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# Off-Board Trading of NYSE-Listed Stocks: The Effects of Deregulation and the National Market System

JAMES L. HAMILTON\*

## ABSTRACT

An econometric time-series model of off-board trading of NYSE-listed stocks shows that high NYSE commission rates were an incentive for third-market trading but that trading on the regional exchanges, which is most of the off-board trading, has been affected very little by commissions or their deregulation. The effects of some changes in the trading organization and rules are estimated, including several that are part of the emerging National Market System. The estimates imply that the NMS has increased competition for the NYSE, as Congress intended, and has prompted the NYSE to improve its performance to retain market share.

THOUGH THE NEW YORK Stock Exchange (NYSE) is the primary marketplace for the stocks it lists, investors and brokers also have traded those stocks on the regional stock exchanges and over the counter in the so-called "third market." This "off-board" trading has been the only competition for the NYSE.<sup>1</sup> The fact that some investors and brokers have chosen to trade off board has supported a widely held opinion that NYSE members would perform their roles poorly in an exchange monopoly. In this way, off-board trading helped to foster the idea that increasing competition for NYSE members would improve their performance. The desire for greater competition was behind two major policy decisions of the Securities and Exchange Commission (SEC) and Congress. The first was to deregulate the commissions charged by NYSE brokers. The second was to reorganize the trading of NYSE-listed stocks into a National Market System, in which the off-board marketplaces could compete more directly with the NYSE.

Although off-board trading has influenced the decisions to deregulate and reorganize, off-board trading has not previously been studied empirically. An econometric time-series model of off-board trading shows the determinants of its market share. The estimated model provides an empirical perspective on two prominent beliefs about off-board trading as competition for the NYSE.

First, in the period prior to deregulation, off-board trading was widely believed to be evidence that the NYSE set its brokerage commission rates above the competitive level, which induced some brokers and investors to trade off board.<sup>2</sup>

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<sup>1</sup> The NYSE also has faced some competition from other marketplaces for the primary listing of new stock issues.

<sup>2</sup> The SEC [17], pp. 904-07, 937-40, identified fixed NYSE commission rates as the primary motivation for off-board trading. Also, see Baxter [3], U.S. House of Representatives [27], and U.S. Senate [28].

This belief about off-board trading supported the SEC's decision to deregulate all exchange commissions after May 1, 1975. However, off-board trading largely has survived, even as exchange commissions fell sharply. Nonetheless, the econometric model shows that NYSE commissions have significantly influenced third-market trading. The model also shows that the greater part of off-board trading, that on the regional exchanges, has been little affected by commissions. Thus, high commissions seem to have been a lesser motive for off-board trading than was suspected prior to deregulation.

The second belief is that the off-board marketplaces are able to compete with the NYSE in other ways than just commission discounting. The persistence of off-board trading since deregulation supports this belief. Concurrently with deregulation, Congress passed the Securities Act Amendments of 1975,<sup>3</sup> which directed the SEC and the securities industry to develop a National Market System (NMS) for listed stocks.<sup>4</sup> The NMS was envisioned as a trading organization that electronically interconnects off-board marketplaces and the NYSE. Congress and the SEC have expected the interconnection to help off-board marketplaces compete with the NYSE, forcing it to make better markets. The econometric model shows that the NMS apparently has increased the competitive pressure on the NYSE.

## I. Determinants of Off-Board Trading Volume

As investors and their brokers choose among marketplaces, whatever costs and benefits they consider are what determine the market share captured by off-board trading. The remainder of this section discusses several hypotheses about the determinants of the off-board market share.

### A. NYSE Commissions

Prior to deregulation, the principal motive for off-board trading was widely believed to be the fixed NYSE brokerage commissions, which exceeded the NYSE's marginal cost of transacting.<sup>5</sup> The excess of commissions over marginal cost also was greater (per share) for larger transactions, the so-called "block" transactions.<sup>6</sup> The hypothesis is that NYSE commission rates relate positively to off-board trading.

The discussions about off-board trading have focused on commissions, and these were the principal target of deregulation, but a complete comparison of NYSE and off-board transactions would compare execution costs rather than just brokerage commissions.<sup>7</sup> However, NYSE commissions have fallen so dramatically that the variation in this component of execution cost undoubtedly

<sup>3</sup> Public Law No. 94-29 (June 4, 1975).

<sup>4</sup> See SEC [22], p. 36. On the national market system, also see SEC [19, 20].

<sup>5</sup> Assuming that what investors paid for transacting off board equaled the dealers' marginal cost of those transactions, then NYSE commissions that exceeded the NYSE's marginal cost of transactions made the ratio of fees paid differ from the ratio of marginal costs, inducing more off-board trading than was optimal.

<sup>6</sup> This is well documented, as in Hamilton [12], pp. 84-87. Blocks conventionally are defined as 10,000 shares or more.

<sup>7</sup> Bid-ask spreads also are an execution cost, as was the New York State tax on transfer of stock ownership. If a trade changed transaction prices, that also is an execution cost.

outweighs the variation in other components. Data on full execution costs are not available.

### *B. Better Transactions*

Quite apart from commissions, off-board transactions differ from NYSE transactions in ways that some investors in some circumstances prefer, other things the same.

First, the NYSE auction exchange is ill-suited for block trades.<sup>8</sup> The marketability of a block depends on a broker actively searching among known large investors for an offsetting order of comparable size and negotiating a mutually acceptable price. The NYSE specialists on the exchange floor are prohibited by NYSE Rule 113 from searching for offsetting block orders. However, some other NYSE members, the so-called “upstairs marketmakers,” do negotiate block transactions and then simply “cross” the prearranged transactions on the exchange floor. Some block traders are not NYSE members, however. Their block trading of NYSE-listed stocks contributes to off-board trading.

Second, even an upstairs NYSE marketmaker may transact a block off board. On the NYSE floor, Rules 91 and 127 may permit small orders, the limit-order book, and the specialist to take precedence over some part of the orders in a block trade.<sup>9</sup> In order not to disrupt a prearranged block trade, the marketmaker may cross it on a regional exchange. Although the upstairs marketmakers often do rely on the NYSE specialists to fill out a block trade, when specialist participation is not needed, there is a motive here for off-board trading that does not exist for smaller orders.

Third, transactions often are more rapid off board; sometimes traders value this speed.<sup>10</sup>

Finally, off-board transactions could be secret (at least temporarily), which traders sometimes have desired.<sup>11</sup>

These traits of NYSE and off-board trading have not changed in ways that create testable hypotheses for a time-series model. They are, nonetheless, motives for off-board trading besides just avoiding excessive NYSE commissions.

### *C. Block Trading Growth*

As seen above, some blocks might be traded better or more cheaply off board. Block trading grew rapidly after 1960.<sup>12</sup> The hypothesis is then that, with all other things the same, the proportion traded off board would be greater as the proportion traded in blocks was greater.

### *D. Satellite Risk*

Off-board trading entails a price risk. Garbade and Silber [8] characterize off-board marketplaces as satellites of the NYSE;<sup>13</sup> they have evidence that trans-

<sup>8</sup> Generally see Garbade [5], pp. 454–59, on block trading.

<sup>9</sup> See Garbade [5], p. 457.

<sup>10</sup> See SEC [17], pp. 887, 932.

<sup>11</sup> See SEC [17], pp. 887, 932, and Garbade [5], pp. 458–59.

<sup>12</sup> See Hamilton [12], pp. 82–84.

<sup>13</sup> Also see SEC [17], pp. 906, 937–40, and U.S. Senate [28], p. 93.

action prices on two of the regional exchanges depend heavily on prior NYSE transaction prices. Consequently, when investors and marketmakers trade off board, based on recent NYSE prices, they risk the possibility that a better price currently is available on the NYSE. If investors and marketmakers are risk averse, the probability of deviating from the price in the dominant marketplace is a cost of off-board trading.

As this risk is less, investors and brokers could transact off board relatively more. First, as stock prices generally change less over time, the probability is smaller that prices would change between transactions. Second, greater aggregate transaction volume would reduce the time between observations on the market prices of stocks.<sup>14</sup> The two hypotheses are that off-board trading relates inversely to temporal price instability and that it relates positively to aggregate trading volume.<sup>15</sup>

### *E. NYSE Rules*

NYSE rules governing its members also have affected off-board trading volume. As noted above, Rules 97, 113, and 127 encourage off-board trading. Rule 390, which prohibits NYSE members from trading as third-market dealers, obviously discourages off-board trading. The NYSE did not modify these rules in the sample period.

Through 1968, NYSE members commonly allowed customer-directed commission give-ups on block transactions. After the SEC banned give-ups, investors and NYSE members partly circumvented the ban with other trading practices, but it did eliminate one incentive to transact on the NYSE rather than off board.<sup>16</sup> Financial institutions also began to join regional exchanges to get commission rebates directly. The hypothesis is that the give-up ban increased off-board trading.

May Day eviscerated a NYSE rule that prohibited members from giving commission discounts to nonmember brokers. Since that rule left a zero margin for the nonmember brokers, they transacted off board instead. Since May Day, however, nonmember brokers have negotiated sufficiently low NYSE commissions that they have a positive margin. Many of the so-called discount brokers that have appeared since 1975 rely on such negotiated access to the NYSE.<sup>17</sup> The hypothesis is that negotiated access reduced off-board trading.

There are two alternative ways to characterize how nonmember broker access affected off-board trading. First, an increase in nonmember trading on the NYSE (and less off-board trading) could simply be part of the positive elasticity of off-board trading with respect to exchange commissions (above). Second, nonmember access to the NYSE could have shifted the demand for off-board transactions. If

<sup>14</sup> In Garbade and Silber's [7] analysis of the liquidity risk of trading, they show that the risk of transacting at a price other than the equilibrium price increases with temporal price instability and decreases with greater trading volume (p. 585). If prices were perfectly stable or perfectly random without trend, then more frequent observation of prices would have no value.

<sup>15</sup> Hamilton's [11] cross-section study of NYSE-listed stocks shows that off-board trading related directly to trading volume and inversely to price instability.

<sup>16</sup> See SEC [18], pp. 2182–2208.

<sup>17</sup> See SEC [23], pp. 85–87.

the NYSE had lowered its fixed retail commissions while continuing to deny discounts to nonmember brokers, then lower commissions would have reduced off-board trading less than when the NYSE also permitted nonmember brokers to negotiate discounts. Thus, repealing the nonmember access rule would have an effect independent of the elasticity of off-board trading with respect to commissions. These two alternative characterizations are compared empirically in Section II.

Finally, in June, 1980, the SEC adopted Rule 19c-3 to permit NYSE members to be third-market dealers in any stocks newly listed after April 26, 1979. For those stocks, Rule 19c-3 repealed Rule 390. The hypothesis is that Rule 19c-3 increased third-market trading.

#### *F. Trading Organization*

Off-board trading may have been affected by a number of changes in the institutional organization of trading NYSE-listed stocks, including the components of the NMS. As Garbade and Silber [6, 8] and Hamilton [9, 13] have shown, institutional changes that lower the cost of communicating market information improve the performance of securities markets.

First, the National Association of Securities Dealers Automated Quotation (NASDAQ) system included third-market dealers by September, 1971. Investors then had more immediate, cheaper, and more comprehensive information about third-market quotations, at least for small orders. The hypothesis is that the NASDAQ increased third-market trading.<sup>18</sup>

Second, since June, 1975, all transactions of NYSE-listed stocks in all marketplaces have been reported on a single consolidated tape. Since off-board traders already had access to the NYSE tape, Garbade and Silber [8] have suggested that the principal effect of the consolidated tape was to make NYSE prices more responsive to "the information content embedded in regional prices" (p. 460). Consequently, the tape might have had little effect on off-board trading unless it demonstrated that off-board prices entailed more or less satellite risk than investors had believed. Thus, the effect of the tape is unpredicted.

Third, in April, 1978, the Intermarket Trading System (ITS) linked the NYSE and the regional exchanges in an electronic network for sending orders among exchange floors. By August, the ITS also displayed specialist quotations from all exchanges. The ITS is the cornerstone of the NMS. However, the ITS is a two-way connection; it is not just for off-board traders to capture orders from the NYSE. In fact, the SEC [24] shows that the NYSE has been a net recipient of trading volume through the ITS.

Fourth, also in 1978, the Cincinnati Stock Exchange started a purely electronic auction trading system, the so-called National Stock Trading System (NSTS). The NSTS was created and operated by Weeden and Co., which was the leading third-market dealer. The NSTS is expected to reduce third-market trading because Weeden then withdrew from the third market.

Fifth, the NSTS joined the ITS in 1981. The SEC [24] shows that the NSTS

<sup>18</sup> Jarrell [14], p. 279, also suggested this effect but had no evidence of it.

also has been a net recipient of volume within the ITS. The hypothesis is that the link increased regional exchange trading.

Sixth, some of the regional exchanges were pioneers in automating the execution of small orders. The Pacific Stock Exchange had inaugurated automated trading by the end of 1978, and the Midwest Stock Exchange had by November, 1980. These systems depend heavily on ITS quotations in order to guarantee execution at the best price available in the market at any moment. In this sense, automated execution systems are an embellishment of the ITS. Since the NYSE did not immediately counter with an equivalent system, the regional exchange share of trading volume is expected to increase.

A major goal of the NMS has been to make off-board trading more competitive with the NYSE. If the ITS and NSTS and automated execution system had done that, the NYSE could have reacted in one of two ways. First, as the dominant firm, the NYSE could have persevered in noncompetitive behavior by accommodating the new competition, but it would have had to surrender some market share. Then ITS and NSTS would have increased the off-board share. Second, the NYSE could have responded by being more competitive. In the extreme case, the theory of perfectly contestable markets shows that even a single-firm monopoly would act as a perfect competitor if the potential for entry and new competition were sufficiently strong.<sup>19</sup> If the ITS and NSTS had increased the ability of off-board marketplaces to compete for transactions in NYSE-listed stocks, then the NYSE could have responded competitively by improving its performance. If it had, it would have kept or possibly even have gained market share, rather than losing it. Thus, the impact of the NMS on off-board trading depends on the nature of the competition between the NYSE and the off-board marketplaces.

### *G. A Model*

Off-board market shares are  $TR/T$  and  $T3/T$ , where  $TR$  is the trading volume on all the regional exchanges,  $T3$  is the third-market trading volume, and  $T$  is the aggregate trading volume in NYSE-listed stocks. The hypotheses about these market shares, as developed in the preceding subsections, are tested using the following model of off-board trading:

$$\frac{TR_t}{T_t}, \frac{T3_t}{T_t} = F(CR_t, CB_t, B_t/T_t, P_t, T_t, D68_t, D71_t, D75_t, I_t \text{ or } D78_t, D80_t). \quad (1a, 1b)$$

$TR$  = an index (1976,  $1Q = 100$ ) of the average number of shares of NYSE-listed stocks traded daily on the regional exchanges (as a group).

$T3$  = an index (1976,  $1Q = 100$ ) of the average number of shares of NYSE-listed stocks traded daily in the third market.<sup>20</sup>

<sup>19</sup> See Baumol, Panzar, and Willig [2].

<sup>20</sup> INSTINET volume is included in third-market volume.

$T$  = an index (1976,  $1Q = 100$ ) of the average number of shares of NYSE-listed stocks traded daily in all marketplaces.<sup>21</sup>

$P$  = the difference between the highest and lowest values of the Standard and Poor's 500 index, as a ratio to the average daily value of the index for the quarter.

$B/T$  = the share volume of block trades (10,000 shares or more) on the NYSE as a proportion of NYSE trading volume.<sup>22</sup>

$CR$  = an index (1965,  $1Q = 100$ ) of the NYSE commission per dollar of principal on a hundred-shares trade.

$CB$  = an index (1965,  $1Q = 100$ ) of the NYSE commission per dollar of principal on a 20,000-shares trade.

$D68$  = dummy variable (= 0 through 1968 and = 1 thereafter) representing the ban on customer-directed give-ups after 1968.

$D71$  = dummy variable (= 0 through 1971,  $3Q$  and = 1 thereafter) representing the extension of the NASDAQ to the third market in 1971.

$D75$  = dummy variable (= 0 through 1975,  $2Q$  and = 1 thereafter) representing both the institution of the consolidated tape and May Day, with negotiated nonmember broker access to the NYSE.

$I$  = the number of stocks eligible for trading through ITS (= 0 through 1978,  $2Q$ ).

$D78$  = dummy variable (= 0 through 1978,  $1Q$  and = 1 thereafter) representing the era of the ITS and the Cincinnati NSTS since 1978.

$D80$  = dummy variable (= 0 through 1980,  $2Q$  and = 1 thereafter) representing a collection of events: installation of automated trading on two regional exchanges in 1979 to 1980, the SEC's imposition of Rule 19c-3 in 1980, and the linking of the NSTS to the ITS in early 1981.

Since  $TR/T$  and  $T3/T$  are alternative dependent variables, (1a) and (1b) are two separate equations. Note that  $D75$ ,  $D78$ , and  $D80$  each represent the effect of two or more events that are too coincident to separate empirically.

There is no single best measure for NYSE commissions. Commission deregulation started prior to May Day for block transactions. The NYSE initiated a quantity discount in 1968. Then, in 1971, the SEC mandated that commissions be negotiable on the portions of transactions in excess of \$500,000, which it reduced to \$300,000 in 1972. After May Day, commissions fell much more sharply

<sup>21</sup> Beginning in 1976, NYSE [16] reports data on  $TR$ ,  $T3$ ,  $TN$ , and  $T$  from the consolidated tape, where  $TN$  is the comparable measure of NYSE trading volume. The SEC *Statistical Bulletin* [26] has  $T3$  and  $TN$  data for 1965 through 1977. The SEC [21] has quarterly data on  $TR$  for 1972 through 1976. Since  $TR$  and  $T3$  each have dual sources, these are converted to indexes that have a common base (1976,  $1Q = 100$ ). Prior to 1972, the  $T$  index is constructed only from  $TN + T3$ . Substitution of regional exchange transactions for third-market transactions is less likely prior to 1972 than subsequently, but, even for 1972 through 1981,  $TN + T3$  and  $TN + TR + T3$  are very highly correlated ( $r = 0.9998$ ). An index for  $T$  is constructed for 1965 through 1972 and spliced to the index for 1972 through 1981.

<sup>22</sup> Block trades on the NYSE ( $B^*$ ) as a proportion of NYSE trading volume ( $TN$ ) are a proxy for  $B/T$ . Since  $T$  and  $TN$  are highly correlated ( $r = 0.9993$  for 1976 through 1981), so are  $B/T$  and  $B/TN$ . Since most blocks still are traded on the NYSE,  $B^*$  is believed to be highly correlated with  $B$ . Since any shift of blocks away from the NYSE would reduce both  $B^*$  and  $TN$ , the bias in  $B^*/TN$  as a proxy for  $B/T$  is believed to be small.

for blocks than for smaller orders. Consequently, one commission index (*CR*) is for a round-lot transaction (one hundred shares), and the other (*CB*) is for a block transaction of 20,000 shares.<sup>23</sup> The two measures are weakly and inversely correlated ( $r = -0.52$ ).

In the model, the ITS and the NSTS are specified in alternate ways for the third market and the regional exchanges. Since the two systems were introduced and expanded concurrently, they cannot be distinguished empirically. For regional exchange trading, the effect of the ITS and the NSTS is expected to be greater as more of the NYSE-listed stocks were traded in those systems. Thus, in the regional-exchange model (4a), the ITS is specified as  $I$ .<sup>24</sup> For the third market, the dominant impact is expected to be the switch of Weeden and Co. from the third market to the regional exchanges as part of starting the NSTS. Therefore, the ITS and the NSTS are specified as  $D78$  in the third-market model (4b).

One reason to estimate (1a) and (1b) separately is that the determinants may affect the third market and the regional exchanges differently. First, third-market trading volume may have been more sensitive to NYSE commissions than was regional exchange volume. Prior to May Day, the regional exchanges had the same commissions as the NYSE since the largest regional exchange members also are NYSE members.<sup>25</sup> Indirect commission rebates probably were greater on the regional exchanges than on the NYSE, but, in the third market, investors simply paid less than the exchange commissions. Thus, investors apparently transacted on the regional exchanges for reasons other than just commission discounts. Second, the third market may entail more price risk than do the regional exchanges since many regional members also are NYSE members. Third, the changes in NYSE rules and the trading organization may have affected them differently.

## II. Estimation of the Model

This section concerns the specification of (1) and reports the estimated parameters for the third market and the regional exchanges.

### A. The Regression Model

The model (1) is estimated as a constant-elasticity function. For the period through 1968 (prior to any of the institutional changes), (1) is

$$\ln \frac{TR_t}{T_t}, \ln \frac{T3_t}{T_t} = \phi(\ln X_t), \quad (2a, 2b)$$

<sup>23</sup> The commissions are a percentage of the principal amount of the transaction. Prior to May Day, commissions are computed using the average share price on the NYSE for the quarter since higher stock prices meant a higher commission. Negotiated discounts on block trades between 1971 and May Day are computed following Freund and Schaeffer [4]. After May Day, the SEC [25] reported average commissions per dollar. The computed commissions before May Day and the SEC data were converted to indexes and spliced at April, 1975.

<sup>24</sup> Although the NSTS is not explicitly specified, the NSTS has traded only about one tenth as many issues as the ITS has.

<sup>25</sup> See SEC [17], pp. 300, 928–29.

where  $X_t$  represents the independent variables in period  $t$ . The institutional changes in trading rules and organization after 1968 are added as intercept dummy variables, represented generally as  $DZ_t$ . Accordingly, for the full sample period, (2) is

$$\ln \frac{TR_t}{T_t}, \ln \frac{T3_t}{T_t} = \alpha + \sum_X \phi_X (\ln X_t) + \sum_Z B_Z DZ_t + u_t, \quad (3a, 3b)$$

where  $u_t$  is an error term,  $\phi_X = \partial \phi / \partial (\ln X)$  is the elasticity with respect to  $X$ , and  $DZ$  shifts the function by  $B_Z$ . Maintained assumptions of the model are that  $E(y_t) = 0$ ,  $\text{cov}(u_t, u_s) = \sigma^2 I$ , and  $E(X_t u_t) = 0$ .

One advantage of specification (3) is that adding  $\ln T$  to both sides avoids having the independent variable  $T$  also appear in the dependent variable. Consequently, the estimated version of the model is

$$\begin{aligned} \ln TR_t, \ln T3_t \\ = \alpha + (\phi_T + 1)(\ln T) + \sum_{X \neq T} \phi_X (\ln X_t) + \sum_Z B_Z DZ + u_t. \end{aligned} \quad (4a, 4b)$$

In (4), the error terms are independent of  $T$  because (1) concerns how a *given*  $T$  is *divided* among the several marketplaces; the *division* does not affect the *level* of  $T$ . This means, however, that the error term in (4a) for  $TR/T$  may not be independent of the error term in (4b) for  $T3/T$ . Even so, since the independent variables are identical in both equations, ordinary least squares still estimates the parameters of each equation efficiently.<sup>26</sup>

### B. The Data

Quarterly time-series data for the variables are used to estimate (4). The SEC began to report data on  $T3$  in 1965, but the data on  $TR$  only begin with 1972. This short sample is a second reason for estimating (4a) and (4b) separately. The sample period ends in 1981 when the SEC stopped collecting data on NYSE commission rates.

### C. The Estimates

The Durbin-Watson statistic ( $DW$ ) showed significant autocorrelation in the third-market model. In its residuals, autocorrelation was particularly strong during 1972 through 1975, indicating that the model was misspecified then. This was the period of block commission discounting prior to May Day. Since the discounts in  $CB$  are from Freund and Schaeffer [4] for 1971 and 1972, the discounts during 1973 through 1975 might have been underestimated in  $CB$ . To account for that possibility, dummy variables were added to equation (4b) for two periods: the four quarters of 1973 and the six quarters of 1974 through May

<sup>26</sup> See Johnston [15], p. 338. An inverse relationship between commission rates and both trading volume ( $T$ ) and block trading ( $B/T$ ) is plausible, but developing and estimating these relationships would extend the scope of the paper excessively. Since neither depends in any plausible way on the extent of off-board trading, these relationships are recursive with (4), not simultaneous. Consequently, ordinary least-squares estimators of (4) are consistent. See Johnston [15], pp. 467–69.

Day. The parameters for these two dummies (not reported) are negative and significant for the third market. The principal effect is to reduce autocorrelation and to increase the estimated elasticities of commissions. For the regional exchanges, adding the two dummies has a negligible effect on the parameters in (4a).

Table I contains the estimated parameters of (4) for the regional exchanges and the third market; (4) is estimated with and without  $D75$  as a shift parameter, reflecting the two alternative specifications of the effect of commission deregulation and nonmember broker access. The model is highly significant for both marketplaces ( $F$ ) and explains ninety-one to ninety-eight percent of the variance in off-board trading ( $\bar{R}^2$ ). While not all of the estimated parameters are statistically significant, the only surprise is that  $(\phi_T + 1) < 1$ .<sup>27</sup> When (4) was estimated with the constraint that  $(\phi_T + 1) = 1$ , the constraint affected the estimated parameters only in minor ways. To further test the robustness of the estimates, (4) also was estimated for 1965 through the second quarter of 1978, the period prior to most of the NMS. The hypothesis tests are very similar to those for the full sample period. Thus, the results in Table I appear to be quite robust.<sup>28</sup>

### III. Interpretations

#### A. Commission Rates

Since the decline in NYSE commissions has not eliminated off-board trading, it clearly was not just cut-rate brokerage. Even so, Table I shows that third-market trading has a good deal of elasticity with respect to NYSE commissions, supporting the belief that NYSE commissions were a motive. The estimate of this elasticity depends, however, on whether deregulation is specified as a demand shift. When  $D75$  is omitted, the assumption is that the decrease in third-market trading by nonmember brokers just reflects the commission elasticity of third-market trading. In that case, both  $\phi_{CR}$  and  $\phi_{CB}$  are fairly large. When  $D75$  is included in the model, the assumption is that the demand for third-market trading shifted. By this second view of deregulation,  $B_{75}$  shows a substantial shift in the demand for third-market trading, and the estimate of  $\phi_{CB}$  is much lower. Of course,  $D75$  also represents the coincident installation of the consolidated tape and any other effects of May Day.<sup>29</sup> Omitting  $D75$  loses any specification of these effects, but they may be small. The only other basis for preferring the inclusion of  $D75$  is the narrow one of a higher  $\bar{R}^2$ .

Fortunately, a choice between the two specifications is not necessary. Both show that deregulation and falling commissions substantially reduced third-market trading. The tests of the other hypotheses in the model are equivalent in the two variants.

<sup>27</sup> In Table I, the statistical-significance tests are for the null hypothesis that  $\phi_T = 0$ .

<sup>28</sup> Tables of the estimated parameters for all of these variations of the model are available from the author.

<sup>29</sup> Since the repeal of the New York State transfer tax coincided with May Day, it would be part of  $D75$ .

Table I  
Estimated Parameters of (4)

| Parameter   | Regional Exchanges<br>(4a), 1972 through<br>1981 |                    | Third Market (4b),<br>1965 through 1981 |                    |
|-------------|--------------------------------------------------|--------------------|-----------------------------------------|--------------------|
|             | Without<br><i>D75</i>                            | With<br><i>D75</i> | Without<br><i>D75</i>                   | With<br><i>D75</i> |
| Intercept   | 0.29                                             | 1.56*              | -5.42**                                 | -1.89**            |
| $\phi_{CR}$ | 0.10                                             | 0.06               | 0.47**                                  | 0.52**             |
| $\phi_{CB}$ | 0.13                                             | -0.15°             | 1.22***                                 | 0.25°              |
| $\phi_B$    | 0.30***                                          | 0.24***            | 0.42***                                 | 0.31***            |
| $\phi_P$    | -0.05°                                           | -0.03              | -0.12**                                 | -0.05°             |
| $\phi_T$    | 0.81***                                          | 0.81***            | 0.81***                                 | 0.85*              |
| $B_{68}$    |                                                  |                    | 0.73***                                 | 0.37***            |
| $B_{71}$    |                                                  |                    | 0.17*                                   | 0.14*              |
| $B_{75}$    |                                                  | -0.16***           |                                         | -0.59***           |
| $\phi_I$    | 0.00                                             | 0.00               |                                         |                    |
| $B_{78}$    |                                                  |                    | -0.53***                                | -0.60***           |
| $B_{80}$    | 0.11**                                           | 0.09**             | 0.21**                                  | 0.11**             |
| $\bar{R}^2$ | 0.97                                             | 0.98               | 0.91                                    | 0.95               |
| <i>DW</i>   | 1.15                                             | 1.14               | 1.40                                    | 1.42               |
| <i>F</i>    | 168.48***                                        | 227.01***          | 64.97***                                | 103.63***          |

Significance levels: ° fifteen percent; \* ten percent; \*\* five percent; \*\*\* one percent.

The picture for regional exchange trading, which is about two thirds of off-board trading, is rather different, however. In Table I,  $\phi_{CR}$  is essentially zero. When *D75* is included,  $B_{75}$  shows that the shift in the demand for regional exchange trades is much smaller than for third-market trades. Although  $\phi_{CB} > 0$  when *D75* is omitted and  $\phi_{CB} < 0$  when it is included, both are small, and only the latter has even marginal statistical significance. If  $\phi_{CB} < 0$ , it would imply that, when exchange commissions were high (including the commissions on the regional exchanges), the regional exchanges lost more trading volume to the third market than they gained from the NYSE. In that case, deregulation has made the regional exchanges a more attractive marketplace, all other things the same. If  $\phi_{CB} = \phi_{CR} = 0$ , however, then the two effects balanced almost exactly. In either case, the small  $\phi_{CR}$  and  $\phi_{CB}$  and the small  $B_{75}$  imply that NYSE commissions were not a major motive for regional exchange trading.

### B. Noncommission Determinants

The survival of off-board trading implies that, even with more competitive NYSE commissions, the other motives for off-board trading<sup>30</sup> are strong enough that off-board marketplaces can compete with the NYSE on some transactions, just as the NMS assumes.

For block trading, the  $\phi_B$  are fairly large in both marketplaces. With this elasticity, the doubling of *B/T* during 1971 through 1981 strongly promoted off-board trading.

<sup>30</sup> These were enumerated in Section I, Subsection B, above.

Finally, satellite risk has been a minor deterrent of off-board trading. The  $\phi_P$  are negative in every case, as expected. For the third market,  $\phi_P$  is small, but, for the regional exchanges,  $\phi_P$  is essentially zero.<sup>31</sup>

### *C. Trading Organization and the NMS*

Prior to the NMS, the give-up ban and the initiation of NASDAQ appear to have augmented third-market trading. The  $B_{68}$  and  $B_{71}$  indicate that the give-up ban had a greater effect than NASDAQ had.

Two of the earliest institutional changes prompted by the National Market System were the ITS and the NSTS. (The consolidated tape is part of the effect of  $D75$ , discussed above.) For the regional exchanges,  $\phi_I$  is essentially zero. That is, the growth of the ITS has had little direct impact on the market share of the regional exchanges. Although  $\phi_I$  is negligible, it is not because the ITS is ineffective, since trading volume in the ITS is substantial. In 1981, ITS volume was four percent of total volume in NYSE-listed stocks. However, the flow of ITS orders to and from the NYSE have nearly balanced; the NYSE has even been a net recipient of ITS volume [24].

The negligible effect of the ITS on regional-exchange market share has two possible interpretations. First, even if the NYSE was behaving noncompetitively, as alleged by many observers, the ITS and the NSTS would increase competition only if the regional exchanges then could outperform the NYSE at the margin of the pre-existing division of trading between the NYSE and the regional exchanges. Thus, the regional exchanges would not gain any market share from the ITS and the NSTS if the regionals just cannot compete in this way. The second interpretation is that the ITS and the NSTS *did* increase competition, which induced the NYSE to improve its performance. In this interpretation, the regional exchanges can compete, so that, if the NYSE persisted in noncompetitive behavior, the ITS would divert a positive net flow of orders to the regional exchanges. Thus, the regional exchanges would not gain market share if the NYSE responded to increased competition enough to hold its own.<sup>32</sup> Subsequent events (below) give some support to this second interpretation. By either of the two explanations, however, the NYSE has performed well enough that the ITS and the NSTS did not increase the market share of the regional exchanges.<sup>33</sup>

Although the ITS itself had a negligible direct effect on the market share of the regional exchanges, once the ITS was in place the regional exchanges added embellishments that have increased their market share. The  $B_{80}$  imply that trading on the regional exchanges was nine to ten percent greater in 1981 than

<sup>31</sup> Since the estimated  $(\phi_T + 1) < 1$ , the hypothesis on  $\phi_T$  is not tested.

<sup>32</sup> Studies of the NYSE specialists' bid-ask spreads repeatedly have found that the specialists tend to quote with narrower spreads as the number of other marketmakers for an issue is greater. A competitive response by the NYSE to the NMS would be consistent with this earlier estimate. However, the SEC [24] found no improvement in the NYSE specialists' spreads following the ITS. The specialists could have improved other dimensions of the NYSE executions, however.

<sup>33</sup> When the ITS and the NSTS were specified in (4a) as  $D78$  rather than  $I$ , then  $B_{78} < 0$ , which suggests that the NYSE actually gained market share through the ITS and the NSTS. The  $B_{78}$  are very small, even though one estimate is statistically significant. The specification  $I$  seems more reasonable here, however.

it otherwise would have been. NSTS trading volume is such a small proportion of total trading volume that the effect of linking it to the ITS would be commensurately small.<sup>34</sup> Therefore, most of the increase in the market share of regional exchanges during 1980 and 1981 apparently is due to their automated trading systems. After 1982, the NYSE began to develop its own automated execution systems. This is consistent with the view that the NYSE has responded to increased competition by improving its own performance; after losing market share to the regional exchange systems, the NYSE responded with a competing system.

In the third market, the direct effect of the NSTS and the ITS was much larger than on the regional exchanges. Third-market trading undoubtedly decreased substantially when Weeden and Co. left the third market for the Cincinnati exchange to start the NSTS. From this and any other effects, the  $B_{78}$  imply that third-market trading in 1981 was forty-one to forty-five percent below what it otherwise would have been.<sup>35</sup>

The major subsequent event in the third market was adoption of Rule 19c-3 in 1980. Several NYSE members did begin trading Rule 19c-3 stocks in the third market. The  $B_{80}$  imply that third-market trading in 1981 was twelve to twenty-three percent above what it otherwise would have been. The effect is modest because the rule only covers some newly listed stocks. In the period since 1981, however, trading in Rule 19c-3 stocks by NYSE members has disappeared.<sup>36</sup> This experience also is consistent with the view that the NYSE has responded to greater rivalry by being more competitive; after initially losing some volume in Rule 19c-3 stocks, the NYSE apparently responded by providing transactions that NYSE members have preferred to their own trading as third-market dealers.

#### D. Conclusion

The estimated parameters of (4) in Table I show that third-market trading and regional-exchange trading differ in several ways. First, while commissions were a strong motive for third-market trading, regional exchanges were much less affected by commission rates. Second, satellite risk has a small effect on third-market trading, but it has no effect on the regional exchanges. Finally, the NMS has affected the regional exchanges much less than the third market.

### IV. Summary and Conclusions

This paper reports an econometric time-series model of off-board trading of NYSE-listed stocks. It shows that high NYSE commission rates have been an incentive for third-market trading but that trading on the regional exchanges has been affected very little by commissions. Since off-board trading has continued to be more than twelve percent of all trading following commission deregu-

<sup>34</sup> In 1981, the Cincinnati Stock Exchange (including the NSTS) had only 0.35 percent of  $T$ . See NYSE, *Fact Book 1983* [16], p. 16.

<sup>35</sup> Using  $I$  rather than  $D_{78}$  in the third-market model gave equivalent estimates, but the  $I$  specification seems less appropriate for the third-market experience. Also,  $D_{78}$  gave a higher  $\bar{R}^2$ .

<sup>36</sup> See Amihud, Ho, and Schwartz [1], pp. 2, 8.

lation, off-board trading clearly has motives other than cut-rate brokerage, especially on the regional exchanges. Indeed, the survival of so much off-board trading is the keystone of the National Market System. However, creating the NMS would increase competition for the NYSE only if off-board marketplaces then could compete better for more of the NYSE's orders. The econometric model and subsequent events on the NYSE imply that the NMS has increased competition and, as intended, has pushed the NYSE to improve its performance somewhat in order to prevent the off-board marketplaces from capturing a greater market share.

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