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COMPETITION AND THE PRICING OF DEALER SERVICE IN THE OVER-THE-COUNTER STOCK MARKET

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I. Introduction

The stock market is in the midst of an era of change unparalleled since the Great Depression. long-standing institutions -- including the major stock exchanges -- are being radically challenged by contemporary developments, and novel approaches to making markets for common stocks are appearing with increasing frequency. In addition, the Martin Report and the recent hearings of the Securities and Exchange Commission on the future structure of the equities market indicate that the regulatory climate surrounding the stock market can be expected to undergo serious change in the near future.[1]

Among the numerous issues currently under discussion, several of the more important are concerned with the question of whether and to what extent competition in the business of providing dealer services improves the effectiveness and efficiency of the market for common stocks. This question lies at the very heart of the ongoing debate concerning the performance of stock exchange specialists.[2] It is also intimately related to matters such as the appropriate relationship between the major exchanges and the so-called third market; the operations of automated trading and information systems, e.g., the recently inaugurated National Association of Securities Dealers Automated Quotation System (NASDAQ, for short);[3] and the impact of these systems on the exchange market.

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[1]For a general discussion of recent developments, see R. R. West, "Institutional Investors and The Changing Stock Market," *Financial Analysts Journal* (May-June 1971), pp. 17 ff. On the Martin Report, see Donald Farrar, "Wall Street's Proposed Great Leap Backward," *Financial Analysts Journal* (September-October 1971).

[2]On this issue see S. Smidt, "The Role of the Specialist" (a paper presented at the 24th Annual Conference of the Financial Analysts Federation, May 18, 1971).

[3]A discussion of NASDAQ can be found in Richard R. West and Seha M. Tinic, *The Economics of the Stock Market* (New York: Praeger Publishers, 1971), pp. 67-68.

The determinants of the supply and pricing of dealer services on the New York Stock Exchange (NYSE) have been the subject of three recent studies.[4] Although the authors of these studies have drawn common conclusions concerning the impact of factors such as trading volume and security price on the pricing of dealer services, their analyses of the impact of interdealer competition (and the related matter of economies of scale in the provision of dealer services) are somewhat at odds. On the one hand, Demsetz and the NYSE conclude that the price of dealer services on the NYSE is not significantly influenced by the presence or absence of competition.[5] To the contrary, Tinic concludes that competition can and does have a measurable impact on the pricing of these services.[6]

Unfortunately, a common weakness of the NYSE and Demsetz's studies is that their conclusions concerning the impact of competition on dealer pricing on the NYSE are based on examining the rather limited (and possibly irrelevant) rivalry provided by the regional exchanges.[7] Whether any of these conclusions is valid in terms of the over-the-counter market or the competition provided for the exchanges by off-board trading in listed stocks is moot. And yet, if recent developments related to the third market and NASDAQ are any guide, it seems certain that this type of competition, rather than that provided by the regional exchanges, will be the most important in coming years.

The primary purpose of this paper is to provide additional evidence concerning the impact of direct interdealer competition on the pricing of dealer services

[4]Harold Demsetz, "The Cost of Transacting," *Quarterly Journal of Economics*, 82 (February 1968), pp. 33-53; Seha M. Tinic, *The Value of Time Preference and the Behavior of Liquidity Costs in the New York Stock Exchange* (unpublished doctoral thesis, Cornell University, 1970); and New York Stock Exchange, "Economic Effects of Negotiated Commission Rates on the Brokerage Industry's Practices and the Market for Corporate Securities" (unpublished report, August 1968), Appendix C. The results of these three studies have been summarized and compared in West and Tinic, *Economics of Stock Market*, pp. 155-169. D. C. Heinze has recently presented the results of a study of spreads in the over-the-counter market. Unfortunately, Heinze was not aware of Demsetz's work and he was not able to derive independently the basic logic developed by Demsetz. As a result, his study lacks both analytical and empirical validity. See D. C. Heinze, "An Empirical Study of Spread Size Determinants," *Business Studies, North Texas State University*, IX (Spring 1970), pp. 52-62.

[5]See Demsetz, "Cost of Transacting," especially pp. 49-53 and New York Stock Exchange, "Economic Effects," pp. 4-7.

[6]Tinic, *Value of Time Preference*, pp. 86-118.

[7]We say "possibly irrelevant" since it may be the case that the volume of trading on regional exchanges is so small that it may not constitute effective competition.

in the over-the-counter market. In brief, our principal conclusion is that increases in the amount of interdealer competition in this market tend to reduce the price of dealer services (reduce spreads) and thus, tend to increase the marketability of issues. This conclusion suggests, of course, that dealership activities in the over-the-counter stocks do not entail economies of scale as significant as those that have been reported by Demsetz and the NYSE for the exchanges. In addition, it lends some support to Tinic's questioning of Demsetz's and the NYSE's findings. Finally, to the extent that ongoing developments erode any economies associated with the dealer function on the exchanges, this conclusion also indicates that the growing competition in dealer services provided by the third market and NASDAQ could have the effect of reducing the cost of dealer services to buyers and sellers of stocks in the future. We will have more to say about these issues below. For now, however, let us turn to a discussion of the theory of dealer pricing activities.

II. The Theory of Dealer Pricing

It has been shown elsewhere that the spread between a dealer's bid and ask prices represents a scale multiple of the actual cost incurred by traders who demand predictable immediacy in buying and selling common stocks.[8] As such, it represents an operational measure of the price of dealer services and provides an estimate of an issue's marketability.

In the spirit of earlier studies of the pricing of dealer services, we began our investigation by hypothesizing that spread behavior was a function of (1) a stock's trading volume, (2) its price level, (3) a measure of its price volatility, and (4) the extent of competition among dealers.[9] On the basis of theoretical considerations and the results of earlier empirical work related to the relationship between spread behavior and trading volume on the NYSE, we hypothesized that spreads should vary inversely with volume. Generally speaking, dealers participate in trading activities to the extent required by temporal imbalances in the inflow of orders. Other things being equal, the probability that there will be an imbalance varies inversely with the time rate of transactions.[10] In other words, when trading volume is high, the disparities and discontinuities in the inflow of buy and sell orders decline, thus giving the market a self-equating

[8]On this point see West and Tinic, *Economics of Stock Market*, pp. 86-101.

[9]If data had been available, we would also have liked to study such factors as the size distribution of transactions, the degree of institutional holdings, and the capitalization of dealers. These factors have been studied by Tinic, *Value of Time Preference*.

[10]See West and Tinic, *Economics of Stock Market*, pp. 145-146.

quality.[11] Of course, as this occurs, the need for the dealer's inventory positioning is reduced, in terms of both the average size of positions and the average holding period of positions. Inactive stocks, on the other hand, require rather extensive dealer participation. To make a fairly continuous market in such issues, dealers must be prepared on the average to hold larger positions for longer periods of time. This being the case, the direct inventory carrying costs associated with dealing in inactive stocks are rather high. Furthermore, dealing in these issues entails considerable risk since inventory positions can deteriorate in value as market prices adjust to new information. Finally, it also reduces a dealer's ability to take on relatively riskless day-light trading in more active issues. To compensate for these factors, dealers can be expected to vary the width of spreads inversely with the time rate of transactions.

We hypothesized that spreads should vary directly with prices. Once again, our conclusion was based on both theoretical and empirical considerations. Concerning the former, Demsetz has noted that "spread per share will tend to increase in the price per share so as to equalize the cost of transaction per dollar exchanged." Otherwise, he notes, "Those who submit limit orders will find it profitable to narrow spreads on those securities for which spread per dollar exchanged is larger."[12] Demsetz's logic has been supported by his own empirical work, as well as studies conducted by the NYSE and Tinic.[13]

Our initial notion was to hypothesize a positive relationship between spreads and price volatility on the grounds that the greater the variability in price, the greater the risk associated with performance of the dealership function. On further reflection, however, we concluded that we should not try to predict the sign of this coefficient since it might be possible for the influence of price volatility to be negligible if a dealer could diversify his operations sufficiently.

Hypotheses concerning the expected relationship between spreads and the number of dealers making a market in a given stock depend in large part on the extent of the economies of scale associated with the dealership function. If these economies are very great -- in other words, if the marginal costs of

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[11]Of course, the size distribution of transactions also influences inventories, but we did not have data on this aspect of trading activities at our disposal.

[12]Demsetz, "Cost of Transacting," p. 48.

[13]See West and Tinic, *Economics of Stock Market*, pp. 155-169 for a comparison of results.

carrying dealer inventories decline throughout the relevant range -- we might not expect to find any significant relationship between the number of dealers and the size of spreads. On the other hand, if these economies are not very great, more likely we might expect to find a negative relationship, reflecting the impact of competitive pressure on the level of spreads. Based on both Tinic's earlier empirical findings and trading conditions in the over-the-counter market, a negative relationship became our initial working hypothesis.[14]

III. Empirical Testing

The results reported in this section are based on analyzing dealer pricing activities in the over-the-counter market for two periods: (1) the day of January 18, 1962, and (2) the first five trading days in November 1971. At the time we began the study on which this paper is based, over-the-counter volume statistics were available only for the earlier period. On November 2, 1971, however, the National Association of Securities Dealers began to issue daily volume statistics based on data collected by NASDAQ.

In view of the fact that the data provided by NASDAQ are so current, it might seem reasonable to rely solely on them for empirical testing. We believe, however, that the analysis of the two bodies of data, separated in time by nearly a decade, can provide a basis for some interesting and relevant comparisons. Put somewhat differently, it is our judgment that the 1962 data provide an excellent "bench mark" against which to compare and contrast current behavior.

A. The 1962 Data and Results

The volume data for 1962 were collected by the SEC as a part of its *Special Study of the Securities Markets*.[15] These data reflect trading volumes and dealer participation for a sample of 135 common stocks for the day of January 18, 1962. For approximately half of these stocks, however, we did not have full information concerning one or more of the factors we desired to study. Thus, our empirical results for 1962 are based on an analysis of data for 68 issues.

1. Preliminary analysis. Using the data for the 68 issues, we estimated the coefficients of the following linear multiple regression equation:

$$S_A = \alpha_0 + \alpha_1 V + \alpha_2 P_A + \alpha_3 R \pm \alpha_4 N_q \qquad (1)$$

[14]See Tinic, *Value of Time Preference*, pp. 85-118.

[15]See *Report of the Special Study of the Securities Markets of the Securities and Exchange Commission*, U.S. 88th Cong. 1st sess. House of Representatives Document 95 (Washington, D.C.: Government Printing Office, 1965), Part 2, pp. 725-728.

where:

S_A = average bid-ask spread quoted,

V = total sales and purchases,

P_A = average price of the stock (in 1961),

$R = (P_{high} - P_{low}) / P_A$, and

N_q = number of dealers quoting bid and ask prices.

The estimated coefficients are presented in Table 1, along with t-ratios and other regression statistics. These results are at once both disappointing and encouraging. On the one hand, the signs of all but one of the coefficients carry the expected sign and the F-level for the equation is significant beyond the .01 level. On the other hand, however, only the coefficient for P_A is significant and the R^2 for the equation is rather low, especially in comparison with results obtained in studies of spread behavior for listed stocks. The relatively poor "fit" no doubt reflects the use of only one day's trading data, i.e., the presence of considerable spurious variability in volume. To eliminate such variability, earlier researchers have averaged daily volumes over a number of days, weeks, or months. As mentioned above, however, we had only one day's data at our disposal for 1962.

TABLE 1

Regressor	Coefficient	t-ratio
α_0	1.2539	3.978*
V	-0.000023	-1.328
P_A	0.00496	2.236**
R	-0.22083	-0.607
N_q	-0.02060	-0.629
$R^2 = 0.182$	s.e. = 0.93029	F = 3.903***

* significant beyond α = .0005 level
** significant beyond α = .025 level
*** significant beyond α = .01 level

The low t-ratios associated with V and N_q result in part from the high intercorrelation between the two variables. When N_q is regressed against V -- see equation (2) -- the estimated coefficients and R^2 are highly significant. These results indicate, of course, that in the over-the-counter market increased trading activity typically encourages additional dealers to begin making a market.

(2)
$$N_q = 5.7321 + 0.000327\ V$$
$$(.56186)\quad(.000046)$$
$$t = 10.202 \quad 7.0345$$
$$R^2 = 0.431 \qquad s.e. = 3.42 \qquad F = 49.48.$$

In fact, the data indicate that average dealer participation, $(\frac{D_P}{N_q})$, is directly related to the level of trading activity; see equation (3). Clearly, these results would seem to indicate that significant economies of scale in the dealer function are not present in the over-the-counter trading.

(3)
$$\frac{D_P}{N_q} = 293.83 - 0.752\ R + 0.040\ V$$
$$t = 3.6 \quad 0.96 \quad 6.576$$
$$R^2 = 0.36 \qquad F = 23.652.$$

Although regression equation (1) does not suffer from severe multicollinearity,[16] the rather high intercorrelation between trading volume, V and N_q, (relative

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[16]Haitovsky's test for multicollinearity =

$|r_{ij}|$ =

V	1.000	-0.188	0.663	0.075
P	-0.188	1.000	-0.058	-0.380
N	0.663	-0.058	1.000	0.054
R	0.075	-0.380	0.054	1.000

$|r_{ij}| = 0.458$

$$X^2\ (v) \cong k \log (1 - |r_{ij}|)$$

$v = 1/2\ n\ (n-1) = 6$
$k = -[N-1-1/6(2n+5)] = -64.8$
n = no. of variables
N = no. of observations

$$X^2\ (6) \cong 17.29 \text{ (significant beyond } \alpha = 0.01).$$

See Yoel Haitovsky, "Multicollinearity in Regression Analysis: Comment," *The Review of Economics and Statistics*, LI (November 1969), pp. 486-489.

to the overall fit of the equation) makes the partitioning of explanatory power between the two variables virtually impossible. If V were excluded from the equation, the multiple coefficient of determination would not be significantly reduced, but the implications of the coefficient of N_q would be somewhat unclear since it would not only reflect the effects of competition but also the influences of trading volume.

2. Adjusting the model. Because of the problems introduced by the intercorrelation between V and N_q, we found it necessary to develop an "activity variable" which could be used to determine the relative influences of trading activity and interdealer competition on the behavior of spreads. This variable, a linear combination of V and N_q, was constructed by utilizing the principal factor method, a variation of the principal component technique in which the elements of the main diagonal of the intercorrelation matrix are replaced by communality estimates.[17] Initial estimates are provided by the square of the correlation coefficient, which is .438. The estimates can be improved by using an iterative scheme that replaces successive communality estimates by variances accounted for by the extracted factors. Iterations are continued to a point where the difference between two successive estimates is negligibly small.

The index which we constructed by this method, A_1, is

$$A_1 = 0.93750\ Z_V + 0.37500\ Z_N, \tag{4}$$

where Z_V and Z_N represent the standardized variables of V and N_q, respectively. Factor A_1 accounts for 99.9 percent of the variance and its associated eigenvalue is 1.15029. A second orthogonal factor, A_2, explains 0.1 percent of the variance and has an eigenvalue of 0.00132. Since such a large portion of the variance is accounted for by A_1, we employed this index in subsequent regression analysis. The relative influences of trading volume and interdealer competition on the bid-ask spreads were determined by substituting A_1 for V and N_q in equation (1) and multiplying its estimated coefficient by the weights assigned to them.

The results of performing the regression analysis for the adjusted equation are presented in Table 2. Based on these results, we can conclude that a unit increase in the standardized variable for trading volume tends to reduce bid-ask spreads by 0.0289, while a unit increase in the standardized variable for N_q, the number of dealers, lowers spread by 0.11569. These results imply, of

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[17]For a description of this technique see Harry H. Harman, *Modern Factor Analysis* (Chicago: University of Chicago Press, 1967).

course, that increases in trading volume have a favorable influence on spread both directly and indirectly through the attraction of additional dealers. We will have more to say about these results below. First, however, let us consider the behavior of the remaining coefficients.

TABLE 2

Regressor	Coefficient	St. Dev.	t-ratio	r^2
α_0	0.66524	0.35259	1.8867*	-
A_1	-0.03085	0.016767	-1.8400**	.0526
P_A	0.00451	0.00243	1.8592*	.0536
R	-0.35687	0.42506	-0.83956	.0114
R^2 = 0.162	s.e. = 0.9876		F = 3.939**	

*significant beyond α = .05 level
**significant beyond α = .025 level

Focusing on the estimated coefficient of P_A in Table 2, we see that it is not significantly different from the coefficient of P (.00515) reported by Tinic for NYSE listed stocks.[18] This result is consistent with what might have been expected, if one assumes that the cost of arbitrage is equal in the two markets. As mentioned above, spreads that are not proportional to prices of stocks provide opportunities for arbitrage activities, which in turn tend to equalize the cost of immediacy per dollar exchanged in different markets.

In the results presented in Tables 1 and 2, the coefficient of price volatility is statistically insignificant. This finding is inconsistent with two earlier studies of the NYSE which reported a statistically significant positive relationship between R and bid-ask spreads. The reader should bear in mind, however, that over-the-counter dealers enjoy better opportunities for diversification than stock exchange specialists. The latter can reduce risks to some extent by diversifying their positions in a limited number of stocks

[18]See West and Tinic, *Economics of Stock Market*, p. 163.

assigned to them, but over-the-counter dealers can virtually eliminate risks by positioning in a very large number of common and preferred issues as well as bonds, and by maintaining long and short portfolios of equal diversification. More importantly, they are not required to make a continuous market: there are no tick- and/or ending-balance tests to measure OTC dealers' performance. When the risk exposure becomes excessive, they can simply cease participation in the market or make very nominal quotes.[19]

3. Actual spread behavior. Since the quoted bid-ask spreads in the over-the-counter market are not necessarily "firm," they at best provide a first approximation of actual dealer pricing activities. For the sample of stocks in the 1962 data set, however, information concerning dealer purchase and sale prices is reported. On the assumption that the differences between these prices are free from brokerage commissions, they of course represent the real magnitude of dealer pricing in over-the-counter stocks and can be used to determine the actual prices paid by traders who demand immediacy.[20]

In order to determine the effects of interdealer competition on the actual dealer prices, we again found it necessary to develop an activity variable which could be used in place of N_q and V in our basic equation. With the inclusion of this variable and the deletion of R (in view of its insignificance in earlier results), we obtained the following equation:

$$D_M = \alpha_0 + \alpha_1 P_A + \alpha_2 A_1 \tag{5}$$

where:

D_M = actual margin between dealers' sales and purchase prices,
P_A = average price (in 1961), and
$A_1 = 0.93750\ Z_V + 0.37500\ Z_N$.

The estimated coefficients of this equation are presented in Table 3.

The coefficient of A_1 in Table 3 indicates that the separate effects of trading volume and the number of market makers on actual margins are -0.01214 and -0.00485 per unit increase of Z_V and Z_N, respectively. Once again, we find that increases in volume have a "double barrelled" impact on margins.

B. The 1971 Data and Results

With the advent of NASDAQ and the disclosure of information on daily trading

[19]A discussion of the question of dealers' ability to influence their inventory positions by varying the bid-ask spread is found in the appendix to this paper.

[20]Our interpretation of the data as presented in the *Special Study* was that they were free from brokerage commissions.

TABLE 3

Regressor	Coefficient	St. Dev.	t-ratio	r^2
α_0	0.24921	0.08433	3.0983*	-
P_A	0.002144	0.000795	2.6962*	0.10495
A_1	-0.01295	0.00527	-2.1850***	0.0715
R^2 = 0.1964	s.e. = 0.349		F = 7.757**	

*significant beyond α = 0.005 level
**significant beyond α = 0.0005 level
***significant beyond α = 0.025 level

volume in over-the-counter markets, it recently became possible for us to retest our hypotheses with current data, a larger sample of common stocks, and a longer trading period. In the following sections, we present the methodology and the results of our empirical tests using 1971 data.

1. The model and analysis. The sample used in the analysis of 1971 data includes 300 common stocks.[21] Unlike the 1962 sample in which we were forced to use information on only one trading day, the NASDAQ data enabled us to avoid spurious day-to-day variability in trading activity, bid-ask spreads, and the number of dealers by averaging over the first five trading days in November. The data on average daily trading volume, spreads, and dealers should portray the more stable, longer-run trading characteristics of the stocks in our sample.

Using these data, the coefficients of the following linear multiple regression equation were estimated:

$$S_A = \lambda_0 + \lambda_1 \ln V + \lambda_2 P_A + \lambda_3 R + \lambda_4 N_q + u \tag{6}$$

[21] Wall Street Journal (November 1-5, 1971), pp. 20, 24, 28, 22, 18, respectively.

where:

S_A = average representative bid-ask spread,

V = average daily trading volume,

P_A = average price,

R = price volatility = $(P_{high} - P_{low})/P_A \times 10{,}000$

N_q = average number of dealers quoting bid and ask prices on both sides of the market, and

u = random disturbance.

The estimated coefficients of this equation are presented in Table 4. All of the coefficients carry the hypothesized signs and, with the exception of price volatility, R, they are statistically significant. As we anticipated, the larger cross section of stocks and trading days substantially improved the explanatory power of the model.

More importantly, the larger sample size made the partitioning of explanatory power between trading volume and the number of dealers possible, thereby eliminating the need for constructing an "activity index, A_1." Indeed, when the equation was tested for multicollinearity, the null hypothesis that the

TABLE 4

Regressor	Coefficient	St. Dev.	t-ratio	r^2
λ_0	1.17865	0.1405	8.3873*	-
lnV	-0.08376	0.02131	-3.9316*	0.04979
P_A	0.01320	0.00086	15.409*	0.4459
R	0.0000025	0.000012	0.20402	0.00014
N_q	-0.000328	0.0000946	-3.4746**	0.0393
$R^2 = 0.497$	R^2(adjusted) = 0.490			
s.e. = 0.3798	F (4,295) = 72.9496			

* significant beyond $\alpha = 0.001$ level

** significant beyond $\alpha = 0.002$ level independent variables were severely multicollinear was rejected at a lower level of significance than $\alpha = 0.0001$.[22] Hence, on the basis of these results we can safely infer that increased competition, as it is measured by the number of dealers maintaining open orders on both sides of the market, N_q, has a distinct contribution to the explanatory power of the model.[23]

When N_q is replaced by N_T, the total number of dealers who are interested in a stock -- including dealers who have no open orders to buy and/or sell -- the estimated coefficients of the model are not substantially altered, but the explanatory power of the model is slightly reduced. In Table 5, we present the estimated coefficients of equation (6) when N_T, the total number of dealers, is employed as a measure of interdealer competition instead of N_q.

We also investigated the relationship between trading activity and the number of dealers making markets. Using the 1971 data, we estimated the following two linear regression equations, where trading volume was used as the regressor and N_q and N_T were incorporated as dependent variables.

$$N_q = \underset{\substack{(0.17190) \\ t = 24.140}}{4.149771} + \underset{\substack{(0.0000119) \\ 12.127}}{0.000145V} \tag{7}$$

$$R^2 = 0.328 \qquad s.e. = 2.5768 \qquad F = 147.06,$$

and

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[22]Haitovsky's test for multicollinearity:

$$[r_{ij}] = \begin{array}{c} \ln V \\ P_A \\ R \\ N_T \end{array} \overset{\begin{array}{cccc} \ln V & P_A & R & N_T \end{array}}{\begin{bmatrix} 1.000 & 0.173 & 0.065 & 0.733 \\ 0.173 & 1.000 & -0.060 & 0.093 \\ 0.065 & -0.060 & 1.000 & -0.290 \\ 0.733 & 0.093 & -0.290 & 1.000 \end{bmatrix}}$$

$|r_{ij}| = 0.986$

$X_H^2\ (6) \cong 551.2^*$

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*significant beyond the $\alpha = 0.0001$ level.

[23]Without N_q the R^2 would have been 0.477 as opposed to its current level of 0.490.

TABLE 5

Regressor	Coefficient	St. Dev.	t-ratio	r^2
λ_0	1.14940	0.15042	7.6414*	-
lnV	-0.08138	0.02338	-3.4800*	0.03943
P_A	0.01325	0.00086	15.393*	0.44543
R	0.0000025	0.000012	0.20452	0.00014
N_T	-0.000205	0.000068	-3.0311**	0.3020

$R^2 = 0.492$ R^2 (adjusted) = 0.486

s.e. = 0.3817 F (4,295) = 71.5711

*significant beyond $\alpha = 0.001$ level
**significant beyond $\alpha = 0.005$ level

(8)
$$N_T = \underset{(0.24852)}{6.08489} + \underset{(.000017)}{0.000248V}$$
$$t = 24.484 \qquad 14.296$$
$$R^2 = 0.4048 \quad \text{s.e.} = 3.725 \quad F = 204.39.$$

Although the R^2's for these equations are slightly lower than the R^2 estimated with 1962 data, trading activity still remains a dominant factor in determining the number of dealers to participate in the market-making process. However, even though a larger number of dealers prefer to make markets in relatively active issues, competition among dealers tends to reduce bid-ask spreads of all common stocks irrespective of their level of trading activity.

C. Comparison of 1962 and 1971 Findings

Due to the significant differences in the sizes of the samples for 1962 and 1971 and the variations in statistical methodology employed, it is not possible to make direct comparisons of the coefficients of the models estimated for these two periods. Nevertheless, it is still fruitful to compare the general implications of these findings. In both time periods, for example, the bid-ask spreads are positively related to the price level of the stocks, thus tending to equalize the cost of dealer services per dollar of securities exchanged by traders. It is also interesting to note that, in both time periods, the price volatility of stocks does not seem to exert any systematic influence on the marketability of common stocks. In other words, all other things being equal, variability in the equilibrium level of price over the short run does not reduce the marketability of stocks; this would seem to imply that dealers' costs are not increased by price volatility, thereby lending support to our hypotheses regarding the ease with which over-the-counter dealers can reduce risks through portfolio diversification.

The results obtained in both time periods concur with respect to the influences of trading volume and interdealer competition on the bid-ask spreads. Thus, in spite of the various changes in the over-the-counter market in response to the SEC reforms of 1964-1965 and the more recent advent of NASDAQ, the fundamental relationship between the level of trading activity and the number of dealers has remained remarkably stable.

In summary, the general implications of the results in the 1962 and 1971 samples are quite similar, leading us to conclude that the explanatory variables such as price, trading activity, and the intensity of competition are probably the basic determinants of the size of bid-ask spreads.

IV. Analysis and Interpretation

The results described above indicate that, for the two samples of over-the-counter stocks studied, increases in the number of dealers quoting a market were significantly related to the price level of dealer services in an inverse fashion. As already mentioned, this finding provides support for Tinic's earlier results but contradicts the conclusions reached by Demsetz and the NYSE. In this section we will try to rationalize these inconsistencies and to discuss briefly the implications of our results.

It is our judgment that the inconsistencies implicit in the comparative results of the various studies of the behavior of dealer prices can be explained largely in terms of (1) differences in the way competition is measured and (2) differences among the types of markets studied. Elsewhere we have already discussed the importance of the first factor as it relates to the studies of the NYSE and Demsetz, on the one hand, and Tinic, on the other.[24] Briefly, we believe that Tinic's method of measuring the impact of the importance regional exchange and OTC competition has on the behavior of the price of dealer services on the NYSE is far superior to Demsetz's or the NYSE's. Since Tinic's findings are generally

[24]See West and Tinic, *Economics of Stock Market*, pp. 160-168.

consistent with those reported in this paper, we might thus conclude that the inconsistency between our results and those of Demsetz and the NYSE can also be attributed to methodological differences. To do so, however, would almost certainly involve oversimplifying the issues: it is our suspicion that, although the methodological differences account for part of the inconsistency, differences among the types of markets studied are also involved. Let us elaborate.

For stocks that are well suited to trading in a continuous auction market such as that made on the major stock exchanges, it seems likely that there are *some* economies of scale associated with the continuous auction market. In other words, the costs of transacting may decline as the volume of trading in an issue increases. Demsetz and the NYSE have interpreted these scale economies as if they pertained to the specialists' dealership function. Tinic, on the other hand, argues that there is no theoretical or empirical support for scale economies associated with the dealership function.[25] If he is correct, the scale economies associated with the continuous auction markets (as a whole) would seem to result from economies in the central brokerage function of the specialist system. Consequently, the specialist, as an aggregate unit performing this dual role, may experience economies of scale. In other words, the absence of scale economies in the dealer function, per se, does not necessarily imply the existence of no economies in the specialist system.

The results presented in this paper, however, indicate that virtually no economies seem to be associated with the dealer function in the over-the-counter market, which is not organized on a continuous auction basis. Given this fact, it may be the case that our findings cannot be directly compared with the aggregated role of the specialists on the NYSE. If so, the inconsistency we have been discussing is of no real consequence and our findings need not have significant implications for exchange behavior. In particular, to the extent that the economies of scale associated with the central brokerage function on the NYSE are greater than on the over-the-counter market, it would seem that we cannot definitely conclude that increasing competition among dealers would necessarily result in lower spreads; it might and, then again, it might not. Interspecialist competition on the NYSE would lead to lower spreads only if the monopoly margins of the specialists in their market-making function were larger than the increase in central brokerage costs that would result due to multiple specialist units.

For the future, nevertheless, it seems reasonable to hypothesize that our findings concerning the over-the-counter market may have very significant implications for the exchanges. We base this judgment on the fact that recent, ongoing

[25] See Tinic, *Value of Time Preference*, p. 76.

developments such as the growth of the third market and NASDAQ indicate that, for a growing number of stocks, the continuous auction method of market making is becoming less viable.[26] To the extent that these and related developments and the growth in demand for dealer services continue, an increasing amount of trading in common stocks now listed on the exchanges can be expected to revert to an over-the-counter type of market, where competition in the dealer function does appear to have an important impact on the level of spreads.

[26]See West, "Institutional Investors," pp. 17 ff., and C. Welles, "Can the New York Stock Exchange Survive," *Institutional Investor* (June 1970), pp. 29 ff.

APPENDIX

The Dealer Purchase-Sales Function

As noted in Section IV above, dealers can adjust their rate of participation in the market in a number of ways. One way is to withdraw from the market by refusing to quote bid and ask prices, another is to vary the size of positions that will be taken at various prices, and a third is to manipulate the bid-ask spread. By taking either of the first two avenues, a dealer *directly* influences his participation rate. Varying the size of the spread has an indirect effect on participation which depends on the price elasticity of demand for dealer services, that is, on the demand for predictable immediacy. If elasticity is high, relatively small variations in spreads should have a significant impact on the level of dealer participation. If demand is relatively inelastic, however, varying the spread may not be an effective way to manipulate participation.

To examine the responsiveness of dealer participation to variations in spreads, we formulated the following regression model:

$$D_P = \alpha_0 + \alpha_1 A_1 + \alpha_2 S_A + \alpha_3 R + \alpha_4 P_A \quad \text{(1a)}$$

where:

D_P = dealer participation measured by (dealer purchases + sales),

S_A = 1000 (bid-ask spread),

$R = \dfrac{\text{Price (high)} - \text{Price (low)}}{P_A}$,

P_A = Average Price (in 1961), and

A_1 = activity factor.

In this equation, D_P represents the quantity of dealer services demanded by traders and S_A is the price of these services. A negative coefficient of S_A would, presumably, validate the hypothesis that dealers can alter their participation in the market by adjusting the prices of these services. By computing an average elasticity measure, we should be able possibly to provide a first approximation of the price elasticity of demand for dealer services.

The estimated coefficients of equation (1a), based on the data for 1962, are presented in Table 1a.[27]

With the exception of price volatility, all the coefficients are statistically significant and carry the anticipated signs. The elasticity of demand for dealer services implied by the coefficient of S_A is substantially below unity.

[27] Unfortunately, dealer participation data are not available for more recent periods.

TABLE 1a

Regressors	Coefficient	St. Dev.	t-ratio	r^2
α_0	12759.05	1002.748	12.724*	-
A_1	706.3426	47.6209	14.833*	0.7857
S_A	-0.904982	0.35394	-2.5568**	0.09825
R	298.1174	1181.811	0.25225	0.00106
P_A	33.22696	6.89277	4.8206*	0.27917
$R^2 = 0.81194$	s.e. = 2730.07		F = 64.76*	

*significant beyond $\alpha = 0.005$ level
**significant beyond $\alpha = 0.01$ level

Specifically, $\Sigma_L = -904.98 \cdot \frac{0.981}{5191} = -0.171.$[28] Thus, at least for the 1962 data, the demand for dealers' services is quite inelastic.

Moreover, the results imply that dealers supply greater liquidity (illiquidity) services in relatively active issues. Interdealer competition, however, seems to improve the depth of liquidity for both active and inactive stocks.

Essentially the same results are obtained when the price of dealer services is expressed as a percentage of a stock's price. The price elasticity of dealer services is not significantly altered: $\Sigma_L = -0.1142$ (see Table 2a).

(2a)
$$D_P = \sigma_0 + \sigma_1 A_1 + \sigma_2 \frac{S_A}{P_A} + \sigma_3 R.$$

[28] Algebraically,

$$\Sigma_L = \frac{\partial D_P}{\partial S_A} \cdot \frac{\overline{S}_A}{\overline{D}_P}$$

where:
$\overline{S}_A$ = average value of S_A, and
$\overline{D}_P$ = average dealer purchases and sales.

TABLE 2a

Regressors	Coefficient	St. Dev.	t-ratio	r^2
σ_0	14125.29	877.1334	16.104*	-
A_1	671.426	53.12146	12.639*	.7237
S_A/P_A	-12.28251	5.7144	-2.1494**	.0704
R	-49.3562	37.2819	-1.3239	.0279
$R^2 = 0.7494$	s.e. = 3125.459		F = 60.8101*	

*significant beyond $\alpha = 0.005$ level
**significant beyond $\alpha = 0.025$ level

It should be noted, however, the elasticity measure estimates by these two equations provide an approximate value for the *industry demand* elasticity. One would expect the elasticity of demand facing individual dealers to be quite elastic. In addition, the data utilized in our statistical analyses reflect the conditions in 1962 when the activities of institutional traders in over-the-counter stocks was much less pronounced. If current data were available, it should not be surprising to discover a relatively larger elasticity value at this time.

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