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The Total Cost of Transactions on the NYSE

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ABSTRACT

This paper develops a measure of execution costs (market impact) of transactions on the NYSE. The measure is the volume-weighted average price over the trading day. It yields results that are less biased than measures that use single prices, such as closes. The paper then applies this measure to a data set containing more than 14,000 actual trades. We show that total transaction costs, commission plus market impact costs, average twenty-three basis points of principal value for our sample. Commission costs, averaging eighteen basis points, are considerably higher than execution costs, which average five basis points. They vary slightly across brokers and significantly across money managers. Though brokers do not incur consistently high or low transaction costs, money managers experience persistently high or lost costs. Finally, the paper explores the possible tradeoff between commission expenditures and market impact costs. Paying higher commissions does not yield commensurately lower execution costs, even after adjusting for trade difficulty. We cannot determine whether other valuable brokerage services are being purchased with higher commission payments or whether some money managers really are inefficient consumers of brokerage trading services.

RECENT YEARS HAVE WITNESSED an explosion of institutional trading on the nation's stock exchanges. In 1970, only 17,000 trades of blocks of 10,000 or more shares were done on the New York Stock Exchange; these accounted for merely fifteen percent of total volume. In 1984, there were 433,000 such block trades, accounting for fifty percent of volume. These trades are costly and, in an informationally efficient stock market, cannot help but have a deleterious effect on the investment performance of institutional investors.

The cost of a trade has at least two components. The first is the commission cost. These have declined precipitously since "May Day" (May 1, 1975), when the New York Stock Exchange abandoned fixed minimum commissions.¹ The second component of transaction costs is the market impact cost of executing a trade. The price of a transaction may reflect both the true equilibrium price plus (for buys) or minus (for sells) a price concession necessary to get the trade done promptly. The deviation from the "equilibrium" price is the market impact cost.

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¹ See Berkowitz and Logue [3].

This paper develops a method for measuring these transaction costs and demonstrates its use.

The paper is organized as follows. A measure of market impact cost is developed in Section I. The application of the volume-weighted average price measure of market impact to assess broker and money manager effectiveness is discussed in Section II. The tradeoff between market impact costs and commission costs is considered in Section III.² Section IV concludes the paper.

I. Measuring Market Impact Costs

Market impact costs differ across money managers and across brokers. Impatient money managers can create very substantial market impacts when they trade large amounts of thinly traded stocks or relatively large blocks of heavily traded stocks, irrespective of whether the trades are liquidity or information motivated. Brokers and broker/dealers also differ, though not consistently so, with respect to their ability to minimize market impact costs, regardless of the commissions they charge.

For practitioners, it is quite important to understand the nature and magnitude of market impact costs and how they correlate with commission costs. For financial economists, this issue is important because it yields insight into market microstructure and the industrial economics of the brokerage industry.

A. Early Attempts

An early attempt to measure market impact costs of large block trades was that of Kraus and Stoll [10]. Using data from the SEC's *Institutional Investor Study Report* [13], they constructed a measure using prices surrounding the block trade. Transactions were sorted into uptick (a price higher than the last trade price) and downtick trades. Upticks are assumed to be buys, downticks to be sells. By measuring differences across the prior day's closing price, the price on a prior block, and the day's closing price, they obtained a price path. The transaction price was compared with this path. Following downtick transactions, there was price recovery. Following uptick transactions, there was no subsequent price decline. A roughly similar method was used by Dann et al. [6] and Holthausen et al. [9] to investigate various features of block trades.

These research teams could not tell which broker or which portfolio manager did a specific trade because the blocks examined were not identifiable; they came from the tape, not specific broker or manager records. A particular trade recorded on the tape could not be linked to a trader. Even if the researchers had access to confirmations provided to money managers and even if these were time stamped, the practice of average cost pricing by brokerage firms would still preclude a linkage between the confirmations and orders submitted by a manager. Average cost pricing arises when a money manager buys or sells the same stock for more

² Such tradeoffs are not uncommon in finance. For instance, Logue and Jarrow [11] find that public utilities that issue shares competitively have lower investment banking spreads but higher market impact costs than those using negotiated offerings. Both types of offerings cost utilities roughly the same amount.

than one account. Say money manager *X* wishes to buy 50,000 shares of stock *Y* for each of two accounts. The broker, in turn, may break the order down into five 20,000-share transactions. The confirmation each account's master trustee receives is for 50,000 shares at the average price obtained. The confirmation thus cannot be linked to any specific trade. Accordingly, the uptick/downtick sort of approach to measure large order execution costs is not practically useful.

A first attempt to measure market impact costs for practical purposes was suggested by Barnea and Logue [1]; a variant was developed and tested by Beebower and Priest [2]. Their method compares the price achieved with that day's closing price and, after an industry index adjustment, to the next day's closing price. Using data from the trading desk at BEA Associates for the first quarter of 1978, they observed that buy transactions had market impact costs of +12 basis points of principal value, while sell transactions had costs of -15 basis points. A plus means trades were done at a "good" price, a minus at a "poor" price relative to the benchmark. For the next calendar quarter, both buys and sells had market impact costs of +11 and +14 basis points, respectively. Subsequent refinements to the methodology show market impact costs to average +8 basis points for buys and -8 basis points for sells.³ Alas, there are two problems that may make after-trade measures less reliable than is desirable.

First, the long-run bias of the stock market is up. Over very long periods, the stock market will rise on roughly two thirds of the days, and individual stocks will tend to move with the market. It is thus not surprising to find that buy transactions had advantageous market impacts. Over a large number of trades, natural market movements would make the buy trades appear to be well executed and sells to be poorly executed.

Another problem with this approach is that the closing price may not be reflective of the real trading prices that occur during a trading day. During the first quarter of 1985, for instance, the aggregate dollar volume of trading on the New York Stock Exchange was \$290.4 billion. Aggregate dollar volume of closing transactions was only \$4.3 billion, less than 1.5 percent of total trading dollar volume.⁴ A recent study by Wood, McInish, and Ord [14] showed that both opening and closing prices are drawn from distributions that differ from return distribution over the course of a day. Indeed, the preponderance of a stock's daily positive (or negative) return seems to occur in the last minute of trading.⁵

B. A New Approach

A market impact measurement system requires a benchmark price that is an unbiased estimate of the prices that could be achieved in any relevant trading period by any randomly selected trader. Measurement of market impact cost then requires computation of the difference between an actual trade price and

³ Gilbert Beebower, "Remarks." Berkeley Program in Finance, Yosemite, CA, April 1985.

⁴ Data from Francis Emory Fitch data tapes.

⁵ It is an open question as to whether this occurs due to (a) activity on the part of the specialist to achieve a desired inventory position or (b) arbitrage of equity positions using options and futures markets.

the benchmark. The relevant question is whether a particular institution achieved a “fair” price on its transaction.

Any measure of market impact costs must recognize that trading is a zero-sum game. When the market impact costs of all buyers, sellers, and middlemen—specialists, market makers, broker/dealers, block positioners, and hedge funds—are added up, they must sum to zero. Any measure that does not have this zero-sum quality is biased, suggesting that there are unexploited arbitrage opportunities. The middlemen may cause both buyers and sellers to face negative sum games, but the system as a whole must be zero sum.

Finally, the market impact measure must not place undue weight on transactions that are nonrepresentative of most trades in a particular trading period. For example, a market impact cost measure using high and low prices, such as that employed by Blum et al. [4], may be misleading. Methods relying upon extreme points, such as the average of the high and low for the day, really may rely upon nonrepresentative trading prices; for many stocks, one or both of the extreme points may be unrepresentative of what occurred over a day. Thus, the average of the two will be a biased representation of prices traders can actually obtain.

The market impact cost measurement standard that we use is the volume-weighted average price over the trading day. Because of the upward drift of the market and because there is some weight given to extreme and closing prices, the same criticisms might be applied to our measure as to the others. The proposed measure, however, substantially mitigates these effects. Accordingly, the proposed measure offers the promise of yielding better estimates of market impact cost than the alternatives.

Our metric is computed as

$$\text{Volume-Weighted Average Price}_j = \sum_{i=1}^N \frac{(\text{Vol}_{ij}) \times (\text{Price}_{ij})}{\text{Vol}_j}.$$

Each transaction in security j is subscripted i . Vol_{ij} is the number of shares in the i th trade in the j th stock, and Price_{ij} is the price at which the i th transaction in the j th stock was done. The time interval over which trades are measured is the trading day, with each day having N trades.⁶

The volume-weighted average price on any day represents the price a “naive” trader can expect to obtain. This is analogous to the way portfolio performance is measured against a passive (or naive) index. With our measure, we can compare the aggressive or active trades to a passive benchmark, just as portfolio managers are compared to passive index returns.

Using this benchmark, the same-day market impact cost of a buy transaction is

$$\text{Market Impact Cost}_{ij} = \text{Volume-Weighted Average Price}_j - \text{Buy Price}_{ij}.$$

⁶ For all practical purposes, days must be used as the relevant trading period. Records retained by custodians of institutional portfolios do not reveal the time of particular transactions.

For a sell transaction, the right-hand subtraction is reversed. This allows us to maintain the convention that market impact costs, on balance, will be negative flows for the investor.

C. Two Problems

One problem with the measure is that it can weight an aberrant trade very heavily. Suppose a very thinly traded, low-capitalization stock experiences a relatively immense trade. When there are such “dominant” trades (when more than, say eighty percent of a day’s volume occurs in one transaction), the trade price itself becomes the volume-weighted average price. The measured market impact cost could then misstate the true impact of the execution.

Fortunately, this is not an empirically relevant problem. Our data show that, for the first quarter of 1985, 25.39 percent of all dollars traded occurred in the top fifty highest capitalization stocks. Moreover, the sample data reveal that less than two percent of all dollars traded were in 50,000-share or larger blocks in stocks smaller than the largest 500 stocks. The data also showed that there were very few successive trading days when there were large or dominating transactions in thinly capitalized stocks. There simply are not many instances where one could presume, *a priori*, that a single trade will be decisive in determining the volume-weighted average price or that, on successive days, a series of large trades will determine the volume-weighted average price. Less than two percent of all trades could be considered dominant trades.

A second problem is the possibility of gaming. A trader, believing that he or she might be evaluated on this basis, might alter behavior so as to look good by the benchmark, despite not trading more intelligently. For instance, the game may be waiting to trade until late in a trading day when current prices are favorable relative to the position of the benchmark, then hoping not much happens afterwards. This is an extraordinarily complex game. There is no assurance that subsequent trades will not upset the tactic. Furthermore, it is relatively simple to extend the execution cost measure to incorporate five trading days, centered on the trade date. That is, two days before and two days after the trade date might be examined along with the trade date.⁷ Doing so also eliminates the difficulty associated with a dominant transaction, the first problem noted above.

The empirical evidence shows that multiday market impact cost computations are revealing only in specialized cases involving (a) dominant trades, presumably largely composed of costly information-based trades, and (b) program trades.⁸

⁷ We did this adjustment using a Paasche index to develop a volume-weighted market index so that market-wide price adjustments could be made for time series-type data. We also adjusted for dividends. The result was an estimate of market impact costs covering the period from two days before the trade date to two days after the trade date. For most trades, such adjustments and multiple-day measures simply made so little difference in our market impact cost estimate that the benefit was not worth the effort. Details of these adjustments will be provided by the authors upon request.

⁸ Program trades are negotiated at a price equal to the reported market price as of one point in time. Usually the close price on an agreed-upon day is selected as the “strike” price for the program. Typical program trades involve portfolios of stocks done (a) to liquidate a fund, (b) to accomplish

We incorporated trades in our analysis that dominated the day's trading volume in specific stocks. However, when we repeated the analysis, eliminating trades where the transaction represented eighty percent or more of the day's dollar volume of trading in any stock, the estimates of market impact costs were the same. Thus, while there are roughly 600 out of more than 14,000 trades that are dominant, they do not affect our aggregate results. Finally, data edit procedures, wherein trades carrying prices that could not have occurred on the particular reporting day were eliminated, reduced the prepriced program trade issue to a manageable one.

II. Application of the Volume-Weighted Price Measures

A. Data

The data for computing the volume-weighted price come from Francis Emory Fitch Co. The tapes contain all transactions reported for securities listed on the New York Stock Exchange (including transactions on other exchanges for NYSE-listed stocks). Fitch creates these tapes under contract to the NYSE for use as the legal record of transactions to settle disputed trades.

Errors sometimes arise on the exchange tapes that serve as a source document for Fitch. We designed an edit process to remove erroneous transactions that had been printed on the tape. The edit criteria are as follows:

- Trades in warrants and preferred stocks are deleted.
- Trades in securities priced below \$1.00 per share are eliminated.
- If the NYSE open for a security deviates from the second and third trades of the day by an amount greater than or equal to \$1.00, the open trade is eliminated, the next trade in chronological sequence is assumed to be open, and the edit test is repeated.
- If a regional trade or OTC trade in a security exceeds the NYSE high or falls below the low by an amount greater than or equal to \$1.00, the trade is eliminated.
- If a regional trade deviates from the previous and next trade in a security by an amount greater than or equal to \$1.00, the trade is eliminated.
- All transactions with a zero price and a zero volume are eliminated.
- All transactions that are settled in other than the usual five-day period are eliminated.

For specific transactions, we used data from State Street Bank and Trust Company. These covered all NYSE transactions made by the equity managers of the plans for which State Street acted as master trustee for the period from January 9, 1985, through March 29, 1985. The data allow comparisons among brokers and money managers. During this period, these managers engaged in 14,133 commission trades, having a dollar value of \$3.2 billion.

index fund balancing, or (c) to accomplish a major change in asset allocation among classes of investments. Typically, such trades get reported as of the day they actually occur, not on the day the "strike" price is set.

Table I
Analysis of Active Managers Using State Street Bank and Trust Company Custodian Services during the First Quarter of 1985^a

	Number of Trades	Number of Shares	Principal	Commission	Commission per Trade	Trade Day Market Impact	Trade Day Total Transaction
Total Buys \$ Per Share	8,297	44,374,251	\$1,636,625,654 \$36.88	-\$3,003,514 -\$0.07	-\$362	-\$145,491 -\$0.00	-\$3,149,005 -\$0.07
% of Principal ^b				-0.18%		-0.01%	-0.19%
Total Sells \$ Per Share	5,836	39,396,960	\$1,530,916,279 \$38.85	-\$2,773,764 -\$0.07	-\$475	-\$1,551,080 -\$0.04	-\$4,324,844 -\$0.11
% of Principal ^b				-0.18%		-0.10%	-0.28%
Total Transactions \$ Per Share	14,133	83,771,211	\$3,167,541,933 \$37.81	-\$5,777,508 -\$0.07	-\$409	-\$1,696,341 -\$0.02	-\$7,473,849 -\$0.09
% of Principal ^b				-0.18%		-0.05%	-0.24%

^a Transactions involving ADR's excluded. Source: data from State Street Bank and Trust Company.

^b Using the weighted-average price times the number of shares instead of the actual price times the number of shares as the denominator yields virtually identical results.

B. Transaction Costs

Table I shows the results of applying our method for measurement of market impact cost to the State Street data. It also shows the commissions actually paid to brokers for these transactions.

For the entire sample, commissions averaged 0.18 percent of principal value, or slightly less than seven cents per share for a thirty-eight-dollar stock, roughly the average NYSE stock price in 1985. Market impact costs averaged 0.05 percent of principal value, or slightly less than two cents per share. Commissions dominate total transaction costs.

Buyers seem cheaper to do than sells, though a *t*-test reveals that the difference is not statistically significant. The difference may, in part, be due to the aforementioned problems of upward drift and weighting of possibly unrepresentative transactions. Nonetheless, this observation is consistent with Wall Street oral tradition: sells are done in larger volumes and with greater haste than buys; thus, they are more costly because sells are more likely to be motivated by information.⁹

Averages mask very substantial differences. Brokers and money managers did not all perform equally well. Of the 268 brokers in the sample, only seventy-eight traded more than 200,000 shares for our sample of managers. For these seventy-eight brokers, transaction costs ranged from +11 basis points (improving performance) to -70 basis points (impairing performance). The median transaction cost was -26 basis points; this is slightly below the average and suggests a mild negative skewness.

One might argue that differences in transaction costs result from differences in the liquidity of stocks being traded by brokers on behalf of specific managers. As we shall see, data do not support this argument.

When we examine the transaction costs associated with trades in the top one hundred capitalization stocks, we find that the average total transaction cost for the ten managers with the largest dollar volume of trades performed by the ten largest brokers range from -62 basis points to +4 basis points. Averaging these same transaction costs by broker, we find that total transaction costs among brokers range from -91 basis points to -13 basis points.

To determine how significant the differences amongst brokers and managers were regarding costs, we regrouped the data. Specifically, we first eliminated brokers or managers who did less than twenty trades. In anticipation of further tests, we also excluded any broker or manager who did not do at least one trade in either the first or second half of our sample's time period. (That is, we split the data into two subperiods, each having the same number of trading days.) Finally, we classified managers and brokers into high, medium, and low cost categories. Each category contained one third of the individual brokers and managers. Note that the samples may not correspond since brokers may have done trades for inactive managers and managers may have traded with inactive brokers. Thus, the final results for the two groups will not be the same.

The total cost as well as component cost results for the entire period are shown in Table II. There is much less variation in total cost for brokers than for

⁹ Holthausen et al. [9] find that sells lead to temporary price drops, while buys produce permanent rises. Their results do not really parallel ours, though they are qualitatively consistent.

Table II
Average Transaction Costs for High-, Medium-, and Low-Cost
Brokers and Managers (as Percentage of Principal Value)

	Brokers			Managers		
	Total	Commission	Market Impact	Total	Commission	Market Impact
High	-0.337 (0.613) ^a	-0.223 (0.152)	-0.114 (0.606)	-0.364 (0.613)	-0.221 (0.149)	-0.143 (0.603)
Medium	-0.236 (0.630)	-0.212 (0.120)	-0.024 (0.622)	-0.218 (0.609)	-0.219 (0.108)	+0.001 (0.605)
Low	-0.148 (0.637)	-0.208 (0.107)	+0.060 (0.637)	-0.66 (0.640)	-0.196 (0.130)	+0.130 (0.644)

^a Standard deviations in parentheses.

managers; the difference in total costs for high- and low-cost brokers is negligible relative to the difference between high- and low-cost managers. The preponderance of the difference in total cost is attributable to differences in market impact costs. Commission costs across categories are relatively constant, though they follow the same general pattern as total costs. Surprisingly, high commission costs associate with high market impact costs. This contradicts our expectation of a tradeoff, but these are aggregate data and do not adjust for risk or any other mitigating factors.

We cannot tell whether brokers and managers are always high or low cost from this arrangement of the data. Perhaps only one or two trades or a large number of trades in a short time led to their particular categorizations. To address this issue, a transition matrix was constructed. The data were asked how brokers and managers were categorized in the second period, given their performance in the first period. That is, are low-cost brokers and managers persistently so? Table III shows results. This table is the same whether total costs or market impact costs are used as the basis for categorization.

Table III shows the number of brokers (managers) who fell into different cost categories in each of the two periods. For example, the entry in the high-high cell in the "Brokers" section of the table indicates that ten brokers fell into the highest-cost third of brokers in both periods.

The data show that brokers tend to move among categories. The chi-square test supports the notion that there is not a statistically significant (at the ten percent level) chance of repeating or moving to a specific other category.

The data also show that there is much less homogeneity amongst managers. High-cost managers tend to remain high cost. The probability that this particular pattern of movement among categories would occur by chance is less than one percent. Whether this is due to the sorts of stocks in which different managers tend to specialize (e.g., small stocks) or to poor trading practices is an open question.

A second issue worth examining is the magnitude of costs in both periods. Table IV addresses this. Given that the lion's share of the variation in total costs is attributable to market impact costs, we chose to show these; results for total costs are qualitatively identical.

Table III
Persistence of Brokers' and Managers' Cost:
Transition Matrices; Number of Brokers and
Managers Who Repeat in Cost Categories

Brokers				
		Period 2		
		High	Medium	Low
Period 1	High	10	7	6
	Medium	9	7	7
	Low	4	9	10
<i>N</i> = 69 brokers.				
Chi-square = 4.21 (insignificant at ten percent level).				
Managers				
		Period 2		
		High	Medium	Low
Period 1	High	30	14	6
	Medium	14	21	14
	Low	6	14	30
<i>N</i> = 149 managers.				
Chi-square = 37.8 (significant at one percent level).				

Table IV
Period-by-Period Market Impact by Cost Category (as Percentage of Principal Value)

	Brokers			Managers		
	High	Medium	Low	High	Medium	Low
Second-Period Cost for those Categorized in First Period	0.023	−0.019	0.025	−0.065	0.019	0.083
First-Period Cost for those Categorized in Second Period	−0.045	0.002	0.002	−0.065	0.016	0.106

Table IV shows the average costs in each period for brokers and managers who were classified as high, medium, or low cost in the other period. It confirms that brokers move around amongst cost categories. For example, first-period medium-cost brokers had, on average, very high costs in the second period. Also, second-period medium- and low-cost brokers had, on average, identical costs in the first period. The data suggest, albeit weakly, that brokers are quite similar regarding market impact costs.

The market impact costs of managers are substantially more predictable. First-period high-cost managers were, on average, second-period high-cost managers. Second-period low-cost managers were, on average, first-period low-cost managers. Managers' cost categorizations seem to persist, not only qualitatively, but quantitatively as well. What we do not know at this point is whether this is due to the mix of stocks they trade or to their trading practices.

III. The Tradeoff between Commission and Market Impact Costs

One hypothesis often advanced by market participants is that high commission costs lead to low execution costs and vice versa. A portfolio manager willing to pay high commissions should be able to induce a broker to search more aggressively for the other side of transactions that favor him or her. Indeed, with a high enough commission, the broker/dealer may even be induced to assume a position in the stock, even though a small trading loss would be virtually guaranteed.

To investigate this hypothesis, we use a simple regression model that relates market impact costs to commission costs while holding constant other economic factors that several analysts, e.g., Demsetz [7] and Copeland and Stoll [5], find influence the specialist's spread and that should be correlated with the subjective concept of trade difficulty.¹⁰ The specialist's bid-ask spread, some argue, represents the cost of liquidity service. Accordingly, the same variables that explain the spread should also help to explain market impact costs, at least well enough to allow us to determine whether a tradeoff between market impact costs and commissions exists. Large, perhaps informationally motivated trades are given credit by a volume variable. Risky stocks, quickly moving up or down, are accounted for by a price range variable.

The regression model is

$$\begin{aligned} \text{Market Impact Costs}_{ij} = & a_0 + a_1(\text{commission cost}_{ij}) \\ & + a_2(\text{high}_j - \text{low}_j / \text{low}_j) \times 100 \\ & + a_3(\text{dollar volume trade}_{ij} / \text{dollar volume}_j) \times 100 \\ & + \text{error}_{ij}. \end{aligned}$$

If there is a tradeoff between commissions and market impact costs, the coefficient a_1 would be negative. (Recall that costs are, by convention, negative.) Both variables are measured as a percentage of principal value, so a perfect tradeoff would have a_1 approach -1.00 .

The variable $(\text{high}_j - \text{low}_j / \text{low}_j) \times 100$ is the trading range of stock j over the day. This is intended to characterize the trading risk of a stock. The sign on this variable should be negative, implying that the higher the risk, the greater the potential market impact cost of a particular trade.

The other explanatory variable is the dollar size of a trade relative to total dollar volume over the day. The sign of a_3 is expected to be negative if there is a size effect. This would suggest that larger trades will lead to higher market impact costs.

The model was estimated for the entire sample and various subsamples. The results appear in Table V. The subsamples show that the stability of coefficients is not great. However, the pattern of signs on variables and the instances of significance of variables tell a suggestive and provocative story.

¹⁰ Trade difficulty is a very subjective notion. Essentially, practitioner consensus suggests that difficult trades are those that are done when the trade is large relative to capitalization or there is a lot of movement in the stock that day.

Table V
Effect of Commission Costs, Trading Range, and Transaction Size on Market Impact: A Regression Analysis with Market Impact Costs as the Dependent Variable; All Costs Measured as Percentage of Principal (*t*-Statistics in Parentheses)^a

Sample	Number of Trades	a_0	a_1 (Commission Costs)	a_2 (High - Low/Low) × 100	a_3 Size of Trade Total Trading × 100	$\bar{R}^2$
<u>All Transactions</u>						
All	14,133	-0.004 (-0.31)	-0.168 (-3.819)	-0.012 (-3.27)	-0.001 (-2.041)	0.01
Buy	8,297	-0.007 (-0.40)	-0.079 (-1.509)	-0.013 (-2.659)	-0.002 (-2.12)	0.01
Sell	5,836	-0.207 (-1.244)	-0.321 (-4.009)	-0.036 (-6.962)	-0.001 (-0.582)	0.01
<u>100 Largest Stocks</u>						
All	3,887	0.081 (3.638)	-0.142 (-1.652)	-0.057 (-7.463)	-0.008 (-2.888)	0.01
Buy	2,227	0.041 (1.513)	0.153 (1.574)	0.003 (0.310)	-0.008 (-2.290)	0.01
Sell	1,660	0.078 (2.114)	-0.762 (-4.626)	-0.128 (-11.022)	-0.008 (-1.906)	0.07
<u>Trades Done by Managers with Brokers Doing at Least 20 Buy & Sell Transactions</u>						
All	1,423	0.060 (1.243)	0.284 (1.730)	-0.008 (-0.48)	-0.004 (-1.18)	0.00
Buy	873	0.074 (1.092)	0.744 (3.163)	0.053 (2.32)	-0.009 (-2.266)	0.02
Sell	550	-0.076 (-1.221)	-0.880 (-4.016)	-0.111 (-5.388)	0.004 (0.741)	0.06

^a Source: data from State Street Bank and Trust Company.

For the entire sample and for many subsamples, risk has the expected negative effect. Similarly, the size of the trade relative to total trading in that stock also adversely influences market impact costs. As the risk and trade size increase, market impact costs rise, though in a few of the specifications the effect is not statistically significant. Market impact costs for hard trades are accommodated by these variables; hence, the measured tradeoff between commissions and market impact costs ought to be relatively clear.

The most important variable is commission cost. In most samples, it has the expected sign and is statistically significant. In only one case is the sign of commission costs incorrect and significant. This is for a sample of buy transactions for money managers doing at least twenty total transactions with a single broker, wherein the sample criteria allow only six percent of the observations to be included in this analysis. Otherwise, when the sign is incorrect, it is not significant. Table VI demonstrates that the same results hold when single trades accounting for more than eighty percent of the daily volume are excluded from the sample.

If there were a one-for-one tradeoff, a_1 would approximate -1.0 . It does not do this in any case. Moreover, in most instances, the difference between the estimated coefficient and its hypothesized value of -1.0 is statistically significant. In the equation using the entire sample, for instance, the coefficient is roughly -17 basis points: for every 10 basis points more in commissions, market impact costs decline by 1.7 basis points, other things the same. When dominant trades are excluded, as in Table VI, our results show that market impact costs decline by 2.3 basis points for every 10 basis points in commissions.

In some subsamples, the magnitude of the coefficient of commission costs approaches -1.0 . For instance, as both Tables V and VI show, the tradeoff gets very close to -1.0 for sells for the hundred largest capitalization stocks and sells done by very active managers and brokers. However, these constitute small fractions of the sample.

In another experiment using the entire sample (not shown), we added a dummy variable for active brokers, defined as the ten brokers who did the most trades. Indeed, they executed 6,513 trades for our sample of managers. The market impact cost for these very active brokers was virtually the same as for less active brokers, the dummy variable being insignificant in the all-transactions regression. It was also insignificant in the regression for sell transactions. In the buy-transactions regression, it was statistically significant. The coefficient on the dummy variable was $+0.036$, suggesting that active brokers had nearly a 4-basis-point (1.3 cents per share for an average priced share) advantage over less active brokers. While statistically significant, it is small and does not make up for commission charges.¹¹

¹¹ Another experiment tried to eliminate "hard" trades. We estimated the parameters of the regression model on a sample consisting of the intersection of the bottom quartile of trades sorted by the range variable and the top quartile sorted by the size variable. Thus, the sample consisted of the largest and least risky stocks. The results confirm our finding that no economic tradeoff exists between market impact costs and commission costs.

One additional experiment assumed that commission costs and market impact costs are jointly determined. To test this model, we estimated a simultaneous-equation system using two-stage least

Table VI
Effect of Commission Costs, Trading Range, and Transaction Size on Market Impact: A Regression Analysis with Dominant Trades Excluded and Market Impact Costs as the Dependent Variable; All Costs Measured as Percentage of Principal (*t*-Statistics in Parentheses)^a

Sample	Number of Trades	a_0	a_1 (Commission Costs)	a_2 (High - Low/Low) × 100	a_3 Size of Trade Total Trading × 100	$\bar{R}^2$
<u>All Transactions</u>						
All	13,497	-0.018 (-1.386)	-0.233 (-5.154)	-0.014 (-3.853)	-0.001 (-1.978)	0.01
Buy	7,767	-0.024 (-1.422)	-0.162 (-3.018)	0.009 (1.869)	-0.001 (-1.782)	0.01
Sell	5,730	-0.024 (-1.101)	-0.307 (-3.776)	-0.035 (-6.760)	-0.001 (-0.906)	0.01
<u>100 Largest Stocks</u>						
All	3,708	0.072 (3.249)	-0.270 (-3.104)	-0.067 (-8.896)	-0.007 (-2.902)	0.01
Buy	2,067	0.039 (1.411)	0.006 (0.059)	-0.013 (-1.364)	-0.007 (-2.054)	0.01
Sell	1,641	0.076 (2.065)	-0.769 (-4.660)	-0.127 (-11.099)	-0.008 (-2.025)	0.07
<u>Trades Done by Managers with Brokers Doing at Least 20 Buy & Sell Transactions</u>						
All	954	-0.077 (-1.715)	-0.544 (-3.499)	-0.056 (-3.943)	0.007 (0.867)	0.03
Buy	502	-0.0714 (-1.154)	-0.389 (-1.878)	0.025 (-1.266)	0.006 (0.544)	0.01
Sell	452	-0.117 (-1.796)	-0.814 (-3.465)	-0.086 (-4.247)	0.007 (0.556)	0.05

^a Source: data from State Street Bank and Trust Company.

IV. Conclusions

We computed a measure of market impact costs, the difference between a trade price and the volume-weighted average price. We compared brokers and managers using this metric and found significant overall differences between high- and low-cost brokers and managers. When we split the sample by time, we found that brokers tended toward homogeneity while managers' costs tended to persist. We also discovered a small tradeoff between market impact costs and commission costs.

There are several important implications for financial economists and practitioners. The first is that market impact costs on the NYSE tend to be small relative to commissions. Second, because commissions are large, total transaction costs can be very large. They averaged 23 basis points when measured against the principal value of the trades. Third, given what we now know about transaction costs, pushing commission charges down makes a great deal of sense; cutting commissions costs does not seem to produce a corresponding increase in market impact costs. Fourth, because early access to research may be profitable (see Elton, Gruber, and Grossman [8]), some institutions may pay higher commissions than warranted by the quality of execution to compensate brokers for timely provision of such research.

Recent years have experienced a surge of interest in the microstructure of securities markets. This paper addresses one aspect of that from a relatively narrow perspective, but our findings should tantalize those who study such markets as well as those who operate them.

squares. We included both the log of price and the log of the number of shares as predetermined variables in explaining commission costs. The result of this experiment offers no evidence that an economic tradeoff exists between market impact costs and commission costs. With two-stage least-squares regressions on the entire sample and on buys and sells separately, commission cost coefficients were never statistically significant. They did not approach -1.0 , and all were statistically different from -1.0 .

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