AN ANALYSIS OF TRANSACTION COSTS IN EQUITY TRADING

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WHAT YOU SEE AND WHAT YOU GET
(Trading Costs: An Empirical Study)

INTRODUCTION

The genesis of this study occurred when a client provided BEA with a list of commissions per share paid by all eight of its money managers. The client wanted to know why the cents per share numbers varied so much from manager to manager. We replied that neither the size of the trades nor the effects of trading on the price paid for the security had been taken into account. We suggested that what the client should be looking at was the total cost as a percent of dollars traded that each manager was incurring, and, not incidentally, what performance premium each manager was achieving as a result of his trading activity. These observations prompted the client to ask where one could get this information. Needless to say, we had to admit that although larger institutions trade tens of millions of dollars in securities a year generating several million dollars in commissions, this major cost center goes unaudited for the most part and few if any people have any idea what it costs to trade. This alone should provide ample reason for wanting to know what transaction costs really are.

Another reason for having good estimates of trading costs centers on the investment question of what reasonable turnover levels should be for an institution. All things being equal, the lower the transaction costs the lower the threshold for readily responding to investment insights. Trading cost numbers bandied around range from less than 1% to well above 5% for a round-trip, not an inconsequential range given long-term performance differentials reported by Becker and others for employee benefit accounts.

Suffice to say, we wanted to know what it costs us to trade -- in total, by manager and by broker. Like many studies, we developed better questions as the study progressed than those with which we started. We did have the sense to consult with good people, principally Gil Beebower and Ron Surz of A. G. Becker along with Myron Scholes here at the University of Chicago.

Gil and I will review the study under four headings:

1. Definition of the Problem
2. Measurement Methodology
3. Interpretation of Data
4. Some Promising Areas for Future Analysis

Before starting, however, I would like to comment on the structure of my firm which is somewhat unique and needs to be understood when reflecting on some of the results.

To begin, the firm is completely employee-owned with no single individual controlling 51%. Compensation is set in an unusual way, with each principal (of which there are eight) having one vote on his salary along with the votes of the other seven. These votes are totaled, extremes if any discarded, and the sum then averaged. This method applies to all professionals including the president. As a result, no one person within the firm can affect another person's job tenure or salary disproportionately. The game of "pleasing the hand that feeds you" is almost eliminated and freedom of expression and client service is encouraged. Each principal is "a money manager" in his own right and can operate with a large amount of freedom. It is not unusual to see different holdings among portfolios although betas and R^2's are tailored to client needs. Trades are placed in the hands of the trading department by each manager and no committee approval is required. We believe this approach to investments provides the client with a superior product. Our belief in the highly competitive nature of the investment market causes us to opt for flexibility and quick response instead of for institutional process and uniformity.

PROBLEM DEFINITION

The initial study aimed at measuring the trading costs (commissions, taxes and market impact) for my firm's trading in equity securities for the twelve month period July 1, 1976 through June 30, 1977. Subsequently, the measurement technique developed has been implemented on an on-line basis and we have monitored all equity trading since January 1, 1978. The results you will see in some detail today are for the first two quarters of 1978. As previously mentioned, we were also interested in obtaining insights into the trading costs for each manager as well as for each broker. We also sought to learn what factors seemed to trigger trades and whether liquidity was important.

MEASUREMENT METHODOLOGY

Working in the area of execution costs has both a positive side and a negative side. The positive side is that there are no standard definitions, giving each researcher free reign to conjure up his own. The negative side is that without an accepted standard definition, we have to try and sell you ours. In the abstract, one is looking to measure the impact a given trade had on the market. This requires

estimating what the market would have done had you not traded. Unfortunately, history does not disclose the results of untaken paths. I think it can be shown that price data alone cannot be used to determine the cost of execution, since prices move for reasons other than a trader's presence in the market. Let me try to explain. In the time between the last trade and your trade, the price may have changed for any or all of the following reasons:

1. some specific "news" may have been announced concerning your stock (dividend, split, earnings, etc.);

2. specific information impacting your stock vis-a-vis other competitive investments may have been announced;

3. a growing awareness of the meaning of prior announcements may have developed;

4. the "market" may have moved;

5. your declaration of interest in trading is recognized.

Only the last reason concerns us in measuring execution costs. Since the price move (or lack thereof) results from all of the above, we would need some exogenous source of data to be able to separate out the execution related moves. Market proxies alone will never get at the specific moves associated with any given stock.

One approach to estimate execution costs would be to aggregate the commissions and trading profits of brokers, market-makers and specialists. The aggregate would represent the leakage or overall execution cost. All other participants are then playing a zero-sum game around this leakage wherein there is a loser for every winner. Identifying losers and winners would then identify good and bad executions. Even then, to evaluate the resultant execution would require knowledge of what instructions were explicity or implicitly given to the trader by the portfolio manager. The portfolio manager might push for less careful (in time) trading if he believes his information warrants speed. Likewise, the interchange between trader and broker would need to be documented. Lastly, portfolio manager intentions need to be known to be able to account for lost opportunity.

What we are setting out to accomplish is no easy task. Nevertheless, we believe that we have made meaningful progress.

What we must do of necessity is measure the execution costs, the impact of the manager/trader/broker relationships, and the very short-term information value which may be present. The information value can be viewed as very short-term performance measurement. Our first disagreement may occur here as to what should be called the trading related performance and what should be called performance measurement in the more traditional sense. With computers we can accommodate virtually anyone's definition although it becomes pointless, when as one trader suggested we should measure trading costs by looking at performance over the subsequent twenty years. I think he may have had an ulterior motive in making that suggestion.

At any rate, we have developed software to measure the change in value (price plus dividend) of a stock from trade price to same day closing price, and each subsequent day out to one year. In fact, we have investigated time periods only up to one day beyond the last trade in a trading package and up to twenty trading days after each trade.

Commissions, taxes, etc., are measured explicitly and can be added to the subsequent period value change.

We have modified the subsequent days' return by removing a market proxy return so as to develop a residual return. The reason for this goes as follows: Under the efficient market hypothesis, the residual return of a stock purchased at the perfectly "fair" price should be zero. Therefore, a subsequent positive residual would imply a trading/information advantage and a subsequent negative residual would imply a trading/information disadvantage. Keep in mind that we are looking as narrowly as we can at only the trading function. Clearly any trading disadvantage might subsequently be rendered insignificant if the information on which the trade was initiated takes months or years to be generally appreciated and incorporated in the price yielding a longer-term portfolio positive alpha. However, in this case, one might question the circumstances which produced the trading disadvantage.

For this short-term performance measurement, we asked ourselves what market proxy was the most appropriate. Given the evidence of the inadequacies of the single index capital asset pricing model (e.g., homogeneous stock groups, the pandemic use of security covariance matrices in optimization programs) and the incisive and disturbing article by Richard Roll, "A Critique of the Asset Pricing Theory's Tests", we chose not to use the S&P 500, any one market proxy, or any beta measure. We used equal-weighted, variance decile indexes from a universe of NYSE and ASE stocks. That is, we measured the variance of daily returns of every NYSE and ASE

stock over the quarter being studied. These stocks were then ranked by variance and divided into ten groups. Equal-weighted indexes were calculated daily for each group. The variance of each BEA stock traded was likewise calculated and that stock's residual was calculated using the associated NYSE and ASE decile index. Clearly, other market proxies are possible, e.g., homogeneous stock groups, industry groups, trading activity groups, among others. The purpose here is to correctly account for the market/economic factors which were moving the stock price. If we had used the S&P 500 Index, we know that growth stocks would appear to have different trading costs than stable stocks -- a potentially grievous error.

The point of measuring this short-term "alpha" after the trade and calling it an execution cost is that this cost is real. It does diminish real wealth. Which sector/group the stock is in also may produce a portfolio alpha unrelated to the transaction; of course, this alpha would be highly related to stock selection.

Before proceeding further with the after-trade analysis description, I would like to talk about the before-trade analysis. Given that one is trading on information, it is possible to "botch" the trade by getting a "fair" price. Therefore, we need to look at what we will call the opportunity cost. Ideally, we would look at the price of a stock when the trade was given to the desk and monitor the returns up to the actual trade. A positive return before the trade would suggest missed opportunity. We cannot be sure the opportunity was really capturable. The return is a result of many exogenous events and, again, history does not let us know what could have been done. One could appear to have missed opportunity by only buying stocks which have just gone up, an easy task for a tape-watcher or reader of the Wall Street Journal. Clearly this opportunity was not capturable since its presence was the necessary trigger for trading. The results of this analysis can be suggestive, however. In a comparative analysis, a persistent loss of opportunity relative to others could suggest a real problem. With BEA, the comparative universe was their four equity managers, their two traders and their major brokers.

In the investment process, the before-trade analysis could be applied to the time from research recommendation, to portfolio manager action, to actual trade to gain some insight into the opportunity lost in the decision process. One would like to have intentions recorded as well as actions. Since BEA did not time-stamp the trades, we measured the change from yesterday's close to today's trade. Our programs have the capability to measure any period before or after the trade. Opportunity costs are only real to the extent that they could have been realized; we have not included them on our definition of execution costs. As I stated before, they are important in a

comparative framework, however, giving indication of relative trading effectiveness.

Back to the execution cost analysis! How can we evaluate whether the results we get are "real" or a result of our methodology and market proxy assumptions? To get a handle on this, we developed a comparison standard. This standard can be used to validate our methodology and estimate the significance of actual trading results. We take the trade data and rerun the analyses substituting variance decile stocks at random for the actual stocks traded, using trade-day closing prices. If the comparison distributions produce a mean execution cost insignificantly different from zero, then our methodology is validated since no trading should produce a zero execution cost. Given confidence in our methodology, we can use three comparisons to evaluate the actual measured results. If randomly feigning trading in same-class stocks, which should not cost anything, gives similar results to those obtained in the real analyses, we have to believe that there were, in fact, no costs (except the explicit ones).

In addition to the opportunity cost, the explicit commission cost, taxes, etc., and the after-trade cost analyses, we have measured two other phenomena. We have regressed trading dollar volume against the NYSE composite index on trade date, and 1, 2, 3 and 4 days prior to trade date to identify whether trading appears to be "triggered" by the moves in the NYSE composite index. We also use the equal-weighted decile group index and the residual change against the decile index to see if any of these factors appear to be triggering trading. These before-trade measures help identify patterns of buying into strength or weakness, thus suggesting the magnitude of possible opportunity captured or lost.

The second phenomena we measured was the 20-day residual returns of the buys and sells. We are asking "did the buys have more positive 20-day residual returns than the sells had?" If the buys did perform better than the sells, then the transactions costs might be justified to get positions more quickly. On the other hand, a neutral or negative performance experience might suggest that less pressure to execute is warranted if transaction costs can thereby be reduced. As is often the case, perfect substitution is not occurring. Instead, an asset or group/sector allocation decision may be implemented. Calculating actual total returns helps get at the implication of these decisions.

Again, we generate a comparison distribution for these results using randomly selected stocks traded at close price to develop a distribution of results against which to estimate the significance of the actual measured results.

In an attempt to measure the impact of being in the market for a security over a multiple day period, we developed the concept of a "trading package." A trading package was defined as a trading program in a single stock during which executions were made without more than "n" day absence from the market. Specifically, one trading package definition we looked at was "not being out of the market more than one day." In other words, trading in the security every day. Any one trade day gap would end one package and start another. We look at 0- to 10-day gap trading packages. In calculating the execution cost, the after-trade residual returns were measured by differencing: (1) the return of the stock from trade to one day beyond the last trade day in the package, and (2) the variability decile index return from trade day close through one day beyond the last trade day in the package. The reason for going one day beyond the last trade was to prevent being bagged by a trade which was the close for that trade day. We don't know whether a trade was made at the beginning, middle, or close of the day, so we must look for any residual return at least one day beyond the last possible trade time.

The data we collected from BEA Associates was taken from their trading blotter. A two week lag was used to permit any errors to be corrected before we captured the data for study. Since it was a manual collection process, we collected redundant information so that we could have a means of auditing the collection process. CUSIP and IDC ticker symbols assigned from the stock name were matched. Trade days were checked against a trade day calendar. Shares times price were matched to gross amount. The difference between gross and net amounts was checked to validate a buy or sell and filtered for outlier explicit cost values. Trade prices were checked against the high-low for the day.

INTERPRETATION OF DATA

The information and measurements which we developed relative to trading costs are shown in Exhibit 1. The trades may be segregated by portfolio manager, trader, broker, account type (such as personal trusts, advisory and employee benefit), any intersection of these definers or others which may be provided and considered relevant. Trades are segregated by "buy" and "sell" and presented in a column. Under the heading "Activity" are presented the total number of tickets (i.e., in the exhibit, 1,797 trades were analyzed in the first quarter), the total dollar value represented by the tickets (i.e., $83.0 million), the number of different securities traded (i.e., 129 different stock names), the number of shares represented (i.e., $3.5 million) and the number of packages defined as continuous daily trading without an arbitrary "n" number of days interruption (i.e., 433 packages).

Under the heading "Trade Size" are presented the thousand dollars per trade (i.e., $46.2 thousand), the thousand share per trade (i.e., 1,930 shares), the thousand dollars per trading package (i.e., $187.3 thousand), the thousand shares per package (i.e., 7,820 shares) and the average package length in days (i.e., 1.95 days).

Under the heading of "Characteristics" are presented the dollar-weighted company capitalization in billions of dollars (i.e., $2.9 billion), the ex-post beta coefficient using daily data over the quarter of the analysis (i.e., 1.07) and the standard deviation of returns over the quarter, annualized by multiplying the daily standard deviation by 252 (i.e., 22.9 percent).

All of the above data can be used to observe trade characteristics which may account for differences in results. We have used some of these characteristics to test various hypotheses of what factors impact trading costs.

The "Cost" heading presents the percent change in price from yesterday's close to today's trade for all first trades in a trading package. Defining a trading package as continuous trading without even a zero day absence from the market results in all trades being considered as first trades. In Exhibit 1, the data show that buys were made, on average, 0.34 percent above yesterday's closing price in the first quarter and 0.60 percent in the second quarter. A negative value here would mean on-average buys occurred below yesterday's closing price. One manager has exhibited a consistent negative value here. The next entry is the commission cost (plus taxes, etc., in the case of sells) in cents per share (i.e., 11.7 cents), followed by this cost as a percent of the trade value.

The "Execution" heading presents the return on the stock from trade to trade-day close plus the residual return through one day beyond the last trade in a trading package (i.e., -0.12 means the residual returns were, on average, +0.12, resulting in a negative cost to the portfolio).

The "Transaction Cost" is the sum of the commission cost and the execution cost (i.e., 0.49 - 0.12 = 0.37). The "Round-Trip Cost" combines the buy transaction cost of 0.37 with the sell transaction cost of 0.89 to equal 1.27 percent). This is an amazingly low number, even less than the explicit costs alone.

All headings are repeated for "sells."

In an attempt to evaluate the significance of the execution cost values, the "buy" and "sell" programs were replicated using the

trade day closing prices of stocks randomly selected from the appropriate volatility decile groups. For example, the 129 stock names bought in Exhibit I were replaced by 129 different stock names (and CUSIP identifiers) from the appropriate volatility decile groups and the analysis repeated with the original dollar values and trade dates but using closing prices. An execution cost was calculated and stored. This procedure, sampling without replacement, was repeated a total of 101 times to produce a percentile distribution of execution costs. The results are shown in Exhibit II. It is gratifying to see the median result close to zero (i.e., 0.03, the mean of 0.01, with a standard deviation of 0.18). With 101 trials, the standard error of the mean is approximately 0.018, leading us to conclude the 0.01 is insignificant from zero. We know the results should be zero since we did not actually trade and, therefore, could not have impacted the market. Mean replicated execution values significanly different from zero would suggest a faulty methodology or mis-specification of the market proxy with which we calculate a residual.

With the "sell" simulations, Exhibit II shows a median execution cost of 0.01 and a mean cost of -0.01 with a standard error of 0.021, also not significantly different from zero. Out of twenty such replications, we found two mean execution costs with t-values greater than 2. When we looked at 20-day residual simulations, we found 4 out of 20 simulations had means significantly different from zero -- somewhat more than we would have expected or wanted. Specifying covariance matrices of stock prices is no easy task as most of us here know.

Returning to Exhibit II and relating it to the execution costs in Exhibit I, we find that the "buy" execution cost of -0.12 is a 22 percentile result in the replication distribution. This would suggest a favorable but not a significant result. On the "sell" side, the 0.15 execution cost ranks 83 percentile, an unfavorable but still insignificant result. With these data alone, we cannot reject the hypothesis that execution costs were zero. Actual rather than replicated comparisons would be very desirable, but I think that replications provide valuable insight nevertheless.

We mentioned some 20 trading day residual replications. Not knowing what the communications were between portfolio manager and trader, we cannot evaluate the execution as to time and market pressures. We can and do, however, look at the 20-day short-term performance results associated with the trading. We can look at actual 20-day returns of "buys" and "sells", and at the volatility decile group derived residual returns. Should the "buys" outperform the "sells" enough to more than compensate for transaction costs, an urgency might be considered warranted. Some residual results are shown in Exhibit III. In the first quarter, "buys" produced a -1.38 percent

residual, the sells a -1.17 percent residual which suggests that the replacement was not apparently worthwhile in the short run. Exhibit IV shows the replication distributions. Notice the means are not significantly different from zero although the buy replication mean is getting close to being significantly statistically different.

The buy residual actual experience of -1.38 ranks 94th percentile, not so good. The "sell" residual actual experience of -1.17 ranks 97th percentile, very good. The difference between "buy" and "sell" residuals show a turnaround or reversal of these negative residuals, not significant, however, and still with a small negative differential. It should be noted that on Exhibit I, the dollar amount of sells is substantially greater than the dollar amount of buys. This could suggest an asset allocation adjustment, the consequences of which are not measured here. The real power of this methodology will unfold with the future time-series analysis of the results.

Exhibit V shows an example of the trading trigger analysis. Three causative variables are investigated: (1) the stock relative strength in its trade-specific market (here defined as its volatility group), (2) the broad market strength as measured by the capitalization-weighted NYSE composite index, and (3) the equal-weighted volatility group, trade specific market. A plus or minus sign after the day indicates a significant relationship of trading volume to the causative variable. For instance, in Exhibit V, the negative sign after the day zero for stock residual indicates a significant relationship of buying on stock relative weakness -- likewise for two days before trading. The only other significant relationship for buying appears to be that buying is occurring three days after a broad market decline day.

On the "sell" side, the indication is that selling is occurring on stock relative strength and one day after a three-day surge in the broad market.

This methodology has been used to analyze nearly 15,000 trades (all of BEA equity trading from July, 1976 through June, 1977 and from January, 1978 through June, 1978), representing over 500 issues and $600 million in value. Round-trip costs during a quarter has varied from 2.1 percent to the low in the second quarter of 1978 of 0.73 percent. In general, purchases were made into weakness and sells into strength with 20-day subsequent performance slightly in favor of the substitution.

When we examined these costs by equity manager (of which there are four), the results varied considerably. One manager consistently purchased securities below yesterday's close only to have the security close above the purchase price. If one included the before-trade

opportunity cost (here negative) in the total, his round-trip trading charges, including commissions, were actually negative over a period of time. Interestingly enough, this same manager had the highest commission costs as a percent of dollar value.

During this period of time, BEA was quite active in the so-called secondary stock component of the market where questions of liquidity often arise. We wanted to know what premiums we were paying for trading in these more volatile, less liquid issues. Round-trip "real" costs for high volatility trades averaged nearly one percent more than for the low volatility trades due entirely to higher commission and taxes costs.

In short, our analysis has led us to conclude that trading costs are probably less than the conventional wisdom number of 3 or 4 percent, at least for us and our guess is for almost everyone. Overall round-trip costs for us are running in the area of 1.4 percent on a real cost basis (approximately the commission costs plus taxes, etc.). Differences among managers were significant with one manager in particular experiencing costs more than 50 percent below the other three.

Analyzing listings of the least and most expensive trades and a complete listing of our largest brokerage relationships, we have come to change some of our trading practices. This was done only after thorough discussions with the managers, traders and, where appropriate, the brokers. These data are not intended to be used in isolation. The true value has been in identifying areas for discussion and in the fact that these discussions usually develop some rational and acceptable confirmation of the analysis.

Some observations from this study are that:

1. Trading is "cheaper" than most people believe.

2. If BEA truly beats the average trade by two or three percentage points, we have a leg up on our competition.

3. If the number generated by this study prove to be typical, one argument in favor of index funds and inventory funds is weakened.

4. Most important, one should see if the trades based on information are worth the cost of the trade in a short time period.

SOME PROMISING AREAS FOR FUTURE STUDY

One area which would be appropriate to investigate is the expertise associated with market orders. This would require obtaining the time-stamp for all market orders. In our current study, no one really knows if the transaction request reached the trader's desk at 10:01 or 3:59. Therefore, "noise" exists in our number. Given the scope of the study and its completeness, however, much of this "noise" is believed to have been "washed out."

A second area of future study concerns unexecuted orders. We did not account for them. While their numbers were small, the impact could have been more than minor in terms of opportunity.

Thirdly, the type of market that existed over this period of time favored smaller, secondary issues. As a result, there could be some systematic bias in our figures which are not reflected in the data. Although the comparison replications should have gone a long way toward removing any bias. This leads us to acknowledge the desirability of a broad, comparative data base in order to better know what real median and mean transaction costs are. Also, far more data is needed from a broad range of trading operations before promising results might be derived from hypothesis testing of the factors relating to trading costs. Such an expanded study is being organized.

Lastly, the introduction of stock trading volume might well answer some of the questions and test some of the hypotheses proffered by traders and academicians.

XHIBIT I

TRANSACTION COST & CHARACTERISTICS

SUMMARY

	BUY TRADES		SELL TRADES	
	1/1-3/31/78	4/1-6/30/78	1/1-3/31/78	4/1-6/30/78
TIVITY				
NO. OF TRADES	1797	1517	1149	1026
DOLLAR VALUE ($M)	82.96	71.01	49.02	100.91
NO. OF NAMES	129	121	242	228
NO. OF SHARES (THOUS.)	3466.	2928.	2137.	3774.
NO. OF PACKAGES	443	332	469	502
DE SIZE				
THOUS. DOLLARS/TRADE	46.17	46.81	42.66	55.27
THOUS. SHARES/TRADE	1.93	1.93	1.06	2.07
THOUS. DOLLARS/PACKAGE	187.27	214.	104.51	201.
THOUS. SHARES/PACKAGE	7.02	8.02	4.56	7.52
PACKAGE LENGTH (DAYS)	1.95	2.09	1.41	1.65
RACTERISTICS				
CAPITALIZATION ($B)	2.92	3.09	2.35	1.97
BETA	1.07	0.96	1.09	1.06
VOLATILITY	22.91	26.14	24.54	28.61
T				
CLOSE TO TRADE (1st)	0.34	0.60	-0.26	0.60
COMMISSIONS (¢/SHARE)	11.73	11.33	16.95	16.73
COMMISSIONS (%)	0.49	0.47	0.74	0.63
EXECUTION (%)	-0.12	-0.22	0.15	-0.14
TRANSACTION COST	0.37	0.24	0.89	0.49
ROUND-TRIP COST	1.27	0.73	1.27	0.73

ACTIVITY
TRADE SIZE
CHARACTERISTICS
COST

EXHIBIT II

	BUYS		SELLS	
Percentile	1/1-3/31/78	4/1-6/30/78	1/1-3/31/78	4/1-6/30/78
0	-0.40	-0.47	-0.46	-0.80
2	-0.34	-0.40	-0.43	-0.60
4	-0.32	-0.37	-0.35	-0.54
6	-0.32	-0.35	-0.34	-0.51
8	-0.27	-0.29	-0.32	-0.60
10	-0.23	-0.26	-0.30	-0.43
12	-0.19	-0.24	-0.26	-0.42
14	-0.18	-0.21	-0.23	-0.36
16	-0.16	-0.20	-0.22	-0.30
18	-0.14	-0.18	-0.22	-0.29
20	-0.13	-0.15	-0.22	-0.28
22	-0.12	-0.15	-0.19	-0.27
24	-0.11	-0.14	-0.17	-0.27
26	-0.10	-0.12	-0.13	-0.26
28	-0.10	-0.12	-0.12	-0.25
30	-0.09	-0.10	-0.10	-0.22
32	-0.08	-0.07	-0.09	-0.20
34	-0.07	-0.07	-0.08	-0.14
36	-0.05	-0.05	-0.06	-0.13
38	-0.04	-0.05	-0.05	-0.13
40	-0.03	-0.02	-0.04	-0.12
42	-0.02	-0.00	-0.04	-0.08
44	0.00	0.00	-0.03	-0.07
46	0.02	0.01	-0.03	-0.06
48	0.02	0.03	-0.01	-0.05
50	0.03	0.04	0.01	0.02
52	0.04	0.05	0.02	0.03
54	0.04	0.06	0.03	0.05
56	0.06	0.08	0.04	0.06
58	0.06	0.12	0.05	0.09
60	0.07	0.13	0.05	0.09
62	0.08	0.13	0.06	0.10
64	0.09	0.13	0.07	0.13
66	0.09	0.14	0.07	0.13
68	0.10	0.15	0.08	0.15
70	0.12	0.18	0.08	0.17
72	0.12	0.19	0.09	0.21
74	0.13	0.19	0.09	0.24
76	0.14	0.20	0.10	0.27
78	0.15	0.22	0.11	0.30
80	0.16	0.23	0.11	0.32
82	0.18	0.23	0.13	0.34
84	0.18	0.24	0.16	0.36
86	0.19	0.25	0.20	0.38
88	0.20	0.27	0.23	0.44
90	0.20	0.28	0.24	0.47
92	0.22	0.30	0.27	0.48
94	0.26	0.30	0.29	0.53
96	0.31	0.32	0.38	0.58
98	0.36	0.51	0.40	0.67
100	0.64	0.66	0.72	0.78
Mean	0.01	0.03	-0.01	0.00
Std. Dev.	0.18	0.23	0.21	0.34

EXHIBIT III

"BUY" VERSUS "SELL" PERFORMANCE

	1/1-3/31/78	4/1-6/30/78
20-Day Buy Residual	-1.38	0.78
20-Day Sell Residual	-1.17	0.80
Net Performance	-0.21	-0.02

EXHIBIT IV

20 DAY RESIDUAL RETURNS - SIMULATION DISTRIBUTIONS

	BUY		SELL	
Percentile	1/1-3/31/78	4/1-6/30/78	1/1-3/31/78	4/1-6/30/78
0	2.05	1.27	1.77	2.38
2	1.26	1.03	1.47	1.27
4	1.22	0.96	1.35	1.02
6	1.15	0.92	1.31	0.92
8	1.02	0.88	1.26	0.80
10	0.98	0.75	1.02	0.76
12	0.94	0.68	0.67	0.74
14	0.87	0.65	0.57	0.69
16	0.78	0.58	0.55	0.67
18	0.75	0.55	0.49	0.64
20	0.68	0.46	0.38	0.61
22	0.59	0.37	0.34	0.52
24	0.50	0.31	0.32	0.44
26	0.36	0.30	0.27	0.41
28	0.31	0.28	0.26	0.40
30	0.28	0.23	0.25	0.37
32	0.14	0.22	0.17	0.35
34	0.11	0.19	0.15	0.33
36	0.06	0.14	0.12	0.29
38	0.04	0.08	0.11	0.25
40	-0.01	0.01	0.06	0.23
42	-0.05	-0.02	0.04	0.22
44	-0.09	-0.04	-0.00	0.17
46	-0.09	-0.06	-0.03	0.12
48	-0.10	-0.09	-0.07	0.09
50	-0.13	-0.10	-0.09	0.02
52	-0.19	-0.15	-0.10	-0.01
54	-0.23	-0.18	-0.11	-0.05
56	-0.26	-0.20	-0.19	-0.05
58	-0.32	-0.27	-0.20	-0.09
60	-0.33	-0.30	-0.24	-0.11
62	-0.41	-0.35	-0.25	-0.18
64	-0.43	-0.36	-0.34	-0.20
66	-0.45	-0.40	-0.37	-0.26
68	-0.54	-0.40	-0.40	-0.32
70	-0.57	-0.42	-0.46	-0.34
72	-0.61	-0.45	-0.46	-0.39
74	-0.66	-0.54	-0.49	-0.47
76	-0.69	-0.56	-0.51	-0.53
78	-0.80	-0.60	-0.59	-0.56
80	-0.90	-0.66	-0.62	-0.63
82	-1.07	-0.66	-0.64	-0.74
84	-1.08	-0.72	-0.66	-0.77
86	-1.11	-0.76	-0.81	-0.85
88	-1.17	-0.81	-0.83	-0.97
90	-1.28	-0.93	-0.86	-1.04
92	-1.33	-1.03	-0.91	-1.16
94	-1.39	-1.13	-1.02	-1.39
96	-1.52	-1.24	-1.12	-1.51
98	-1.69	-1.41	-1.28	-1.80
100	-1.94	-1.61	-1.53	-2.29

EXHIBIT V

TRADING TRIGGER RESULTS

PRICE MOVEMENTS THAT APPEAR TO HAVE INFLUENCED TRADE SIZE

		DAY	TRIGGER
BUY			
	STOCK RESIDUAL		
		0	-
		-1	
		-2	-
		-3	
		-4	
	BROAD MARKET		
		0	
		-1	
		-2	
		-3	-
		-4	
	TRADE-SPECIFIC MARKET		
		0	
		-1	
		-2	
		-3	
		-4	
SELLS			
	STOCK RESIDUAL		
		0	+
		-1	
		-2	+
		-3	
		-4	
	BROAD MARKET		
		0	
		-1	+
		-2	+
		-3	+
		-4	
	TRADE-SPECIFIC MARKET		
		0	
		-1	
		-2	
		-3	