THE JOURNAL OF FINANCE • VOL. LIV, NO. 5 • OCTOBER 1999

Preferencing, Internalization, Best Execution, and Dealer Profits

OLIVER HANSCH, NARAYAN Y. NAIK, and S. VISWANATHAN*

ABSTRACT

The practices of preferencing and internalization have been alleged to support collusion, cause worse execution, and lead to wider spreads in dealership style markets relative to auction style markets. For a sample of London Stock Exchange stocks, we find that preferenced trades pay higher spreads, however they do not generate higher dealer profits. Internalized trades pay lower, not higher, spreads. We do not find a relation between the extent of preferencing or internalization and spreads across stocks. These results do not lend support to the "collusion" hypothesis but are consistent with a "costly search and trading relationships" hypothesis.

A LARGE ACADEMIC, LEGAL, AND REGULATORY controversy has arisen about the effect of the practices of preferencing and internalization on the quality of execution in dealership markets, especially the Nasdaq. This controversy has its roots in papers by Christie and Schultz (1994), and Christie, Harris, and Schultz (1994). Christie and Schultz (1994) allege that Nasdaq market makers have engaged in tacit collusion and they argue that institutional practices like preferencing, internalization, and best execution may allow the sustenance of tacit collusion.

In this recent controversy about the adverse effects of preferencing and internalization on the quality of execution in dealership markets, different authors have defined the terms preferencing and internalization in different

* Hansch is from Pennsylvania State University, Naik is from the London Business School, and Viswanathan is from the Fuqua School of Business, Duke University. Part of this research was undertaken while Hansch was at the London Business School and the Birkbeck College, and Viswanathan was at the Wharton School. We are indebted to Stephen Wells and Graham Hart of the London Stock Exchange for providing us with the data. We are especially grateful to Stephen Wells for his encouragement and support and for several discussions on the issues involved in this paper. We thank Michael Barclay, Robert Battalio, Sudipto Bhattacharya, John Board, Richard Brealey, William Christie, Julian Franks, Bob Goldstein, Bruce Grundy, Roger Huang, Robert Jennings, Eugene Kandel, Pete Kyle, Colin Mayer, Bob Nobay, Maureen O'Hara, Peter Reiss, Eric Sirri, Paul Schultz, Duane Seppi, Hyun Song Shin, René Stulz, David Webb, Ingrid Werner, Pradeep Yadav, two anonymous referees, and the participants in the Dealer Market Conference at Ohio State University in November 1996, the Western Finance Association Meetings in June 1997, the European Finance Association Meetings 1997, and seminar participants at Ohio State University, Oxford University, and the London School of Economics for their comments and suggestions. The authors are grateful for a Q-Group grant for partial funding of this research. Naik is also grateful for funding from the European Commission's Training and Mobility of Researchers program grant (network ref. ERBFMRXCT 960054). We are responsible for all errors.

ways. In this paper, we follow the definition of preferencing by Godek (1996) and Huang and Stoll (1996), and define *preferencing* as the act of directing an order to a market maker who is not posting the best price but who has agreed in advance to execute the order at best quoted price. Under this definition, preferencing is synonymous with best execution.[1] We define *internalization* as the act of a broker routing the order flow to a dealer belonging to the same firm.[2]

It has been argued that if practices like preferencing, internalization, and best execution are allowed, market makers who bear the risk of offering the best price, and hence facilitating the price discovery process, are not rewarded with increased order flow.[3] This reduces the incentives of market makers to improve quotes and leads to wider inside spreads. Hence, it is believed that practices like preferencing and internalization reduce price competition and worsen the quality of execution for the order flow as a whole.

Although there is an extensive academic debate about best execution, preferencing, and internalization, this debate has been hampered by the lack of any direct evidence of the effect of preferencing and internalization on execution costs in dealership markets.[4] This paper provides direct and comprehensive evidence of the effect of preferencing and internalization on quality of execution and the profitability of market making in a competitive dealership market using a rich dataset from the London Stock Exchange (LSE).

The LSE is a competitive dealership market similar to Nasdaq, and like Nasdaq it allows the practices of best execution and preferencing of order flow. Although these two dealership markets share many similar characteristics, there exist some important institutional differences as well. Although, as on Nasdaq, "soft dollar" arrangements (in which brokerage firms receive an agreed amount of commission business in exchange for research and other services) are legal on the LSE, it is illegal to make cash payments to purchase the order flow. In terms of competition in market making, on the Nasdaq

[1] See Macey and O'Hara (1997) for an interesting discussion of the legal interpretation of the term "best execution." Other studies (Kandel and Marx (1998) and Bloomfield and O'Hara (1998)) focus on the precommitment involved in a preferencing agreement. Such agreements are unobservable to us as researchers. However, because these agreements involve routing of small orders, we are able to shed light on this issue by examining the quality of execution of retail-size orders.

[2] Our definition of internalization is synonymous with the definition of preferencing in Section 510 of the 1996 *Securities Improvement Act*: "the practice of a broker acting as a dealer on a National Securities Exchange, directing the orders of the customers to buy and sell securities to itself for execution under rules that permit the broker to take priority in execution over same-priced orders or quotations entered prior in time."

[3] In this paper we use the words "dealer" and "market maker" interchangeably as they are synonymous in dealership markets.

[4] Battalio, Greene, and Jennings (1997) do not find any effect of internalization of order flow on regional exchanges on the quoted and effective spreads at the national level. They attribute their results partly to the degree of fragmentation being too small and partly to the data not being of sufficient quality. In a laboratory experimental market, Bloomfield and O'Hara (1998) find that preferencing has a significant effect when fewer than three market makers exist.

there exist more than 400 market makers who exhibit considerable diversity in terms of the retail, institutional, wholesale, and regional nature of their businesses (Schwartz (1991) and Kleidon and Willig (1995)). In contrast, on the LSE there exist only 21 market makers—a great majority of them compete for business primarily in the large (FTSE-100) stocks and a few specialize in making a market in the small stocks. In terms of the composition of the order flow, a larger proportion of turnover on the LSE seems to be generated by institutions that trade in large sizes. Finally, unlike the Nasdaq, the LSE has no mandatory tick size and allows decimal trading.

Our dataset identifies the party (broker or institutional investor) who initiates the trade, the market maker who executes the trade, and contemporaneous quotes posted by every dealer, which enables us to determine whether a trade is preferenced and/or internalized.

Our empirical results indicate that, on average, preferenced trades receive worse execution than nonpreferenced trades and internalized trades receive better execution than noninternalized trades, after controlling for such factors as the size of the trade, the width of the inside spread, short-run volatility, illiquidity, etc. This finding holds for trades up to one Normal Market Size, for which quotes are firm, as well as for the overall order flow, and is robust to delays in reporting of trades.

In terms of market making profitability, we find that dealers earn, on average, a "dealer profit" (before subtracting the costs of market making: salaries, technology, cost of capital, etc.) that is not statistically different from zero. It is lower than that earned by the specialists on the NYSE (Sofianos (1995)) and that estimated to be earned by dealers on the Nasdaq (Huang and Stoll (1996)), and appears inconsistent with collusive behavior on the part of the market makers.

When we decompose market makers' overall trading profit into a spread margin (the execution component) and a position margin (the price movement component), we find that dealers earn an effective half-spread of 23 basis points and a position margin of -27 basis points, leading to a net trading loss of four basis points per Pound Sterling of public turnover.[5] These low margins seem to be partly driven by the fact that the relative tick size is much smaller on the LSE relative to the U.S. exchanges.[6] When we ana-

[5] Sofianos (1995) uses a similar decomposition in his analysis of specialist trading revenues on the NYSE. Earlier analyses of dealer profits include Neuberger (1992), Hasbrouck and Sofianos (1993), Hansch, Naik, and Viswanathan (1994), and Hansch and Neuberger (1993). More recently, Naik and Yadav (1996a) use a similar measure to compare the quality of execution offered by different market makers to different brokers and institutional investors.

[6] There is no mandatory tick size on the LSE. As a norm, the prices are quoted in pence (decimal quotes). More important, transactions on the LSE can and do take place at per share prices that are in fractions of a penny. In our sample, the average tick size corresponds to about 20 basis points, which is less than half of that on the NYSE and the Nasdaq in Sofianos's (1995) and Huang and Stoll's (1996) samples. For more recent comparison of trading costs on the NYSE and the Nasdaq, see LaPlante and Muscarella (1997), Jones and Lipson (1996a, 1996b), Bessembinder and Kaufman (1997), and Barclay (1997).

lyze the profitability of executing order flows of different size categories, we find that market makers make money (24 basis points) on small trades, break even (−1 basis points) on large trades, but lose money (−16 basis points) on medium-sized trades. This suggests that medium-sized trades are most informative, a finding that directly corroborates Barclay and Warner's (1993) "stealth trading" hypothesis.[7]

We examine whether a particular type of order flow (e.g., preferenced versus nonpreferenced, and internalized versus noninternalized) is more profitable to the market makers. Toward that end, we regress the trading profit of each dealer in each stock on the proportions of the different types of order flows executed by that dealer in that stock. We do not find that any particular type of order flow is more profitable than any other type of order flow. Thus, even if the dealers charge a higher spread for preferenced trades and for noninternalized trades, cross-sectionally we do not find that dealers who execute a larger proportion of preferenced or noninternalized order flows earn higher trading profits. If we assume a trade reporting delay of five minutes, we find at best a marginal relationship between the fraction of preferenced order flow executed by the dealers and their trading profits.

Since the effect of the degree of preferencing in a stock on the overall execution quality for that stock is an important regulatory issue, we examine the relation between the average execution quality in a given stock and the degree of preferencing and internalization in that stock. We use the average inside spread and average effective spread as measures of execution quality. In both cases, cross-sectionally we do not find a relation between the degree of preferencing in a stock and the quoted inside spread or effective spread in that stock. These results also hold if we assume that that all trades are reported with a delay of five minutes.

Overall, these results are contrary to the predictions of the "collusion" hypothesis and the "quotes are free options" hypothesis (described in Section I below). However, they are consistent with the hypothesis that there are costs of negotiating quotes and that customers have trading relationships with dealers.

Our paper is organized as follows. Section I discusses various hypotheses on preferencing, best execution, and internalization. Section II describes the data and Section III discusses the results on quality of execution for different types of order flows. Section IV computes dealers' trading profits and examines whether a particular type of order flow is more profitable than another. Section V examines whether differences in the extent of preferencing and internalization in stocks are related to the average inside spread and effective spread in that stock. Section VI offers concluding remarks.

[7] Barclay and Warner (1993) examine the price movements induced by trades. They show that a disproportionate amount of price volatility comes from intermediate-sized trades. They also show that the evidence on insider trading suggests that insiders use medium-sized trades.

I. Motivation, Theory, and Testable Implications

Given the belief that preferencing, internalization, and best execution can worsen the quality of execution in dealership markets, we review the various theories that have been put forward in the market microstructure literature that are of relevance to the debate on preferencing and internalization.

A. Preferencing and Collusion

A number of papers (e.g., Battalio and Holden (1996), Dutta and Madhavan (1997), and Kandel and Marx (1998)) argue that preferencing facilitates collusion. Although their models differ in exact details, in general they are similar in maintaining that preferencing reduces incentives to cut prices because market makers who undercut other market makers cannot attract the preferenced order flow that is captive. Consequently, these papers argue that preferencing results in higher bid-ask spreads for the order flow as a whole, with the quality of execution for preferenced order flow being worse than that for nonpreferenced order flow. Hence, dealers make higher profits on preferenced order flow. Additionally, these models imply that as the extent of preferencing increases, the inside spread widens, the average execution quality worsens, and dealers' profits increase.

B. Preferencing and the Free Option in Quotes

The essence of the "quotes are free options" viewpoint lies in the notion that posted quotes are free options written by the dealers (Copeland and Galai (1983)). In particular, when information arrives and the dealer is not able to change his quotes immediately, the quotes may be picked off.[8]

If the posting of best quotes leads to writing such free options, dealers who do not post best quotes but who can attract the public order flow may benefit. When a trade is routed to a dealer who is not posting the best quotes (preferenced), the dealer gets to execute the trade without giving away this free option. For such a trade, the dealer may wish to offer better execution by sharing a part of the savings from not having to give away the free option. Thus, the free option hypothesis, like the collusion hypothesis, implies that preferenced trades should be more profitable than nonpreferenced trades. In contrast to the collusion hypothesis, the free option hypothesis implies that the execution quality is better for preferenced trades. It also suggests that dealer profits should be higher in stocks where a larger proportion of order flow is preferenced. The free option hypothesis, however, does not offer any clear-cut implications as to how an increase in the extent of preferenced order flow affects the average spread or the average execution quality.

[8] It has been argued that the small order execution system (SOES) on Nasdaq facilitates such picking off of quotes (see Kleidon and Willig (1995) and Harris and Schultz (1997)).

C. Preferencing, Costly Negotiation with Heterogeneous Dealers, and Customer-Dealer Relationships

An important feature of dealership markets that has received less attention in the theoretical literature is the presence of large institutional traders who can negotiate trades and thus receive price improvement relative to the quotes. These institutional traders trade regularly with one or more broker-dealers. As a consequence, they may choose to go to a dealer posting the best quotes or to their regular dealer.

Since the posted quotes are valid only for a certain quantity and since prices for all larger sized trades need to be negotiated, trading in dealership markets involves search costs because the cost of negotiating and obtaining the best price improvement relative to the quotes is nonzero. Harris (1993), Kleidon and Willig (1995), and Grossman et al. (1997) argue that the costly search feature of such markets may explain why there is differential execution of small and large trades. Rhodes-Kropf (1997) presents a model in which renegotiation occurs and show that this leads to wide posting of quotes followed by price improvement for customers who can negotiate quotes. This leads to differential execution for different customers. In this view of dealer markets, dealers are heterogeneous because of inventory differences. Consequently, as in Ho and Stoll (1983), quotes are informative about dealer inventories and indicate a greater willingness to trade on one side.[9]

If dealership markets involve costly search and negotiation, routing of the order flow to a regular dealer who may or may not be posting the best quote occurs when the customer desires immediacy and does not wish to search. Alternatively, a customer who does not desire immediacy and is willing to search for the best price will search and will generally execute with dealers who post best quotes on the relevant side of the touch. If posting the best quote on one side of the touch indicates a greater willingness to transact in that direction (due to, say, inventory reasons), then market makers on the relevant side of the touch may offer a price improvement from the posted quotes for such nonpreferenced trades. Consequently, the quality of execution will be worse for preferenced trades (for which a dealer may only match the best price) relative to nonpreferenced trades (for which a dealer may offer an improvement over the best price). However, this does not translate into greater profits for dealers on preferenced trades. Since dealers are heterogeneous, a dealer who accepts a trade when he is not posting the best quote is accepting a trade that moves his inventory position away from the desired level. This would make preferenced trades less profitable than nonpreferenced trades. Also, it would imply that cross-sectionally stocks with more preferencing have worse execution quality (less price improvement). However, the implication for the cross-sectional distribution of dealer profits is ambiguous as the higher spreads could be eroded by the inventory differences.

[9] This implication of the inventory model that quotes are one-sided is shown to hold in Chan, Christie, and Schultz (1995) and Hansch, Naik, and Viswanathan (1998).

Table I

Hypotheses

Implications are shown of three hypotheses about the effect of preferencing on relative execution quality and dealer profits (Panel A) and the effect of the degree of preferencing on average spreads (Panel B).

Panel A: Preferencing, Execution Quality, and Dealer Profits		
Hypothesis	Execution Quality for Preferenced Order Flow	Dealer Profits for Preferenced Order Flow
Collusion	Worse	Higher
Free option	Better	Higher
Negotiation with heterogeneous dealers	Worse	Same or worse

Panel B: Preferencing and Average Spreads		
Hypothesis	Average Spreads	Average Dealer Profits
Collusion	Higher	Higher
Free option	Ambiguous	Higher
Negotiation with heterogeneous dealers	Higher	Ambiguous

We summarize in Table I the implications of these hypotheses for preferenced trades.

D. Internalization

Internalization represents a situation where the broker routes a trade to a dealer belonging to the same firm. To the extent that internalization represents captive order flow and facilitates collusive practices, the implications of the collusion hypothesis hold—internalized order flow receives worse execution and dealers make higher profits. The free option in quotes hypothesis has no implications for internalized order flow.

In our data, we observe dealer and broker codes. Hence, we view order flow as being internalized when these two codes are identical—that is, the broker belongs to the same firm as the market maker. Unfortunately, this order flow represents not only captive order flow but also order flow directly negotiated by large institutions. These institutions have access to dealers' quotes and can directly negotiate with them. Since there is no broker involved, the dealer is presumed to be both the dealer and the broker. Clearly, such order flow does not represent captive order flow.

If most of the internalized order flow represents such directly negotiated order flow, then any differences in the quality of execution represent differences in the abilities of institutions and brokers in the costly search process. Since, a priori, there is no theory as to why dealers ought to have higher profits for either category of order flow, this hypothesis implies that a better execution quality for internalized order flow must translate into lower dealer profits and vice versa.

II. Data Description

We begin with a short description of the trading system used on the LSE, and then describe the data used in this study.[10] The LSE is a competitive dealership market where several market makers post quotes in a stock and trades are made by negotiations over the phone. The orders can be executed by any market maker, regardless of her current quotes. For orders that do not exceed the quoted size, the market maker must at least match the best quotes on the screen. For orders larger than the quoted size, no such rule applies and the prices can be negotiated freely. Arrangements by brokers to send order flow to any one particular market maker are legal. In contrast to Nasdaq, no direct cash payments can be received for such arrangements. However, research and other services may be provided to ensure that brokers route order flow toward a particular dealer.

Our dataset provides the details of quotes posted by and transactions executed by all market makers in all stocks during the month of August 1994. Before describing the details of the dataset, we examine how the trading activity in August 1994 compares with the rest of the months in 1994. The average daily public turnover in U.K. and Irish equities in 1994 was approximately £1.4 billion (a minimum of £1.2 billion in December and a maximum of £1.9 billion in January); that in August 1994 was £1.42 billion.[11] Trades per day in 1994 averaged 37,000 (minimum 29,000 in December and maximum 53,000 in January); in August 1994 there were 38,000 trades per day. Value per trade in 1994 averaged £65,000 (minimum £58,000 in March and maximum £67,000 in October); that in August 1994 was £64,000. With respect to the volatility of the FTSE-100 index, the month of August 1994 also appears similar to the rest of the year. This suggests that although we have a relatively short time span of data, the sample period is representative of a typical month in 1994.

For the month of August 1994, our dataset identifies the following:

- the name of the stock traded
- the quotes (bid and ask prices) posted by each market maker registered in a stock and the quantities for which these quotes are firm
- the identities of the buyer and seller participating in each transaction
- the dealing capacity of buyer and seller in each transaction (whether they acted as an agent representing a public order, or as principal and possibly market maker), allowing each public trade to be classified as either a public buy or sell
- the transaction price
- the date and time of the transaction
- the quantity traded as reported by the buyer and as reported by the seller.

[10] See Neuberger and Schwartz (1990) and Hansch (1997) for a detailed description of the LSE.

[11] Source: *Stock Exchange Quarterly*, 1994, winter edition, pp. 72–73.

This dataset identifies the quotes and transactions of all market makers at all points in time and is richer than that used by Reiss and Werner (1993, 1998) and Hansch et al. (1998) in some important respects. The dataset allows us to distinguish whether a public trade was routed by a broker to a dealer belonging to the same firm (internalized) or not. Equally importantly, the dataset identifies market makers and brokers *across stocks*. The latter feature allows us to distinguish portfolio trades executed by a dealer from other trades. This distinction is important because in the case of a portfolio trade the dealer's commission is not included in the reported price (i.e., it is paid separately) but on individual trades it is included in the transaction price. Clearly, the presence of unidentified portfolio trades biases the estimates of quality of execution.

The distinction between portfolio trades and individual trades is of some importance in understanding the effective spread paid on trades and in addressing the issue of preferencing. When a trader wishes to trade in an individual stock, he finds the best price by looking at the screen. He then decides whether to negotiate the trade with a dealer posting the best price or with a dealer not posting the best price (i.e., preference the trade). By contrast, when a trader, who would typically be an index fund manager or a cash-index arbitrageur, negotiates a portfolio trade with a dealer, his focus is on the commission (15 to 20 basis points) he must pay and not on whether that market maker is posting the best price in some or all of the stocks in the portfolio. Clearly, the issue of preferencing is less relevant in the case of a portfolio trade, and therefore we report most of our results with and without the inclusion of portfolio trades.

Although our dataset lists transaction details for all stocks on the LSE, for computational tractability we focus on trading in the most liquid 100 stocks,[12] which are listed in Appendix A. The total public turnover in our sample stocks during August 1994 is worth £13.8 billions (approximately £620 millions per day), which is about 50 percent of public turnover in all of the U.K. and Irish equities in August 1994. Moreover, in our sample there is £5.8 billions worth of interdealer trading.

We segregate trades into portfolio trades and individual trades as follows. We define a trade in a stock as part of a portfolio trade if we find that the trade is executed at the touch midprice and if the same market maker and broker also report trades in five or more other stocks within two minutes on either side of that trade. Out of the total public turnover of £13.8 billions, we estimate that £2.6 billions consist of portfolio trades and the remaining £11.2 billions consist of nonportfolio or individual trades. Since our algorithm to distinguish portfolio trades may not be fully accurate, we report our results with and without portfolio trades.

In our sample, 19 market makers post quotes and trade in some or all of the stocks. In general, the larger market makers post quotes in all stocks, and the smaller market makers post quotes in about 60 to 95 stocks. When

[12] In August 1994, the FTSE-100 index comprised 102 securities.

we rank the market makers in descending order of their public turnover, we find that the top seven market makers execute approximately 90 percent of the public turnover.

Table II presents the distribution of stock prices, quoted spreads, inside spreads, and effective spreads for the full sample and 10 size deciles. In our sample, the mean share price is £5.13 (minimum £0.63, maximum £13.54). The mean quoted spread is 125 basis points, and the mean inside spread is 64 basis points. This indicates that many market makers are on one side of the touch (the inside spread formed by the lowest ask and the highest bid), a fact documented in greater detail in Hansch et al. (1998). In our sample, the mean effective spread is 54 basis points, suggesting an average price improvement of five basis points relative to the respective side of the inside spread.

On the LSE, dealers who are making market in a stock are required to post quotes that are firm for the Normal Market Size (NMS) defined as 2.5 percent of the average daily trading volume in that stock. Thus, the NMS depends on trading activity in a particular stock and therefore varies across stocks. In our empirical work, we pool cross-sectional and time-series data. To facilitate comparison of trade sizes across stocks, we define trade size as relative to the average trade size in each stock. For much of our empirical work, in addition to the results for all public trades, we also report results for trades up to one NMS.

In our sample, approximately 71 percent of trades are executed by market makers not posting the best quotes (preferenced) and 29 percent are nonpreferenced.[13] With respect to internalization, we find that approximately 62 percent of trades are internalized (i.e., the market maker and the broker belong to the same firm). The size of internalized trades averages £280,000, which suggests that a large proportion of these trades are from institutional investors who prefer to deal directly with the market makers.[14]

Since each public trade can be classified as preferenced or nonpreferenced and internalized or noninternalized, we sort public trades into four categories. Of £13.8 billions worth of public trades, we find that 45 percent (£6.2

[13] Recall that according to our definition of preferencing the market maker could be straddling the touch or on the opposite side of the touch. Although, at first glance, the fraction preferenced seems high, it may not be the case given the one-sided quote posting behavior of the market makers. For example, consider a stock that has 17 market makers and assume that the customers go to their favorite dealer irrespective of her quotes. If, on average, four of them post the lowest ask (but not the highest bid), four of them post the highest bid (but not the lowest ask) and the remaining seven straddle the touch, then, on average, 12 of the 17 market makers *will not be* on either side of the touch. Therefore, in such a stock, the fraction of order flow preferenced will be 12/17 or 70 percent.

[14] When dealers act as brokers they may charge a commission for providing brokerage services. Institutional customers who directly negotiate trades typically avoid this commission (generally about 20 basis points); however, they incur the salary costs for employing personnel to negotiate their trades. The total revenue earned by the dealers consists of trading profits as well as brokerage commissions. We compute the former in Section IV and discuss the relative importance of the latter in our concluding remarks.

Table II

Stock Prices and Spreads across Deciles

The distribution of stock prices, the quoted spreads, the inside spreads, and effective spreads are reported for the entire sample and across the 10 size deciles. The sample consists of the 102 constituent stocks of the FTSE-100 index during August 1994. We report means (Mean), medians (Med.), standard deviations (Std.), minima (Min), and maxima (Max).

						Spread (in basis points)														
	Price (in pence)					Quoted Spread					Inside Spread					Effective Spread				
Decile	Mean	Med.	Std.	Min	Max	Mean	Med.	Std.	Min	Max	Mean	Med.	Std.	Min	Max	Mean	Med.	Std.	Min	Max
1	552	494	223	291	1096	112	105	26	79	158	51	51	7	41	64	44	43	6	37	54
2	552	433	258	245	1040	114	106	32	69	164	53	51	10	39	70	47	45	11	33	68
3	468	440	180	196	842	109	98	31	70	155	59	57	13	41	80	50	49	10	38	64
4	533	554	190	158	802	111	114	33	69	189	60	59	12	41	82	53	48	11	39	78
5	497	499	154	237	742	136	120	38	95	211	75	71	16	57	112	61	60	9	47	78
6	495	564	223	63	884	159	131	105	93	472	82	71	31	58	168	69	59	29	48	149
7	455	449	117	259	635	152	136	45	90	256	85	85	16	57	111	65	67	11	45	86
8	516	533	233	198	957	137	118	51	91	252	75	71	20	50	121	62	56	17	43	100
9	456	388	281	120	976	151	146	50	79	250	91	83	33	46	149	69	66	18	39	103
10	440	400	328	156	1354	165	150	59	69	293	86	90	21	50	126	74	71	22	27	118
All	513	481	221	63	1354	125	124	49	69	472	64	66	21	39	168	54	56	16	27	149

billions) are preferenced and internalized (P&I), 26 percent (£3.6 billions) are preferenced and noninternalized (P&N-I), 16.7 percent (£2.3 billions) are nonpreferenced and internalized (N-P&I), and 12.3 percent (£1.7 billions) are nonpreferenced and noninternalized (N-P&N-I).

If we exclude portfolio trades from our sample, we find that £11.2 billions worth of individual trades are distributed in similar proportions across the four types of order flows. In particular, we observe that 45.5 percent (£5.1 billions) worth of trades are P&I, 26.3 percent (£2.95 billions) are P&N-I, 16.5 percent (£1.85 billions) are N-P&I, and 11.7 percent (£1.30 billions) are N-P&N-I.

Having described the data, we proceed with the investigation of the effect of preferencing and internalization on the quality of execution and profitability of market making.

III. Execution Quality

This section compares the quality of execution of trades which differ in terms of whether they are preferenced or not, and whether they are internalized or not. We measure the execution quality in terms of the effective half-spread (the difference between the transaction price and the touch midprice as a percentage of the touch midprice). For example, if the touch in a particular stock is 105–95 pence and a public buy occurs at 103 pence, then our measure of execution quality equals (103 − 100)/100 or three percent.[15]

If the hypothesis that preferenced order flow receives worse execution is correct, it should be reflected in the effective half-spread divided by the touch midpoint. However, to undertake such a test, we need to control for other factors that affect the quality of execution. Table III shows, for all trades, the correlation coefficients between the dummies indicating whether a trade is preferenced and/or internalized, the touch size (touch divided by the touch midpoint), a variable called market maker imbalance (described below) which captures the relative propensity of market makers to trade on one side of the market, and the trade size (as a fraction of the mean trade size in that stock). The table indicates that the internalized trades (both preferenced and nonpreferenced) are positively correlated with size, suggesting that these are likely to be trades directly negotiated by institutional investors with the market makers.[16]

To understand the impact of preferencing and internalization on execution quality, we run a regression of the effective half-spread against three dummies (P&I, P&N-I, and N-P&I), the size of the touch (Touch), the market maker imbalance (MMimbal), and the relative size of the trade (Size). For a public buy (sell), we define the market maker imbalance as the number of

[15] Our measure of execution quality is thus related to the earlier work of Reiss and Werner (1995) on the LSE. Like them, we consider the variation in execution quality across order sizes, and we also consider whether the trade is preferenced and whether it is internalized. Additionally, we examine the profitability of different types of order flows.

[16] The correlation structure of the data is similar when we exclude portfolio trades.

Table III

Summary Statistics and Correlations

The table shows summary statistics (Panel A) for and correlation coefficients (Panel B) between preferencing and internalization dummies, as well as touch, trade size, and market maker imbalance variables using all public trades in the 102 constituent stocks of the FTSE-100 index during August 1994. Pref&Int, Pref&Non-Int, and Non-Pref&Int are dummy variables to indicate if the trade is preferenced and internalized, preferenced and noninternalized, or nonpreferenced and internalized, respectively. Touch denotes the contemporaneous touch size expressed in basis points of the touch midprice. MMImbal denotes the difference between the number of market makers quoting competitively on the transaction side of the touch and the market makers quoting competitively on the opposite side. Size denotes trade size as a fraction of average trade size in that stock.

Panel A: Summary Statistics

Variable	Mean	Std Dev	Minimum	Maximum
0–1 NMS (240,120 obs.)				
Pref&Int	0.05	0.22	0	1
Pref&Non-Int	0.61	0.49	0	1
Non-Pref&Int	0.02	0.15	0	1
Touch	63.31	29.29	0	495.87
MMImbal	0.13	6.09	—	—
Size	0.24	0.84	0.00	29.30
All trades (252,653 obs.)				
Pref&Int	0.07	0.25	0	1
Pref&Non-Int	0.59	0.49	0	1
NonPref&Int	0.03	0.18	0	1
Touch	63.70	29.57	0	495.87
MMImbal	0.13	6.06	—	—
Size	0.87	4.94	0.00	418.35

Panel B: Correlations

	Pref&Int	Pref&Non-Int	Non-Pref&Int	Size	Touch	MMImbal
0–1 NMS						
Pref&Int	N/A	N/A	N/A	0.23	−0.02	−0.05
Pref&Non-Int	N/A	N/A	N/A	−0.11	−0.14	−0.31
Non-Pref&Int	N/A	N/A	N/A	0.17	0.04	0.06
Size	0.23	−0.11	0.17	1.00	−0.03	0.00
Touch	−0.02	−0.14	0.04	−0.03	1.00	−0.01
MMImbal	−0.05	−0.31	0.06	0.00	−0.01	1.00
All trades						
Pref&Int	N/A	N/A	N/A	0.23	−0.01	−0.05
Pref&Non-Int	N/A	N/A	N/A	−0.11	−0.14	−0.30
Non-Pref&Int	N/A	N/A	N/A	0.14	0.06	0.07
Size	0.23	−0.11	0.14	1.00	0.00	0.00
Touch	−0.01	−0.14	0.06	0.00	1.00	−0.01
MMImbal	−0.05	−0.30	0.07	0.00	−0.01	1.00

dealers on the ask (bid) side of the touch minus the number of dealers on the bid (ask) side of the touch. When this variable is positive, there exist more market makers on the relevant side of the touch than on the opposite side of the touch and one expects a better quality of execution (i.e., a lower effective half-spread). To control further for cross-sectional heterogeneity across stocks, we allow for a dummy variable for each stock (fixed effects).[17] Specifically, we run the following regression:

$$\text{Exqual}_{t_s,s} = \sum_{s=1}^{s=102} D_s + \beta_1\,\text{P\&I}_{t_s,s} + \beta_2\,\text{P\&N-I}_{t_s,s} + \beta_3\,\text{N-P\&I}_{t_s,s} + \beta_4\,\text{Size}_{t_s,s} + \beta_5\,\text{Touch}_{t_s,s} + \beta_6\,\text{MMimbal}_{t_s,s} + \beta_7\,\text{Size Square}_{t_s,s} + \epsilon_{t_s,s}, \quad (1)$$

where Exqual is the execution quality (effective half-spread), t_s is the t^{th} transaction in stock s, and D_s is the stock-specific dummy. $\text{P\&I}_{t_s,s}$ is a dummy for preferenced and internalized trades, $\text{P\&N-I}_{t_s,s}$ is a dummy for preferenced and noninternalized trades, and $\text{N-P\&I}_{t_s,s}$ is a dummy for nonpreferenced and internalized trades.

Table IV presents the results of the regression for all public trades (second column).[18] It is clear that compared to the benchmark of nonpreferenced and noninternalized (N-P&N-I) trades, both preferenced and internalized (P&I) as well as nonpreferenced and internalized (N-P&I) trades receive better execution by 3.81 basis points and 5.62 basis points, respectively. Compared to the average half inside spread of 32 basis points in our sample (see Table II), this represents a price improvement of 12 to 18 percent of the half inside spread, suggesting that institutions that directly negotiate trades with market makers or brokers who route the order flow to their own market makers are able to obtain significant price improvement for their trades.

Among trades that are internalized, those that are preferenced (P&I) receive lower price improvement by 1.81 (= 5.62 − 3.81) basis points compared to those that are not (N-P&I). This lower price improvement is likely due to the fact that P&I trades are more likely to arrive at a time when the dealer for inventory reasons may prefer not to take the trades. The lower price improvement finding also holds for noninternalized trades (which constitute 61 percent of all trades): Preferenced and noninternalized (P&N-I) trades receive worse execution by 0.2 basis points compared to nonpreferenced and noninternalized (N-P&N-I) trades. Thus, we find that preferenced trades receive worse execution compared to nonpreferenced trades irrespective of whether the trade is internalized or not. However, since the average half-spread in our sample is about 32 basis points, the difference in the quality of execution is "economically" significant primarily for the internalized trades.

[17] Some of the large trades on the LSE are executed as protected trades that are worked over time and are reported when complete (Franks and Schaefer (1995)). For these trades, the preferencing dummy is likely to be misclassified. However, this problem does not apply to trades in the zero to one NMS category for which the quotes are firm.

[18] All t-statistics reported in this paper are based on White (1980) heteroskedasticity corrected standard errors.

Table IV

Preferencing, Internalization and Execution Quality

The table shows the coefficients of the following regression:

$$\text{Exqual}_{t_s,s} = \sum_{s=1}^{S} D_s + \beta_1 \text{ Pref\&Int}_{t_s,s} + \beta_2 \text{ Pref\&NonInt}_{t_s,s} + \beta_3 \text{ NonPref\&Int}_{t_s,s} + \beta_4 \text{ Touch}_{t_s,s} + \beta_5 \text{ MMImbal}_{t_s,s} + \beta_6 \text{ Size}_{t_s,s} + \beta_7 \text{ Size}^2_{t_s,s} + \epsilon_{t_s,s},$$

where $\text{Exqual}_{t_s,s}$ is the effective half-spread paid by the t^{th} transaction in stock s, and D_s is the stock-specific dummy (fixed effect). Pref&Int, Pref&NonInt, and NonPref&Int are dummy variables to indicate if the trade is preferenced and internalized, preferenced and noninternalized, or nonpreferenced and internalized, respectively. Touch is the inside spread in basis points. For a public buy MMImbal is the number of market makers on the ask side of the touch minus the number on the bid side of the touch (opposite for public sell). Size is the size of the transaction in multiples of the average trade size in that stock. All estimates are fractions of stock price and expressed in basis points; t-statistics are in parentheses. The table contains results for seven regressions: The first two columns show the results for small trades (0–1 NMS) and all trades where preferencing is defined according to contemporaneous quotes. In the next two columns preferencing is defined according to quotes five minutes prior to the reported trade time. The last three columns show the results for stocks in the top, middle, and bottom average touch size quintiles (with preferencing defined according to contemporaneous quotes). The coefficients for the stock-specific fixed effects are not shown below, but with few exceptions they are significant at the 1 percent level.

	Quotes Contemporaneous		Quotes 5 min. Prior		Touch Quintile		
	0–1 NMS	All	0–1 NMS	All	1st	3rd	5th
Pref&Int	−2.29	−3.81	−2.24	−3.51	−2.52	−2.92	−4.91
	(−14.91)	(−26.42)	(−14.40)	(−24.27)	(−15.76)	(−11.08)	(−7.23)
Pref&NonInt	0.18	0.20	0.35	0.37	0.15	0.46	1.13
	(2.99)	(3.30)	(5.87)	(6.07)	(2.20)	(3.56)	(3.35)
NonPref&Int	−3.77	−5.62	−3.84	−5.05	−3.86	−4.28	−5.82
	(−17.27)	(−28.08)	(−17.89)	(−26.18)	(−16.24)	(−10.56)	(−6.76)
Touch	0.33	0.32	0.34	0.33	0.34	0.32	0.31
	(143.95)	(138.48)	(158.86)	(152.68)	(126.74)	(114.08)	(56.70)
MMImbal	−0.54	−0.54	−0.37	−0.37	−0.40	−0.63	−0.97
	(−110.66)	(−109.28)	(−78.46)	(−76.98)	(−72.18)	(−53.14)	(−33.80)
Size	−3.06	−0.19	−2.60	−0.12	−0.14	−0.33	−0.83
	(−32.09)	(−10.63)	(−29.53)	(−7.99)	(−9.52)	(−10.65)	(−6.77)
Size^2	0.16	0.001	0.13	0.001	0.001	0.003	0.014
	(15.32)	(5.01)	(15.04)	(7.07)	(7.10)	(6.23)	(3.75)

Several other variables turn out to be significant as well. Quality of execution seems to be a nonlinear function of size. The slope coefficient of size is negative and that of the square of size is positive, suggesting that the quality of execution improves with size but at a decreasing rate. The fact that execution quality improves as the trade size increases (albeit at a decreasing rate) is contrary to the typical inventory or asymmetric-information-based models but is consistent with the presence of fixed costs (order processing, administration) involved in executing a trade. When the touch is wider (potentially reflecting more uncertainty), customers pay a higher effective half-spread.[19] Finally, the market maker imbalance variable has a negative slope coefficient, which is intuitive. When there are a greater number of market makers on the ask (bid) side of the touch than on the bid (ask) side of the touch, more dealers are keen on selling (buying) stock than on buying (selling) stock. Thus, public trades that are in a direction desired by the market makers—for example, public buy (sell) trades—receive better execution.

We rerun the regression given in equation (1) for zero to one NMS trades and find results similar to those for the overall order flow (see Table IV, first column). In particular, we find that preferenced and internalized (P&I) trades receive worse execution compared to nonpreferenced and internalized (N-P&I) trades, and we find that preferenced and noninternalized (P&N-I) trades receive worse execution compared to nonpreferenced and noninternalized (N-P&N-I) trades. Thus, the finding that preferenced trades receive worse execution and internalized trades receive better execution also holds for small-sized trades, in which regulators have particular interest.

We conduct some robustness checks for our results. We examine the sensitivity of our results to delayed reporting of trades, which may affect the classification of preferenced trades (but not internalized trades). We rerun the regression (equation (1)) by assuming that all trades are reported with a delay of five minutes. We find that overall about six percent of the trades get reclassified from preferenced to nonpreferenced and vice versa. However, as columns 3 and 4 in Table IV show, the finding that preferenced trades receive worse execution compared to nonpreferenced trades and that internalized trades receive better execution compared to noninternalized trades remains unchanged for the overall as well as for the zero to one NMS category of order flow. This suggests that our findings are not sensitive to misclassification due to potentially delayed reporting of trades.

We also divide our sample stocks into five touch quintiles and rerun the regression. The last 3 columns in Table IV report the regression results for stocks in three of those five quintiles: the smallest (quintile 1), the intermediate (3), and the largest (5). We observe that preferenced order flow receives worse execution and internalized order flow receives better execution across all touch quintiles. The price improvement for internalized order flow seems to be monotone in the size of the average touch with stocks in the largest average touch quintile receiving the most price improvement. The results for the zero to one NMS category across the touch quintiles (not reported) are similar as well. This suggests that our findings are robust across different touch quintiles.

To examine the sensitivity of these findings to the presence of portfolio trades, we repeat the regression using £11.2 billions worth of individual trades. Table V summarizes the findings when portfolio trades are excluded

[19] Our results on slope coefficients of size and touch are consistent with the findings of Reiss and Werner (1995).

Table V

Preferencing, Internalization, and Execution Quality for Nonportfolio Trades

Coefficients are shown of the following regression for *nonportfolio trades*:

$$\text{Exqual}_{t_s,s} = \sum_{s=1}^{S} D_s + \beta_1 \text{ P\&I}_{t_s,s} + \beta_2 \text{ P\&N-I}_{t_s,s} + \beta_3 \text{ N-P\&I}_{t_s,s} + \beta_4 \text{ Size}_{t_s,s} + \beta_5 \text{ Touch}_{t_s,s} + \beta_6 \text{ MMimbal}_{t_s,s} + \beta_7 \text{ Size Square}_{t_s,s} + \epsilon_{t_s,s},$$

where $\text{Exqual}_{t_s,s}$ is the effective half-spread paid by the t^{th} transaction in stock s, and D_s is the stock-specific dummy (fixed effect). Pref&Int, Pref&NonInt, and NonPref&Int are dummy variables to indicate if the trade is preferenced and internalized, preferenced and noninternalized, or nonpreferenced and internalized, respectively. Touch is the inside spread in basis points. For a public buy MMImbal is the number of market makers on the ask side of the touch minus the number on the bid side of the touch (opposite for public sell). Size is the size of transaction in multiples of the average trade size in that stock. All estimates are fractions of stock price and expressed in basis points; t-statistics are in parentheses. The table contains results for seven regressions: for small trades (0–1 NMS) and all trades and where preferencing is defined according to contemporaneous quotes; for t preferencing defined according to quotes five minutes prior to the reported trade time; and for stocks in the top, middle, and bottom average touch size quintiles (with preferencing defined according to contemporaneous quotes). The coefficients for the stock-specific fixed effects are not shown below, but with few exceptions they are significant at the one percent level.

	Quotes Contemporaneous		Quotes 5 Min. Prior		Touch Quintile		
	0–1 NMS	All	0–1 NMS	All	1st	3rd	5th
Pref&Int	−4.64	−6.32	−4.49	−5.86	−4.20	−5.52	−10.04
	(−30.60)	(−45.39)	(−29.35)	(−41.72)	(−26.82)	(−21.43)	(−15.09)
Pref&NonInt	0.10	0.10	0.23	0.21	0.09	0.27	0.66
	(2.01)	(1.98)	(4.61)	(4.13)	(1.91)	(2.34)	(2.26)
NonPref&Int	−6.87	−8.76	−6.67	−7.83	−5.96	−7.14	−11.82
	(−31.50)	(−44.06)	(−31.15)	(−41.00)	(−25.41)	(−17.94)	(−13.92)
Touch	0.34	0.33	0.36	0.34	0.35	0.32	0.32
	(192.7)	(175.8)	(200.0)	(185.6)	(139.2)	(122.56)	(60.85)
MMImbal	−0.38	−0.39	−0.28	−0.28	−0.29	−0.51	−0.71
	(−89.39)	(−88.04)	(−67.12)	(−65.46)	(−58.04)	(−45.52)	(−26.82)
Size	−2.33	−0.10	−1.82	−0.04	−0.08	−0.22	−0.04
	(−28.17)	(−6.68)	(−23.61)	(−3.31)	(−6.48)	(−7.09)	(−3.32)
Size^2	0.12	0.001	0.09	0.001	0.001	0.002	0.007
	(14.40)	(4.19)	(12.53)	(2.82)	(5.88)	(4.80)	(2.13)

from our sample. Comparison of the second columns in Tables IV and V shows that when we exclude the portfolio trades, the magnitude of price improvement offered to internalized trades increases from 3.81 basis points to 6.32 basis points for P&I trades, and from 5.62 basis points to 8.76 basis points for N-P&I trades. By contrast, in the case of noninternalized trades, although the quality of execution received by P&N-I trades is not as bad, it remains worse than that received by the benchmark N-P&N-I trades. Thus, the finding that preferenced trades receive worse execution compared to nonpreferenced trades and that internalized trades receive better execution compared to noninternalized trades continues to hold. This finding remains robust to delayed reporting of trades and holds across different touch quintiles, which suggests that our finding is not sensitive to the presence of unidentified portfolio trades in the data.

To summarize, we find that preferenced trades receive worse execution than nonpreferenced trades, irrespective of whether the trades are internalized or not. Also, internalized trades receive better execution than noninternalized trades, irrespective of whether the trade is preferenced or nonpreferenced. The evidence that internalized order flow receives better execution than noninternalized order flow is inconsistent with the collusion hypothesis, which suggests that internalized order flow is captive and therefore should receive worse execution. The finding that preferenced order flow receives worse execution compared with nonpreferenced order flow is opposite to the prediction of the free option in quotes hypothesis (see the top panel of Table I). However, it is consistent with the collusion hypothesis and the negotiation with heterogeneous dealers hypothesis. In an effort to distinguish between these two hypotheses, we examine the relative profitability of different types of order flows.

IV. Dealer Profits

This section measures dealers' trading profits (the gross trading revenues of the dealers before subtracting any costs of market making) and examines whether these profits are related to the composition of the order flow they execute.[20]

Let TP_s^j denote the trading profits of dealer j over the sample period in stock s by participating in transactions T_s, which could be a public trade or an interdealer trade. Let p_{si_s} denote the price for transaction $i_s \in [1,\dots,T_s]$ in stock s, and let t_{si_s} denote the signed quantity of that transaction (+ for dealer sell and − for dealer buy). Let I_{s0} and I_{sT_s} indicate the dealer's starting and ending inventories in stock s, and let $\hat{p}_{s0}$ and $\hat{p}_{sT_s}$ represent (a measure of) the value of the stock at the beginning and at the end of the sample period.[21] Then dealer j's trading profits in stock s equal

$$\mathrm{TP}_s^j = \hat{p}_{sT_s} I_{sT_s} + \sum_{i_s=1}^{T_s} p_{si_s} t_{si_s} - \hat{p}_{s0} I_{s0}. \tag{2}$$

[20] These trading profits are a part of the total revenue earned by the dealers. They also earn commissions for providing brokerage services. However, since a large number of independent houses compete with the dealers to provide these services, it is not likely that the dealers can charge excessive commissions to subsidize their dealing activity. See the concluding remarks in Section VI for the relative magnitudes of trading profits and commissions from 1991 to 1996.

[21] Inventories can be valued at the inside quote midpoint, the current best quote on buy or sell side, the last trade price, etc.

To obtain the dealers' trading profits we value the starting inventory I_{s0} and ending inventory I_{sT_s} at the prevailing touch midpoint because there is no reason to believe that the quote midpoint is systematically biased upward or downward. Moreover, since dealers on the LSE make market in a number of stocks, errors in individual stock values cancel out across a portfolio of stocks (this is the usual diversification argument). We also assume that the beginning inventory is zero, which implies that we are focusing on the profits made due to transactions over this period as opposed to profits due to a revaluation of the initial inventory.

Our measure of dealer *j*'s trading profits in stock *s* thus equals

$$\text{TP}_s^j = m_{sT_s}\left(\sum_{i_s=1}^{T_s} t_{si_s}\right) + \sum_{i_s=1}^{T_s} p_{si_s} t_{si_s}, \tag{3}$$

where m_{sT_s} is the touch midpoint for stock *s* at the terminal transaction T_s and $(\sum_{i_s=1}^{T_s} t_{si_s})$ is the net change in inventory due to execution of public and interdealer trades in stock *s* by dealer *j*.

Before examining the profitability of different types of order flow, we estimate the mean overall trading profit earned by the dealers in our stocks (see Appendix B). We find that although the dealers charge an average spread margin of 23 basis points, overall they lose four basis points per Pound Sterling of public turnover. When we examine the profitability of executing trades of different sizes, we find that dealers make a mean overall trading profit of 24 basis points on small-sized trades (0–1 NMS) and break even (−1 basis points) on large-sized trades(6 + NMS). In contrast, the dealers lose 16 basis points on medium-sized trades (1–6 NMS). As the spreads charged on all three categories are very similar, the differences in the mean overall trading profits are primarily due to differences in the degree of informativeness of order flows of different size categories. Since the dealers sustain a trading loss on medium-sized trades, these trades are likely to be the most informative—a finding directly corroborative of the stealth trading hypothesis proposed in Barclay and Warner (1993).

We know from Section III that the dealers earn a higher spread margin on the preferenced and noninternalized trades. In the following regression we examine whether a particular type of order flow is more profitable than any other type of order flow. Toward that end, we regress the trading profit of each dealer in each stock on the fraction (by value) of different types of order flows executed by that dealer in that stock. Specifically, we run the following regression with fixed effects:

$$\begin{aligned}\text{TP}_s^j = {} & \beta_1 \text{ Pref\&Int Frac}_s^j + \beta_2 \text{ Pref\&NonInt Frac}_s^j + \beta_3 \text{ NonPref\&Int Frac}_s^j \\ & + \beta_4 \text{ Inter-Dealer Frac}_s^j + \sum_{s=1}^{S} \delta_s \text{ Stock-Dummy}_s + \epsilon_s^j,\end{aligned} \tag{4}$$

where TP_s^j is dealer j's trading profit in stock s.[22] Pref&Int $Frac_s^j$ is the value of preferenced and internalized trades executed by dealer j in stock s expressed as a fraction of dealer j's total turnover in stock s. Similarly, Pref&NonInt $Frac_s^j$, NonPref&Int $Frac_s^j$, and Inter-Dealer $Frac_s^j$ represent respectively the value of preferenced and noninternalized, nonpreferenced and internalized, and interdealer trades executed by dealer j in stock s expressed as a fraction of dealer j's total turnover in stock s.[23] The stock dummies control for stock-specific effects such as volatility, turnover, touch, price, number of market makers, etc.

In our trading profit calculation, we value the ending inventory at the touch midprice. An alternative approach is to allow the dealer to sell the final inventory to the public and earn an effective half-spread on the final inventory. For the sake of robustness, we recompute dealers' trading profits assuming that the dealers earn half-spread on their ending inventory. We also recompute the fractions of different types of trades assuming that trades are reported with a delay of five minutes. Thus, in total we run four different versions of the regression given in equation (4): Namely, with half-spread, without half-spread, with contemporaneous reporting of trades, and with a five-minute delay in reporting of trades.

Table VI summarizes the results of the four versions of regression (4). We find that dealer profits generally are not consistently related to the fraction of any particular type of order flow across all four versions. For example, in the case of no reporting delay (i.e., the contemporaneous touch case) and where dealers earn average effective half-spread on ending inventory, the fraction of nonpreferenced and internalized order flow is negatively related to dealer profits. This is intuitive because the dealers offer the maximum price improvement (charge the lowest spread) to these trades. However, this variable does not come out significant in the other three versions of regression (4). Similarly, in the case of five-minute delayed reporting of trades and without half-spread, the fractions of preferenced and internalized trades, preferenced and noninternalized trades, and interdealer trades come out significantly related to dealer profits. Once again, the positive relationship between fractions of preferenced trades and dealer profits is intuitive because these trades pay a higher spread. However, in the other three versions of regression (4), these variables do not come out significant. Taken together, the evidence in Table VI fails to show a consistent relationship between dealers' trading profits and the composition of the order flows. Moreover, when occasionally a statistically significant relationship between the dealer profits and the composition of order flow is observed, the changes in adjusted R^2 are small, suggesting that economically the magnitude of the effect is not very significant.

[22] In total we obtain 1,276 observations for dealer profits.

[23] See Reiss and Werner (1998) and Naik and Yadav (1996b) for an empirical investigation of interdealer trading on the LSE.

Table VI

Dealer Profit Regressions

The table shows the results of the following regressions:

$$\mathrm{TP}_s^j = \beta_1 \text{ Pref\&Int Frac}_s^j + \beta_2 \text{ Pref\&NonInt Frac}_s^j + \beta_3 \text{ NonPref\&Int Frac}_s^j + \beta_4 \text{ Inter-Dealer Frac}_s^j + \sum_{s=1}^{S} \delta_s \text{ Stock-Dummy}_s + \epsilon_s^j,$$

where TP_s^j is the trading profits of market maker j in stock s expressed in basis points of her total turnover. Pref&Int Frac_s^j, Pref&NonInt Frac_s^j, and NonPref&Int Frac_s^j respectively denote the fraction of public order flow executed by market maker j in stock s that is preferenced and internalized, preferenced and noninternalized, and nonpreferenced and internalized. Stock-Dummy_j indicates the dummy for sample stock. All estimates are expressed in basis points; t-statistics are in parentheses.

Shown in the first two columns are the results where market maker j's ending inventory is assumed to earn the average effective half-spread and this extra spread revenue is added to the market maker's trading profits. The last two columns show the results where the final inventory is valued at the midprice of the stock at the end of the sample period. For both dealer profit measures, we show the results for preferencing defined with respect to contemporaneous quotes (contemp.) as well as with respect to quotes five minutes prior to the reported trade time.

	With Half-Spread		Without Half-Spread	
Coefficient	Contemp	5 Min. Delay	Contemp.	5 Min. Delay
Pref&Int Frac	34.67	−86.72	15.05	52.70
	(0.37)	(−0.98)	(0.52)	(3.05)
NonPref&Int Frac	−5.90	−71.99	44.38	22.58
	(−2.04)	(−0.27)	(1.19)	(1.02)
Pref&NonInt Frac	−4.71	−46.17	19.21	54.34
	(−0.04)	(−0.40)	(0.53)	(2.41)
Inter-Dealer Frac	37.67	145.74	−38.66	−48.16
	(0.42)	(1.56)	(−1.79)	(−2.71)
Adjusted R^2	0.06	0.04	0.05	0.06

The regression results when portfolio trades are excluded (not reported) are qualitatively similar. We find that with no reporting delay and with half-spread earned on ending inventory, the fraction of nonpreferenced and internalized trades is the only variable negatively related to dealer profits. However, in the other three versions of the regression, not one of the four variables shows any systematic relationship. Once again the adjusted R^2s are of similar magnitude (four to six percent). This indicates the absence of any relationship between dealer profits and the composition of order flow is not sensitive to the presence of portfolio trades in our sample.

On the whole, we find that the regression results do not lend support to the prediction of the collusion hypothesis that preferenced order flow should be more profitable than nonpreferenced order flow. However, our findings are consistent with the "costly negotiation with heterogeneous dealers and customer-dealer relationship" hypothesis.

We investigate directly the extent of trading relationships between brokers and market makers. Toward that end, we rank brokers by turnover and select the top 19 brokers who are not affiliated with any market maker. We examine how these 19 brokers distribute their order flow across the 19 market makers. We find evidence of strong trading relationships. For each broker, when we rank the market makers in descending order of that broker's business, we find that, on average, the top market maker executes 27 percent of the broker's business (minimum 18 percent, maximum 92 percent). For expositional convenience, if we call this market maker the most favored market maker, then in total we find that six of the 19 market makers happen to be the most favored market makers of at least one of the 19 brokers. The largest (second largest) market maker happens to be the most favored market maker of nine (six) brokers. Collectively, these six most favored market makers execute more than 85 percent of the order flow of the brokers, which suggests that the brokers allocate a vast majority of their business to a handful of market makers.

In the absence of any trading relationships, we expect the brokers to distribute the order flow more or less independently across the market makers. Pearson's test of association attempts to capture this notion of independence. For this test, since we know the total business executed by each broker and each market maker, under the assumption of independence we estimate bivariate probabilities for broker i and dealer j as $P_{i,j} = P_i P_j$, where P_i (P_j) is the Pound Sterling value of broker i's (dealer j's) business expressed as a fraction of the total business (B) executed by the 19 brokers with the 19 market makers. We compute expected values of the distribution of business $E_{i,j} = B\, P_{i,j}$ under the assumption of independence. We calculate deviations of observed distribution from expected distribution $(O_{i,j} - E_{i,j})$, compute $(O_{i,j} - E_{i,j})^2/E_{i,j}$, and sum it across the 19 brokers and across the 19 market makers. This statistic in our case is distributed chi-square with 324 $((19 - 1)\cdot(19 - 1))$ degrees of freedom. The critical value for the test-statistic at the 1 percent level equals 268, and we obtain a test-statistic value of 17,803. This further supports the notion of trading relationships on the LSE.[24]

V. Preferencing, Internalization, and Spreads: A Cross-Sectional Analysis

In this section we investigate whether there exists any evidence in support of the claim that practices such as preferencing and internalization worsen the quality of execution for the order flow as a whole. In particular, we examine whether the average inside or average effective spread in a

[24] Pearson's test of association does not control for the differences in the propensity of market makers to post competitive prices. However, the finding that 66 percent of the trades are executed by dealers not posting the best price (see Table III) in 0–1 NMS as well as in all trade categories suggests that brokers have strong trading relationships with dealers.

given stock is related to the fraction of trades preferenced and/or internalized in that stock.

To implement our cross-sectional test, we compute the average inside spread and the average effective spread (twice the mean effective half-spread) in each of our sample stocks. We also measure the fraction (by value) of preferenced and internalized trades, preferenced and noninternalized trades, nonpreferenced and internalized trades, and interdealer trades in each stock. We regress the average inside spread and the average effective spread in each stock on the fractions of these four types of order flows in that stock while controlling for such well-known determinants of spreads as volatility, turnover rate, price of the stock, and the number of dealers making market in that stock. Specifically, we run the following regression assuming no delay in the reporting of trades, and for robustness, assuming a five-minute delay in reporting of trades.

$$\begin{aligned} \text{Spread}_s = {} & \beta_0 + \beta_1 \text{ Pref\&Int Frac}_s + \beta_2 \text{ Pref\&NonInt Frac}_s \\ & + \beta_3 \text{ NonPref\&Int Frac}_s + \beta_4 \text{ Inter-Dealer Frac}_s + \beta_5 \text{ Volatility}_s \\ & + \beta_6 \text{ Turnover}_s + \beta_7 \text{ Midprice}_s + \beta_8 \text{ MMnum}_s + \epsilon_s, \end{aligned} \tag{5}$$

where Spread_s is the average inside or average effective spread in stock s. $\text{Pref\&Int Frac}_s$ is the value of preferenced and internalized trades in stock s expressed as a fraction of total turnover in stock s. Similarly, Pref&NonInt Frac_s, $\text{NonPref\&Int}_s$, and $\text{Inter} - \text{Dealer}_s$ represent respectively the value of preferenced and noninternalized, nonpreferenced and internalized, and interdealer trades in stock s expressed as a fraction of total turnover in stock s. Volatility_s is the standard deviation of daily log returns of stock s, Turnover_s is the average daily total turnover in stock s, Midprice_s is the average midprice of stock s during the sample period, and MMnum_s is the number of competing market makers in stock s.

Table VII summarizes the results of our regression using average inside spread and average effective spread, with and without delay in reporting of trades. In the case of no delay in reporting of trades (the contemporaneous touch panel), relative proportions of the different types of order flow in a stock are unrelated to the average inside spread and average effective spread in that stock. For both inside and effective spreads, other independent variables are highly correlated with spreads as suggested by the 62 percent and 65 percent R^2.

The results look marginally different under an assumed trade reporting delay of five minutes. In the case of the inside spread regression, we find that the fraction of preferenced and internalized (P&I) trades (and to a lesser extent the fraction of preferenced and noninternalized (P&N-I) trades) and the average inside spread are positively related. This is consistent with the notion that preferencing reduces the incentive to narrow quotes. Moreover, we find that the average inside spread and fraction of interdealer trades are negatively related. This suggests that in stocks with a high degree of interdealer trading, market makers are able to share risk more easily and are

Table VII

Inside and Effective Spread Regressions

The table shows the results of the following regressions:

$$\text{Spread}_s = \beta_1 \text{ Pref\&Int Frac}_s + \beta_2 \text{ Pref\&NonInt Frac}_s + \beta_3 \text{ NonPref\&Int Frac}_s + \beta_4 \text{ Inter-Dealer Frac}_s + \beta_5 \text{ Volatility}_s + \beta_6 \text{ Turnover}_s + \beta_7 \text{ Midprice}_s + \beta_8 \text{ MMNumber}_s + \epsilon_s,$$

where Spread is the average inside and the average effective spread in stock s expressed in basis points of the midprice, and where Pref&Int Frac, Pref&NonInt Frac, and NonPref&Int Frac denote the fraction of public order flow which is preferenced and internalized, preferenced and noninternalized, or nonpreferenced and internalized, respectively. Inter-Dealer Frac denotes the fraction of total order flow that is among dealers. Volatility is the standard deviation of daily log returns (scaled by 1/10000). Turnover is the average daily total turnover in the stock. Midprice is the average price of stock s during the sample period. MMNumber is the number of competing market makers in stock s. All estimates are expressed in basis points. White (1980) heteroscedasticity corrected t-statistics are in parentheses. The first panel shows results for the inside spread or touch, the second panel shows the results for the effective spread. For both spread measures, we show the results for preferencing defined with respect to contemporaneous quotes as well as with respect to quotes five minutes prior to the reported trade time.

	Inside		Effective Spread	
Coefficient	Contemporaneous	5 Min. Delay	Contemporaneous	5 Min. Delay
Intercept	127.37	126.95	62.76	63.18
	(18.11)	(18.33)	(21.50)	(22.09)
Pref&Int Frac	4.31	8.16	2.44	3.97
	(1.23)	(2.26)	(1.54)	(2.44)
NonPref&Int Frac	−2.56	−3.78	−1.09	−2.13
	(−0.59)	(−0.93)	(−0.57)	(−1.21)
Pref&NonInt Frac	3.73	7.93	2.38	3.80
	(0.88)	(1.83)	(1.24)	(1.96)
Inter-Dealer Frac	−2.11	−7.77	−0.01	−2.55
	(−0.58)	(−2.06)	(0.00)	(−1.40)
Volatility	0.43	0.44	0.17	0.17
	(5.85)	(5.91)	(6.19)	(6.22)
Turnover	−1.85	−1.87	−0.69	−0.70
	(−13.53)	(−14.10)	(−11.06)	(−11.55)
Midprice	−0.04	−0.05	−0.03	−0.03
	(−13.74)	(−14.17)	(−16.60)	(−16.95)
MMNumber	−2.25	−2.27	−1.04	−1.06
	(−6.69)	(−6.70)	(−7.51)	(−7.56)
Adjusted R^2	0.62	0.63	0.65	0.65

willing to post tight quotes. This evidence supports the recent models of interdealer trading (Naik, Neuberger and Viswanathan (1998) and Werner (1997)) and also further corroborates the empirical evidence in Reiss and Werner (1998).

Similarly, in the case of the effective spread regression and under an assumed reporting delay of five minutes, the average effective spread and the fraction of preferenced trades (both internalized and noninternalized) are positively related, potentially reflecting worse execution received by preferenced trades compared to nonpreferenced trades. The negative relationship between average inside spread and the fraction of interdealer trading suggests that for those stocks where it is easier to lay off the inventory risk in the interdealer market, dealers are willing to charge a lower spread. However, none of these variables that appear significant under an assumed reporting delay of five minutes show any relationship under no reporting delay. Furthermore, the differences in R^2s are very small, suggesting that these effects are at best marginal and economically not very significant.

To examine the sensitivity of our findings to the presence of portfolio trades, we rerun regression (5) excluding portfolio trades (results not reported). We also rerun regression (5) including all trades but specifying the fraction of portfolio trades in a stock as an additional independent variable. In neither case do we find any consistent and significant relationship between the fractions of the different types of order flows in a stock and the average inside or the average effective spread in that stock. This suggests that our finding is not sensitive to the presence of portfolio trades.

Thus, these regression results do not lend support to the prediction of the collusion hypothesis that stocks with a higher extent of preferencing or internalization should have wider (inside or effective) spreads. These results, however, are consistent with the costly negotiation with heterogeneous dealers model of Rhodes-Kropf (1997), where dealer profitability is unrelated to the fraction of customers who receive price improvement. On the whole, the evidence does not show any consistent and significant relationship between the extent of preferencing and/or internalization in a stock and the inside spread or the effective spread in that stock.

VI. Concluding Remarks

In this paper, we measure the execution quality and dealer profits for various types of order flow on the LSE. We find that preferenced order flow receives worse execution than nonpreferenced order flow and that internalized order flow receives better execution than noninternalized order flow. Interestingly, we do not find any significant relationship between the trading profit of a dealer in a stock and the fractions of preferenced and/or internalized order flows executed by that dealer in that stock. These findings are robust to potential delay in the reporting of trades and the presence of portfolio trades in our data.

Our results neither lend support to the collusion hypothesis nor to the free option in quotes hypothesis. However, they are consistent with costly negotiation with heterogeneous dealers and customer-dealer trading relationship hypothesis. If customers require immediacy, they do not pay the cost of negotiating quotes and go to their regular dealers irrespective of their quotes. If customers are more patient, they search and negotiate for the best price and receive better execution. As a result, preferenced order flow pays a higher spread margin.

Our results on overall dealer profits indicate that market makers on the LSE earn a trading profit that is not significantly different from zero (at least in our sample period). This seems to suggest that practices like preferencing and internalization are at best necessary but not sufficient to lead to collusive profits. Our results also suggest that dealers make money on small and large trades but lose money on medium-sized trades. These differences are mainly due to the larger negative position margins on medium-sized trades, which suggests that these trades represent informed order flow—a finding consistent with Barclay and Warner's (1993) stealth trading hypothesis.

The absence of any significant cross-sectional relationship between the extent of preferencing or internalization and the average inside and average effective spread in a stock is consistent with the claim of Christie and Schultz (1996) that these practices are not sufficient to explain the wider spreads in dealership markets like the Nasdaq. Since in our sample there are more than two market makers in every stock, our results are also consistent with the findings of Bloomfield and O'Hara (1998) in a laboratory experimental market.

Before we conclude, we would like to relate our results with findings of other papers. In terms of profitability, our finding is consistent with the member firms' financial performance report published by the London Stock Exchange. When we use Stoll's (1993) methodology to compute the trading profits, we find that dealers earned a trading profit of £220 million on a public turnover of £357 billion or about six basis points during all of 1994, with the months around the sample period reporting the worst trading profits since 1990.[25] Our evidence of stealth trading is consistent with the findings of Hansch and Neuberger (1996) for 25 liquid stocks over the October 1991 to March 1992 period. Finally, our results on execution quality are similar to those of Reiss and Werner (1995) and Board and Sutcliffe (1995) pertaining to an earlier period.

Thus, our overall results do not seem to be highly specific to the sample period under observation. They are, however, specific to the London Stock Exchange and their generalizability to other dealership markets like the Nasdaq remains an open question. More studies using data from different dealership markets are needed to confirm our conclusions.

[25] The trading profits from 1991 to 1996 are as follows: 13 basis points in 1991, 10 basis points in 1992, 13 basis points in 1993, 6 basis points in 1994, 9 basis points in 1995, and 11 basis points in 1996. The dealers also earned commissions leading to a total revenue of 25 basis points in 1991, 20 basis points in 1992, 24 basis points in 1993, 19 basis points in 1994, 20 basis points in 1995, and 22 basis points in 1996.

Appendix A. The 102 Firms in the Sample

3i Group plc	General Electric	Reuters Holdings
Abbey Natl. plc	Glaxo	Rolls Royce
Alld Domecq plc	Granada Group	Royal & Sun Allnc.
Arjo Wigg. Appltn	Grand Metropolitan	Royal Bnk of Scot.
Asda Group plc	Great Univ Stores	Royal Insurance
B A T Ind. plc	Guard. Royal Exch.	Safeway
BAA plc	Guinness	Sainsburys
BOC Group	HSBC Holdings	Schroders
BTR plc	HSBC $H10	Schroders 'NV Ord'
Bnk of Scot.	Hanson	Scot. & Newcastle
Barclays Bank	ICI	Scottish Power
Bass plc	Inchcape	Sears
Blue Circle Ind.	Kingfisher	Severn Trent
Boots Co plc	Ladbroke Group	Shell T&T 'Regd'
British Aerospace	Land Securities	Shell T&T 'Br'
British Airways	Legal & General	Siebe
British Gas	Lloyds Bank	Smith & Nephew
British Petroleum	Lloyds TSB	SKB Corp
British Steel	MEPC	Southern Electric
British Telecom	Marks & Spencer	Std. Chartered
Burmah Castrol	NFC	TI Group
Cable & Wireless	National Power	Tesco
Cadbury-Schweppes	NatWest Bank	Thames Water
Carlton Communictns	Pearson	Tomkins
Coats Viyella	Peninsular & Orient	Unilever
Commercial Union	PowerGen	United Biscuits
Courtaulds	Prudential Corp	United Utilities
De La Rue Co	Rentokil	Vodafone Group
EMI Group	RMC Group	Warburg(S G)
Eastern Group	RTZ Corp	Wellcome
Enterprise Oil	Rank Organisation	Whitbread
Forte	Reckitt & Colman	Williams Hldgs
GKN	Redland	Wolseley
General Accident	Reed Intntal	Zeneca

Appendix B. Profitability of Order Flows of Different Size

In order to analyze the relative profitability of trades of different sizes, we compute dealers' trading profits for trades in different size categories. Toward that end, we follow an approach similar to that in Sofianos (1995) and divide the trading profit into two components: Spread revenue and positioning revenue. We define the spread margin earned by dealer j in stock s as

$$\mathrm{SM}_s^j = \sum_{i_s=1}^{T_s} (p_{si_s} - m_{si_s}) t_{si_s} \tag{B1}$$

and define the position margin as

$$\mathrm{PM}_s^j = \mathrm{TP}_s^j - \mathrm{SR}_s^j = m_{sT_s}\left(\sum_{i_s=1}^{T_s} t_{si_s}\right) + \sum_{i_s=1}^{T_s} m_{si_s}\, t_{si_s}, \tag{B2}$$

which represents the profit (loss) made by dealer j while reversing the trades.

We obtain dealer j's overall margin (OM^j) by summing his trading profits across all stocks and dividing it by his public turnover across all stocks. Similarly, we obtain his average spread margin (SM^j) and average position margin (PM^j) across all stocks. Specifically, we compute

$$\mathrm{OM}^j = \frac{\sum_{s=1}^{s=S} \mathrm{TP}_s^j}{\sum_{s=1}^{s=S} \sum_{i_s=1}^{T_s} p_{si_s} |t_{si_s}|}, \tag{B3}$$

$$\mathrm{SM}^j = \frac{\sum_{s=1}^{s=S} \mathrm{SM}_s^j}{\sum_{s=1}^{s=S} \sum_{i_s=1}^{T_s} p_{si_s} |t_{si_s}|}, \tag{B4}$$

$$\mathrm{PM}^j = \frac{\sum_{s=1}^{s=S} \mathrm{PM}_s^j}{\sum_{s=1}^{S} \sum_{i_s=1}^{T_s} p_{si_s} |t_{si_s}|}. \tag{B5}$$

We aggregate the margins earned by individual dealers and obtain the mean overall margin (OM) earned by all the dealers in our sample. The mean overall margin (OM) is simply the trading profits earned by all dealers divided by the total public turnover collectively executed by them. We find that although the market makers charge (SM) an average spread margin of 23 basis points, they lose (PM) 27 basis points while unwinding the trades and overall make (OM) a loss of four basis points.

To understand how the overall margin varies across trade sizes, we segregate all public trades into three size categories: small (0–1 NMS), medium (1–6 NMS), and large (6 + NMS) and compute the overall margin for each size category as described above. If we assume dealers earn a half-spread on the final inventory, then we find that that they earn 24 basis points on small trades, lose 16 basis points on medium-sized trades, and break even (−1 basis points) on large trades. Overall the dealers lose four basis points. If we value the ending inventory at the touch midprice, then corresponding margins turn out to be 22 basis points, −19 basis points, and −6 basis points, respectively, and overall the dealers lose six basis points. We note that this calculation does not include any commission on portfolio trades. If we allow for a 20-basis point commission on portfolio trades, we find that they just about break even on the overall order flow.

REFERENCES

Barclay, Michael J., 1997, Bid-ask spreads and the avoidance of odd-eighth quotes on Nasdaq: An examination of exchange listings, *Journal of Financial Economics* 45, 35–60.

Barclay, Michael J., and Jerome B. Warner, 1993, Stealth trading and volatility: Which trades move prices?, *Journal of Financial Economics* 34, 281–306.

Battalio, Robert, Jason Greene, and Robert Jennings, 1997, Do competing specialists and preferencing dealers affect market quality?, *Review of Financial Studies* 10, 969–993.

Battalio, Robert, and Craig Holden, 1996, Does increased competition in securities markets always lower trading costs?, Working paper, Indiana University.

Bessembinder, Hendrik, and Herb Kaufman, 1997, A comparison of trade execution costs for NYSE and Nasdaq listed stocks, *Journal of Financial Economics* 46, 293–319.

Bloomfield, Robert, and Maureen O'Hara, 1998, Does order preferencing matter?, *Journal of Financial Economics* 50, forthcoming.

Board, John, and Charles Sutcliffe, 1995, The effects of trade transparency in the London Stock Exchange: A summary, Working paper, London School of Economics.

Chan, K. C., William G. Christie, and Paul H. Schultz, 1995, Market structure and the intraday pattern of the bid-ask spreads for the Nasdaq securities, *Journal of Business* 68, 35–60.

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.

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., and Paul H. Schultz, 1996, The initiation and withdrawal of odd-eighth quotes among Nasdaq stocks: An empirical analysis, Working paper, Vanderbilt University.

Copeland, Thomas E., and Dan Galai, 1983, Information effects and the bid-ask spread, *Journal of Finance* 38, 1457–1469.

Dutta, Prajit K., and Ananth Madhavan, 1997, Competition and collusion in dealership markets, *Journal of Finance* 52, 245–276.

Franks, Julian, and Stephen M. Schaefer, 1995, Equity market transparency on the London Stock Exchange, *Journal of Applied Corporate Finance* 8, 70–77.

Godek, Paul, 1996, Why Nasdaq market makers avoid odd-eighths quotes, *Journal of Financial Economics* 41, 465–474.

Grossman, Sandford, Merton Miller, Daniel Fischel, Kenneth Cone, and David Ross, 1997, Clustering and competition in asset markets, *Journal of Law and Economics* 40, 23–60.

Hansch, Oliver, 1997, Competitive dealership markets: Empirical investigations on the London Stock Exchange, Ph.D. dissertation, London Business School.

Hansch, Oliver, Narayan Y. Naik, and S. Viswanathan, 1994, Trading profits, inventory control, and market share in a competitive dealership market, Working paper, London Business School.

Hansch, Oliver, Narayan Y. Naik, and S. Viswanathan, 1998, Do inventories matter in dealership markets: Evidence from the London Stock Exchange, *Journal of Finance* 53, 1623–1656.

Hansch, Oliver, and Anthony Neuberger, 1993, Block trading on the London Stock Exchange, Working paper, London Business School.

Hansch, Oliver, and Anthony Neuberger, 1996, Strategic trading by market makers on the London Stock Exchange, Working paper, London Business School.

Harris, Jeffrey H., and Paul H. Schultz, 1997, The importance of firm quotes and rapid executions: Evidence from the January 1994 SOES rules changes, *Journal of Financial Economics* 45, 135–166.

Harris, Lawrence, 1993, Consolidation, fragmentation, segmentation and regulation, *Financial Markets, Institutions and Instruments* 2, 1–28.

Hasbrouck, Joel, and George Sofianos, 1993, The trades of market makers: An analysis of the NYSE specialists, *Journal of Finance* 48, 1565–1594.

Ho, Thomas, and Hans Stoll, 1983, The dynamics of dealer markets under competition, *Journal of Finance* 38, 1053–1074.

Huang, Roger, and Hans Stoll, 1996, Dealer versus auction markets: A paired comparison of execution costs on Nasdaq and NYSE, *Journal of Financial Economics* 41, 313–358.

Jones, Charles, and Marc L. Lipson, 1996a, Measuring price impacts and trading costs on the Nasdaq and NYSE/AMEX, Working paper, Princeton University.

Jones, Charles, and Marc L. Lipson, 1996b, A note on institutional trading costs, Working paper, Princeton University.

Kandel, Eugene, and Leslie M. Marx, 1999, Payments for order flow on Nasdaq, *Journal of Finance* 54, 35–66.

Kleidon, Allan, and R. Willig, 1995, Why do Christie and Schultz infer collusion from their data?, mimeo, Cornerstone Research.

LaPlante, Michele, and Chris Muscarella, 1997, Do institutions receive comparable execution in the NYSE and Nasdaq markets? A transaction study of block trades, *Journal of Financial Economics* 45, 97–134.

Macey, Jonathan R., and Maureen O'Hara, 1997, The law and economics of best execution, *Journal of Financial Intermediation* 6, 188–223.

Naik, Narayan Y., Anthony Neuberger, and S. Viswanathan, 1998, Trade disclosure regulation in markets with negotiated trades, *Review of Financial Studies*, forthcoming.

Naik, Narayan Y., and Pradeep Yadav, 1996a, Execution costs and order flow characteristics in dealership markets: Evidence from the London Stock Exchange, Working paper, London Business School and University of Strathclyde.

Naik, Narayan Y., and Pradeep Yadav, 1996b, Risk sharing among dealers: Evidence on interdealer trading on the London Stock Exchange, Working paper, London Business School.

Neuberger, Anthony, 1992, An empirical examination of market maker profits on the London Stock Exchange, *Journal of Financial Services Research* 6, 343–372.

Neuberger, Anthony, and Robert Schwartz, 1990, Current developments in the London Equity Market, *Finanzmarkt and Portfolio Management* 4, 281–301.

Reiss, Peter C., and Ingrid M. Werner, 1995, Transaction costs in dealer markets: Evidence from the London Stock Exchange; in Andrew Lo, ed.: *Industrial Organization and the Regulation of the Securities Industry*, (NBER and University of Chicago Press).

Reiss, Peter C., and Ingrid M. Werner, 1998, Inter-dealer trading: Evidence from London, *Journal of Finance* 53, 1657–1704.

Rhodes-Kropf, Matthew, 1997, On price improvement in dealership markets, Working paper, Duke University.

Schwartz, Robert, 1991, *Reshaping the Equity Markets: A Guide for the 1990s* (Harper Business Publication, New York).

Sofianos, George, 1995, Specialist gross trading revenues at the New York Stock Exchange, Working paper, NYSE.

Stoll, Hans, 1993, Equity trading costs in-the-large, *Journal of Portfolio Management* 19, 41–50.

Werner, Ingrid M., 1997, A double auction model of interdealer trading, Stanford Business School research paper no. 1454.

White, Halbert, 1980, A heteroskedasticity consistent covariance matrix estimator and a direct test of heteroskedasticity, *Econometrica* 48, 817–838.