Trade Execution Costs and Disintermediated Order Crossing Systems on the London Stock Exchange

Bruce W. Weber
Information Systems Department
New York University

Abstract. *The growth of alternative trading systems that compete with established stock markets will have profound effects on many securities exchanges and their member firms. New screen-based markets match investors' orders directly without the involvement of a broker or a dealer, saving intermediation costs such as the bid-ask spread and broker commission costs. Competing market makers operating on the London Stock Exchange's SEAQ market provide an intermediated "quote-driven" trading mechanism, but the approaching roll-out of several alternatives will provide investors with new opportunities to trade without market makers. A model of order arrival, information change, and trading in a competing dealer market based on SEAQ is used to examine the consequences of "disintermediated" trading systems. The results indicate low-cost trading systems reduce dealing margins and the role of intermediaries. While alternative trading systems lessen the transactions costs borne by some traders, those requiring immediate execution and dealer intermediation may pay more in future marketplaces.*

Introduction. Two important and controversial trends affecting securities markets are the growth of passive fund management, and the emergence of alternative market mechanisms that compete for order flow with established exchanges. In many cases, screen-based trading systems allow investors' orders to meet directly without the involvement of a broker or a dealer, saving bid-ask spread costs and broker commissions. Because these systems can reduce trade execution costs, "passive" index and quantitative fund managers in the U.S. and elsewhere are using them more actively. However, disintermediated trading mechanisms often require users to wait for counterparty orders to arrive, and do not guarantee that submitted orders will be completed. Supporters point out that the new trading systems introduce additional competition, reduce trading costs, and give institutional fund managers greater flexibility in trading. Critics argue that these systems often lack liquidity and impose price risks because investors' orders may not execute immediately.

To analyze these arguments, we developed a simulation model of order arrival and trading in a competing dealer market based on the London Stock Exchange (LSE) SEAQ market. The model is used to examine the effects of low-cost investor trading activity, and to compare outcomes when passive investor orders are routed to:

1) SEAQ market makers who execute orders at the middle price (the average of the best bid and offer quotes) when an order does not increase their position further beyond their position limits, **or**
2) an alternative trading system that crosses offsetting buy and sell orders at the middle price three times a day

Overview. The results highlight the potential for trading cost reductions in alternative trading systems. However, crossing systems have several drawbacks and can impose costs on users. We identify disadvantages that partly offset the benefits predicted by "electronic markets" research [2][13] and by proponents of securities market disintermediation [7][15]. Although investors can significantly reduce their transactions costs by seeking midspread trade executions, achieving savings in the alternative trading system however requires a "critical mass" of activity to develop. Opposing that could be a pattern of market maker response that inhibits activity on a disintermediated system. By sacrificing some of their dealing margins and trading aggressively with passive traders at "midspread" prices, market makers may retain order flow from investors who would then find little advantage from the trading system.

The model also identifies "negative selection" costs from using a crossing system; orders that do not complete often pay more than they would have paid to execute immediately with a market maker. Finally, we find that market makers have incentives to submit position-balancing orders to the crossing system. The added orders, however, have the effect of raising the proportion of submitted orders that execute, making the system more attractive to investors seeking to bypass the dealers. Although crossing systems are in an embryonic stage of development, their adoption is likely to be rapid, and the performance of market participants unprepared for the consequences is likely to deteriorate.

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Active and Passive Investing. New approaches to investment management are emerging, and the changes are pressuring market intermediaries and securities exchanges to adapt. Investors' trading needs are an outgrowth of their investment technique. Most ***active*** fund managers feel they distinguish themselves on the basis of "stock selection", with low trading cost a secondary consideration. Discussing trading techniques, an active fund manager in London noted *"we are not worried about the odd 1p or 2p [in trading costs]."* (in [6]) Active managers' trades demand greater immediacy and capital commitment from market makers. The current LSE market structure provides the greatest support for investors that initiate trades and pay for member firms' brokerage and market making services.

Indexation and model-driven quantitative investing are growing responses to the fact that few active fund managers consistently outperform market indexes.

- A survey in 1990 of 36 of the largest US pension funds with assets totaling $259 billion found 34% of their domestic equities holdings were indexed, up from 30% in 1986 [8]
- A 1994 LSE internal survey of 29 UK fund managers found that 12% of their £290 billion under management was invested passively

Passive strategies require low-cost trading, and do not demand immediate execution of trading orders as provided by the SEAQ market makers. One of the largest pension fund managers in the U.S. pointed out that *"the lion's share of our trading now is over electronic systems, and if we had to pay full freight (about 5-10 cents per share) we would not do the trades. Our commission is at most 2 cents per share this way, and if it were 5 cents the portfolio strategy would be unprofitable."* [in 6] To avoid paying for immediate execution and market makers' capital, passive traders input their buy and sell interests into systems, but do not initiate trades. A managing director of a major institutional brokerage house in New York remarked that "institutions are so cost-conscious they'll bypass the [New York Stock Exchange] floor and us anyway they can to trade directly with each other." A survey of 150 U.S. fund managers with $1,500 billion under management found that [9]:

- 46% of respondents delayed trades over time to obtain a price more favorable than the current market price

While investors are willing to sacrifice trading immediacy for savings, they also recognize the risk of delaying trade executions:

- 55% found the "opportunity costs of missing a price" the most important cost they face in trading compared to 41% for "market impact" and 4% for "commissions"

New Trading Mechanisms. With investors' trading needs exhibiting growing variation, any one market system is less likely to be suited to any investor's strategy. Increasingly, institutions regard the selection of a trading mechanism as a way to enhance investment performance. Two electronic crossing networks - The Crossing Network and Posit - were introduced in the U.S. in 1986 and 1987 as alternatives for passive traders to bypass the established exchanges. Posit has been more successful, and in the second quarter of 1994 executed 9.1 million shares a day on average up from 6.3 million in the second quarter of 1993. For comparison, daily volumes in the second quarter of 1993 and 1994 on the New York Stock Exchange (NYSE) were 252 million and 269 million shares. In early 1994, Posit operated three daily crossings — at 10am, 11:15, 1:15pm — in which offsetting buy and sell orders were matched at the average of the existing bid and offer prices from the NYSE.

The NYSE's specialist-led floor market has suffered a significant loss of market share in the trading of its listed stocks to Posit and other alternative trading mechanisms. The NYSE's share of trading volume has fallen from 88 percent in 1980 to 79 percent in 1993. Including the volume of U.S. stocks now traded overseas and not reported, the current NYSE share of trading volume is about 70 percent. In contrast, off-exchange systems in London have languished. Ariel, an inter-institutional trading system, was introduced in the U.K. in 1974. Activity on Ariel never reached a significant level, and it was soon phased out. Since 1987, Instinet has provided a facility for disintermediated trading, but its activity levels in the U.K. have been low in comparison to the U.S., where it trades about 20 million shares a day mostly of NASDAQ stocks. Currently, nearly all equities trading in London occurs through SEAQ market makers. SEAQ displays the bid and offer quotes of the competing dealers in a stock, and investors telephone the dealer of their choice. The recent introduction of U.K. versions of successful U.S. off-exchange trading systems, and the approaching roll-out of TradePoint, a screen trading system, will provide institutions with additional opportunities to trade without SEAQ market makers.

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An Order Flow and Trading Model. Missing in the controversy about low-cost fund management and off-exchange trading systems have been controlled studies of their effects on market participants and market quality. We developed a model of trading in a single, representative equity, and analyze it under *ceteris paribus* order flow conditions using computer simulation. Simulation is a widely used technique in engineering and management science [12]. Commercial software is available, and the model is implemented in PC SIMSCRIPT II.5 from CACI Products.

We use the model to look at three scenarios. In Scenario I, we increase from 0% to 60% the proportion of institutional-size liquidity orders (defined below) that will ***seek to trade*** with SEAQ dealers at the current middle price. In this scenario, institutional clients, aware of TradePoint and other low-cost trading facilities, will offer business to their customary market makers at middle prices. We assume that a market maker receiving a midspread order will execute it against his inventory at the middle price unless his position in the stock is beyond the position limit (set in the simulation to a predetermined multiple of the average order size) and to be enlarged by the arriving order. In the latter case, the market maker will still deal, but at the SEAQ touch bid or offer. In Scenario II, an alternative trading mechanism is added to the model to assess, again, the impact of midspread trading on the market and on market makers, and the additional effect of a periodic crossing system. The crossing system accepts investors' orders and matches the offsetting quantity three times a day at the current middle price from the SEAQ market. Notice that the alternative mechanism is not a price discovery call auction [7]; it "borrows" prices from the main SEAQ market. Unexecuted orders remain in the system for a day, and are sent to a market maker after their third unsuccessful crossing. In Scenario III, market makers participate by submitting their excess inventories into the crossing. Note that in Scenarios II and III, the midspread trading mechanism could be an off-exchange system, or a system offered by the established exchange.

Components of the Model. Trading in the model is the result of machine-generated order flow interacting with the programmed decision rules of market maker intermediaries. A number of assumptions are made about the arrival process of investors' orders, random walk changes to the "fair value" (p*) at which buy and sell order arrival rates are equal, and the proportion of investors seeking to reduce transactions costs by trading at the middle price. The model is based on a stochastic supply and demand structure widely used in financial economics [14], operational details of the SEAQ market [5], the author's collaboration with the Director of Equities Operations of a London-based securities firm, and interviews with experienced traders at other firms.

Market makers buy and sell securities based on their quoted bid and offer prices, and build positions that absorb transient fluctuations in investor buying and selling. These imbalances might otherwise lead to more volatile changes in market prices. In the model, dealers do not speculate by taking long-term positions, but seek to maintain an essentially flat book (zero position in the security). The dealers do not know the value of p*, and change their quoted prices in response to their inventory, the observable order flow, and other market maker actions.

Order arrival and trading. Investors' orders arrive according to a stochastic Poisson process[1] with an expected arrival rate of 21.3 orders per hour. Based on the dealers' market shares and whether they are making the touch bid or offer, arriving orders are allocated to a specific market maker. Consistent with *preferencing*, a dealer not making the inside quote (i.e., the best quote to buy or sell) has a smaller (but non-zero) probability of receiving a customer order.[2] The normal ratio of buy orders to sell orders is 1:1, although this will increase to 2:1 whenever p* is greater than the lowest offer (*informed* buying), or p* is below the highest bid (*informed* selling).

In addition, the model accounts for the evidence that market prices follow more run patterns than predicted by a random process by including *momentum* orders. In actual markets, momentum trading could result from "chartists" inferring short-term price trends from one-sided trade activity, or from traders who infer that successive trades on one side of the spread presage price movement. In the SEAQ market, the adage is *"blue makes buyers and red makes sellers"* because the SEAQ screen displays prices in red when they reflect a fall from the previous price and in blue when they reflect an increase. When the number of consecutive bid-side trade prices and midtouch quote declines (a sell run) is five or more, the ratio of sell orders to buy orders will increase to 8:5. A buy run is equivalently defined. About four percent of the order flow in the model comes from such trend traders. To reflect improvements on the SEAQ touch quotes, (the Stock Exchange ***Quarterly***, Spring 1994, reported that 35 percent of all U.K. equity bargains occur inside the touch bid and ask quotes.) when the touch is 5p or wider, trades for more than 5 units (institutional size) will execute 1p above the bid if selling, or 1p below the offer if buying.

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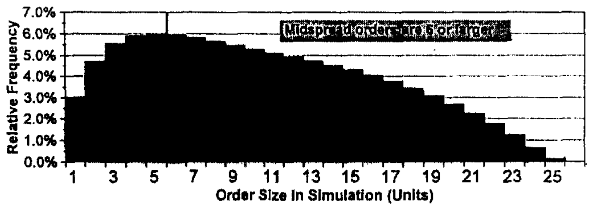
Order sizes. In the simulation, buy and sell orders submitted to the market vary in size from 1 to 25 units. This convenient normalization means that a unit represents shares with a value of £10,000. Hence the range of orders considered is from £10,000 to £250,000. Trades of this size account for about 65 percent of total value of LSE bargains. Beyond 25 units, we assume the trade would be handled as a negotiated block trade, or arrive in the market in smaller broken-up pieces. In 1993, the average bargain value in FTSE-100 stocks was £68,905. The average order size in the model is 7 units, or £70,000. On the basis of its fit with empirical data from the London Stock Exchange's Quality of Markets data, the Beta distribution was selected for order sizes in the simulation (see Figure 1).

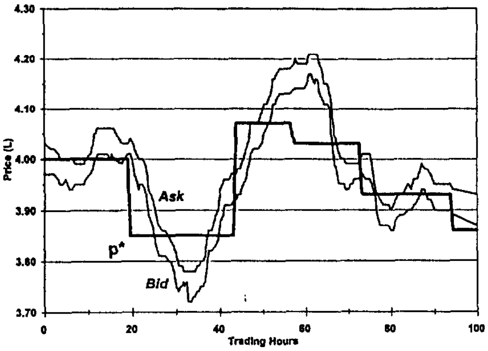
FIGURE 1: SIMULATION ORDER SIZE DISTRIBUTION



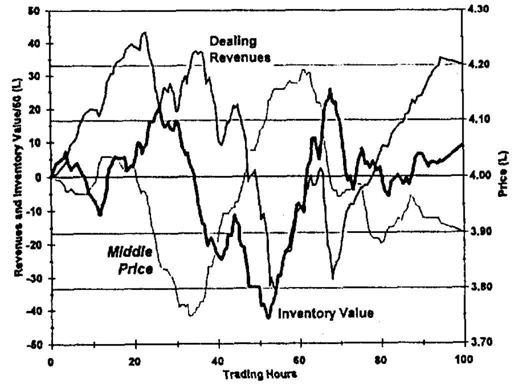
In Figures 2a and 2b, the model and market maker operations are illustrated over a 100 hour period. We consider a stock with a mean time between orders of about 3 minutes, and set its initial equilibrium value at £4.00. Market makers revise their quotes over time to reflect changes to their inventory positions. Figure 2a's left vertical axis is in units of pounds sterling and reflects the touch bid and ask, and p*. The touch bid and ask quotes track p* subject to some lag and some overshooting. The left vertical axis in Figure 2b represents the market-to market value of the market makers' inventory, and the market makers' aggregate dealing revenues. An initial p* of £4.00 is used, and dealers' spreads are 1.5 percent. As represented by the two thin lines, the initial touch is £3.97 bid and £4.03 offered. Once trading begins, the dealers' inventory value rises to over 400 in the first few hours, which causes the dealers to adjust their quotes 3p-4p downward. The dealers' positions return to zero, and then become short. After about 10 hours of trading the touch offer falls below p* (Figure 2a). At that point, the touch bid and ask no longer straddle p*. The low ask quote triggers informed buying: i.e., the ratio of buy orders to sell orders rises from 1:1 to 2:1. Between hours 10 and 20, growing short positions force the dealers to raise their quotes. After about 20 hours, p* falls from £4.00 to £3.85. With the touch bid greater than p*, the market makers positions become very long, forcing downward quote revisions and a price "freefall" between hour 20 and 30. At hour 43, the p* increases to £4.07 leading to a buying imbalance and growing short positions for the market makers. After 100 hours, the market makers have aggregate profits of 34.0 currency units or about a 5 basis points dealing margin on turnover of 62,000 currency units.

FIGURES 2A AND 2B: MODEL ILLUSTRATIONS

(a) Random walk of p*, market touch bid and ask



(b) Dealing revenues, midprice, inventory value



Simulation Scenarios. In the first of three scenarios, midspread orders are routed to market makers, who execute them at their discretion. Unless the order is to sell and the market maker is long beyond his position limit (or the order is to buy and his inventory position is short beyond his position limit), the order will execute at the middle price, which can be in half-pennies. If the market maker does not accommodate the midspread order, he executes it at the SEAQ touch quote. Since other orders will execute 1p inside the touch quote, a midspread order that is turned down executes at a less attractive price. The experimental design varies the midspread-seeking trading proportion of the large order flow (6 units or more) from zero in the base case to 60 percent. Scenarios I, II, and III are illustrated in Figure 3.

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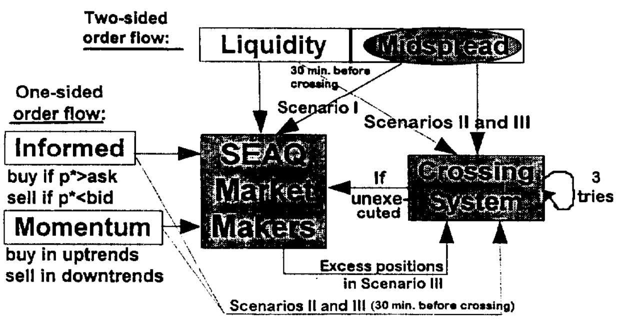
FIGURE 3: SCHEMATIC OF THREE SCENARIOS

I) Market makers trade at their discretion with midspread orders
II) Midspread orders are routed to a crossing system
III) Midspread orders are routed to a crossing system, in which market makers can participate



In the second and third scenarios, an alternative trading mechanism is introduced. The disintermediated mechanism is a periodic crossing system that matches offsetting buy and sell orders according to time priority at the mid-touch price. It enables midspread orders to be entered anonymously and crossed, thus bypassing SEAQ market makers. Crossings are conducted three times a day: at 11:10am, 1:50pm, and 4:30pm. The experimental design again varies the proportion of the large order flow that is for midspread trading from 7.5 percent to 60 percent. All midspread orders are entered into the system, and in the last half hour before the crossing time, the given proportion (7.5%, 15%, 30%, 45%, 60%) of all other incoming orders for six or more units will go to the crossing system. Other orders are routed to a market maker. Non-midspread orders that are entered participate in only one crossing, and if unexecuted are routed to a SEAQ market maker for execution just after the crossing. Unexecuted midspread orders attempt three crossings then go to a market maker. Although an average FTSE 100 stock has 17 market makers, most dealers are fairly inactive, hence only six are used in the simulation. Otherwise, the input variables were chosen to reflect a typical stock in the FTSE 100. In the second scenario, an investor-only crossing system matches buy and sell orders three times daily. In the third scenario, market makers can use the order crossing system, and are assumed to enter orders for their "excess" inventory positions. For instance, a dealer with a position limit of 14 that is long 25 units, will enter an order to sell 11 units. The model's input parameter settings are listed in Table 1.

TABLE 1

Model Input Parameter	Value
Mean order arrival rate	21.3 per hour
Arrival rate ratio: Buy:Sells	1:1
when p* > Touch Ask	2:1
when p* < Touch Bid	1:2
Standard deviation of daily return of p*	1.50%
Expected time between p* changes	12 trading hours
Trading day length	8 hours (8:30am-4:30pm)
Initial fair value price	£4.00
Number of market makers	6 (Dealers #1-#6)
Market makers' position limits	18(#1-2),14(#3-4),10(#5-6)
Market makers' market shares	25.0% (#1-2), 16.7% (#3-4), 8.3% (#5-6)
Market maker spread	1.5% of share price rounded to 1p (initially 6p)

Results. Each cell in Table 2 presents the averages of eight replications each covering 250 days of trading in a stock. Nonparametric Wilcoxon ranked sums tests [4] indicated that statistically significant differences exist across the different scenarios at the $(\frac{1}{2})^8 = .004$ level in the 60% case, and between the base case (0% or 7.5%) and the 60% case for all three scenarios. The starred measures in Table 2 are significantly different. The average values for Scenario I is in the top line of each row, and Scenarios II and III are below. Indicated in the column headings, is the treatment variable, share of institutional order flow, which is set at six different levels.

Empirical validation of the output data, based on several measures from the actual LSE market, indicates that the model provides a realistic representation. In the simulation, the average touch spread was 1.13 percent in the base case (no midspread orders) compared to the average touch spread for FTSE 100 shares of 1.10 percent in 1992, and 0.84 percent in 1993. In the simulation, there were 202 customer bargains per day compared to 212 per day for a FTSE 100 stock on average in 1993, and 166 per day in 1992. The average dealing margin for market makers in the simulation was 4.3 basis points (dealing profits ÷ total dealer volumes), or 5.9 basis points when intramarket volumes are single counted (dealing profits ÷ total turnover). In a six month sample of trading in 25 FTSE 100 shares, Hansch and Neuberger (1993) found market maker margins to be 8.9 basis points. These figures are consistent with transactions cost data for U.S. equities trading from Berkowitz, Logue, and Noser (1988) who found in a large sample of trades that gross market maker profits were 0.06 percent, or 6 basis points. In the base case, investors submitting orders to the market incur round-trip transactions costs on average of 0.85 percent. A round-trip represents the act of buying and later selling during the 250 day simulated market period.

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TABLE 2

Scenario I) Market Makers trade at their discretion with midspread orders
Scenario II) Midspread orders are routed to a crossing system
Scenario III) Midspread orders are routed to a crossing system, in which market makers can participate

— SHARE OF LARGE ORDER FLOW THAT SEEKS TO TRADE AT MIDDLE PRICE —

Means over 8 sample runs:		0%	7.5%	15%	30%	45%	60%
Arriving orders and executed trade sides		42,604.4					
Executed customer trade volume		298,306 (same in all settings)					
	Scenario I)	411,419	409,539	414,652	418,512	416,396	415,031
Market maker volumes*	II)		394,378	375,060	329,167	281,206	237,084
	III)		389,920	371,040	325,063	277,301	232,190
Touch spread	I)	4.5p	4.6p (1.15%)	4.6p (1.16%)	4.7p (1.17%)	4.7p (1.19%)	4.8p (1.20%)
(as a % of mean price)	II)	(1.13%)	4.6p (1.15%)	4.6p (1.15%)	4.6p (1.15%)	4.6p (1.15%)	4.6p (1.15%)
	III)		4.6p (1.15%)	4.6p (1.15%)	4.6p (1.15%)	4.6p (1.15%)	4.6p (1.15%)
Midspread trading as a percent of	I)		4.85%	9.64%	19.3%	29.0%	38.6%
total customer volume*	II)	na	5.91%	11.0%	22.4%	33.7%	44.0%
	III)		6.29%	12.1%	23.5%	34.8%	45.2%
AverageCost of aRound-Trip Transaction*							
Market orders		0.85%	0.91%	0.91%	0.98%	1.01%	1.04%
Midspread orders		na	0.40%	0.36%	0.34%	0.32%	0.38%
All	I)	0.85%	0.89%	0.86%	0.85%	0.81%	0.78%
Market orders			0.90%	0.87%	0.93%	0.87%	0.89%
Midspread orders			0.20%	0.29%	0.21%	0.14%	0.16%
All	II)		0.87%	0.83%	0.81%	0.72%	0.68%
Market orders			0.91%	0.87%	0.85%	0.91%	0.95%
Midspread orders			0.09%	0.16%	0.18%	0.10%	0.17%
All	III)		0.86%	0.81%	0.74%	0.75%	0.73%
Fill rates*: Percentage of	I)	na	80.1%	79.6%	79.1%	78.5%	78.1%
midspread order volume completed	II)		40.6%	53.2%	63.4%	68.7%	67.4%
by market makers or in a crossing	III)		67.2%	73.4%	78.5%	80.8%	81.2%
	I)		1.42p	1.42p	1.43p	1.44p	1.45p
Executed midspread order savings	II)		1.40p	1.29p	1.39p	1.45p	1.43p
	III)	na	0.61p	0.85p	1.07p	1.19p	1.27p
Unexecuted midspread order selec-	I)		0.00p	0.00p	0.00p	0.00p	0.00p
tion cost*(midspread orders after	II)		−0.17p	−0.48p	−0.30p	−0.26p	−0.42p
3 cross tries, others after 1 try)	III)		−1.23p	−0.70p	−0.44p	−0.39p	−0.44p
	I)	694.1	597.5	328.8	136.2	−191.0	−438.7
Market makers' trading revenue*	II)	(0.043%)	586.8	628.5	538.8	531.3	452.7
	III)		749.2	783.7	646.2	628.1	592.3
	I)	7.0	7.0	7.0	7.0	7.0	7.0
Market makers' average bargain size*	II)		6.9	6.8	6.5	6.2	5.8
	III)		6.9	6.8	6.5	6.2	5.8

Informed orders trade on difference between p* and the quotes. For the 16 cases considered, they sell at an average of between 10p and 12p (2.5-3.0 percent) above their purchase price. Because market makers often improve on the touch prices and bear the risk of trading with the informed orders, their average dealing margin of 4.3 basis points recovers just 4 percent of the quoted touch spread.

Impacts of Low-Cost Trading. Four principal impacts of increasing midspread trading activity are evident in the results of the simulation.

RESULT 1. Dealer margins fall at higher levels of midspread trading. In Scenario I, total dealer profits fall from 4.3 basis points to −2.7 basis points when midspread orders are 60 percent of the large order flow. (See Graph 5) This raises the questions how dealers will respond to lower margins if they accommodate midspread trading, or how they will respond to smaller volumes if a crossing systems draws order flow away. Widening spreads on the remaining market orders could drive more investors to use a crossing system.

Margins fall because investors' transactions costs — from which dealers earn profits — go down as the proportion seeking midspread execution increases. Net of changes in the stock price, a round-trip using market orders pays a cost due to the spread between bid and offer prices. *Conditional on executing both the buy and sell legs*, a round-trip transaction using midspread orders will not have a cost, i.e., they will buy and sell at the same price on average. Notice that an 80 percent fill rate (Fill rate row Table 2) implies the probability of executing both sides of the transaction with midspread orders is just $(.80)^2 = 64$ percent.

Round-trip transactions costs are the weighted average of the transactions cost of using market orders

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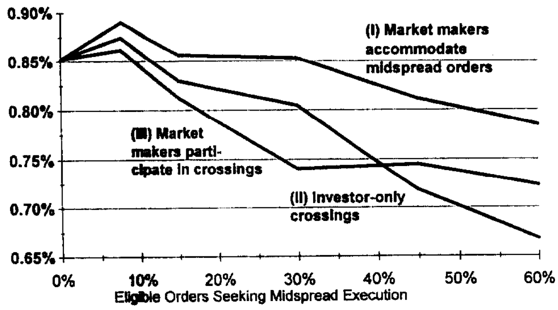
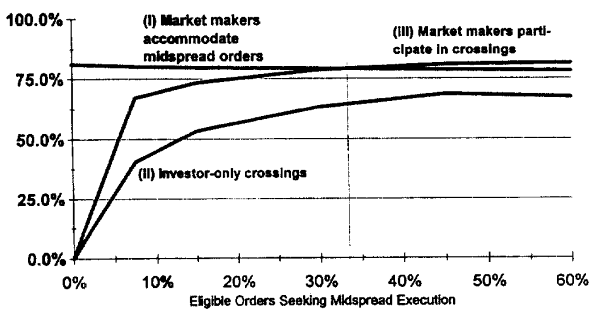
weighted by market orders' proportion of turnover and the transactions cost of using midspread orders weighted by midspread orders' proportion of turnover. Informed orders are not included. The average cost of a round-trip decreases from 0.85% of trade value to 0.78% when 60 percent of large orders are midspread orders. The cost falls to 0.68% when the crossing system is available, and 0.73% when market maker participate in the crossings. Market makers' participation in the crossing system reduces round-trip costs for low percentages of midspread orders (II vs. III). At higher levels of order submissions, however, dealers in the crossing raise investors' costs.

GRAPH 1: ROUND-TRIP TRANSACTIONS COST (% OF TRADE VALUE) FOR CUSTOMER ORDERS



RESULT 2. <u>A crossing system will be effective only if it achieves a critical mass of activity.</u> Without a significant proportion of the eligible orders entered into the crossing system, it will not provide execution rates (executed volume in crossing ÷ submitted volume) that are comparable to what market makers would provide by dealing at the midspread on request. For the conditions examined here, the hurdle is at about 30 percent of order flow (Graph 2) when market makers participate. In actual markets, there is no reliable estimate of what proportion of investor orders use passive trading methods, but crossing system use in the U.S. is growing and could soon approach critical mass.

GRAPH 2: FILL RATES ON MIDSPREAD ORDERS



The results show that reaching critical mass in U.K. equities could be hampered by a pattern of market maker response that impedes development of liquidity on a disintermediated system. By sacrificing some of their dealing margins and trading with passive traders at "midspread" prices as in Scenario I, market makers will retain order flow from investors who will find little advantage from the crossing system at submission levels. If the crossing volumes remain low, fill rates will remain unattractive.

Fill rates of actual crossing systems in use in the U.S. are about 10 to 20 percent. The fill rates are higher in the simulation because the model's largest order size is 25, or about 3½ times the average order size. Crossing systems in use attract orders that are often far larger than the average. Hence, relative to the model, they have high submitted volumes (i.e., the denominator in the fill rate equation) compared to what crosses (i.e., the numerator).

RESULT 3. <u>Selection cost risk exists in passive crossing systems</u>. Orders that <u>do not</u> complete promptly in a crossing system eventually execute at prices that may be worse than those available for immediate execution at the time the order was submitted. Graphs 3a and 3b indicate the execution price a midspread order achieves compared to the price it would have received from a market maker at the time it entered the crossing system. In all cases, orders that cross in the first auction after they are entered save about 2p. Orders that are filled in their second attempt at crossing save about 1p if the crossing system excludes market makers, but give up a half-penny if market makers participate. The selection cost grows to as much as 8p for orders that are unfilled in the auction after three attempts, and the residuals revert to a SEAQ market maker for execution. Negative selection risk occurs because the lack of a contra side in the crossing indicates that the short-term price movement is likely to work against the passive trader's order. As Graph 3b indicates, the selection cost effect is intensified by the presence of market makers in the auction. Dealers are likely to be on the unfilled side of the market and adjust their quotes after the auction so that unsatisfied client orders pay more when buying or receive less when selling. Most orders execute in the first crossing (Graph 4), and the ***average*** execution cost for midspread orders reflects a saving compared to immediate execution with a market maker (Cost row in Table 2). An order entered into the crossing, however, faces uncertainty about its eventual execution price. This helps to explain why investors are often willing to pay for a dealer for immediacy.

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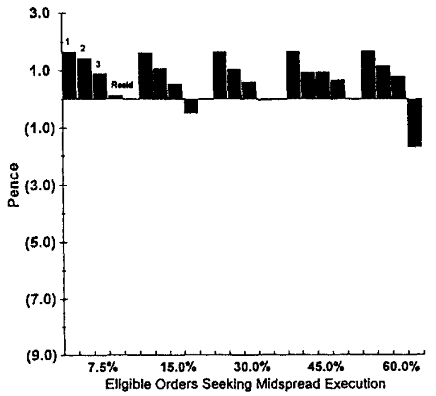
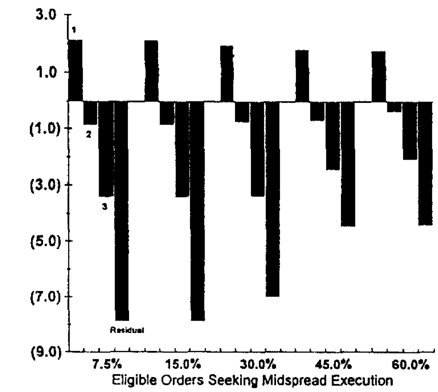
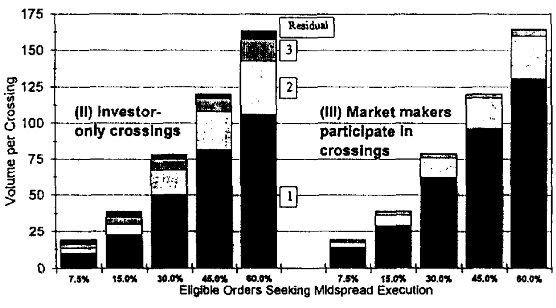
GRAPHS 3A AND 3B: EXECUTION COST SAVINGS COMPARED TO IMMEDIACY (II) Investor-only crossings



(III) Market makers participate

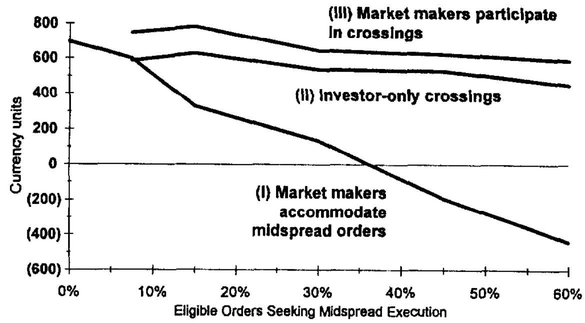


GRAPH 4: CROSSING VOLUME BY CROSS NUMBER



RESULT 4. <u>Dealing margins improve when market makers submit excess positions to the crossing system, and market makers will choose to participate when offered the choice</u>. Although dealing revenues are greater when market makers take part in the crossings, their participation has the effect of increasing the system's execution rate. In part, the revenue increase is due to the reduction in the market makers' average bargain size when the crossing system operates (Bottom row in Table 2). Large trades in the model are higher risk and less profitable for market makers because they often lead to the dealers raising or lowering quotes in the absence of a shift in p*. The crossing system executes many of the large orders, leaving the market makers with smaller orders that are more profitable on average. A similar distribution of profits (large trades are often "loss-leaders") was found in empirical data [11].

GRAPH 5: MARKET MAKER DEALING REVENUE (AVERAGES OVER 250 SIMULATED TRADING DAYS)



Conclusions. Fund management has been transformed by new portfolio strategies, and innovative market and trading technology. The alternative trading mechanisms available today threaten many established stock exchanges and their traditional intermediaries. We presented a model of London's traditional market operations, and assessed three alternative scenarios. The results indicate that changes in investor behavior and new trading alternatives will have profound effects on the market and LSE member firms. Trading costs will fall, but market maker volumes and profitability may come under attack. Equity investing, however, is made more attractive by reducing the round-trip transactions costs paid by the average investor. Several questions remain: if dealers attempt to recover profitability by widening spreads, will that spur even more disintermediated trading and bypass of the Exchange market? Will market makers support the costs of "price discovery"when they handle a diminished proportion of trading volume? Finally, what proportion of investors will eventually use passive trading methods?

The model provides a basis for making objective judgments about market structure and policy choices. A shortcoming of the LSE may be its traditional support for an intermediated, competing dealer mechanism for

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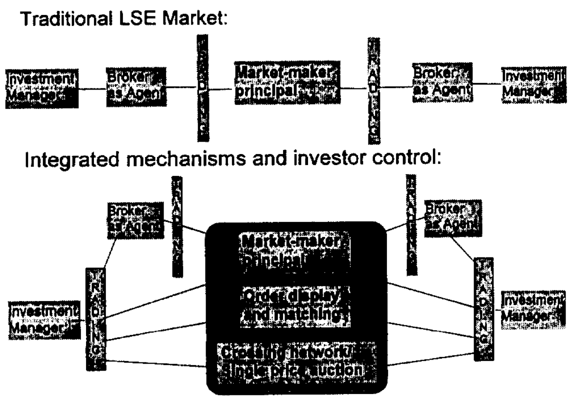
trading at a time when alternative investment management approaches are flourishing, and trading needs exhibit growing variation. A competing market maker system is suited to some, but not all, investors' strategies. Keeping order flow from deserting an exchange may require augmenting the market structure with alternative, lower-cost trading mechanisms. Similar proposals have been made in the U.S. [1] The exchange's best response may be to preempt these alternatives by offering a range of linked trading mechanisms (Figure 4), including competing SEAQ market maker quotes, limit order facilities, and periodic crossings.

FIGURE 4: RESPONDING WITH AN INTEGRATED, HYBRID MARKET STRUCTURE



While the model provides useful comparisons between several alternative situations, it has several limitations. Left out are investors' responses to market conditions. For instance, the proportions of liquidity, momentum, information, and midspread orders could change over time or as a result of market conditions. The model represents trading in a single security. Market participants usually do not consider a security in isolation; market makers cover several stocks and investors manage portfolios of securities. In some cases, the risk of a dealer's position could be greatly reduced by an offsetting position in a related security. While the security examined is representative of a FTSE 100 stock, sensitivity analysis to determine changes in the effects for different security characteristics was not undertaken. Finally, some of the input parameters that are assumed to be constant — such as volatility and order arrival rates — could be affected by changes in trading and investor behavior. For developing an understanding of the impacts of alternative trading systems, however, the limitations are fairly minor, and we find our general results on the impact of passive investing and disintermediated trading to be robust to broad variation in the model's input parameters. Disintermediated trading systems may soon grow out of their early stages of development. At that time, the pace of adoption is likely to quicken, and market participants unprepared for the growth of passive low-cost trading systems will face difficulties and worsening performance.

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