ELSEVIER

Journal of Financial Economics 41 (1996) 465–474

JOURNAL OF Financial ECONOMICS

Why Nasdaq market makers avoid odd-eighth quotes

Paul E. Godek

Economists Incorporated, Washington, DC 20036, USA

(Received July 1995; final version received September 1995)

Abstract

Recent studies argue that implicit collusion explains the tendency of Nasdaq market makers to avoid odd-eighth price quotes. This paper focuses on the role that preference trading plays in determining quoted spreads. Under the postulated effects of preference trading, an analysis of the relation between spreads and price fractions explains the paucity of odd-eighth quotes on Nasdaq. Empirical results from a comprehensive data set show that exogenous economic characteristics explain the distribution of price fractions across securities, and illustrate the stability of that distribution over time. These results contradict empirical results offered as support for the collusion hypothesis.

Key words: Nasdaq market markers; Quotes; Spreads; Preference trading; Collusion
JEL classification: D23; G18; K21

1. Introduction

It has been discovered that Nasdaq market makers persistently avoid odd-eighth quotes on many, but not all, listed securities – a fascinating enigma. To be more specific, Christie and Schultz (1994) find a bimodal distribution of odd-eighth price fractions on the inside quoted spreads for a sample of Nasdaq securities. About one-third of the securities in their sample have a distribution of odd-eighth price fractions centered near 50%, as expected. For the remaining two-thirds of the securities, however, the frequency of odd-eighth price fractions is near zero.

The author thanks Kenneth Cone, Dean Furbush, Margaret Guerin-Calvert, Gregg Jarrell, Kent Mikkelsen, Merton Miller, G. William Schwert, David Smith, Jeffrey Smith, Bruce Snapp, and René Stulz for helpful comments. The views expressed are the author's alone.

SSDI 0304-405X(95)00863-A

Christie and Schultz argue that market makers competing for order flow would not avoid odd-eighth price fractions without an implicit agreement to do so. They further argue that the inability of a cost-based econometric model to explain the bimodal distribution of price fractions supports the implicit-collusion hypothesis. In a subsequent paper, Christie, Harris, and Schultz (1994) study the effect that the publicity surrounding the Christie and Schultz paper had on quoted spreads. They again argue that the results suggest implicit collusion.

The focus on collusion, however, understates the importance of preference trading as an institutional determinant of quoted spreads. Under the postulated effects of preference trading, an analysis of the relation between spreads and price fractions explains the paucity of odd-eighth quotes on Nasdaq. Consistent with that analysis, empirical results from a comprehensive data set show that exogenous economic characteristics explain the distribution of price fractions across securities. The data also reveal the stability of that distribution in the face of substantial adverse publicity. The empirical results are, therefore, in opposition to those offered as support for the collusion hypothesis.

The paper is organized as follows. Section 2 examines the role that preference trading plays in the competitive interaction among market makers and in the determination of quoted spreads. Section 3 examines the mathematical relation between spreads, price fractions, and clustering. The empirical relation between the economic characteristics of securities and the distribution of price fractions is discussed in Section 4, and the stability of that distribution over the relevant time period is demonstrated in Section 5. Section 6 concludes with a brief mention of the broader questions posed by the issues analyzed in the paper.

2. Preference trading

The clustering of quotes on even-eighth price fractions is a common phenomenon on securities exchanges.[1] While there is that reason to expect some clustering on Nasdaq, the question is whether there is more clustering than would occur in a competitive equilibrium. (Clustering means that, on the inside quoted spread, even-eighth price fractions constitute significantly more than 50% of all price fractions.) To understand this aspect of the Nasdaq market, it is first necessary to understand one of the mechanisms affecting the interaction of market makers.

As Christie and Schultz note, brokers and market makers on Nasdaq are allowed to direct or 'preference' an order to any market maker who has agreed

[1]Grossman et al. (1995) show the prevalence of stock *quote* clustering. Harris (1991) documents the prevalence of stock *price* clustering. Christie and Schultz find clustering in their NYSE/AMEX sample, where even-eighth price fractions are about 55% of all price fractions.

in advance to execute orders at the best quoted price, regardless of the price actually quoted by the market maker to whom the order is directed. (The term 'best price' refers to the best quoted bid or ask.) That is, brokers and market makers are not required to trade with the market maker offering the best price, as long as they fulfill their obligation to execute the trade at the best price. And virtually all market makers are 'preference traders'; that is, they have agreed in advance to execute orders at the best price.

It is clear that preference trading can diminish the incentive to narrow the quoted spread. Since no competitor has the incentive to encourage narrow spreads, and since the transaction occurs at the best price anyway, market makers might well be expected to routinely pass over a competitor offering an unusually good price. To the extent that preference trading encourages passing over such prices, it discourages them from being offered at all. Compared to offering the single best price, a market maker may get more order flow by queuing up with others at a more common, less favorable price. Hence, narrowing the spread below a certain level might not only fail to attract trades, but could actually tend to repel them. In that case, there can be a disincentive to narrow the spread.[2]

Preference trading also allows brokers and market makers to direct trades based on nonprice considerations, such as established business relationships or pre-arranged 'payments for order flow', which are rebates paid by market makers to retail brokers. Similarly, a market maker is allowed to execute an order internally – in effect, preference trading with itself – as long as the trade occurs at the inside spread. In those cases as well, because preference trading attenuates the connection between the best price and order flow, a market maker does not necessarily gain an advantage in attracting order flow by narrowing the spread.

3. Even-eighth price fractions, even-eighth spreads, and clustering

Quoted spreads are, of course, only one indicator of overall transactions costs, and whether or not the transactions costs on Nasdaq tend to be higher than on other exchanges is a complex and unsettled question. The most recent study of transactions costs is by Huang and Stoll (1996). For other examples, see Affleck-Graves et al. (1994) and Schwartz (1993). [That preference trading could help explain the level of transactions costs on Nasdaq has not to my knowledge

[2]It may seem that this analysis, which is based on the incentive to pass over the narrowest quoted spread, implies no limit to the bid–ask spread. That is not correct. Even monopoly prices are finite. The point is that preference trading increases the (competitive) quoted spread. But whether spreads are competitive or collusive, they are no wider than if they were set by a monopolist.

been suggested before, although Huang and Stoll (1992) recognize the spread-increasing incentives of the practice.] In any case, the focus here is on the prevalence of even-eighth price fractions on Nasdaq quotes. Once the effect of preference trading on the distribution of spreads has been taken into account, the low incidence of odd-eighth price fractions becomes less of a mystery.

Since odd-eighth spreads involve one even- and one odd-eighth price fraction, while even-eighth spreads involve either two even- or two odd-eighth price fractions, the discrepancy between even- and odd-eighth price fractions reflects an asymmetric distribution of even-eighth spreads. ('Even-eighth spreads' are those evenly divisible by 0.25.) That is, the clustering of quotes around even-eighth price fractions implies that even-eighth spreads occur disproportionately on even-eighth price fractions. Indeed, the discrepancy between even- and odd-eighth price fractions reveals the amount by which even-eighth spreads occur disproportionately on even-eighth price fractions.

Let α represent the percentage of even-eighth price fractions, γ represent the percentage of even-eighth spreads, and θ represent the percentage of even-eighth spreads that occur on even-eighth price fractions. Finally, let δ represent the discrepancy between even- and odd-eighth price fractions. Thus:

$$\delta = \alpha - (1 - \alpha) = 2\alpha - 1 . \tag{1}$$

It is straightforward to show that the percentage of even-eighth spreads that occurs on even-eighth price fractions is given by

$$\theta = (\delta + \gamma)/(2\gamma) . \tag{2}$$

Rearranging Eq. (2) reveals the relation between the discrepancy (δ) and the amount by which even-eighth spreads occur more frequently on even-eighth price fractions (θ):

$$\delta = 2\gamma(\theta - \tfrac{1}{2}) . \tag{3}$$

Eq. (3) shows that the discrepancy between even- and odd-eighth price fractions is directly associated with a disproportionate share of even-eighth spreads occurring on even-eighth price fractions (indicated by $\theta > \frac{1}{2}$). Hence, clustering, which occurs to some extent on all securities exchanges, means that even-eighth spreads occur disproportionately on even-eighth price fractions.

Indeed, those few securities on the NYSE that are quoted predominately in even-eighth spreads are also quoted predominately on even-eighth price fractions. On both the NYSE and Nasdaq, as the proportion of even-eighth spreads approaches one, the proportion of even-eighth price fractions also approaches one. In this respect, the difference between the other exchanges and Nasdaq is not the distribution of even-eighth price fractions (conditional on the proportion of even-eighth spreads), it is the distribution of even-eighth spreads.

How would the distribution of price fractions reflect the distribution of spreads on Nasdaq, compared with other exchanges? Substantially fewer

spreads of one-eighth, which is the most common odd-eighth spread on other exchanges, increases the incidence of even-eighth spreads. Given that even-eighth spreads tend to fall disproportionately on even-eighth price fractions, a higher proportion of even-eighth price fractions is expected. Since there is nothing surprising about a prevalence of even-eighth spreads – given preference trading – there is nothing surprising about a prevalence of even-eighth price fractions.

4. Economic fundamentals and the bimodal distribution

Not only is there an overall preponderance of even-eighth price fractions on Nasdaq, but it is also true that those price fractions are asymmetrically distributed. Across all of the approximately 2,500 Nasdaq National Market (NNM) common stocks, Fig. 1 shows a bimodal distribution similar to that in the Christie and Schultz sample of 100 securities.[3] About one-third of the securities have more than 25% odd-eighth price fractions, with a distribution of their average percentage of odd-eighth price fractions centered near 50%. About two-thirds of the securities have fewer than 25% odd-eighth price fractions, with a distribution of their average percentage of odd-eighth price fractions near zero. Can the exogenous economic characteristics that determine the transactions costs of securities explain the distribution of price fractions?

To answer that question, Christie and Schultz examine four exogenous characteristics of a security normally associated with the spread. The characteristics are the security's price, volume, return variance, and market capitalization. The specific question is whether a logistic model, with those characteristics as independent variables, can correctly classify securities into the two regions of the price-fraction distribution. A high correlation between exogenous cost factors and the distribution of price fractions would tend to refute the collusion hypothesis. The logistic model's lack of explanatory power in their sample leads Christie and Schultz to conclude that economic fundamentals do not explain the absence of odd-eighth quotes.

The results in Table 1 (panel A) show that for all NNM common stocks, however, the same logistic model is highly successful at correctly assigning

[3]NNM securities are the more actively traded Nasdaq securities that meet certain standards for such criteria as net assets and number of publicly available shares. The requisite data are available for these securities, unlike the Nasdaq Small Cap securities. See the 1993 Nasdaq Fact Book & Company Directory. All data in this paper are from the NYSE's TAQ database, which became available for Nasdaq securities beginning in 1993. Following Christie and Schultz, stocks are classified into the few-odd-eighths group if the proportion of odd-eighth price fractions on the inside quoted spread is below 25%.

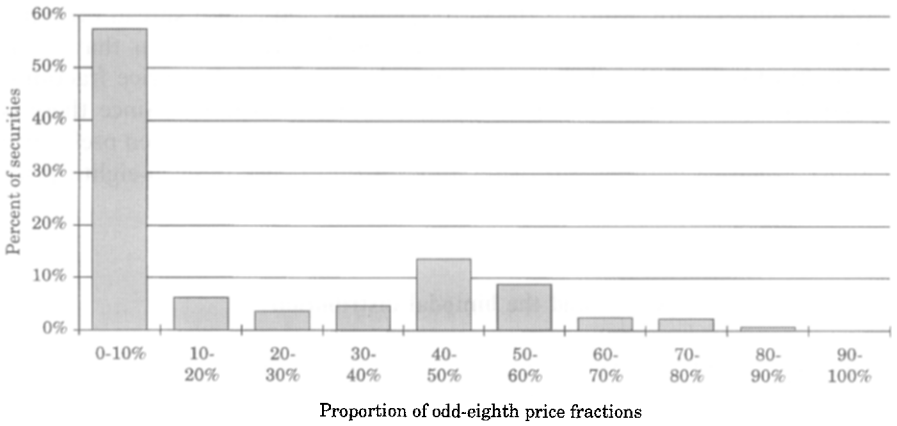

Fig. 1. Distribution of odd-eighth price fractions on inside quoted spreads, Nasdaq national market common stocks: 1993. *Source*: See Table 1.

securities to the two regions of the price-fraction distribution. With the exception of market capitalization, all of the exogenous variables are highly significant. The model correctly classifies 87.0% of the 2,486 securities. A prediction that all securities will be in the few-odd-eighths group, referred to as the naive model, correctly classifies 65.6%. The difference between the fitted model and the naive model is 21.4 percentage points, out of a maximum possible difference of 34.4 percentage points (34.4 = 100 – 65.6). That ratio (21.4/34.4) has been suggested as a reasonable goodness-of-fit measure for logistic regressions – a pseudo-R^2 – which equals 0.622 in this case (see Amemiya, 1981). As a whole, the regression model is highly significant.

Furthermore, the distribution based on the entire year hides the fact that within the year there is substantial switching between the few-odd-eighths and the many-odd-eighths groups. Only 1,874 of the 2,486 securities (75.4%) stay consistently within one group or the other for all 12 months of 1993. For the securities that do stay within one group or the other throughout the year, the logistic regression generates the results in Table 1 (panel B). The percent correct increases to 92.2, while a naive model correctly classifies 68.6%, an increase of 23.6 percentage points out of a possible 31.4 (31.4 = 100 – 68.6). The ratio 23.6/31.4 generates a pseudo-R^2 of 0.752.

While more remains to be done to better understand the bimodal distribution, three economic fundamentals normally associated with spreads – a security's price, trading volume, and variance of return – are significant and important determinants of the frequency of odd-eighth price fractions. The higher the price, the lower the volume, and the higher the return variance, the more likely it is that securities are quoted predominately on even-eighth price fractions. It can be

Table 1
Logistic regressions that classify stocks according to their frequency of odd-eighth price fractions

Variable	Parameter estimate	Standard error	*t*-statistic
Panel A: Data set: All 2,486 Nasdaq national market (NNM) common stocks, 1993			
PRICE	−4.258	0.221	19.284*
VARIANCE	−0.883	0.108	8.167*
VOLUME	1.709	0.116	14.717*
MKTVALUE	0.006	0.129	0.043
Model chi-square		1,134.357*	
Overall % correctly classified		87.0%	
Few-odd-eighths correctly classified		89.4%	
Many-odd-eighths correctly classified		82.3%	
Panel B: Data set: 1,874 NNM common stocks that did not switch groups across months in 1993			
PRICE	−5.925	0.384	15.446*
VARIANCE	−1.485	0.181	8.199*
VOLUME	2.536	0.204	12.457*
MKTVALUE	0.066	0.197	0.335
Model chi-square		1,001.678*	
Overall % correctly classified		92.2%	
Few-odd-eighths correctly classified		93.5%	
Many-odd-eighths correctly classified		91.0%	

Securities are classified as being quoted in odd-eighths – and the dependent variable takes a value of 1 – if the proportion of quotes on odd-eighths is a least 25%. The logistic regression estimates a probability that a security will be quoted in odd-eighths and classifies it accordingly. The independent variables are as follows: *PRICE* is the average of the bid–ask midpoint over all quotes; *VARIANCE* is measured using daily returns calculated from the midpoint of the closing bid–ask spread; *VOLUME* is total yearly volume; *MKTVALUE* is shares outstanding times price. Independent variables are in natural logs. Data are from the NYSE's TAQ database.

Asterisks (*) indicate significance at the 1% level.

inferred that when the economic fundamentals of a security (and the trading structure on Nasdaq) lead to quoted spreads of at least 0.25 then even-eighth spreads, and consequently even-eighth price fractions, will dominate.

5. A stable equilibrium

In a subsequent study, Christie, Harris, and Schultz (1994) document the effect that the Christie and Schultz (1994) paper had on certain Nasdaq stocks. They found that newspaper articles about the initial study led to declines in spreads through the use of odd-eighth quotes for four of five stocks that had routinely

been quoted only in even-eighths. Those newspaper articles followed an NASD meeting with market makers about the impending publicity and the prospect of increased regulation. The newspaper articles also preceded private lawsuits filed against market makers, alleging antitrust and securities law violations. Christie, Harris, and Schultz state that it is difficult to reconcile a competitive model with the immediate decline in trading costs through the use of odd-eighths. It should be noted, however, that price declines around the announcement of antitrust lawsuits have been observed in other instances, in particular in cases where the parties were eventually acquitted (see Sproul, 1993). Sproul's research suggests that it might have been more surprising had there been no effect whatsoever from the confluence of events at the end of May 1994, regardless of the degree of competition.

To investigate this phenomenon further, Fig. 2 shows the monthly fraction of securities with more than 25% odd-eighth price fractions for all 2,182 NNM common stocks that traded throughout 1993–94. The percentages for the months immediately following May 1994 continue along the slight upward trend established over the prior year. (The emergence of the upward trend in the middle of 1993 is associated with a change in the 'excess-spread' rule. The excess-spread rule confines quote revisions to be within 125% of the average of the three narrowest spreads.) Indeed, the percentage change from May to June in the number of securities in the odd-eighths group is not significantly different from the changes over the 12 prior months. Adding July through September to the post-event period still produces no significant effect. One can detect a slight increase in the trend only by looking four or five months after the relevant events.

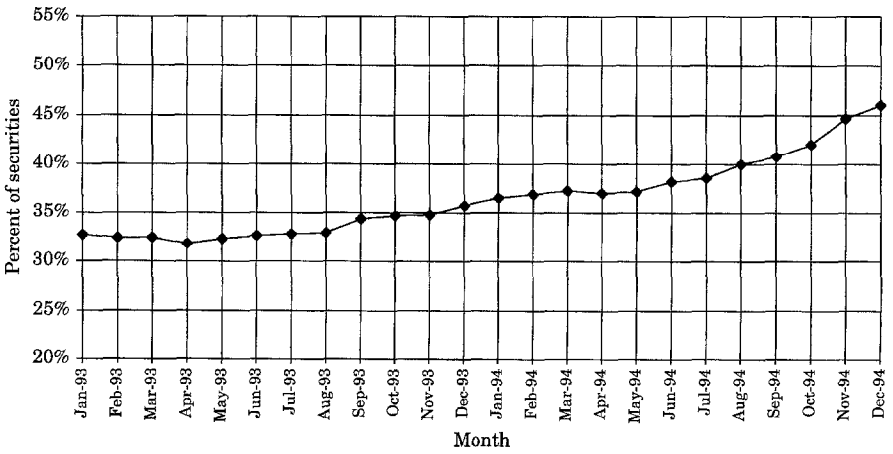

Fig. 2. Percent of Nasdaq national market securities with more than 25% odd-eighth price fractions on inside quoted spread: 1993–1994. *Source*: See Table 1.

In addition, the stable trend occurs despite a substantial amount of switching between the few-odd-eighths and the many-odd-eighths groups. Table 2 shows the number of securities switching groups from month to month over these two years. From May 1994 to June 1994, 71 securities switch from the few-odd-eighths group to the many-odd-eighths group, and 48 securities switch in the other direction. From May 1994 to June 1994, the percentage of securities switching to the few-odd-eighths group *exceeds* the percentage of securities switching to the many-odd-eighths group, a pattern that is consistent with the prior 12 months. (The frequency and consistency of the overall switching suggests that it is due to changes in the exogenous characteristics of the individual securities over time.) Again, one can detect a slight change in the trend, but only by looking four or five months after the relevant events. The inherent stability observed, despite the legal and regulatory turbulence, refutes the implication that the Christie and Schultz paper substantially affected the Nasdaq market.

Table 2
Number of securities switching between groups

Month	Odds	Evens	To odds	To evens	To odds/ evens	To evens/ odds	Difference
Jan-93	714	1468	–	–	–	–	–
Feb-93	707	1475	57	64	3.88%	8.96%	– 5.08
Mar-93	708	1474	57	56	3.86%	7.92%	– 4.06
Apr-93	694	1488	44	58	2.99%	8.19%	– 5.21
May-93	705	1477	60	49	4.03%	7.06%	– 3.03
Jun-93	712	1470	53	46	3.59%	6.52%	– 2.94
Jul-93	716	1466	57	53	3.88%	7.44%	– 3.57
Aug-93	719	1463	56	53	3.82%	7.40%	– 3.58
Sep-93	750	1432	72	41	4.92%	5.70%	– 0.78
Oct-93	757	1425	53	46	3.70%	6.13%	– 2.43
Nov-93	759	1423	53	51	3.72%	6.74%	– 3.02
Dec-93	780	1402	51	30	3.58%	3.95%	– 0.37
Jan-94	797	1385	53	36	3.78%	4.62%	– 0.84
Feb-94	805	1377	49	41	3.54%	5.14%	– 1.61
Mar-94	813	1369	47	39	3.41%	4.84%	– 1.43
Apr-94	808	1374	47	52	3.43%	6.40%	– 2.96
May-94	811	1371	57	54	4.15%	6.68%	– 2.53
Jun-94	**834**	**1348**	**71**	**48**	**5.18%**	**5.92%**	**– 0.74**
Jul-94	842	1340	69	61	5.12%	7.31%	– 2.20
Aug-94	873	1309	78	47	5.82%	5.58%	0.24
Sep-94	890	1292	62	45	4.74%	5.15%	– 0.42
Oct-94	918	1264	77	49	5.96%	5.51%	0.45
Nov-94	975	1207	92	35	7.28%	3.81%	3.47
Dec-94	1005	1177	68	38	5.63%	3.90%	1.74

'Odds' refers to the number of securities in the many-odd-eighths group. 'Evens' refers to the number of securities in the few-odd-eighths group.

6. Conclusion

Based on a comprehensive data set, the empirical results presented here are in opposition to results offered in support of the collusion hypothesis. The results suggest that the few-odd-eighths phenomenon can be characterized as a competitive equilibrium under the current trading structure. That characterization, of course, does not necessarily imply that the trading structure itself is efficient. Economic theory does imply, however, that given the number of market makers and the lack of entry barriers, excess profits that would otherwise exist under the current trading structure would be competed away – if not on price, then along other margins. Examining how the potential profits from wide quoted spreads are competed away could reveal the costs and benefits of that structure. Stated differently, does preference trading induce an excess supply of market-maker services, or is it a necessary component of a diffuse market-maker system? That broader question remains to be addressed.

References

Affleck-Graves, John, Shantaram P. Hedge, and Robert E. Miller, 1994, Trading mechanisms and the components of the bid–ask spread, Journal of Finance 49, 1471–1488.

Amemiya, Takeshi, 1981, Qualitative response models: A survey, Journal of Economic Literature 19, 1483–1536.

Christie, William G. and Paul H. Schultz, 1994, Why do Nasdaq market makers avoid odd-eighth quotes?, Journal of Finance 49, 1813–1840.

Christie, William G., Jeffrey H. Harris, and Paul H. Schultz, 1994, Why did Nasdaq market makers stop avoiding odd-eighth quotes?, Journal of Finance 49, 1841–1860.

Grossman, Sanford J., Merton H. Miller, Daniel R. Fischel, Kenneth R. Cone, and David J. Ross, 1995, Clustering and competition in asset markets, A Lexecon report.

Harris, Lawrence, 1991, Stock price clustering and discreteness, Review of Financial Studies 4, 389–415.

Huang, Roger D. and Hans R. Stoll, 1992, The design of trading systems: Lessons from abroad, Financial Analysts Journal 48, 49–54.

Huang, Roger D. and Hans R. Stoll, 1996, Dealer versus auction markets: A paired comparison of execution costs on Nasdaq and the NYSE, Journal of Financial Economics, this issue.

National Association of Securities Dealers, 1993, 1993 Nasdaq fact book and company directory (NASD, Washington, DC).

Schwartz, Robert A., 1993, Reshaping the equity markets: A guide for the 1990s (Irwin, Homewood, IL).

Sproul, Michael F., 1993, Antitrust and prices, Journal of Political Economy 101, 741–754.