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Marketmaker Behavior in an Auction Market: An Analysis of Scalpers in Futures Markets

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ABSTRACT

This paper focuses on the role of scalpers as marketmakers in the competitive auction of futures exchanges. We use transactions data of a representative scalper to identify the source of scalper earnings. We find that scalpers provide liquidity services to incoming market orders, thereby facilitating commercial hedging. Scalper earnings are positively related to the bid-asked spread and negatively related to the length of time a position is held.

FUTURES TRADING IS organized as an auction market, with buyers and sellers confronting each other directly in a trading pit or ring on an exchange floor. Bids and offers are represented in the pit by open outcry. Trades are consummated throughout a trading session (which usually last 4 to 6 hours) whenever a bid is hit or an offer lifted by some other agent on the floor.

Participants in futures markets include hedgers and speculators whose orders are called in and are represented by floor *brokers* in the pit. In addition, floor *traders* participate by bidding and offering for their own account. Some floor traders fall into the category of short-term speculators (day traders) who prefer to trade for themselves rather than execute orders through a floor broker. A somewhat more specialized group of floor traders are known as scalpers. They are essentially marketmakers who quote bids and offers against which market orders can be executed. They do not have an affirmative obligation to provide liquidity by quoting bids and offers but do so in the expectation of earning a return.

This paper examines the activities of scalpers on futures exchanges in order to identify the role of marketmakers in a freely competitive auction. We focus on the nature of scalper decision-making as well as on the contribution of scalpers to economic welfare. One of our main concerns is with the source of a scalper's earnings. If the scalper is primarily a voluntary marketmaker who provides liquidity to incoming market orders, then the return on his time and effort should stem primarily from his quoted bid-asked spread and the frequency with which his bid is hit and and his offer lifted. On the other hand, if a scalper is simply

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another type of speculator, there need not be any connection between his profitable trades and the bid-asked spread.

This issue is important from two vantage points: the economic role of futures markets and the literature on market microstructure. The source of returns to futures traders has been scrutinized by Houthakker [6] and Rockwell [7]. The objective was to identify the gainers and losers in futures trading and to document the welfare contribution of futures markets. In our context, if the earnings of marketmaking scalpers stem from providing liquidity services, they thereby facilitate commercial hedging and improve economic welfare.

Much of the literature on market microstructure assumes that marketmaker returns come from providing liquidity services (see, for example, Tinic [10]). An alternative hypothesis stresses that dealers earn a substantial part of their income from actively positioning securities and risk-taking (see Garbade [1982, p. 482]), rather than from the bid-asked spread. Our analysis provides the first formal test of these alternative hypotheses.

Section I of this paper briefly reviews the literature on market microstructure and shows why marketmarkers emerge in a competitive auction. Section II describes the rules and customs of pit trading in futures markets and identifies the nature and function of a scalper. Section III presents empirical evidence on marketmaker behavior based on a unique data base: the detailed trading records of a representative scalper, with the term representative discussed more fully below. The results are summarized in Section IV.

I. Continuous Auctions and the Need for Marketmakers

The temporally and geographically consolidated auction of the Walrasian world is a useful analytical device for describing the exchange process underlying equilibrium price determination. The only economic actors in that world are the ultimate buyers and sellers. The auctioneer's role is limited to announcing excess demands or supplies and ordering recontracting until a price is reached where buying and selling interests match perfectly. A single multilateral transaction takes place at that unique price.

Most real world markets (with the prominent exception of the twice daily London gold fixing) do not operate via recontracting that consummates in a single multilateral transaction. Most markets trade continuously through time rather than at discrete points. With continuous trading, buyers and sellers with price-compatible trading interests might arrive at the marketplace at different moments, hence their orders to buy and sell might not be crossed by a pure auctioneer. Moreover, the desire of some participants to transact immediately means that actual transactions prices could differ considerably from the equilibrium price emerging from a temporally consolidated Walrasian auction.

Stigler [9] was the first to emphasize that inventory specialists (marketmakers or dealers) would emerge in response to the profit opportunities created by the temporally fragmented order flow associated with a continuous auction. In particular, a marketmaker who stands ready to buy at his bid price from all sellers and sell at his offer price to all buyers provides the liquidity service of immediate execution to public orders (the ultimate buyers and sellers). The

marketmaker uses his inventory to bridge the gap between stochastically arriving buy and sell orders and earns a return based on his bid-asked spread. The return compensates the dealer for the opportunity cost of standing at the marketplace awaiting public orders, for the capital tied up in inventory, and for the risk exposure associated with equilibrium price fluctuations.

One of the main benefits of dealer participation in a continuous auction is a reduction in the volatility of actual transactions prices around the true (temporally integrated) equilibrium price (see Garbade and Silber [3]). An alternative technique for minimizing such transaction price volatility is to consolidate public order flow by holding a periodic, rather than continuous, auction. But periodic auctions leave the public exposed to the risk of equilibrium price changes between auctions. Thus, most auction markets, especially those for assets with considerable potential for equilibrium price volatility, permit continuous transactions, with marketmaking dealers emerging in the process to minimize transactions price fluctuations.[1]

II. The Nature and Function of Scalpers in Futures Markets

Large equilibrium price volatility in the underlying commodity is one of the main stimuli to the emergence of futures trading (see Gray [5], Silber [8], and Working [11]). Thus, it is not surprising that futures exchanges permit trading continuously during a specified number of hours each day. It is also not surprising, therefore, that specialized marketmakers emerge in the process. What is somewhat unique is the form that these marketmakers take. In particular, futures exchanges do not impose any affirmative obligations on the scalpers who act as marketmakers in the various trading pits. Nor do the futures exchanges assign anyone to trade in any specific commodity. Rather, in keeping with the freely competitive spirit embodied in futures exchanges, these marketmakers behave in ways that maximize their utility within the general rules of the open auction conducted in the pit. Thus, scalper behavior provides a unique opportunity to observe the development of freely competitive marketmakers within an auction market.

It is important to review some of the rules of the open outcry auction of futures trading that influence scalper behavior. The most fundamental rule is that all bids and offers must be announced publicly to the pit—the literal open outcry of

[1] Continuous transactions might literally imply trading 24 hours a day. This is technologically feasible and has been considered by the New York Stock Exchange and the Chicago Mercantile Exchange. Limiting trading hours over finite time intervals has the advantage of consolidating order flow and reducing transactions price volatility associated with random tenders. The optimal frequency of an auction depends on, among other things, a balancing of transactions price volatility versus equilibrium price volatility, as shown in Garbade and Silber [3].

In some cases, there are two types of auctions for an asset. In particular, the London gold fixing takes place twice daily, while a continuous auction for (cash and future) gold takes place on the floor of the Commodity Exchange in New York. Those desiring immediate execution to avoid equilibrium price volatility execute orders on the Commodity Exchange, while those desiring the transactions benefits of consolidating order flow will execute orders at the London gold fixing. Large-sized orders may choose to wait for the consolidated auction if the perceived transactions price volatility of immediate execution exceeds the risk exposure of equilibrium price volatility.

buy or sell orders. In particular, no prearranged trades are permitted on futures exchanges.[2] This rule is designed to expose all orders to competitive pricing.

The second rule requires strict price priority in the pit. The highest bid price and lowest offer take precedence. Specifically, lower bidders must keep silent when a higher bid is called out and higher offerers are silenced when a lower offer is announced. Thus, when several members in the pit are simultaneously bidding and/or offering, they are all bidding at the same price or offering at the same price. Of course, a trader who wants to increase his probability of buying can choose to raise his bid or lower his offer at any time. And all other bidders or offerers must either follow or be silent. This rule is designed to insure best execution in the sense that sales occur at the highest bid price and purchases occur at the lowest offering (see Garbade and Silber [4]).

Two proscriptive rules are crucial as well. First, there is no "all-or-nothing" order in futures trading. Thus, a broker representing an order to buy 20 Treasury bond contracts at a price of 73 cannot refuse to buy only 2 contracts if they are offered to him at a price of 73 (unless his order has already been filled). This rule forces the integration of large and small orders (or of professional/commercial orders and public orders).

The second proscriptive rule is that there is no time priority in a futures ring. If one agent started offering at 73½ and a second agent began offering at 73½ 30 seconds later there is nothing to prevent another trader from buying from the second offerer first. This rule emerges because of the difficulty of enforcing time priority in the rapidly changing competitive environment of a futures pit.

Another rule stemming from the volatility of prices is that bids or offers "live" only as long as they are coming out of the mouth of the trader. Quite literally, a second after a bid has been made, the bidder can refuse to buy (the same goes for a seller and his offer).

All of these rules are designed to make price competition the only criterion for preferring one buyer (seller) over another. This is in keeping with the overall approach of futures trading: standardize a commodity so that a single price can emerge from the buy and sell orders submitted by hedgers and speculators.

The rules requiring equal treatment of all bids and offers in the trading pit clearly serve important objectives, but they create a problem for the marketmaking scalper. In particular, how does the scalper distinguish his bids and offers from others in the trading pit so that he attracts the order flow necessary to earn a living? This question takes on a broader perspective once it is recognized that *all* bids and offers at specific prices provide liquidity to incoming orders to buy or sell at prevailing quotes. In other words, all *limit* orders provide liquidity and all *market* orders consume liquidity. A market participant, such as a commercial hedger, can instruct a floor broker to buy 50 contracts "at the market," in which case the broker lifts the offers of others in the pit. Alternatively, the commercial hedger can try to buy more cheaply by instructing the floor broker to bid for 50 contracts at the prevailing bid price in the pit. In the first case, the market order uses the immediate execution services provided by the offerers in the pit (whoever

[2] This contrasts with the stock market where block trades are arranged "upstairs" in broker/dealer offices and then crossed on the stock exchange floor as a mere formality.

they are). In the second case, the bid represented by the floor broker can be used by others to sell into, thereby providing liquidity.

As an aside, it should be noted that bidding along with others in the second case does not guarantee that the commercial hedger will succeed in buying at that price, since other bidders may increase their bids to increase their probability of buying. This is especially likely to occur if the existing offers in the pit are lifted by incoming market orders. The hedger could have purchased the liquidity service of immediate execution at a fixed price by lifting the existing offers rather than by bidding. That is precisely why the bid-asked spread usually measures the cost of liquidity services.

Scalpers are self-styled marketmarkers who provide liquidity in competition with limit orders represented by floor brokers, as well as with the bids and offers of other floor traders who are primarly speculating on future price movements. A scalper's main competitive weapon lies in establishing a reputation for continuity and reliability so that other agents in the pit look to him when they want to sell immediately (by hitting a bid) or buy immediately (by lifting an offer). In particular, a scalper uses a number of specific signals to differentiate himself from other floor traders. First, he is likely to bid and offer continuously rather than occasionally. Second, he will voluntarily let his bids and offers "live" somewhat longer than other traders. Third, a scalper will often quote both a bid and offer simultaneously, despite the fact that such two-sided marketmaking is not required by anyone. Finally, a scalper will try to accommodate as much of a broker's market order that his risk aversion and capital permit. A broker with a market order to sell 10 contracts would much prefer to sell to one individual (which can be accomplished instantaneously) rather than to parcel out 1 and 2 contracts to numerous traders. Thus, a scalper will buy or sell more than he is willing to absorb even temporarily in his inventory in an effort to attract market orders from brokers.

What does all of this imply about a scalper's trading pattern? A marketmaker's objective is to turn over his inventory quickly at a profit. Thus, he wants to sell at his offer what he has bought at his bid or buy back at his bid what he has already sold at his offer. Unlike the risk-taking speculator, a scalper holds an inventory position only as long as necessary to accommodate market orders and turn a profit. Thus, a scalper's inventory should not deviate from zero for any considerable length of time.[3]

We have just noted, however, that in order to attract market orders, a scalper must frequently buy or sell more than he thinks he can turn over at a profit. In such cases, the scalper is likely to try to offset part of his position immediately without loss or gain. Thus, if he absorbed a market order of 10 contracts at his bid price of 73, he might immediately turn around and sell 5 contracts to someone else at their bid of 73. Such zero profit or "scratch" trades are executed immediately upon accommodating a public order that the scalper does not think he can turn over at a profit.

[3] Marketmakers in securities where short sales are more costly than sales out of existing inventory may prefer to deal continuously from a net positive inventory position (see Garbade and Silber [2]). A marketmaker in futures contracts does not have that problem since there is no distinction between short sales and sales out of inventory.

The desire to turn over inventory rapidly combined with the necessity to accommodate public orders implies that the scalper earns a relatively small amount per contract traded. In fact, his average return per contract traded should be less than the normal bid-asked spread. This follows from the fact that the scalper will scratch some trades and may lose on those that he cannot turn over before the prevailing bid and offer change, while his gains are limited by his propensity to buy at his bid and sell at his offer without holding inventory for speculation.[4]

There is one other dimension to scalper behavior that should be mentioned. It would seem from what has been said thus far that a scalper's decision-making is not influenced by his expectations of the direction of price movement. This is not quite correct. A scalper continuously evaluates the probabilities of his offer being lifted and his bid hit. Thus, if he observes many brokers simultaneously hitting bids with new incoming market orders, he may conclude that it will be difficult for him to sell at his offer the inventory he would own if he were bidding; he might even have to liquidate his position at a loss by hitting lower bids himself. Similarly, if he observes brokers simultaneously lifting offers with new incoming market orders, he may decide it will be difficult to buy back what he would sell if he were offering. When a scalper's evaluation of the market suggests a high probability of an imminent change in bids or offers, he will probably make only a one-sided market. Even if he quotes a two-sided market, he will make his quotes good for different sizes. For example, he might allow his bid to be hit for only 1 contract while his offer could be lifted for 10 or 15 contracts. More importantly, if the scalper has a nonzero inventory position when he perceives an imminent change in market quotes, he will try to close out the trade without a profit or loss by hitting or lifting other bids or offers. Thus, we see that "scratch" trades also emerge from the scalper's continuous reevaluation of market conditions.

Note that if a scalper's expertise permits him to gauge accurately the short run imbalance of buy and sell orders, then he should usually close out a position quickly, whether or not he has made a profit. The longer a scalper holds a position, the more likely are the initial conditions to change and the less likely he is to turn over his position at a profit. In addition, given that prices follow a random walk, the variance of price changes increases per unit time so that, at the very least, the variance of his profit increases with the length of time his position is held. A risk averse marketmaker should find it optimal, therefore, to close out a position quickly.

Before turning to the empirical evidence in the next section, it is useful to cite Working's [12, p. 208] summary of scalper behavior: "Scalpers who devote their attention to the smallest dips and bulges make a great number of purchases and sales each day, tend to hold the resulting speculative positions for only brief

[4] It would seem from our discussion that a pure scalper should never earn more than the bid-asked spread on any trade. That is not necessarily the case because if a scalper has already bought at his bid and is offering while the bidders raise their bids without lifting all of the offers (which often occurs), then a scalper can offer at a still higher price and earn a return larger than the bid-asked spread.

intervals of time, and almost invariably end the day with a zero speculative position." Working called such scalpers unit-change scalpers because they "stand ready to buy at a cent below the last price and sell at a cent above it, . . . where a cent is the minimum price change in the market" (see Working [12, p. 208]). Clearly, Working's unit-change scalper is identical with the marketmaking dealer described above. In the next section, we examine whether these economic agents actually behave the way our analysis and Working's observation suggest.

III. An Empirical Evaluation of Scalper Behavior

The usual difficulty with empirically testing microeconomic behavior stems from the absence of available data. Houthakker [6] and Rockwell [7] could only infer the returns to speculators in futures trading based on aggregate data reported to the Commodity Exchange Authority from traders classified as hedgers or speculators.[5] These classifications are frequently suspect, but they are the best available source of information. Unfortunately, no reporting data are recorded for marketmaking scalpers.

Working [12] studied scalper behavior using the 2-month trading records of "Mr. C," the "leading scalper" on the New York Cotton Exchange in 1952. Our data come from a similar source: 6 weeks of trading records from "Mr. X," a *representative* scalper on the floor of the New York Futures Exchange (NYFE) during 1982–83.

Establishing that Mr. X is truly representative of scalper behavior is crucial to the usefulness of our results. Perhaps the best source of information about trader behavior lies with the clearing firms that guarantee a trader's transactions with other members of an exchange. Obviously, clearing firms have a strong incentive to monitor closely trader behavior, but they do not publish their data. As a first step, therefore, we interviewed the manager of Mr. X's clearing firm (the largest on NYFE) to ascertain how Mr. X's trading compared with others. Clearing firms impose different capital requirements on their traders, depending upon whether the trader is a scalper (with small variance in daily profit and loss) or a position trader (with large swings in daily earnings). The clearing firm had clearly placed Mr. X in the scalper category and required a minimum balance of only $12,000.00 in his account, compared with $50,000.00 cash balances (or more) required of some position traders. Moreover, Mr. X was put into the class of four or five active and successful scalpers who never had a week in which they lost money.

The clearing firm identified another trader, Mr. Y, who also conformed with scalper characteristics and who was willing to provide additional transactions data. We will compare a subset of Mr. X's trading records with data made available by Mr. Y to identify any peculiarities in Mr. X's trading patterns. To anticipate somewhat, we find that the behavior of Mr. X and Mr. Y are remarkably similar. All of the raw data, of course, are available on request.

[5] The Commodity Exchange Authority was part of the Department of Agriculture and was charged with regulating commodities trading under the provisions of the Commodity Exchange Act of 1936. In 1975 the Commodity Futures Trading Commission was established by Congressional legislation and assumed the regulatory responsibility over commodities trading.

A final indication that Mr. X's data are representative of scalpers more generally comes from an informal survey of three other successful scalpers on NYFE. Each of these scalpers has been active on NYFE for 2 years, they ranged in age from 23 to 40, operated with less than $15,000.00 capital in their accounts, never had a week in which they lost money, and averaged approximately $1,000.00 profit per day in their trading. These descriptions also apply to Mr. X and Mr. Y.

Given that Mr. X conforms with general scalper characteristics, we can now turn to the more specific hypotheses outlined above. We expect to observe that Mr. X's inventory deviates from zero for only short intervals, he should rarely hold an overnight position and he should complete a nontrivial percentage of scratch trades. Perhaps the most fundamental hypothesis concerns the determination of profitable versus unprofitable trades. In particular, our discussion above suggests that a scalper's trades will be profitable when his own market (bid or offer) is acted upon by others, while trades that occur primarily via the scalper acting on another agent's market will not be profitable.

A second set of hypotheses concerns the numerical values for average profit per contract traded. Specifically, our analysis suggested: (1) average profit per contract traded should be less than the bid-asked spread; (2) average profit per contract traded should decrease as the time the trade is held open increases; and (3) variance of the profit per contract traded should increase with the length of time the trade is held open.

These hypotheses will be tested against the actual transactions recorded by Mr. X on the New York Futures Exchange between December 1, 1982 through January 14, 1983. Transactions data normally consist of the following bits of information: the time bracket (in half-hour intervals) during which the transaction occurred, the number of contracts bought or sold, the specific identity of the futures contract (including the settlement month), the price at which the trade occurred, and the other party to the specified transaction. As a supplement to this normal data, Mr. X agreed (in advance of the observation period) to record two additional bits of information: (a) the precise time (to the nearest second) of each transaction; and (b) whether the transaction occurred by others acting on his quoted market or whether he initiated the transaction by hitting or lifting another trader's bid or offer.

The remainder of this section is organized as follows: First, we briefly describe the specific futures contract traded by Mr. X to provide a framework for evaluating the empirical results. Second, we review a sample 30-minute trading record to illustrate a number of crucial definitions as well as to describe the summary statistics calculated from the raw data. Finally, we analyze these summary statistics to determine whether we can confirm or reject the various hypotheses concerning scalper behavior.

A. Contract Description

The most active futures contract traded on the New York Futures Exchange between December 1, 1982 and January 14, 1983 was the contract based on the New York Stock Exchange (NYSE) composite stock index. This is a cash

settlement futures contract requiring that the short deliver to the long \$500.00 times the value of the NYSE composite index on the settlement date. The minimum permissible price change (tick) on the futures contract is 0.05, which has a value of \$25 (\$500.00 × 0.05 = \$25.00). There is no maximum price change on the contract. During the observation period the index varied between 77.00 and 87.00, implying that the value of a contract fluctuated between \$38,500.00 and \$43,500.00. The average daily price range of the futures contract was 1.81 (equal to \$905.00). Trading volume during the observation period was reasonably active, with an average of 12,000 contracts traded per day. Thus, we have the opportunity to observe a scalper's behavior under conditions of active trading with nontrivial price volatility.

B. Sample Trading Record and Summary Statistics

Table I shows a sample trading record: Mr. X's transactions during the first bracket (half-hour) on January 13, 1983. These raw data illustrate the definitions of a transaction, a trade, and the number of contracts traded, as well as other related statistics. A transaction occurs whenever there is a purchase or sale of one or more futures contracts. Each of the 19 lines in Table I represents a transaction. The first transaction (line 1) occurred at 5 minutes and 29 seconds into the bracket (10:05:29) and was a purchase of 2 contracts at a price of 85.70. The entry under the column headed Q records whether the trade occurred on

Table I

Trades from First Bracket on January 13 from Mr. X

Transaction	Time	Contracts Bought (+) Sold (−)	Q	Price
1	10:05:29	2	1	85.70
2	10:06:47	−2	1	85.75
3	10:08:10	5	1	85.80
4	10:09:15	−1	1	85.85
5	10:09:49	−2	0	85.85
6	10:10:25	−1	0	85.85
7	10:11:20	−1	0	85.80
8	10:12:56	6	0	85.90
9	10:13:29	−3	1	85.95
10	10:15:38	−1	1	85.95
11	10:16:58	−1	1	85.90
12	10:17:23	−1	1	85.90
13	10:22:25	−5	0	85.80
14	10:23:11	3	1	85.80
15	10:23:23	2	1	85.80
16	10:25:26	5	0	85.75
17	10:26:12	−1	1	85.75
18	10:26:18	−1	1	85.75
19	10:28:12	−3	1	85.70

Mr. X's quoted market (a value of 1) or whether Mr. X acted on someone else's market (a value of zero). In this case, Mr. X indicates by the entry 1 under Q that his quoted bid was hit. At 6 minutes and 47 seconds into the bracket the second transaction took place: Mr. X sold 2 contracts at 85.75, once again on his own quoted market ($Q = 1$, implying his offer was lifted to complete the sale).

The line under transaction 2 indicates that this transaction completes a trade, where we define a trade as going from a zero (flat) inventory position back to a flat inventory position. (Mr. X started this day, and all others in the sample, with zero inventory.) A trade is the most economically meaningful unit of observation, especially for a scalper whose objectives permit only temporary deviations from a zero inventory position. Since Mr. X traded only the near month of the stock index contract, whenever an opening purchase (sale) is followed by an equal number of contracts sold (purchased), a trade is completed. Thus, Table I shows that a total of five trades occurred in the first bracket on January 13, 1983.

The number of contracts traded is defined as the number of *round turns* completed, e.g., a purchase (sale) of 1 contract with an offsetting sale (purchase) of 1 contract counts as 1 contract traded. Thus, for the first trade in Table I, a total of 2 contracts were traded. Note that the normal practice in futures trading is to impose commissions only on round turns, i.e., after an opening transaction (purchase or sale) is offset by a closing transaction (purchase or sale). Obviously, the total number of purchases and sales is twice the number of round turns.

Since a trade (flat to flat inventory position) is the most meaningful unit of observation for a scalper, we calculate a number of summary statistics for each trade in the sample. The total profit on a trade equals the sale price times the number of contracts sold minus the purchase price times the number of contracts bought. Thus, the total profit on the first trade in Table I is \$50, since 2 contracts were purchased at 85.70 and were sold at 85.75, and each 0.05 is worth \$25.00. The profit per contract traded is simply total profit divided by the number of contracts traded. In the first trade this equals \$25.00 (\$50.00/2). Recall that our hypothesis concerning the magnitude of scalper earnings focuses on the value of average profit per contract traded.

A few other examples from Table I will illustrate these statistics in more complicated cases. Transaction 3 at 10:08:10 initiates a new trade with the purchase of 5 contracts at Mr. X's bid ($Q = 1$) at a price of 85.80. At 10:09:15 Mr. X sells 1 contract at this own offer ($Q = 1$) at a price of 85.85, at 10:09:49 he sells 2 contracts at 85.85 by hitting someone else's bid ($Q = 0$), at 10:10:25 he sells 1 contract at 85.85 by hitting another bid, and he finally completes the trade at 10:11:20 by hitting a bid at 85.80. Total profit for the trade is \$100 and profit per contract traded is \$20 (\$100/5). Note that the size of the trade is defined as 5, and equals the maximum size of his inventory position at any point during the trade.

Mr. X completes three other trades during this bracket, with sizes of 6, 5, and 5 contracts, respectively. His profit per contract on the 6-contract trade is \$16.67 (\$100/6), on the 5-contract short sale (line 13) he earned zero profit per contract traded, and on the last 5-contract position (line 16) he lost \$15 per contract traded (\$75/5).

Table II

Part A. Trading Characteristics of Mr. X (31 Trading Days: December 1, 1982–January 14, 1983)

	Sample Total
1. Number of Transactions	2106
2. Number of Contracts (Round Turns) Traded	2178
3. Number of Trades	729
a. Profitable	353 (48%)
b. Unprofitable	157 (22%)
c. Scratch	219 (30%)

Part B. Characteristics of a Trade (Sample Size: 729 Trades)

	Mean	Standard Deviation	Minimum	Maximum
1. Profit per Contract	\$10.56	\$37.25	−\$233.33	\$141.67
2. Size (Number of Contracts)	2.9	1.9	1	12
3. Weighted Average Time (Seconds)	116	85	0	547
4. Percent of Trade Done on Own Market (Q)	77%	29%	0%	100%

Two other numerical measures must be identified with each trade: the average length of time the position was held open and the percentage of the trade done on Mr. X's own market.[6] The time the position is held open is defined as the weighted average closing time minus the weighted average opening time, where the weights are the number of contracts bought or sold in each transaction. Thus, for the fourth trade beginning in line 13, the weighted average closing time is 10:23:16 (the weighted average of 3 contracts bought at 10:23:11 and 2 contracts bought at 10:23:23), and the opening time is 10:22:25; hence the average time the position is held open is 51 seconds. The percentage of the trade done on Mr. X's own market is simply the percentage of $Q = 1$ for all contracts in the trade. Thus, for the fourth trade the value of Q is 0.5 because half of the contracts traded were on his own market (in particular, the opening short sale occurred on another trader's market while the closing purchases were made on his market).

C. Testing Specific Hypotheses

With the data calculations completed, we can now turn to examining the hypotheses listed above. The summary statistics on Mr. X's trading between December 1, 1982 and January 14, 1983 appear in Parts A and B of Table II. Even these overall statistics shed considerable light on the nature of scalper behavior. Part A describes the scale and success rate of Mr. X's trading activity

[6] Note that by calculating these statistics on a per trade basis rather than per transaction we avoid the "LIFO-FIFO" problem of arbitrarily assigning specific opening transactions with specific closing transactions. This problem would be even more pronounced when a series of opening transactions (e.g., −2, −4) is followed by a series of closing transactions (e.g., +3, +1, +2) or when openings and closings are interspersed within a complete trade (e.g., −2, −4, +1, −1, +3, +1, +2).

during the 31 trading days of the sample. A total of 2,106 transactions (line A.1) were recorded during this period. These transactions produced 2,178 round turns (line A.2) and resulted in 729 trades (line A.3). Of these 729 trades, 48 percent were profitable (line 3.a), 22 percent were unprofitable (line 3.b), and 30 percent were scratches (line 3.c). The fact that 30 percent of Mr. X's trades resulted in neither a profit nor a loss is consistent with our expectation that scalpers will scratch a nontrivial percentage of their trades. Unfortunately, there is no standard against which this statistic can be compared. Thus, we cannot tell whether speculators and hedgers behave in a similar way, although anecdotal evidence suggests they scratch a much smaller percentage of trades compared with scalpers.

Part B of Table II lists the key characteristics of the 729 trades completed over the sample. Line B.1 shows that the average profit per contract traded is \$10.56. Our earlier analysis suggested that a scalper's average profit per contract traded would be less than the bid-asked spread. During the sample period, the spread between bid and offer in the pit was normally one tick, or \$25.00 (when the market was inactive the spread became two ticks, or \$50.00). The t-statistic on the null hypothesis that \$10.56 is not significantly different from \$25.00 is 283.1. There is less than one chance in 1,000 that this number is due to chance. Thus our data confirm that the scalper's average profit per contract traded is significantly less than the bid-asked spread.[7]

The remaining summary statistics in Part B of Table II show that the average size of a trade is 2.9 contracts (line B.2), the average time a trade is held open is 116 seconds (line B.3), and an average of 77 percent of the contracts bought and sold were done on Mr. X's own market ($Q = 0.77$ in line B.4). The fact that Mr. X's trades were held open on average for less than 2 minutes confirms our expectation that scalper decisions are relevant for extremely short time horizons. It also implies that Mr. X's inventory deviates from zero for less than 2 minutes on average. Thus, Working's [12, p. 208] impression that scalpers hold a position for between 1 and 10 minutes is correct (the maximum time held by Mr. X just happens to be 9 minutes and 12 seconds), but the average of under 2 minutes for Mr. X suggests an even shorter perspective for scalper decision-making than implied by Working.

A somewhat more detailed examination of the data permits us to test other dimensions of scalper behavior. Table III separates profitable, unprofitable, and scratch trades so that we can identify the characteristics of each group. Column 1 repeats the number of trades in each category; Column 2 shows the average Q-value for each; Column 3 displays the average size; and Column 4 shows the average time each position is held (standard deviations of the means are shown in parentheses). Our main hypotheses concern the relationships between Q and profitability and time and profitability. In particular, we expect that profitable

[7] Another explanation of low profitability per contract traded is that Mr. X simply did not earn much during this period. Mr. X's daily profit averaged \$742 during this period and varied between a low of \$50.00 on one day to a high of \$2,250.00 on another. This represented the return on the upper quartile of scalpers on NYFE.

Note that the \$10.56 average profit per contract traded is before commissions. During the sample period, Mr. X averaged \$1.22 in commissions per contract traded. Thus, his *net* profit per contract traded is \$9.34 and his *net* average daily profit is \$672.00.

Table III

Characteristics of Profitable Versus Unprofitable Trades for Mr. X (Means with Standard Deviations in Parentheses)

	No. of Trades	*Q*-Value	Size	Time
Profitable Trades	353	0.82	3.3	109
		(0.27)	(2.0)	(74)
Unprofitable Trades	157	0.68	3.0	164
		(0.32)	(2.0)	(110)
Scratch Trades	219	0.75	2.4	92
		(0.30)	(1.5)	(65)
Total Trades	729	0.77	2.9	116
		(0.29)	(1.9)	(85)

trades will occur primarily when the scalper's markets are acted upon (high Q) and when trades are closed out relatively quickly (a short average time the position is held open).

These relationships are confirmed in Table III, where the average value of Q for profitable trades exceeds the value for unprofitable trades and the average time held for profitable trades is smaller than for unprofitable trades. We can reject the null hypothesis that the means are the same at more than a one percent confidence level. In particular, the t-statistic for the difference of means of Q in the profitable and unprofitable categories is 4.97 and the t-statistic for the difference of means of the time variable is 5.79. With 510 degrees of freedom, there is less than one chance in 1,000 that these values are due to chance.[8] Thus, we conclude that profitability is positively related to Q and negatively related to time.[9]

The significant positive relationship between Q and profitability clearly conforms with our model of scalper behavior. The scalper provides liquidity services and earns profits on his trades to the extent that other traders use those services. The significant negative relationship between time and profitability conforms with our description of scalper expertise in evaluating short-run imbalances in order flow. The longer a position is held the less likely are those initial favorable conditions to remain.

There is an alternative explanation for the negative relationship between time and profitability that must be addressed. It is possible that a losing trade is held longer because a scalper hopes that by holding it the trade will turn profitable. Despite the fact that scalpers deny such behavior, it is possible that scalpers unwittingly behave in such counterproductive ways.

[8] The t-statistic is appropriate as long as the respective means were drawn from independent random samples. Since each trade forms a separate observation and since trades are independent of each other, the independence assumption is quite reasonable. The fact that Q is a zero-one variable for each observation suggests that a binomial distribution might be more appropriate. However, for large samples (>100 observations) the normal distribution closely approximates the binomial.

[9] A multiple regression of profit per contract confirms a significant positive coefficient for Q and a significant negative coefficient for time.

Table IV

Time Profile of Trades for Mr. X (Means with Standard Deviations in Parentheses)

Time Held	No. of Trades	Profit per Contract	Q-Value	Size
0–1 minutes	182	\$11.87	0.79	2.5
		(23.80)	(0.30)	(1.7)
1–3 minutes	426	\$15.25	0.77	2.9
		(33.90)	(0.29)	(1.9)
>3 minutes	121	−\$7.87	0.71	3.7
		(55.39)	(0.30)	(2.0)

To examine this alternative explanation, we present the characteristics of trades held over varying time intervals in Table IV. The time periods were divided into 0–1 minutes, 1–3 minutes, and over 3 minutes, where the middle category was designed to straddle the average length of time a position is held (approximately 2 minutes). A modest refinement of the expertise model suggests that a scalper's profit will be largest for the time period corresponding with his short-run expertise, however long that lasts. The alternative "hope" hypothesis implies that profits decline monotonically the longer the position is held. Table IV shows that profit per contract traded reaches a maximum in the 1–3 minute time period. The fact that this maximum occurs at the middle time period is inconsistent with the "hope" hypothesis.[10] The scalper expertise model, on the other hand, is consistent with the optimal time period for profits once we recognize that off-floor orders enter the pit with a slight time delay (e.g., 30 seconds). Thus, a scalper who properly judges an imbalance of orders among floor traders in the pit will reap the full gains of his inventory position if he waits for incoming off-floor orders to enter the trading arena.

Table IV also shows, as we expected, that the variance of profit per contract increases with the time the position is held open. If the scalper's return were solely compensation for bearing risk between stochastically arriving buy and sell orders, we should observe larger returns earned on positions that are held longer. Since the scalper's returns are negative for positions held more than 3 minutes, there must be other factors that influence scalper earnings. In particular, the skill in evaluating short-run imbalances in bids and offers commands a return as well. In this instance, those returns can be realized only over relatively short time horizons.

D. Corroborating Evidence

The empirical observations discussed thus far conform with our earlier theoretical analysis of scalper/marketmarker behavior. As indicated above, to help

[10] A regression of profit per contract on Q, size, time, and time-squared showed statistically significant coefficients for both time and time-squared (as well as for Q), confirming the nonlinear relationship. The maximum profit derived from solving the estimated equation analytically occurred at 1 minute and 40 seconds. Thus, the optimality of the middle time period is confirmed by formal regression techniques.

Table V

Comparison of Two Scalpers (January 11, 1983–January 14, 1983)

	Mr. X	Mr. Y
1. Total Number of Transactions	319	729
2. Total Number of Contracts (Round Turns) Traded	367	823
3. Total Number of Trades	103	249
a. Profitable	55 (53%)	143 (57%)
b. Unprofitable	14 (14%)	41 (16%)
c. Scratch	34 (33%)	65 (26%)
4. Average Profit per Contract	$13.59	$12.12
5. Average Size of a Trade[a]	3.5	3.1

[a] Note that average size of trade is defined as the average size of the maximum inventory position in a trade and is not equal to the total number of contracts traded divided by the number of trades.

corroborate the generality of these results, we obtained a second set of data from Mr. Y, a trader also characterized as a marketmaker/scalper by his clearing firm. Mr. Y's data cover 4 days that were also in Mr. X's observation period—January 11, 1983 through January 14, 1983. Mr. Y was not contacted prior to the observation period; hence, he did not collect the supplementary data on the precise minute a transaction was completed nor did he collect observations on Q. Nevertheless, the comparison in Table V of other summary statistics for Mr. X and Mr. Y is instructive.

As can be seen in lines 1, 2, and 3 of Table V, Mr. Y did about 2½ times the amount of business done by Mr. X during the 4-day period. The main explanation according to both Mr. X and Mr. Y is the longer time Mr. Y had spent on the exchange. In particular, his reputation as a reliable scalper attracted more market orders compared with Mr. X.[11]

Despite the difference in their scale of operations, the basic trading characteristics of both scalpers are quite similar. First, the proportions of profitable, unprofitable, and scratch trades, reported in lines 3a, 3b, and 3c, are not significantly different from each other. In particular, we cannot reject the null hypothesis that each of these proportions are the same at a five percent confidence level. Second, and most importantly, the profit per contract traded reported in line 4 is virtually the same for both traders. We cannot reject the null hypothesis that these two profit numbers are the same at a five percent confidence level. Since these summary statistics for Mr. X and Mr. Y both conform with our theoretical discussions above regarding marketmaker behavior, and since both Mr. X and Mr. Y are treated as scalpers by their clearing firms, we can conclude that our empirical results are representative of scalper behavior in general.

One qualification is in order on this last point. While the trading data presented here conform with ex ante notions of scalper behavior, the specific statistics are also a function of the characteristics of the futures contract. For example, the

[11] Note that both Mr. X and Mr. Y maintained approximately the same capital, less than $15,000.00, so that we can reject greater capitalization as an explanation of their relative activity.

average time a trade is held open depends not only on the scalper's skill but also on the frequency of order flow into the pit. Thus, a futures contract that trades only 2,000 contracts per day (such as feeder cattle) might produce somewhat different statistics for a scalper compared with our data (which come from a market trading 12,000 contracts per day). Thus, our specific numerical results are most representative of scalper's trading futures contracts with similar characteristics.

This qualification is less restrictive than it may seem. While the trading volume of different futures contracts varies considerably (e.g., CDs average less than 5,000 contracts per day, while Treasury bonds average over 50,000 contracts per day), the number of scalpers in each pit also varies directly with the volume of trading. Actively traded contracts attract (and support) more marketmakers than inactive contracts. Thus, the "order flow" per scalper and the implications for trading frequency and inventory positions are likely to be more homogeneous than appears at first glance. More concretely, Working's [12] overall description of scalper behavior was based on trading data from the New York Cotton Exchange plus general observations from the Chicago Board of Trade. As we noted above, his description corresponds with our detailed analysis of Mr. X on the New York Futures Exchange. It should not be surprising that the economic process creating the profit opportunity for marketmaking behavior produces similar experiences even under widely divergent circumstances.

IV. Conclusions

The most important evidence presented in this paper concerns the nature and function of marketmakers in futures exchanges. We have shown that the so-called scalper in a futures pit conforms with the general role of a marketmaker in a freely competitive environment. His earnings stem from providing liquidity to market orders. Thus, scalper activities facilitate the execution of hedging orders, and hedging activities are the ultimate economic contribution of futures markets.

The specifics of scalper decision-making were illustrated by the detailed trading records of Mr. X, a representative successful scalper on the New York Futures Exchange. Perhaps the most interesting implication of the trading record is the extremely short time horizon of scalper decision-making. The average time a trading position is held open is less than 2 minutes. Moreover, the data indicate that this limited perspective is quite appropriate to the scalper's expertise of evaluating short-run imbalances in bids and offers in the pit. Trades that are held open longer than 3 minutes produce losses on average. Thus, scalper earnings compensate for the skill in evaluating market conditions in the very short run and for providing liquidity to the market over that time horizon.

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