ON A THEORY OF STOCK PRICE BEHAVIOR*

Geoffrey P.E. Clarkson

107-65
ON A THEORY OF STOCK PRICE BEHAVIOR*

Geoffrey P.E. Clarkson

107-65

*To be presented at American Meeting, Institute of Management Sciences, San Francisco, February 1965.

This paper is a draft for private circulation and comment. It should not be cited, quoted or reproduced without the written consent of the author. The research is supported by a grant from the Sloan School of Management.
On a Theory of Stock Price Behavior

Introduction

Under classical economic theory market behavior is analyzed in terms of demand and supply schedules and the stability of their intersection at equilibrium. The procedure by which equilibrium is reached is customarily represented by some form of Walrasian tatonnement process—a process that permits prices to respond to excess demand through a contracting device which only allows exchanges to take place when equilibrium is reached.\(^1\) One consequence of this theory is that all changes in price are a result of shifts in either the demand or supply schedules. Concurrently, once such movements in price are stated as a time series of actual prices these prices represent a sequence of equilibrium positions. To understand the behavior of a specific market it is necessary to be able to account for such price changes. If one employs classic theory one is led to search for the processes which govern the behavior of the demand and supply schedules as well as the process or processes that represent the equilibrating mechanism.

Behavioral theory,\(^2\) on the other hand, provides a somewhat different theoretical schema by which to interpret market phenomena. Decision-makers


are represented by a set of decision processes that act on as well as react to information which is already available in memory or is procurable from the environment. All behavior, under this theoretical framework, is a consequence of some describable decision process acting upon an ascertainable body of information. In short, whether one is dealing with one or many individuals acting by themselves or in groups, the resulting decision behavior can be described by a set of decision processes acting upon the relevant information. Since both individuals and firms frequently buy and sell commodities through the medium of a market it is a reasonable extension of this theory to hypothesize that market behavior is a direct consequence of the interaction of a collection of such individual decision processes.

A market's behavior is usually described in terms of variations in the price and quantity of items purchased and sold. At any one instant of time only one price is in effect for each item within a specific market. Over time these prices change, and it is this alteration in price that constitutes one important aspect of a market's behavior. Accordingly, it is these price fluctuations that must be accounted for if one is to be able to explain and predict market behavior.

Little attention, however, has been paid to the problem of trying to explain a market's behavior by accounting for the interactions which take place among the actual decision processes of its participants. Although only

---

3/ Clearly, a commodity's price can differ within, for instance, wholesale and retail markets. But for a particular market at one period of time there is only one of such prices in effect.
in its initial stages, the research reported in this paper is directed toward this specific task. In brief, the object of this research is to demonstrate that the behavior of prices in a particular market--namely, the Over-the-Counter security market--can be explained by a knowledge of the decision behavior of the individuals concerned.

**General Considerations**

One reason for the lack of empirical research on market processes may well be that in many market situations price is a part of the information required by the individual or firm in order to decide on the quantity to buy or sell. As such, price is one item in a decision-maker's set of information prior to making a decision. While prices may change over time, the price at any one moment is that which is used by the decision-maker. In these instances price itself is not subject to negotiation. The buyer (seller) can decide to buy (sell) more or less of a particular commodity at the stated price. But he is not provided with an opportunity to revise the price by a tatonnment or other similar process while the decision is being made.

A consumer in a department store, supermarket, or any other retail establishment is an example of such activity. All items have a stated price and the consumer's problem is to decide how much of each, if any, to purchase. To explain a consumer's behavior, all one needs to know are the prevailing prices and his decision processes. It is not necessary to know anything about the mechanism by which these particular prices are set. In some situations it may be necessary to know something about the recent history of certain prices, e.g., are they special sales prices? Even in this event, however, to explain
the consumer's behavior it is quite unnecessary to know why the prices have changed.\textsuperscript{4/}

On the seller's side of the market an example is provided by decision processes which account for the setting of prices in a department store. Again, at each moment of time there is only one price attached to each item in the store. It is up to the price setter to decide whether to alter these prices or not, but such alterations do not take place from instant to instant. They are based on a set of decision rules which are activated by certain events—notably, the recent history of sales, the level of inventories, the change in seasons, the approach of holidays, etc. All this information constitutes part of the initial conditions for the price setting decision process. Although, prices do change over time, prevailing prices at any one period of time can be explained solely by means of this process and not by a process which incorporates the customer's immediate reaction to these prices.\textsuperscript{5/}

In brief, under such conditions a classical market, with its own mechanisms for setting and adjusting prices, does not appear to exist. Prices are set by one set of decision processes and purchase decisions are determined by another. At no one point in time do these processes directly interact. That is to say, the department store or supermarket is perhaps a convenient place for consumers to examine the available goods and for merchants to display their wares. But


\textsuperscript{5/}For a detailed model of the price setting decision process in a department store, which has survived empirical tests, see: R.M. Cyert and J.G. March, \textit{op. cit.}, Chapter 7.
within these shops all purchases and sales are conducted at set prices and there is no opportunity for the classic balancing of prices and quantity to be carried out from one moment to the next. To understand the behavior of the buyer or seller, therefore, it is sufficient to know their respective decision processes. Consequently, to account for this class of market behavior it is not necessary to develop a further set or body of theory. Manifestly, it is sufficient to be able to explain the behavior of the individual participants.

There are other types of markets, however, in which buyer and seller come together and by their interaction directly establish price and quantity. One such case is provided by the various security markets. In this instance the commodity in question, whether it be a bond, a stock, or a future, is known to both buyer and seller, and it is through their interaction that purchase and sales agreements are made. Since it is the fluctuation in prices that is one of the chief characteristics of these markets, it is here if anywhere that a classical theory of market behavior might be required. Indeed, if it is a function of a theory of market behavior to explain movement in prices, then the price fluctuations of security markets are prime candidates for explanation by such a theory.

It is my position that in order to explain the behavior of security prices a theory of market behavior, as such, is not required. For even in this situation price behavior is a direct consequence of the decision processes of the individuals concerned, and no additional mechanism or theory is required to account for this behavior. Although classical theory employs a supply-equal-to-demand relation to establish an equilibrium market price, it is my contention
that the inclusion of such a mechanism is completely unnecessary. In brief, I am suggesting that the behavior of prices can be explained without explicit reference to a separate equilibrating process. And further, that market behavior is strictly determined by the decision processes of the individual participants.

While this is hardly a novel conclusion, in that it is a somewhat obvious statement of the case, it implies for any specific market that one needs to know in detail the decision processes of all participants. If the behavior of certain commodity prices is being examined the number of such participants could be very large indeed. Indeed, if one has to be able to describe each of these decision processes an explanation of price behavior will be a formidable and wearisome task. Security markets, however, like other types of markets, are not composed of a collection of individuals indiscriminately competing for the opportunity to buy and sell. On the contrary, the process by which orders to buy and sell are executed is governed by certain institutional constraints, and the participants in the market can be classified into different categories. For example, in a security market actual transactions are usually conducted through official agents, such as brokers and traders, and the participants can be categorized as to whether they represent investment societies, banks, insurance companies, pension funds, or private individuals.6/ Now, if the traders in a particular market behave according to a specific set of decision rules, then, and this is clearly a testable proposition, it is possible to

6/While this is hardly an exhaustive set of categories, the participants in any market can be classified into observable sets of different types of investors.
describe the decision processes which determine their decision behavior. Similarly, if each category of investors behaves in recognizably different ways, such discrepancies must be a result of differences in their decision processes. Accordingly, if within each category decision behavior is sufficiently similar, then a set of decision rules can be described which will represent the decision-making procedures of each class of investors. Under these assumptions, all of which can be analyzed for their empirical validity, the problem of explaining price behavior becomes relatively simple and straightforward. For the prevailing price at any one moment will be a direct consequence of the interaction of the relevant classes of decision processes.

Price Behavior in a Security Market

The market selected for this study is the Over-the-Counter security market which accounts, it should be noted, for approximately three-fourths of the gross value of all security sales in the United States. According to the previous discussion a theory can be constructed to account for this market's behavior solely by determining the decision processes of the relevant classes of participants. Clearly, it has yet to be demonstrated that each class of investors, traders and brokers can be adequately represented by one type of decision process. But for expository ease permit the assumption to be made that such a classificatory scheme is practicable.

The theory then consists of a set of such decision processes where market behavior--fluctuations in the prices of particular securities--is generated by specific sequences of interactions among these processes. In particular, it is hypothesized that there are three main classes of decision processes--to wit, those of investors, brokers and traders. This is not to say, for example, that
all investors have identically the same portfolio selection process. Rather, it is being postulated that there is a describable class of decision procedures which represent investor decision behavior and that differences among investors can be accounted for by alterations in certain parameters within this class of decision mechanisms.

In order to illustrate this general schema as well as to describe in some detail the particular decision processes as they have been developed so far consider in turn the decision behavior of the three classes of market participants.

A. The Trader

In the Over-the-Counter market a trader deals only with stock brokers or other traders. Under no circumstances is it possible for a private individual or institution to deal directly with a trader. The stock broker takes orders from private or institutional investors and then telephones a trader to ascertain price. Since brokers charge a fee for this service, the cost per share to the ultimate purchaser differs somewhat from the price set by the trader. Each trader maintains an interest in between fifteen and twenty stocks, and in response to an inquiry will quote either a selling (asked) or a buying (bid) price on any one of these securities.\(^7\)

A trader is undoubtedly influenced by many different items of information. For instance, a single trader has access to a number of sources of information, e.g., the Dow Jones ticker, the Dow Jones broad tape, the daily publication

\(^7\)The difference between asked and bid prices is what is known as the spread.
of the National Quotation Bureau which gives for each security the traders concerned and the respective prices at the middle of the preceding day, and telephone conversations with other trades and stock brokers. Nonetheless, all trading activity is carried on over a telephone in very brief intervals of time. Accordingly, at any one moment a trader can be asked over the telephone for the price on a particular security. He responds, as a rule, with the bid and asked prices on a hundred-share lot. If this price is accepted, a transaction has been made and the trader has either sold or bought a number of such lots.

It follows from this outline of the procedure that when a trader receives a telephone call he knows that the broker has an order to buy or sell. Thus, whether there will be an immediate transaction or not depends entirely upon the broker's reaction to the trader's quoted price. Since the broker can telephone any of the traders who are known to have an interest in this particular security, he is not dependent upon a single quote from one trader. However, as soon as the broker accepts a price that is the price at which the transaction is made. In short, it is the market price in the particular security at that instant of time.

Before examining a trader's pricing decision process in detail it is pertinent to consider his possible alternative strategies. One alternative is for the trader to deliberately maintain either a net long or net short position in a particular security. In a rising market the value of his inventory will increase, and as a result he would want to have a net long position. Conversely, in a falling market a profit can be made by buying back stock at a lower value than that which he sold it for. Accordingly, he would want to
maintain a net short position. During certain periods of time traders may actively seek to maintain long or short positions. Currently, the strategy is to make a profit by trading on the difference between the bid and asked prices. Although traders may make a certain amount of profit by taking advantage of a position they find themselves in, the principal monetary return comes from buying at the bid and selling at the asked price. As a result, to be successful the trader must maintain this spread between prices such that when combined with the volume of trading an adequate level of compensation is assured.

A.1 The Pricing Decision

Given this brief description of the trader's function in the Over-the-Counter market, it is now relevant to examine the pricing or quoting decision process itself. A decision is required of a trader each time a broker telephones to ask for a price. Since a trader must reply virtually immediately, one would not expect the pricing process to be unduly complex. According to a recent study the basic components of the pricing process can be represented as follows:

![Diagram of Pricing Decision Process]

---

8/ The most notable period when these strategies were actively pursued was in the latter part of the 1920's, see: I. Friend, et. al, The Over-the-Counter Securities Markets, McGraw-Hill, New York, 1958.

While each of these components is influenced by a number of other factors, the decision process which takes place at the end of a telephone can be represented by the interaction of these four items. For example, a trader alters his quote depending upon the characteristics of the inquirer. Such factors as whether the inquirer is a buyer or seller, whether the orders from this person are usually large or small and whether he is a friendly competitor or not affect the quote in a manner to be outlined below.

Concurrently, a trader knows whether he wants to increase or decrease his current long or short position in a particular stock. For at all times the trader is aware of his current position as well as his estimate of the position he would like to have. Since traders normally have a maximum amount of money that they can invest in any one security, their general impressions and attitudes toward the market, constrained by this limit, are what identify the position he would currently like to be in. Any discrepancy between the desired and actual position provides what has been labelled the "desired direction of position change."

The estimate of the street or current market price is derived by the simple process of listening to the broker's reply on the telephone. If a trader's quote is accepted then he is either right on or a little low (on asked price), right on or a little above (on bid price) the current market. Conversely, if no transaction is effected, his asked price is a bit high and his bid price is a bit low. If, for some reason, the stock has not been traded for awhile, an individual

---

10/ For a full description of the decision process see ibid., Chapter 3.

11/A friendly competitor is one who does not take advantage of a bargain or poor quote.
trader can obtain an estimate of the current price by telephoning a competitor. But if the stock is being actively traded, each trader will have a fairly accurate estimate of the current market price. Given this estimate and any desired change in position, the quoted price can be directly determined.

While the actual increments, e.g., 1/8, 1/4, 1/8, etc., may vary with different securities\(^\text{12}\) the price setting decision process can be represented by the following table:

<table>
<thead>
<tr>
<th>Inquirer and His Interest</th>
<th>Desired Direction of Position Change</th>
<th>Desired Price Relation to Street</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bid Price</td>
<td>Asked Price</td>
</tr>
<tr>
<td>Retail Buyer</td>
<td>longer</td>
<td>1/8 above street</td>
</tr>
<tr>
<td></td>
<td>indifferent</td>
<td>equal street</td>
</tr>
<tr>
<td></td>
<td>shorter</td>
<td>1/4 below street</td>
</tr>
<tr>
<td>Retail Seller</td>
<td>longer</td>
<td>equal street</td>
</tr>
<tr>
<td></td>
<td>indifferent</td>
<td>1/8 below street</td>
</tr>
<tr>
<td></td>
<td>shorter</td>
<td>1/4 to 1/2 below street</td>
</tr>
<tr>
<td>Friendly Competitor</td>
<td>longer</td>
<td>equal street</td>
</tr>
<tr>
<td>(Interest unknown)</td>
<td>indifferent</td>
<td>equal street</td>
</tr>
<tr>
<td></td>
<td>shorter</td>
<td>1/8 below street</td>
</tr>
<tr>
<td>Enemy Competitor</td>
<td>longer</td>
<td>much lower</td>
</tr>
<tr>
<td>(Interest unknown)</td>
<td>indifferent</td>
<td>much lower</td>
</tr>
<tr>
<td></td>
<td>shorter</td>
<td>than street</td>
</tr>
</tbody>
</table>

Table 1

\(^{12}\)See ibid., Chapters 3 and 4 for a detailed discussion of the variation in spread—in particular the relation of the size of the spread to volume and price.
Table 1 describes the components of the price quoting decision process in sufficient detail to permit some of the processes to be subjected to test. Further, from the evidence presented in the study, these decision processes are sufficient to account for a substantial proportion of the observed changes in traders' prices for a number of securities. Consequently, it can be accepted, for the moment, as a detailed representation of the price setting decision process.

Of particular interest in this decision procedure is the mechanism by which a price is changed. If a trader quotes a price which does not result in a transaction, no change is made in the price. But, if a transaction is effected--i.e., the broker accepts the trader's price--then the trader's price will change in the direction specified by the process outlined above. As a result, price changes are, for the most part, a consequence of a transaction being consummated and are seldom altered to secure a transaction. Thus, prices respond to the occurrence of transactions--and are in effect determined by these contracts.

Lest the reader feel that somehow the price setting process could not be as simple as portrayed above, or that it would be more likely for the trader to change his price in order to get transactions, it is worth noting that the process outlined above apparently reflects a decision procedure which is used by many people when placed in roughly the same situation. That is to say, when faced with the task of bidding for contracts in an experimental market situation most subjects employ decision procedures which are strikingly similar to those used by the Over-the-Counter trader. This observation is one result of a series

13/ See ibid., Chapters 4 and 5.
of experimental investigations of individual and group decision processes.\(^\text{14/}\)

The experiment itself consists of placing a subject in a situation where he has to announce bids in two markets simultaneously. The subject states his bids in monetary terms, and the experimenter by consulting a specific list of random numbers determines whether these bids "win" or "lose." A bid "wins" when it is below the experimenter's number, and "loses" when it is equal or above it. In some cases there is a fixed cost associated with each trial, but in all variations examined so far the subject is restricted to making at most one new bid on each trial. Hence, on each trial the subject has to decide which market to leave alone and which bid to alter, if at all. A subject's earnings are a direct function of the contracts he wins over a given number of trials.

In this experiment a subject's behavior is a record of prices on two markets. These prices change over time. Hence, an explanation of this behavior consists of an explanation of the changes in the respective prices. Since subjects have no direct knowledge about the list of numbers employed by the experimenter, their behavior is clearly a function of how they decide to respond to their record of wins and losses as it unfolds. While many of the subjects who participate in this experiment employ slightly different decision procedures, there is one set of processes that characterizes and accounts for a large proportion of the observed behavior. This process is expressed by the following table:

This set of processes does not include the amount to alter the price by, nor does it contain a procedure for deciding what to do in the event both markets have won or lost and both bids are the same. But, it does contain the principal components of most subjects' price setting procedures. The primary characteristic of the process, aside from its simplicity and symmetry, is that new bids are made in response to contracts made or lost. Prices are lowered when losses occur and are raised or held the same when contracts are won.

The significant point is that it would be perfectly simple to choose prices according to some sampling or other statistical procedure. To employ a notion of sampling one would note the frequency of wins and losses at various prices in each of the markets and choose that price which appeared to yield the desired earnings. In fact, despite the statistical training of many of the subjects, very few chose to behave in this or any other significantly different fashion. As a result, it appears that when little or nothing is directly known about the behavior of the environment, processes are frequently employed which respond to rather than anticipate the occurrence of the relevant events. This is not to suggest that the subjects in this experiment are all fledgeling traders, nor is it being suggested that the two situations are the same. But the similarity of the characteristics of traders' and subjects' decision processes is too striking to ignore. And since the simplicity of the traders' pricing decision process is

<table>
<thead>
<tr>
<th>WIN</th>
<th>LOSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>WIN</td>
<td>Raise the lower of the two bids</td>
</tr>
<tr>
<td>LOSE</td>
<td>Lower the losing bid</td>
</tr>
</tbody>
</table>

Table 2
reflected in the bidding process of the subjects, the empirical validity of the trader's price setting process has received a certain measure of independent empirical support.

B. The Broker

In the Over-the-Counter market the broker's function is to accept orders from customers and by talking directly with traders negotiate the transactions. Clearly, a broker does not have to accept the first price he receives over the telephone. But if he frequently deals with a particular set of traders he in turn will have an estimate of the relation between their prices and the prices of other traders, i.e. the street. What the broker does not know is the trader's desired direction of position change, and hence whether his price is deliberately slightly above or below the street price. A broker's task is to find a favorable price for his customer, and if he believes he can do better by trying another trader all he has to do is pick up the telephone and find out.

One of the factors which influences the trader's price, not noted above, is the activity or volume of purchases or sales in a particular security. Each trader has a ceiling on the amount of money he can commit to a single stock which, given the prevailing price, places a limit on the number of shares of this stock that he can hold. Now, if traders in Stock A are known to be holding approximately 500 shares each, and a broker receives an order to buy (sell) 4,000 shares, he is clearly placed in a bit of a dilemma. Since no one trader can fill his order, he must buy (or sell) from a number of traders. News of this activity in Stock A will spread to competing traders fairly rapidly. Consequently, the broker can expect the price to rise (fall) as he proceeds from one trader to the next. Thus, a broker faced with a large order for a particular security is unlikely to be
able to negotiate the entire transaction at a single price.\footnote{15}{The possibility of a broker carrying an inventory of securities is currently ignored.}

The theory, then, makes a number of simplifying assumptions about a broker's decision behavior. First, it does not allow (so far at any rate) a broker to carry an inventory of securities in his own account. Second, no provision is made for the possibility of a broker advising an investor on what securities to buy or sell. In short, a broker is represented as an agent whose task is to transact a client's orders at a favorable price, where the term "favorable price" is defined in terms of the broker's estimate of the street price. However, the decision process which accounts for this segment of a broker's decision behavior has not yet been examined in detail. Thus, while the current model contains a brokerage mechanism that permits transactions to take place it cannot be reported upon as one which has been subjected to empirical test.

C. The Investors

The investor, whether he represents himself or an institution, constitutes the origin of the orders which a broker receives. While each investor may feel that he analyzes the market and its securities by an unique method, there appears to be a number of similarities among these methods of approach. In fact, it is posited that investors can probably be placed in a modest number of categories where these categories are defined in terms of the methods of analysis and selection employed. To identify these categories it is necessary to examine the portfolio selection processes of a number of types of investors.

For example, the portfolio selection process of investors of trust funds for banks has already, in part, been examined. This process consists of a
particular set of decision processes which are described in terms of specific discrimination nets. These nets contain a collection of individual tests that in turn refer to those attributes of securities which are considered important for trust investment purposes. While the theory of trust investment cannot as yet claim to represent the portfolio selection process of all trust investors, it would not be a difficult task to conduct the requisite tests. If such tests corroborate the theory, then this particular set of decision processes would represent in detail the procedures by which investors of trust funds select securities for their portfolios. Once these procedures are known the only other items of information required are the amount of funds available for investment classified by the types of portfolios desired, e.g. growth, income, income and growth, etc. By an application of the decision process to current market data specific portfolios of securities are generated. These portfolios represent the orders which are given to the broker by the investor. Hence, it is the portfolio decisions which constitute the origin of a broker's orders.

It is worth noting that portfolio decisions are relatively insensitive to the exact prices prevailing in the market at the time the portfolios are selected. The actual price for a particular order is only determined after the broker has received it and has contracted with a trader. Hence, the investor must select his portfolios on the basis of some previous prices. These prices may closely approximate the actual prices paid after the broker has completed his transaction.

---


17/ Indeed, part of this testing process has been carried out with quite favorable results on the trust investment process of banks in Massachusetts. See: W. Mihaltse, "A Model of an Institutional Investor," unpublished Master's thesis, Sloan School of Management, Massachusetts Institute of Technology, 1965.
Nevertheless, portfolio decisions are clearly made without an exact knowledge of the price per security that will be paid.

Due to various legal constraints investors of trust funds are not allowed to purchase securities on the Over-the-Counter market. Hence, with respect to this market a knowledge of the trust investment process does not provide the basis for one category of investors. However, since it is possible to describe the portfolio procedures of trust investors there is no reason to suppose that the investment behavior of other institutional investors who do participate in the Over-the-Counter market cannot be described in a similar manner. Consequently, since a theory of each class of investors can be constructed and tested, it is clearly possible to describe the processes by which brokers' orders are generated.

**Testing the Market Processes**

In the current model market behavior is generated by the interactions among brokers and traders. Given the traders' decision process as described above, and given a simple decision process to account for broker behavior, the behavior of prices is determined by these two processes. That is to say, if one is not concerned with explaining the flow of buy and sell orders to the broker, all that is required is the sequence of orders to the brokers plus the two decision procedures. If orders are considered as part of the model's initial conditions, the behavior of the relevant prices are a result of the interaction of the broker's transaction process and the trader's price setting process.

In order to subject the theory to empirical test two types of market situations are being considered. The first is the simple case where there is only one trader who holds an inventory in a particular stock. Since this condition is likely to occur only when there is little interest and activity in a security,
the number of brokers who receive orders for this stock will also be quite limited. Hence, the behavior of the price of this security will be a direct consequence of a few brokers interacting with one trader. Given such a situation, it is neither difficult nor laborious to specify the relevant parameters of the decision processes employed by each of the participants. Once these processes are described, with the brokers' orders forming a part of the initial conditions, the price behavior of this particular security can be immediately explained. For the interaction of these decision processes will generate a sequence of price movements which should be identical to the observed.

To test the accuracy with which this model reproduces the observed price movements in the selected security, it is only necessary to set up a criterion of success and failure and compare the two time series. Such a comparison can be conducted upon the actual prices themselves, as well as on whether the model produces a set of prices that move at each decision point in the same direction as the observed. Once measures of success and failure are defined--i.e. the conditions under which the model's movements in price are to be considered the same as the actual--the model's level of success can be measured by the frequency with which it accounts for the observed changes. Thus, since each of the individual decision processes can be independently subjected to test, the model as a whole can be satisfactorily tested on its ability to reproduce the observed time series.

The second case considers a situation where there is more than one trader who holds an inventory in a particular security. Under this condition the model becomes correspondingly more complex. For once there are several traders as well as a number of brokers there may be more than once price prevailing at any one point in time. Each broker agrees to a transaction when he thinks he has secured
a favorable price. But each broker does not canvass all traders before making a
decision. In addition, more than one broker may be interested in a certain secu-
rit y at one period of time. Therefore, it is possible for there to be slightly
different prices prevailing over any given interval of time.

In order to reproduce these detailed events the model has to include the
individual decision processes of each participant. To empirically determine these
separate processes is a time consuming task. But if a complete explanation of a
particular stream of price behavior is desired the separate decision processes
must be taken into account.

However, if an explanation of each movement in price is not required and if
the behavior under investigation is concerned only with some of the more aggregate
characteristics of price behavior over an interval of time, e.g., direction of
change from beginning to end of interval, incremental change, etc., then a sim-
plified model would suffice. Such a model would consist of a generalized broker's
decision process interacting with a generalized price quoting process. Whether
such a model would produce the desired behavior is open to empirical investigation.
But since each of the individual processes can be independently subjected to
empirical test, the empirical validity of the entire model is not solely dependent
upon the general characteristics of the generated time series being similar to
the observed. Consequently, it would appear that it is quite possible to develop
a general model of price behavior without too much difficulty.

The point to note is that none of these models require a special equilibrat-
ing mechanism. Each is based solely upon the interaction of independent decision
processes. Thus, although their empirical validity has yet to be demonstrated,
the research described above is in my opinion sufficient to indicate theoretical
and empirical merit of this approach. Accordingly, while only one type of market has been examined in any detail, it would appear that all market behavior could be explained by theories which include the decision processes of the individual participants and which do not incorporate the classic equilibrating hypothesis as a distinct and separate market process.