteristics of the markets in which they trade. *Journal of Economic Literature* Classification Numbers: G10, G19, G20, G23. © 1999 by Academic Press

The relative cost of buying and selling securities on the major U.S. exchanges has been a source of contentious debate in recent years. Most observers agree that bid–ask spreads are wider on the Nasdaq multiple dealer market than on the specialist markets of the New York Stock Exchange (NYSE) and American Stock Exchange (AMEX). However, there is little agreement on the source of

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these spread differences; some attribute the difference to characteristics of listed securities, while others assert that the structure of the market or the behavior of market-makers is responsible.[1] Furthermore, there is a growing acknowledgment that bid–ask spreads do not provide a complete picture of execution costs.[2]

In this paper we confront the question: how do execution costs compare across the major U.S. exchanges? We examine this question using a sample of institutional equity orders in firms that change exchange listings. This approach has three important features. First, by examining firms that switch exchanges, we hold constant their idiosyncratic firm characteristics and isolate the impact of the listing venue on the cost of trading. Second, our data record the stock price at the time the order was released to the trading desk, as well as the average execution price and commissions paid. This enables us to accurately measure the cost of establishing a position. Finally, our data allow us to identify orders that were worked by an institution's trading desk and also identify the investment style of the managers initiating orders. As a result, we can compare execution costs across execution strategies and investment styles and examine how managers pursuing various investment styles alter their execution strategies or activity levels when firms change listings.

We find no evidence that average execution costs including commissions change when firms switch to the NYSE from either the Nasdaq or the AMEX. These results are important because many studies conclude that execution costs are lower on the NYSE than on the Nasdaq.[3] For this sample of institutional orders, only execution costs *before* commissions decrease when firms switch from the Nasdaq, a result that is consistent with earlier findings that effective bid–ask spreads are smallest on the NYSE.[4] However, larger NYSE commissions offset this decline.

Of course, one should not focus too closely on average execution costs for the following reason. Keim and Madhavan (1997) find that momentum and index traders (who are more aggressive in establishing desired positions) incur significantly higher execution costs than value traders. As a result of this cross-sectional variation across managers, changes in average execution costs may reflect changes in the mix of institutional trader types pre- and post-switch, as well as any

[1] Comparisons of execution costs can be found in Berkowitz *et al.* (1988), Affleck-Graves *et al.* (1994), Christie and Huang (1994), Petersen and Fialkowski (1994), Goldstein (1994), and Huang and Stoll (1996), among others. Christie and Schultz (1994), Grossman *et al.* (1995), Barclay (1996), Dutta and Madhavan (1996), and Lipson (1998) discuss interpretations of these differences.

[2] This point has been recently made by Edwards and Wagner (1993), Keim and Madhavan (1995), and Jones and Lipson (1997).

[3] For example, Christie and Huang (1994) state that "our empirical results indicate that large reductions in trading costs are realized when firms move from a dealer market to a specialist system" (p. 302), while Huang and Stoll (1996) conclude that "the cost of executing transactions is higher on the NASDAQ than on the NYSE by every measure we calculate" (p. 351). See also the articles identified in footnote 1.

[4] These differences have been documented in Christie and Huang (1994), Affleck-Graves *et al.* (1994), Huang and Stoll (1996), and LaPlante and Muscarella (1997), among others. Goldstein (1994) adjusts for NYSE commissions and finds that trading costs are still lower on the NYSE than on the Nasdaq.

structural differences across exchanges. Thus, an increase in the fraction of momentum trading when firms switch to the NYSE may lead to higher average execution costs on the NYSE due only to the change in the activity by investment style. Fortunately, the data allow us to track and control for investment style. In fact, we find that momentum traders account for a larger fraction of trading activity after a firm switches to the NYSE. Nevertheless, after controlling for investment style, there remain no statistically reliable differences in execution costs across exchanges.

We also examine worked orders in some detail. These are of interest because they are typically larger than other orders, may be more difficult to complete, and may be more costly to execute due to information leakage and price impacts.[5] Worked orders are indeed more expensive than other orders in this sample. For firms that move from the AMEX to the NYSE, there is essentially no change in the prevalence of worked orders. However, for Nasdaq-to-NYSE switches, institutions are more likely to work an order on the NYSE. This change is clearly a response to structural differences between the exchanges.

Our analysis extends the work of Chan and Lakonishok (1997), the Plexus Group (1996), and Keim and Madhavan (1997), all of whom contrast institutional execution costs across the Nasdaq, NYSE, and AMEX market systems. Chan and Lakonishok (1997) construct institutional orders from a sample of institutional trades and conclude that execution costs are lower on the Nasdaq for orders in small firms and lower on the NYSE for orders in large firms. The Plexus Group (1996) and Keim and Madhavan (1997) use the same information on orders as in our study, but conclude that execution costs on the Nasdaq exceed those on the specialist exchanges. The principal difference between our study and these studies is that we isolate idiosyncratic firm characteristics directly, by examining orders in firms that change listings, rather than controlling for firm characteristics in a regression or characteristic-matching framework.

The remainder of this paper is organized as follows. Section 1 describes our institutional trade sample. Section 2 provides an overview of execution costs, execution strategy, and investment style in our sample. Section 3 presents our analysis of execution costs while Section 4 concludes the paper.

## 1. SAMPLE CHARACTERISTICS

We use the Center for Research in Securities Prices (CRSP) data base to identify firms that switched to the NYSE from another exchange in 1993–1995. A small number of these firms are excluded from the sample because a major corporate event, such as a large acquisition or a change in the number of classes of common stock, occurs simultaneously with the change in listing venue. This results in 148 firms that switched from the Nasdaq to the NYSE over this time interval and 64 firms that switched from the AMEX to the NYSE.

[5] See, for example, Plexus Group (1996) for a discussion of trade difficulty. Economides and Schwartz (1995) survey the trading practices of institutional investors and find that more than half break up at least 20% of their orders for 100,000 shares or more for execution through a series of trades.

Our sample of institutional orders was provided by the Plexus Group and includes all orders by their clients from 1993 through 1995 in the above firms. The Plexus Group is a widely recognized consulting firm that monitors the costs of institutional trading. Their clients manage over $750 billion in equity assets and the firm has access to trading records covering approximately 20% of marketplace volume. Plexus clients include Scudder, State Street Global, and Alliance, as well as managers of smaller, specialized portfolios.

Plexus clients do not trade in all of the firms that changed listing during our study period. For a firm to be included in the sample, we require at least one Plexus client order in the 250 trading days before the switch, as well as at least one order in the 250 trading days after the switch. We limit our study to the 250 trading days before and after the listing change in order to hold constant the characteristics of firms.[6] This data requirement results in 114 Nasdaq-to-NYSE firms and 12 AMEX-to-NYSE firms, for which there are a total of 20,440 institutional orders.

Panel A of Table I contains descriptive statistics for firms in our sample and all firms that changed listings over the study period. The average market capitalization for these firms is about $500 million with average stock prices in the low 20's. Not surprisingly, Plexus clients tend to execute trades in the larger switching firms.

Panel B of Table I presents summary statistics for our sample of Plexus client orders and for all recorded trades in the sample firms (obtained from the TAQ data sets produced by the New York Stock Exchange). Plexus clients account for 4 to 13% of the daily dollar trading volume in the switching firms, depending on the exchange. As expected of institutional traders, Plexus client orders are generally large, averaging over 20,000 shares per order. This contrasts with an overall average trade size in these firms of less than 2,000 shares. However, these numbers are not directly comparable, since the data consist of Plexus client *orders*, which may be executed in a number of constituent trades.

It is well known that, all else equal, a decentralized multiple dealer system such as Nasdaq generally results in higher reported volume than the specialist system.[7] Consistent with this, total daily volume and the number of transactions

[6] It is possible that market makers may alter their behavior in the last few trading days to account for the end of market making in the given security, or that abnormal price movements occur just prior to the new listing. It is also possible that announcement of the listing change conveys fundamental information about the firm (see Grammatikos and Papaioannou (1986a, 1986b) and McConnell and Sanger (1987)). To test whether our results may be confounded by either of these effects, we exclude from our analysis the two months surrounding the listing change, since nearly all listing changes occur within one month of announcement. Our results are unchanged.

[7] Suppose that investor A wishes to sell 100 shares, and investor B wishes to buy the same 100 shares. If the stock is traded on Nasdaq, investor A sells to a dealer and investor B buys from a dealer, resulting in two transactions of 100 shares each. There could even be a third transaction if the two investors had transacted with different dealers, who then conduct an inter-dealer trade to rebalance their inventory position. On the NYSE or AMEX, investor A is much more likely to sell directly to investor B, resulting in one transaction (if the specialist acts as intermediary, two transactions would also appear on the NYSE or AMEX records). This is sometimes referred to as the "double counting" issue.

TABLE I
Summary Statistics

| Panel A: Firm characteristics | Nasdaq to NYSE | AMEX to NYSE |
|---|---|---|
| All switching firms | | |
| Stock price | $23.47 | $20.56 |
| Market capitalization (thousands) | $484,862 | $350,719 |
| Number of firms | 148 | 64 |
| Switching firms with Plexus orders | | |
| Stock price | $23.45 | $23.77 |
| Market capitalization (thousands) | $548,335 | $391,936 |
| Number of firms | 114 | 12 |

| | Nasdaq to NYSE | | AMEX to NYSE | |
|---|---|---|---|---|
| Panel B: Trading activity | Nasdaq | NYSE | AMEX | NYSE |
| Average daily dollar volume (thousands) | | | | |
| All trades in firms with Plexus orders | $3,726 | $2,947 | $1,215 | $2,864 |
| Plexus orders only | $175 | $251 | $153 | $150 |
| Average daily number of trades/orders | | | | |
| All trades in firms with Plexus orders | 68.78 | 50.02 | 30.39 | 48.74 |
| Plexus orders only | 0.29 | 0.36 | 0.32 | 0.23 |
| Average trade/order size (shares) | | | | |
| All trades in firms with Plexus orders | 1,926 | 1,726 | 1,485 | 1,225 |
| Plexus orders only | 21,988 | 24,582 | 23,315 | 20,180 |
| Average trade/order size ($ thousands) | | | | |
| All trades in firms with Plexus orders | $44,064 | $40,982 | $29,937 | $30,366 |
| Plexus orders only | $615,039 | $692,620 | $480,665 | $643,055 |

*Note*. The sample of all listing changes includes all firms that switched to the NYSE during 1993–1995. The Plexus subsample contains only those securities that were traded by Plexus institutional clients in the 250 trading days (approximately 1 year) before and after the switch. Mean stock price and market capitalization are calculated on the date of the switch. Stock price, market cap, and daily volume are means across firms. Trading activity measures are given for all trades in firms that were traded by Plexus institutional clients (obtained from the TAQ database) and for all orders placed by Plexus institutional clients.

for the switching sample drops by about one-third when firms leave the Nasdaq for the NYSE. However, for these stocks there is an increase in Plexus client volume, number of orders, and average order size post-switch. When firms leave the AMEX, Plexus client volume and number of orders decline, while average order size measured in shares falls slightly and average order size measured in dollars rises slightly.

## 2. INVESTMENT STYLES AND EXECUTION STRATEGY

For each order, the Plexus data record:

(a) the date and time at which the order is released to a firm's trading desk,

(b) the weighted average transaction price during the ten-minute period that the order is released to the trading desk,

(c) the execution price reported by each broker executing the order,

(d) any commissions paid to brokers, and

(e) the investment style of the manager.

Plexus classifies each client as one of the following three styles: (1) momentum trading, where portfolio managers try to profit from short-term movements in prices, (2) value trading, where portfolio managers try to identify undervalued stocks that will perform well over the long term, or (3) index trading, where portfolio managers try to track the performance of a given stock index. The execution costs of these management styles will differ depending on their need for immediacy of execution (see Keim and Madhavan (1997)).

We would expect institutions to select execution strategies appropriate to the order they wish to execute. One determinant of execution strategy is certainly the size of the order. Another would be the traders' assessment of prevailing market conditions, including liquidity. For example, small orders executed under favorable conditions are most likely to be executed in a single trade while large orders executed under poor conditions are more likely to be worked by an institution's trading desk. Our sample allows us to assess whether traders respond to differences in market systems by changing the proportion of orders they choose to work.

Unfortunately, we do not have sufficient information to exactly partition the data set into worked orders vs orders executed in a single trade. The confounding factor is that execution prices in our sample are obtained from broker reports to institutions. While a broker may report every trade to the trading desk, a broker may also give the average execution price for a number of trades executed within a single day. Similarly, but far less commonly, a broker may allocate a single executed trade to more than one executing trader's account and report each account. Thus, each observation may represent a single trade, a group of trades, or a part of a trade. Nevertheless, if an order is executed by multiple brokers or over multiple days, we know that it must have required multiple trades. These orders are classified as worked orders. This represents about 15% of the orders in the sample. The remaining orders are more likely, but not certain, to have been executed in a single trade.

Table II shows the change in the proportion of trading volume in our sample associated with various investment styles and execution strategies. Panel A shows the change in activity by investment style, where trading activity is measured by number of orders, share volume, and dollar volume. In each case, there is an increase in momentum trading and a decrease in value trading following Nasdaq-to-NYSE listing changes. For example, momentum trading increases from about 19% of share volume pre-switch to about 30% of share volume post-switch. For AMEX-to-NYSE listing changes, there is once again a clear increase in momentum trading, but it is less clear where the associated reduction comes from. By number of orders, it comes at the expense of value traders, but by share or dollar volume, it comes at the expense of index trading.

TABLE II
Change in Investment Style and Execution Strategy around Exchange Listing Changes

| | Nasdaq to NYSE | | | AMEX to NYSE | | |
|---|---|---|---|---|---|---|
| | Nasdaq | NYSE | Change | AMEX | NYSE | Change |
| Panel A: Changes in distribution of trading activity by manager type | | | | | | |
| Number of orders | | | | | | |
| Momentum | 14.5% | 19.0% | +4.5%*** | 5.7% | 10.2% | +4.5%*** |
| Index | 11.2 | 12.7 | +1.5*** | 8.9 | 9.3 | +0.4 |
| Value | 74.3 | 68.3 | −6.0*** | 85.4 | 80.5 | −4.9*** |
| Share volume | | | | | | |
| Momentum | 18.8 | 29.1 | +10.3*** | 7.3 | 14.5 | +7.2*** |
| Index | 10.7 | 10.1 | −0.6 | 10.5 | 4.3 | −6.2*** |
| Value | 70.4 | 60.7 | −9.7*** | 82.2 | 81.3 | −0.9 |
| Dollar volume | | | | | | |
| Momentum | 20.5 | 30.3 | +9.8*** | 6.8 | 11.7 | +4.9*** |
| Index | 11.1 | 11.9 | +0.8 | 9.2 | 3.8 | −5.4*** |
| Value | 68.4 | 57.8 | −10.6*** | 84.0 | 84.5 | +0.5 |
| Panel B: Worked orders as a proportion of trading activity | | | | | | |
| Number of orders (%) | 12.6 | 17.3 | +4.7*** | 14.6 | 12.0 | −2.6 |
| Share volume (%) | 25.4 | 39.8 | +14.4** | 27.5 | 27.7 | +0.2 |
| Dollar volume (%) | 25.7 | 42.6 | +16.9*** | 29.5 | 25.6 | −3.9 |
| Panel C: Changes in proportion of worked orders, by manager type | | | | | | |
| Momentum | 23.7 | 23.9 | +0.2 | 23.7 | 40.2 | +16.5** |
| Index | 20.0 | 19.4 | −0.6 | 14.1 | 10.0 | −4.1 |
| Value | 9.4 | 14.6 | +5.2*** | 13.9 | 8.4 | −5.5*** |

*Note*. Trading activity measures are for manager trading styles around listing changes and changes in the proportion of orders that are worked for all traders and by manager style. Proportions are the ratio of Plexus trading activity for the given category to the total Plexus trading activity in the pre- and post-listing change periods across all firms, expressed as percentages. Significance tests are based on the daily time-series of proportions in the pre-listing change time period.

*** Significant at the 1% level.

** Significant at the 5% level.

Why does style vary across markets? One possibility is that institutions strategically alter their trading behavior when a stock switches exchanges. Another possibility (mentioned to us by an anonymous referee) is that institutions of certain styles are attracted to certain universes. For example, it could be that some feature of the specialist system attracts institutions that follow a momentum style. As a more prosaic example, if a very large firm moves from the Nasdaq to the NYSE, Nasdaq 100 indexers will no longer trade the stock, reducing the share of trading done by index funds, all else equal. Though it is beyond the scope of the current paper, it would be interesting to further explore this style variation across markets, and particularly why the NYSE and AMEX are more attractive to momentum traders.

Panel B of Table II shows the change in worked orders as a proportion of trading activity. For Nasdaq-to-NYSE listing changes the proportion of worked orders

increases across all measures of activity. For example, worked orders increase from about 25% of share volume to about 40% of share volume. For AMEX-to-NYSE listing changes, on the other hand, there appears to be no significant change in execution strategy. Overall, this is strong evidence that the decision to work an order depends on the structure of the exchange where the stock is listed.

We also consider whether the change in execution strategy is associated with a particular investment style. In Panel C of Table II, we show the change in the proportion of worked orders by number of orders (results are qualitatively similar for other measures) for each investment style. For Nasdaq-to-NYSE listing changes, value traders appear to work orders more frequently after the listing change. For AMEX-to-NYSE listing changes, the momentum traders more frequently work orders after the listing change, while value traders are somewhat less likely to work orders after the listing change.

These results suggest that listing venues not only differ in structural and institutional features but also differ in the trading activity levels of managers pursuing various investment strategies. More importantly, we observe a change in the execution strategy of traders, suggesting that traders are aware of and respond actively to differences in characteristics of market systems.

## 3. EXECUTION COSTS

To measure execution costs, we examine both implementation costs and the sum of implementation costs and commissions (total costs). For orders, the implementation cost is the difference (expressed in basis points) between the volume-weighted average execution price of trades executed as part of the order and the price prevailing at the time the institution released the order to its trading desk. This prevailing price is the weighted average transaction price for the ten-minute interval during which the order was released.

Our definition of implementation costs captures as closely as possible the execution costs incurred by traders wishing to establish a position in a given stock. Most important, when more than one trade is executed to complete an order, this measure includes any additional costs incurred as prices move in response to a trader's earlier activities. For example, as a trader makes multiple purchases of a security, the price would be expected to rise, making later purchases more expensive than earlier ones.[8]

[8] Market makers will rationally set prices to reflect the information contained in a given trade. For example, a market maker will set a higher price for a market buy than the market maker's unconditional estimate of a security's value because the purchase itself reveals information. After a buy, the market maker will revise upward the conditional value of the security and prices will rise. Note that we may observe positive spreads even when there are no frictions in the market. The link between information and spreads was initially developed by Glosten and Milgrom (1985) and Glosten (1987) and generated a number of subsequent empirical estimates (see Glosten and Harris (1988), George *et al.* (1991), and Huang and Stoll (1996, 1997)).

There are other avenues through which information on an institution's order can affect market prices. For example, the trading desk may contact a number of market makers on the Nasdaq to obtain price indications, and this contact provides information to market makers. These information leakages may precede order execution and may significantly impact execution costs even when orders are executed in a single trade. The prevailing price at the time an order is released to the trading desk, therefore, captures the price before any information on the order is likely to have reached the market.[9] Thus, our implementation cost captures all order execution effects associated with a given market system.

### *3.1. Average Execution Costs*

We begin our analysis with a characterization of average execution costs. Note that these costs are volume weighted costs and therefore reflect the average cost of a dollar traded by Plexus clients in these firms.

Table III presents execution costs for worked orders and the remaining orders. Before a Nasdaq-to-NYSE listing change, implementation costs for worked orders are about 103 basis points whereas execution costs for the remaining orders are about 60 basis points. The 43 basis point difference is highly significant and estimates for total costs are very similar. These results are not surprising since traders are more likely to work more difficult orders. The greater difficulty of worked orders is further reflected in their larger size, in terms of both dollars and shares traded, with worked orders roughly twice the size of the remaining orders.[10]

The difference in execution costs between worked orders and remaining orders is also observed on the NYSE, after both a Nasdaq-to-NYSE and an AMEX-to-NYSE listing change. After a Nasdaq-to-NYSE listing change, the difference is about 103 basis points, and after an AMEX-to-NYSE listing change the difference is about 144 basis points. We observe no statistically reliable difference between worked and remaining orders on the AMEX, but that sample is quite small (about 150 worked orders).

Table IV presents implementation and total execution costs before and after each listing change for all trades, by trade size, by investment style, and by execution strategy. When stocks move from the AMEX to the NYSE, there is no discernible impact on execution costs, either across all orders, within any order size category, or for any investment style.[11] In general, these results are consistent with the structural similarities across these two exchanges.

[9] An alternative benchmark is the price at the close of trading the day prior to an order release. Our results are essentially identical using that price. However, the prior day closing price is a noisier estimate of the price in effect when an order is released and, particularly for momentum traders, does not reflect the market conditions when a trading decision is made.

[10] We do not report statistical tests on the difference across listing venues for worked or remaining orders because traders may choose to work different orders on different exchanges.

[11] There are relatively few Plexus client orders in firms that made AMEX-to-NYSE listing changes over our sample period. For this reason, the lack of statistically reliable changes may be due to the reduced power of our tests.

TABLE III
Execution Costs for Worked Orders

| | Nasdaq to NYSE | | AMEX to NYSE | |
|---|---|---|---|---|
| | Before | After | Before | After |
| Worked orders | | | | |
| Execution costs | | | | |
| Implementation costs | 103.0 | 140.8 | 73.0 | 154.1 |
| Total costs | 111.1 | 157.8 | 91.8 | 173.0 |
| Order characteristics | | | | |
| Number of orders | 1,037 | 1,813 | 151 | 90 |
| Size in dollars (thousands) | $1,251 | $1,678 | $974 | $1,382 |
| Size in shares | 44,190 | 56,342 | 43,964 | 46,800 |
| Remaining orders | | | | |
| Execution costs | | | | |
| Implementation costs | 59.7 | 38.1 | 57.4 | 9.9 |
| Total costs | 63.1 | 54.9 | 78.0 | 23.6 |
| Order characteristics | | | | |
| Number of orders | 7,163 | 8,634 | 886 | 666 |
| Size in dollars (thousands) | $523 | $486 | $396 | $543 |
| Size in shares | 18,774 | 17,913 | 19,796 | 16,583 |
| Difference (worked minus remaining) | | | | |
| Implementation costs | +43.3*** | +102.6*** | +15.6 | +144.2** |
| Total costs | +47.9*** | +102.8*** | +13.8 | +149.4** |

*Note.* The sample includes Plexus client trades in firms that changed listings to the NYSE, where execution costs are partitioned on whether the order was likely to have been worked by the institution's trading desk, or not. The difference represents the cost of worked orders relative to the remaining orders. Implementation cost is the difference between the transaction price and the price prevailing at the time the order was released to the trading desk, expressed in basis points. Total cost equals implementation cost plus commissions and is also expressed in basis points. Presented figures are averages (over time) of dollar-volume weighted daily averages (across firms) within each specified grouping. Tests of significance for execution costs are calculated using the standard error of the cross section of firm-level execution costs.

*** Significant at the 1% level.

** Significant at the 5% level.

Perhaps more interesting are firms that move from the Nasdaq to the NYSE. Average implementation costs are indistinguishable before and after the move (71 basis points pre-switch versus 81 basis points afterward). When we partition by order size, we find weak evidence of a decrease in implementation costs for very small orders (1,000 shares or less) and medium orders (10,001 to 100,000 shares). For example, implementation costs for very small orders decrease from 32 to 19 basis points. There is no significant change for small orders (1,001 to 10,000 shares) or large orders (greater than 100,000 shares).

While declines in implementation costs are consistent with the smaller effective spreads commonly documented on the NYSE, these results can be misleading. Since commissions are generally assessed separately for NYSE/AMEX trades but are often built into spreads for Nasdaq trades, implementation costs may not be

TABLE IV
Institutional Execution Costs around Exchange Listing Changes

| | Implementation costs | | | Total costs | | | Observations | |
|---|---|---|---|---|---|---|---|---|
| | Before | After | Change | Before | After | Change | Before | After |
| Nasdaq to NYSE | | | | | | | | |
| All orders | 70.8 | 81.3 | +10.5 | 75.4 | 98.2 | +22.8** | 8,200 | 10,447 |
| Order size categories (shares) | | | | | | | | |
| 1,000 or smaller | 32.4 | 18.5 | −13.8* | 39.3 | 35.1 | −4.2 | 1,644 | 2,018 |
| 1,001 to 10,000 | 44.1 | 36.5 | −7.6 | 49.1 | 55.0 | +5.9 | 3,347 | 4,302 |
| 10,001 to 100,000 | 53.5 | 40.1 | −13.4* | 57.5 | 56.4 | −1.1 | 2,915 | 3,623 |
| More than 100,000 | 108.9 | 131.8 | +22.9 | 114.4 | 149.6 | +35.1 | 294 | 504 |
| Investment style | | | | | | | | |
| Momentum | 78.9 | 143.7 | +64.8** | 93.0 | 163.8 | +70.8*** | 1,192 | 1,994 |
| Index | 68.8 | 34.6 | −34.3* | 74.1 | 52.6 | −21.5 | 916 | 1,323 |
| Value | 68.7 | 58.2 | −10.6 | 70.4 | 73.1 | +2.7 | 6,092 | 7,130 |
| AMEX to NYSE | | | | | | | | |
| All orders | 62.0 | 46.8 | −15.2 | 82.1 | 61.8 | −20.3 | 1,037 | 756 |
| Order size categories (shares) | | | | | | | | |
| 1,000 or smaller | 10.9 | 29.1 | +18.2 | 30.7 | 44.6 | +13.9 | 174 | 150 |
| 1,001 to 10,000 | 32.4 | 18.5 | −13.9 | 51.8 | 33.2 | −18.6 | 447 | 287 |
| 10,001 to 100,000 | 45.0 | 33.3 | −11.7 | 64.2 | 46.9 | −17.3 | 369 | 293 |
| More than 100,000 | 93.1 | 93.5 | +0.4 | 114.6 | 112.8 | −1.8 | 47 | 26 |
| Investment style | | | | | | | | |
| Momentum | 297.4 | 248.7 | −48.7 | 327.0 | 268.3 | −58.7 | 59 | 77 |
| Index | −5.4 | 23.6 | +29.0 | 25.4 | 60.8 | +35.4 | 92 | 70 |
| Value | 50.3 | 19.8 | −30.5 | 68.4 | 33.2 | −35.2 | 886 | 609 |

*Note*. The sample includes Plexus client trades in firms that moved to the NYSE in 1993–1995. Implementation cost is the difference between the transaction price and the price prevailing at the time the order was released to the trading desk, expressed in basis points. Total cost equals implementation cost plus commissions and is also expressed in basis points. Presented figures are averages weighted by the dollar amount of each order. Tests of significance are calculated using the cross-sectional distribution of changes in costs.

*** Significant at the 1% level.

** Significant at the 5% level.

* Significant at the 10% level.

directly comparable across market systems. Total costs, which are implementation costs plus commissions, are a more comparable measure. For Nasdaq-to-NYSE moves, total costs are 75 basis points pre-switch vs 98 basis points post-switch, an insignificant 23 basis point increase.[12] Furthermore, there is no evidence of changes

[12] Formally, we test $\beta_1 = 0$ in the panel regression, weighted by dollar volume,

$$\mathrm{TC}_{i,t} = \beta_0 + \beta_1 \mathrm{POST}_{i,t} + e_{i,t},$$

where $\mathrm{TC}_{i,t}$ is the average total cost of trading in firm $i$ during time period $t$ (pre-switch or post-switch), and POST is an indicator variable equal to one if the observation is post-switch.

in total costs for any order size category. Thus, our results suggest that, where NYSE implementation costs are lower, higher commissions on NYSE trades essentially offset this difference. We focus on total costs for the remainder of the paper.[13]

As expected, execution costs are increasing with order size. On the Nasdaq, total costs rise from 39 basis points for very small orders to 114 basis points for large orders, while on the NYSE total costs rise from 35 basis points for very small orders to 150 basis points for large orders. Among investment style categories, the most dramatic result is a marked increase in total execution costs for momentum traders following a Nasdaq-to-NYSE listing change.

### *3.2. Matched-Pair and Regression Analyses of Execution Costs*

The results thus far suggest that there are changes in order strategy and investment style around listing changes and that execution costs differ across investment styles, yet there is little difference in average realized costs across exchanges. However, changes in the distribution of order sizes (even if there are no changes in average size) and changes in investment style may affect measures of average execution cost, even when costs are unchanged within these categories. We also know from prior research that firm characteristics and market conditions may affect execution costs (Keim and Madhavan (1997) and Plexus Group (1996)). In this section we use both order-matching and regression approaches to control for the characteristics of firms, orders, and market conditions which might affect execution costs.

Table V presents an analysis of the change in total execution costs across listing changes for pairs of orders that are matched by firm, by investment style, and by order size (matched to within 5.00% in dollars). The table shows mean and median changes along with *t* tests and Wilcoxon signed rank tests of significance. Overall, execution costs are indistinguishable across exchanges. For Nasdaq-to-NYSE listing changes, there is some evidence that very small orders are cheaper post-switch (median costs decline by about 18 basis points). There is clear evidence of an increase in total execution costs for the largest orders (a significant increase

[13] When brokers provide research and other services to their clients, a portion of the commission paid to the broker is actually a payment for services and not a true cost of the order. The payments for these services are soft-dollar payments. Furthermore, since commissions are usually built into prices on the Nasdaq but are explicitly charged for NYSE/AMEX trades, the change in commissions reflects both a soft-dollar effect and a reporting convention effect. It is therefore possible that an increase in soft- dollar payments may mask a reduction in execution costs when firms move to the NYSE. In recent research, Conrad *et al.* (1998) find that soft-dollar payments are involved in only about 7% of Plexus client trades. Furthermore, they find that soft-dollar trades are about 20 basis points more costly than other trades. Based on these numbers, soft-dollar changes might account for a 1.5 basis point change in average trading costs, an amount insufficient to explain our results. For a small sub-sample of our data we were able to obtain soft-dollar data. Of the 1,014 orders for which this data was available, 37 (about 4%) have some kind of soft-dollar arrangement. In the sub-sample, the difference in total costs between the trades directed to soft-dollar brokers and other trades is about 30 basis points but is not reliably different from zero. Though our sub-sample is quite small, these analyses, taken together, suggest that our results are not driven by soft-dollar effects.

TABLE V
Listing Changes and Execution Costs: Firm, Size, and Investment Style Matched Pairs

| | Change in implementation costs | | Change in total costs | | Number of pairs |
|---|---|---|---|---|---|
| | Mean | Median | Mean | Median | |
| Nasdaq-to-NYSE | | | | | |
| All orders | −10.9 | −10.9 | +1.3 | 0.0 | 4,085 |
| Order size categories (shares) | | | | | |
| 1,000 or smaller | −30.5*** | −31.3*** | −18.9 | −18.1** | 564 |
| 1,001 to 10,000 | −20.0*** | −10.8*** | −9.2 | −2.5 | 1,768 |
| 10,001 to 100,000 | +0.6 | −7.0 | +14.6** | +6.7 | 1,672 |
| More than 100,000 | +87.2* | +54.7* | +96.8** | +67.6** | 81 |
| Investment style | | | | | |
| Momentum | −27.4* | −18.6*** | −25.4* | −16.4** | 390 |
| Index | −16.2 | −6.5 | −7.5 | +3.4 | 280 |
| Value | −8.6* | −10.4*** | +5.1 | +0.6 | 3,415 |
| AMEX-to-NYSE | | | | | |
| All orders | −7.5 | 0.0 | −8.5 | −2.7 | 445 |
| Order size categories (shares) | | | | | |
| 1,000 or smaller | +16.3 | +0.6 | +14.9 | +3.1 | 76 |
| 1,001 to 10,000 | −23.7 | −8.2** | −24.9 | −14.8** | 170 |
| 10,001 to 100,000 | −4.1 | +0.9 | −4.8 | +0.3 | 196 |
| More than 100,000 | +96.7 | +6.6 | +89.6 | +3.1 | 3 |
| Investment style | | | | | |
| Momentum | −58.5 | +8.0 | −71.5 | −12.4 | 8 |
| Index | +69.2 | +39.5 | +49.0 | +2.7 | 4 |
| Value | −7.2 | 0.0 | −7.8 | −2.0 | 433 |

*Note.* Orders are matched by firm and institutional manager style; dollar volumes must be within 5.00% of each other. Implementation cost is the difference between the transaction price and the price prevailing at the time the order was released to the trading desk, expressed in basis points. Total cost equals implementation cost plus commissions. Standard *t* tests are used for means and Wilcoxon signed rank tests for medians.

*** Significant at the 1% level.
** Significant at the 5% level.
* Significant at the 10% level.

in both mean execution costs, about 97 basis points, and median execution costs, about 68 basis points). As before, depending on the sub-sample being considered, NYSE implementation costs are sometimes lower than Nasdaq implementation costs, but these declines are at least partially offset by increases in commissions.

While our matched sample approach controls for firm characteristics, order size, and investment style, it does not control for market conditions. For example, during periods of increased volatility, execution costs are likely to be higher. Furthermore, the matched pair approach reduces the sample size by about 60% (from about 20,000 orders to about 4,000 order pairs). Our next analysis uses a regression approach to control for order size, investment style, and market conditions.

For each firm, we regress execution costs on the following order characteristics and market condition variables.

| | |
|---|---|
| $D^{\text{POST}}$ | An indicator variable for orders released after the listing change. |
| SIZE | The size of the order in shares divided by total shares outstanding. |
| IP | The inverse of the prevailing price at the time the order is released to the trading desk. |
| RET | For buy orders, RET is the stock return for the two days preceding the release of an order. For sell orders, it is the negative of the return for two days preceding the release of an order. |
| $\sigma_i^2$ | The square of the stock return for the day preceding the release of an order. |
| $D^{\text{MOMEN}}$ | An indicator for orders placed by momentum traders. |
| $D^{\text{INDEX}}$ | An indicator for orders placed by indexers. |

The first variable, $D^{\text{POST}}$, reflects the effect of listing venues on execution costs and is central to our analysis. Large orders are more costly than small orders, and SIZE controls for this effect. Changes in price levels may affect execution costs if minimum price increments are binding, and we include IP to capture this effect. Conventional wisdom suggests (and the evidence in Keim and Madhavan (1997) confirms) that if prices are generally rising (falling), it is more difficult to execute a buy (sell) order. RET captures this price momentum effect. Similarly, when markets are volatile, it may be more costly to establish a given position. This is captured by $\sigma_i^2$. The variables $D^{\text{MOMEN}}$ and $D^{\text{INDEX}}$ measure the additional execution costs incurred by momentum and index traders relative to value traders (for whom the indicator variable is omitted).

Since an important advantage of using a sample of exchange listing changes is that firm characteristics vary little over the analysis period, we perform our regression on a firm-by-firm basis and report summary statistics on the firm-level parameter estimates. We require at least five observations in both the pre- and the post-listing time periods for a firm to be included in the regression analysis. Furthermore, not every firm has orders from each investment style. We therefore perform two regressions. In the first, we limit the analysis to firms that have observations for all investment types. In the second, we omit the investment type indicators and conduct the regression on all firms with the minimum number of observations. The resulting sample sizes are reported below the regressions.

Table VI presents the results. For each parameter we report the mean across firms of the parameter estimates; below that is the median across firms, and below that we show the number of individual firm regressions in which the parameter estimate was significantly positive/negative at the 10% confidence level. Hypothesis tests are performed on the cross section of parameter estimates assuming cross-sectional independence.

Consider the Nasdaq-to-NYSE listing changes. Not surprisingly, execution costs are increasing in the size of an order. Index trading is somewhat more costly than

TABLE VI
Exchange Listing Effects: Regression Analysis for All Orders

| | Nasdaq-to-NYSE | | AMEX-to-NYSE | |
|---|---|---|---|---|
| Independent variables | (1) | (2) | (1) | (2) |
| Intercept | −41.9 | −21.6* | 136.7* | 145.5*** |
| | −3.6 | 1.3* | 116.0 | 130.2*** |
| | 9/13 | 10/14 | 3/0 | 2/0 |
| $D^{\text{POST}}$ | 14.9 | 11.5 | −0.6 | −4.5 |
| | 12.6* | 13.8** | −5.3 | −13.3 |
| | 10/5 | 13/10 | 0/1 | 0/1 |
| SIZE | 14.4*** | 17.6*** | 21.5 | 15.8 |
| | 10.0*** | 11.7*** | 11.4 | 8.5 |
| | 23/3 | 25/6 | 3/0 | 3/0 |
| IP | 1,869.9** | 1,849.5* | −3,494.0 | −2,486.7 |
| | 982.1** | 876.7** | −2,300.9 | −1,588.5* |
| | 13/5 | 15/6 | 0/1 | 0/1 |
| RET | 113.7 | 153.0 | 201.3 | 92.8 |
| | 64.5 | 77.6* | 421.6 | 363.2 |
| | 1/6 | 15/3 | 1/0 | 2/0 |
| $\sigma_i^2$ (× 1,000) | 10.1 | 8.1 | −9.4 | −11.9* |
| | −1.2 | 0.4 | −5.7 | −13.0 |
| | 9/7 | 10/9 | 0/1 | 0/2 |
| $D^{\text{MOMEN}}$ | 20.4 | | 62.2 | |
| | 11.0* | | 56.0 | |
| | 14/12 | | 2/0 | |
| $D^{\text{INDEX}}$ | 32.6** | | 24.4 | |
| | 6.3 | | 20.2 | |
| | 11/12 | | 1/0 | |
| Average adjusted $R$ square | 0.075 | 0.081 | 0.096 | 0.071 |
| Number of firms | 74 | 88 | 5 | 8 |
| Number of observations | 15,689 | 16,394 | 1,458 | 1,715 |

*Note.* Summary statistics are for the parameter estimates of the firm-by-firm regressions

$$(1)\ C_i = \alpha_0 + \alpha_1 D_i^{\text{POST}} + \alpha_2 \text{SIZE}_i + \alpha_3 \text{IP}_i + \alpha_4 \text{RET}_i + \alpha_5 \sigma_i^2 + \alpha_6 D_i^{\text{MOMEN}} + \alpha_7 D_i^{\text{INDEX}} + \varepsilon_i$$

$$(2)\ C_i = \alpha_0 + \alpha_1 D_i^{\text{POST}} + \alpha_2 \text{SIZE}_i + \alpha_3 \text{IP}_i + \alpha_4 \text{RET}_i + \alpha_5 \sigma_i^2 + \varepsilon_i,$$

where the dependent variable $C_i$ is the total cost of order $i$ (in basis points), $D_i^{\text{POST}}$ is a dummy variable equal to one if the order was completed after the change in listings, $\text{SIZE}_i$ is the ratio of the order size in shares to the shares outstanding, $\text{IP}_i$ is the inverse of the price prevailing at the time the order is released, $\text{RET}_i$ is the return over the two days before the order is released multiplied by 1 if the order is a buy and by −1 if the order is a sell, $\sigma_i^2$ is the square of the stock return on the day prior to the release of the order, and $D_i^{\text{MOMEN}}$ and $D_i^{\text{INDEX}}$ are set equal to one if the order was placed by a manager pursuing a momentum or an index investment strategy, respectively, and zero otherwise. We present the mean across firms, below which is the median across firms, and below that is the number of parameter estimates in the firm by firm regressions that are significantly positive or negative (+/−). Standard $t$ tests are used for means and Wilcoxon signed rank tests for medians.

*** Significant at the 1% level.
** Significant at the 5% level.
* Significant at the 10% level.

value trading, but none of the other parameter estimates are reliably different from zero. Most importantly, there is no evidence that $D^{POST}$ decreases. In fact, the change in median values shows some evidence that more firms experience increases than declines, though average costs do not reliably increase. For AMEX-to-NYSE listing changes the results are generally weaker, no doubt due to the smaller size of the sample.

These results are robust to a number of specification changes. For example, the results are essentially the same if the coefficient on trade size varies across market systems, if we use one-day returns to capture price momentum, or if we use the absolute value of returns to capture momentum. We also calculate (but do not report) execution costs using the closing price on the day before an order is released; the results are unchanged.

### *3.3. Observations on Listing Choices*

One potential concern about our research design is that the listing decision is not an exogenous event.[14] In fact, expected execution costs are an important determinant of the listing venue, though Aggarwal and Angel (1998) emphasize that execution costs are not the only consideration. One possibility, modeled by Lipson (1998) and consistent with the data in Chan and Lakonishok (1997), is that small stocks are cheaper to trade on Nasdaq while large stocks are cheaper to trade on the NYSE. As firms grow (and expect to continue to grow), they switch to the NYSE when execution costs are about equal across the two market systems. If this model describes the listing decision, then it is not surprising that our institutions experience similar execution costs in these stocks pre- and post-switch.

However, suppose that the null hypothesis is somewhat more general: firms switch exchanges when this increases value. Then we would expect trading costs to actually *decline* after a switch to the NYSE and AMEX, because listing fees on the NYSE and AMEX are much higher. This suggests that our sample would, if anything, be biased in favor of finding reductions in execution costs. However, our evidence indicates that, at least for the institutions studied, there are no such reductions. The absence of cost savings is also consistent with the continued listing of very large firms, such as Microsoft, on the Nasdaq. Of course, there are clear differences between our sample of institutional orders and typical retail orders from small investors. Perhaps firms that switch to the NYSE are able to lower execution costs for their small investors. Nevertheless, our results for small institutional orders (less than 1,000 shares) suggest that there may be no significant changes for retail trades either.

The most important contribution of our paper, however, is to dispel a popular conception about execution costs across exchanges. A number of other papers have compared execution costs across exchanges either with lower quality data or by controlling for firm-specific factors in a regression approach. These papers generally conclude that execution costs are lower on the NYSE than on the Nasdaq and have contributed to a general perception that the NYSE is the superior

[14] We thank an anonymous referee for highlighting this issue.

market. If this hypothesis is true, then any firm making a switch to the NYSE should experience a decline in execution costs. Our findings contradict this popular and persistent hypothesis and suggest that one system does not provide cheaper execution for all stocks at all times. Of course, given the endogeneity of listing choices, we caution again that our results do not allow us to conclude that firms are indifferent between listing venues, nor that Nasdaq vs NYSE execution costs would be the same for any firm considering a switch.

We should also emphasize that trade executions do not always take place on the listing exchange. Thus, we essentially contrast the costs associated with trading NYSE or Nasdaq listed securities, not necessarily the costs of execution on these exchanges. For example, a substantial portion of Nasdaq volume is executed through alternative trading systems, such as Instinet, and we cannot distinguish between Nasdaq and Instinet executions.

## 4. CONCLUSION

We examine execution costs for a sample of institutional orders placed in stocks that changed exchange listings during 1993–1995. By comparing execution costs before and after the change in listings, we are able to isolate the effects associated with the characteristics of listing venues by holding constant idiosyncratic characteristics of traded firms. Our sample of orders, rather than individual trades, allows us to capture the effects of sequential trading on execution costs and also enables us to look at execution costs for particular execution strategies and investment styles.

Taken together, the results of our analysis indicate that execution costs for institutional traders are altered little when firms change listings between the major U.S. listing venues. We also find significant changes in the trading activity of various types of traders as well as changes in their execution strategies. These results paint a picture of institutions as sophisticated traders who adjust their trading activities to accommodate differences in market characteristics.

Our work suggests a need for additional research on exactly how and why institutions trade equities differently across markets. With more detailed data, potential comparisons include (a) how long institutions take to execute orders, (b) whether and how institutions break up their orders, and (c) whether limit orders are used more often in one market. These comparisons would help researchers identify essential differences (and similarities) between specialist and dealer market systems. Clearly, they would also be of interest to practitioners and regulators.

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