

Reputation, Bid-Ask Spread and Market Structure

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Ever since Jack Treynor's classic analysis of the role of the specialist, it has been recognized that the specialist will end up losing money to informed traders. To protect himself against this risk, the specialist widens the bid-ask spread. The wider spread increases the transaction costs of both informed and uninformed traders, but informed traders presumably recoup the increase through trading profits. In effect, the specialist's losses to informed traders must, on average, be made up by gains from trading with uninformed traders. This suggests that alternatives to a specialist system may better serve the needs of uninformed traders.

Analysis of the specialist market organization suggests, however, that uninformed traders may lose less than commonly thought to informed traders. If brokers are able to signal specialists whether a trade is informed or not, the specialist may have an incentive to accommodate uninformed trades at spreads that are beneficial to uninformed traders. Division of exchange mem-

bership into two classes, specialists and brokers, may work to decrease overall transaction costs and to increase broker and specialist income through increased order flow.

The way trading is carried out on the major equity market in the United States, the New York Stock Exchange, appears at first glance to have anticompetitive elements that are undesirable from the point of view of society as a whole. Trading takes place through designated market-makers, "specialists," and all trades must pass through a broker who is a member of the NYSE. Thus the public does not have direct access to the market, but must go through a broker who has paid a fee, by the purchase of a seat, for the right to transact business on the trading floor. Further, the rules of the exchange require that all members expose all trades to the trading crowd. Trades that completely bypass the crowd are not permitted. At first blush, it would appear that these restrictions may be detrimental to the economy and represent a manifestation of the kind of monopoly power that can lead to dead-weight losses. It seems reasonable to ask whether traders might be better served by a market that gives them the option of direct access to the market-maker, rather than forcing them to go through an intermediary.

This article presents the outlines of a theory that shows how the current arrangement may be optimal for traders. If this theory is true, then attempts to change the trading floor—by, for example,

replacing the specialist with a computer program—may be detrimental.

A Simple Presentation

The basic idea of this article is that there is a fundamental difference between a market in which the trader (either informed or uninformed) has *direct* access to the market-maker and one in which he or she must employ an agent to approach the market-maker. The reason for this is that while the trader may trade only infrequently with the specialist, the agent—actually the floor broker—approaches the specialist on a continuing basis. Consider a market with the following participants.

- **Uninformed Traders:** Uninformed traders are investors who must trade for reasons other than information about the true value of the security in question. Their trading may be motivated by liquidity concerns. They face a dynamic optimization problem in that, on the one hand, the more frequently they trade, the greater their trading costs in the form of commissions and bid-ask spreads. On the other hand, less frequent trading means that their portfolios deviate further from optimal allocations. If transaction costs were reduced, they would trade more.
- **Informed Traders:** Informed traders have received some information about the true value of an asset. If the current price is far enough from the true value to cover transaction costs, they will trade. Their information may be noisy, but noise only serves to limit the extent to which they will trade on the infor-

mation they have. Because many securities are traded in the market, it is possible for a trader to be informed about some securities and uninformed about others. Because traders trade over time, the same trader may be informed at some times and uninformed at others.

- **Brokers:** The broker is a member of the exchange who takes orders from informed and uninformed traders to the trading floor. These orders may be for immediate execution ("market orders") or for execution if the price reaches a specific level ("limit orders"). The broker is assumed to use his skill at order execution to attempt to get the best price for his customer. For example, he may break up a large order into a number of smaller orders, or may stand close to the market-maker to keep track of the order flow in a particular security and choose the best time to execute. Note, however, that the time he can devote to order execution is limited. The more time he devotes to one order, the less he has available for others. Also, we may assume that the broker has an ongoing relationship with the trader. He has learned, through past observation, something about the frequency with which this trader trades for information purposes. Because he executes the trader's transactions in all stocks, he observes and draws inference from all the trader's activities.
- **Specialists:** The specialist is the market-maker. He accepts orders for conditional execution ("limit orders") from the broker. He also accepts market orders. He supervises the traders in a given security. His involvement with trade may take any of three forms. First, if the trade involves one broker trading directly with another,

the specialist merely records the trade. Second, if the trade involves a broker executing the other side of one of the conditional orders that he has received, he is acting as a broker for the conditional order. Finally, he may trade on his own account with the broker, in which case he is a dealer. The specialist continually maintains, and advertises, the price and quantity of the best bid and ask prices either from the conditional orders in his "limit book" or from his own account. He may, at his discretion, reveal to a broker additional information regarding the state of the market, such as the prices and quantities of unexecuted limit orders or other formal and informal indications of interest in securities. The broker and the specialist have an ongoing relationship.

In 1971, Jack Treynor, writing in this journal under the *nom de finance* "Walter Bagehot," initiated an examination of how specialists, or other market-makers, could be expected to behave when faced with the possibility that they are transacting with traders who are better informed about the value of the securities they are trading.¹ While Treynor outlined the major idea—that we would expect the specialist to increase the bid-ask spread in such an environment—it remained for others, notably Copeland and Galai and Glosten and Milgrom, to formalize the intuition.² Now we see empirical work on this issue appearing. A common finding is that, while an analysis of observed spreads suggests that part of the spread is attributable to the adverse selection problem, this explanation explains only a small portion of the variation in spreads. For example, Glosten and Harris report an estimated average adverse selection component of the spread of roughly \$0.01 for a trade of 10 round lots (1000 shares).³ With the average

Glossary

► **Information:**

Knowledge about the true value of an asset. The information is noisy, or imperfect, if there is a random observation error associated with the information.

► **Informed Traders:**

Traders who possess some information regarding the true value of an asset.

► **Liquidity Needs:**

A trader's demand for cash or near-cash. A trader will sell (purchase) assets if he or she needs more (less) liquidity.

► **Noise:**

Noise is the random error associated with an estimate or observation of the true value of an asset. For example, suppose the true value of the asset is \$1, the actual observation will be \$1 plus a random error which is, on average, zero.

► **Reputation:**

One's trustworthiness in revealing his or her own private information.

► **Uninformed Traders:**

Traders who have no information about the true value of an asset. They trade only for liquidity needs.

spread on the NYSE around \$0.25, the adverse selection component is clearly a small percentage of the total spread. As a byproduct of the analysis presented in this article, we will provide a rationale for why the adverse selection component of spread is so low.

The basic problem presented by Treynor is that, when the specialist observes a potential seller (purchaser), he does not know whether the trader is motivated by liquidity needs (which tell him nothing about the value of the

shares) or by information (which would imply that the current price does not reflect some information about the firm). Faced with this problem, the specialist sets the bid (ask) price below (above) that demanded by the simple expenses of trading and market-making in the absence of this potential problem. The increased spread provides, in effect, insurance against the informed trader and gives the specialist a zero expected profit on his trades.

In the formal models of this process, and in the verbal description provided by Treynor, the specialist is dealing with a particular trader in a one-shot situation. Furthermore, the trader is acting as the principal—that is, he is trading on his own account. In our analysis, the specialist deals with a broker who is acting on behalf of a trader and who has an ongoing relationship with the specialist. We will see that this may change matters considerably.

In the situation described by Treynor, the informed trader has the advantage. In reality, however, the specialist has certain advantages with respect to the trader. First, the specialist has the useful information contained in the limit book. While the common view is that the limit book is private information to the specialist, a few moments spent on the trading floor belies this view. In fact, the specialist will often share this information with the floor broker upon request. Thus the specialist can, if he desires, provide the floor broker with valuable information about the demand and supply curves for the security. Another advantage the specialist has is that, at his discretion, he can execute a trade against the limit orders in the book—that is, at the quoted spread—or he can execute the trade for his own account inside the spread. If he chooses to trade with the broker within his spread, the broker will receive a higher price on any sale and pay a lower

price on any purchase. He will receive better execution.

The Idea

We leave a formal model that presents the details of our argument to an appendix. Essentially, we want only to introduce a possible role for “reputation” in a model like Treynor’s. If there is a reputation, then it may make sense for a trader to reveal his characteristics to the specialist. He may do this, even if it costs him on this trade, so that he will be believed on some future trade. Unfortunately, it is difficult to see how a reputation could make economic sense in a model like Treynor’s or a formal version of a similar model such as that presented by Glosten and Milgrom. The problem is that, in order to have reputation be of economic value, all parties must know they will meet again; in the one-shot models, the trader will never see the specialist again. Contrast this with the situation on the floor of an exchange. In reality, the trader does not have direct access to the specialist, but rather must trade through a floor broker. A formal model of this situation is presented in the appendix. Below, we present a verbal description of the model and its conclusions.

We start with a world like that posited by Glosten and Milgrom. In this world, the specialist sets the spread so that, on average, he will break even. He knows that some fraction (say Z) of the traders who approach him are informed. Consider how he sets the ask price (the analysis for the bid price is symmetric). If a trader indicates that he is interested in buying at the ask price set by the specialist, the specialist knows that either (1) the trader is uninformed and trading for liquidity purposes (with probability $(1 - Z)$) or (2) the trader is informed (with probability Z) and the value of the security is actually higher than the price he has set. He thus expects to lose money to informed traders, a loss he will have to make up from unin-

formed traders. This has some implications for bid-ask spreads. For example, it is well known that the ask (bid) price will be higher (lower) when there are more informed traders. That is, the higher the probability that the specialist is trading against an informed trader, the higher the spread will be.

How does the situation change if the trader must go through a floor broker? It is clear from the above analysis that a liquidity trader will receive more favorable terms of trade from the specialist if his identity can be ascertained. In this model, floor brokers, because of their ongoing and close relationships with their clients, have information about whether the client tends to trade on information or for liquidity. It turns out to be important that the specialist not be able to identify accurately *every* informed trader.⁴ This can be accomplished in the model by assuming the broker observes the nature of the customer only with noise or by having an equilibrium in which the broker does not fully reveal his information about the customer. It may be in the interest of the broker to convey uninformed traders’ identities to the specialist and, if such communication has some credibility, secure for them more favorable terms of trade.

What will happen in this case? The specialist has some prior probability (Z) that a particular order comes from an informed trader. He then receives a signal from the floor broker regarding whether or not the trader is informed. For the sake of argument, let the uninformed trader be correctly identified as such by the floor broker with probability π . This signal allows the specialist to adjust his probability that the trader is informed, conditional on receiving the signal “uninformed,” to be less than Z .

The extent to which he will adjust the probability depends on the accuracy of the broker’s signal. For example, if the broker tells

the specialist that the trader is uninformed, and the specialist believes the broker is always accurate, he will set the price so that the adverse-selection component of the spread is zero, because he need not fear trading against an informationally advantaged trader. To the extent that the broker's signal is informative, but not always accurate, the specialist will set his bid and ask prices so that there is an adverse-selection component to the spread, but the spread will be less than it would be if the trader had direct access to the specialist. As shown in the appendix, simple application of Bayes' rule and a little algebra will show that the spread for uninformed traders is, in fact, narrower than the spread facing all traders when there are no floor brokers; furthermore, the spread decreases with the accuracy of floor brokers' revelations.

Implications

We have established that, in a world in which floor brokers are required in order to bring a trade to the market-maker, uninformed traders will be better off if an equilibrium is established in which the floor broker truthfully reveals his information to the specialist. Now consider how these various aspects of the trading floor may come together to reach an equilibrium in which (1) the broker usually reveals to the specialist any information he has regarding the informed/uninformed status of his customer and (2) the specialist finds it in his interest to reveal to the broker the information he has regarding unexecuted orders and indications of interest.

The floor broker deals with a single trade at any point in time. During the course of a day, however, he executes trades on behalf of a number of investors. Some of these investors are trading on the basis of information and others are trading for liquidity purposes. For the time being, assume that the broker knows which is which.

Assume further that there are a

number of brokerage houses that compete for public (non-broker) business and that a major characteristic investors use to choose a broker is the quality of trade execution. Furthermore, assume that most traders are trading for liquidity purposes.

Upon receipt of an order, the broker approaches the specialist. If the broker could credibly reveal to the specialist whether he is trading for an informed or an uninformed trader, would he do so? The answer to that question may well be "yes." We have seen that the broker could obtain better execution of trades on behalf of liquidity-motivated customers if he informed the specialist that the customer is trading for liquidity rather than information purposes. If such assurances could be made credible, the specialist would not need to protect himself against the possibility that the broker is trading for an informed client, and the spread should narrow (that is, the specialist may take part of the order himself inside the quoted spread). The specialist may, and indeed often does, share the information in his limit book and even other verbal indications of interest he has received. This knowledge may be useful to the broker considering the likely effect of an order.

The other side of the coin, of course, is that the broker would have to inform the specialist when his client is informed, and this would lead to poorer execution for informed traders. If informed traders are in the minority, however, the gains in the form of improved execution for liquidity traders may outweigh the losses associated with poorer execution for informed traders.⁵

If the broker could build a reputation for truth-telling, this reputation may be valuable. Formal economic models of reputations face the problem that one side or the other will tend to exploit the reputation, especially if the relationship that engendered the reputation is about to end. In our

case, for example, a broker who is not going to be around after this trade has no incentive to tell the specialist when he is trading on behalf of an informed trader, thus leading the specialist to protect himself in the manner described by Bagehot.

Interestingly enough, the specialist also has some incentive for dealing fairly with the broker. The specialist would like the broker to engage in truth-telling. Although we tend to think of the specialist as a monopolist, in fact he faces competition from a number of sources. The customers of the public houses may choose to take their business to third-market firms if the service their broker receives is deficient. Once an order has been placed, it may well be in the size range that would permit it to go either to the floor or upstairs. The specialist, then, may not be in a position to exploit any information advantages he has regarding the limit book or other indications of interest. It may well be in his interest to reveal his information and not take advantage of the broker. That is, a reputation may also be valuable to the specialist.

What are the conditions that foster reputation building? First, there must clearly be a *repeated* relation. Indeed, in some sense the very structure of the market makes the game very long-lived. For example, the presence of many second and even third-generation specialists provides a kind of institutional history, so the broker knows his reputation may well outlive the particular person with whom he deals. Second, there must be possible retaliation for attempts to violate the implicit contract for truth-telling inherent in the reputation. Given that the broker and the specialist will trade with each other again, this requirement is fulfilled by the fact that the specialist can either (1) refuse to reveal the unexecuted orders in the limit book or (2) refuse to trade on his own account within the spread.

Indeed, the very nature of the business, and the socializing and gossiping that goes on around it, almost guarantees that misbehavior soon becomes common knowledge. It would be difficult for a broker to lie to one specialist about the nature of his clients and not discover that all other specialists start treating him warily. Finally, the game must not have a known end date. A specialist (broker) who will not trade any more may find it tempting to lie. The previously mentioned characteristics of the market, including the multigenerational aspects of the specialist-broker relationship, suggest that this may be only a minor problem.

An interesting side effect of the scenario is that the specialist is able to interfere in the principal-agent relationship between the broker and his customer. The informed customer would presumably like his broker to hide that fact. Because the broker deals primarily with uninformed customers, and because the specialist can affect the quality of trade execution, there are incentives for the broker to reveal information-motivated traders. Note that the customer cannot avoid this problem by using a broker who specializes in serving informed customers. The very choice of broker then identifies him and results in the same execution he would have received if the original broker had simply revealed.

What does the story presented here mean? It does *not* mean that specialists do not widen their spreads when facing the possibility of an informed trader. It does mean that the likely effects of this adverse selection problem may be mitigated by the interests that both the floor broker and the specialist have in building and maintaining a reputation for not taking advantage of each other.

This article has not presented a formal model of the process. While the outlines of a formal model are reasonably clear, there is one issue we have not ad-

dressed. If the broker always correctly identifies the informed trader as informed—that is, if $\pi = 1$ —would the broker still share this information with the specialist? In this case, it may be optimal for the broker to randomize. That is, the broker may choose to reveal at some times and to conceal at others. Such a contract between the broker and the trader will keep informed traders in the market. If informed traders were *always* identified, either because the broker always revealed or because they used a broker who never revealed (such a broker would never be used by an uninformed trader), then informed traders might well find it optimal to defect from the market. Of course, this argument for a randomizing strategy is only relevant if π , the probability of correctly identifying the trader as informed or uninformed, is 1.

Another interesting aspect of this analysis is that, suitably extended, it provides a rationale for a market with a trading floor characterized by limited access and traders meeting face-to-face. This kind of arrangement, with a limited number of brokers acting on behalf of the public, provides a framework in which brokers can build a reputation that makes the market work more efficiently. As an alternative, consider a world in which the NYSE permitted anyone to come on the floor and trade with the specialist. The specialist would not have experience with those against whom he is trading, and they would not have an opportunity—there being so many of them—to build up an identity, and thus a reputation. In this world, the specialist would tend to set wider spreads in order to protect himself. Thus the story outlined here suggests that there is a benefit to the use of agents (brokers) by the public. That is, there may well be a net agency benefit, rather than an agency cost, associated with using member firms as brokers.

This model also provides another rationale for the way in which the NYSE is organized into two classes of members, brokers and specialists. It may well be that the provision of better execution for liquidity traders increases the profits of *both* brokers and specialists through increased order flow.⁶

Appendix

A simple model in which the broker has information about the nature of the trader on whose behalf he approaches the specialist is presented below. For the time being, we assume that the broker has sufficient incentive to tell the truth. The model is a straightforward extension of Glosten and Milgrom.⁷

- *Value of Security:* The intrinsic value of the security is normalized to be zero at time 0. The value of the security at time 1 is given by v , where v is uniformly distributed over $[-1, 1]$. Even though the distribution of v is common knowledge, only informed traders observe a signal about its value before time 1, the next trading date.
- *Traders:* There are N traders in the market for the security. Among them, $(1 - Z)N$ are liquidity traders and ZN are informed traders.
- *Specialist:* The specialist sets the bid-ask spreads to break even on average, taking into account the informational advantage of the informed traders.

Consider first how the bid-ask spread is set in the absence of a floor broker. We consider the specialist's problem of setting the ask price. (The analysis for the bid price is done similarly.) Suppose the ask price is a . The expected gain for the specialist from trading with a liquidity trader is a , since with no information about v , the value of the security is still zero. If the trader is informed, however, the fact that he will pur-

chase the security at a implies that it is worth at least a . The expected value of the security conditional on an informed purchase is thus $(1 + a)/2$ (by the assumption of uniform distribution of ν). The specialist thus expects a loss from dealing with the informed trader of $(1 - a)/2$.

The probabilities of trading with a liquidity trader and an informed trader are $(1 - Z)$ and Z , respectively. The ask price that allows the specialist to break even on average is determined by equating the expected gain from a liquidity trade to the expected loss from an informed trade, as follows:

$$(1 - Z)a = Z\left(\frac{1 - a}{2}\right),$$

or writing a as a function of Z :

$$a(Z) = \frac{Z}{(2 - Z)}.$$

Note that the ask price lies in the interval $[0, 1]$ and is higher, the more likely the specialist will encounter an informed trader. This is intuitive, as the specialist has to set a higher ask price to compensate for increased expected loss from the informed trades. When $Z = 1$ (all traders are informed), the only ask price at which the specialist can break even is 1, the maximum value of ν . This is the case where the adverse selection problem is most acute. When $Z = 0$ (all traders are liquidity traders), the specialist sets the ask price at 0.

Suppose that a broker can ascertain the identity of a trader with a probability π , $\pi > 1/2$. This simple information structure is given by the matrix in Table AI. Given the information structure, a broker updates his belief about whether the trader is informed when a signal about the trader's identity is received. It is straightforward, using Bayes' rule, to compute the conditional probability of a trader being informed

Table AI Probabilities of Trader Being Informed/Uninformed

True Type of Trader	Probability of Broker's Signal Indicating that	
	Trader is Informed	Trader is Uninformed
Informed	π	$(1 - \pi)$
Uninformed	$(1 - \pi)$	π

given the broker's signal. Denote the conditional probability that the trader is informed given the signal that he is "uninformed" and "informed" by Z_u and Z_i , respectively. Then:

$$Z_u = \frac{Z(1 - \pi)}{Z(1 - \pi) + (1 - Z)\pi},$$

and

$$Z_i = \frac{Z\pi}{Z\pi + (1 - Z)(1 - \pi)}.$$

A liquidity trader, absent the existence of a broker, is perceived to be informed with probability Z . When floor brokers exist, his identity will be correctly conveyed with probability π , in which case he will be perceived to be informed with probability Z_u . However, he may be misidentified with probability $(1 - \pi)$ and perceived to be informed with probability Z_i . Therefore, the expected ask price for an uninformed trader, with the broker, denoted by A , is:

$$A(Z, \pi) = \pi a(Z_u) + (1 - \pi)a(Z_i).$$

Substituting for Z_u and Z_i , we have:

$$A(Z, \pi) = \frac{Z(2 - Z)\pi(1 - \pi)}{[Z(1 - \pi) + 2(1 - Z)\pi][Z\pi + 2(1 - Z)(1 - \pi)]}$$

Straightforward algebraic computations show that A is a decreasing function of π ; that is, the more accurate the broker's signal, the better the quality of the execution of trades for the uninformed. The gain to an uninformed trader with the broker, relative to the case

without a broker, is $a(Z) - A(Z, \pi)$. When π is close to $1/2$, or when the broker's signal is only marginally informative, the savings in transaction costs is insignificant. However, when π is close to 1, or when the signal is almost perfectly informative, the savings is close to $a(Z)$.

Footnotes

1. W. Bagehot (pseud.), "The Only Game in Town," *Financial Analysts Journal*, March/April 1971.
2. T. Copeland and D. Galai, "Information Effects on the Bid/Ask Spread," *Journal of Finance* 25 (1983), pp. 383-417, and L. Glosten and P. Milgrom, "Bid, Ask and Transaction Prices in a Specialist Market with Heterogeneously Informed Traders," *Journal of Financial Economics* 14 (1985), pp. 71-100.
3. L. Glosten and L. Harris, "Estimating the Components of the Bid/Ask Spread," *Journal of Financial Economics* 21 (1988), pp. 123-42.
4. Clearly, the specialist will be unwilling to trade with any trader he knows to be informed because that trader will be willing to trade only at a price that makes the specialist worse off. Thus, if informed traders can be perfectly identified, they will be forced from the market (or leave voluntarily).
5. How this poorer execution would show up in the data depends on how one tests the model. If the specialist knew that the broker approaching him was trading on behalf of an informed trader, for example, he might raise both the bid and the ask prices at which he would transact with that broker. Because he knows that the trader is interested in purchasing, however, he need only report the ask price to the floor broker, while changing the bid price only with his clerk. Thus, because he did not change the reported bid price, it may appear that the spread has widened. This is a misperception caused by the presence of an old, and now irrelevant, bid price at which the specialist knows no transaction will occur. Of course, the specialist would change the bid price after this trade is executed rather than let it stand to be picked off.
6. We thank Larry Harris, David Hirshleifer and Richard Roll for their helpful comments.
7. Glosten and Milgrom, "Bid, Ask and Transaction Prices," op. cit.