

Floor versus Automated Trading Systems: A Survey of the Issues

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1. Introduction

Last summer, the Bangladeshi Stock Exchange replaced its trading floor with a new fully automated trading system. At the same time, the New York Stock Exchange considered where to build a new trading floor.

Large and small exchanges throughout the world are replacing their floor-based trading systems with computerized systems. Are automated trading systems better than floor-based trading systems? Traders widely perceive them to be more fair, more efficient and cheaper to operate than floor-based systems. Why then would the New York Stock Exchange consider building a new trading floor?

The continued commitment of The New York Stock Exchange to its trading floor may be its most important decision at the turn of the millennium. The men and women who are making this decision are fully aware of its significance. They believe that the tremendous success of the NYSE is due in large part to its floor-based market structure. They also know that they may lose much, if not all, of their franchise if they are wrong. Naturally, they are also hedging their bets.

The New York Stock Exchange is the world's most liquid equity market. If the liquidity comes from its floor-based market structure, eliminating the floor would be foolish. However, if the liquidity is due to other factors, a switch to electronic trading may be feasible and perhaps even desirable.

Many competitors to the NYSE have electronic screen-based trading systems. These include both domestic and foreign markets like Nasdaq, the Cincinnati Stock Exchange, and the proposed Pacific Exchange/Archipelago merger, the Toronto Stock Exchange, Deutsche Börse, the Paris Bourse, the Tokyo Stock Exchange and TradePoint. The NYSE also competes with electronic communication networks (ECN's) such as The Island ECN, Archipelago, Bloomberg's TradeBook, Reuters' Instinet, POSIT and Optimark. Some of these ECNs have applied to the SEC to be regulated as exchanges. In addition, the NYSE also competes with third market dealers like Knight/Trimark and Bernard L. Madoff Investment Securities that use extensive electronic order routing and automatic execution systems to support their trading.

Some of the NYSE's electronic competitors are quickly gaining market share. Concerns about electronic competition coupled with a natural desire to reduce costs and increase efficiency have led the NYSE to invest more than a billion dollars in the last ten years in new electronic technologies to support its floor-based trading systems.

The Chicago Board Options Exchange, the American Stock Exchange and the Pacific Exchange are the world's most liquid equity options exchanges. Like the NYSE, they use floor-based trading systems. Early this summer, they will face competition from the newly established electronic International Stock Exchange.

The Chicago Board of Trade and the Chicago Mercantile Exchange (CME) are the world's most liquid futures markets. They also have floor-based trading systems while many of their

competitors operate successful fully automated trading systems. They face the same quandary faced by the NYSE, and they have hedged significantly through their investments in Globex and Project A.

The Chicago Mercantile Exchange faces significant potential competition in its flagship long Treasury bond contract from the Cantor Futures Exchange. The CFE is a new electronic exchange that is a joint project of Cantor Fitzgerald and the New York Board of Trade. This exchange allows Cantor's existing clients to trade bond futures using the same screen that they presently use to trade the underlying bonds. Although the CFE has not yet been particularly successful, the size, penetration and importance of the Cantor's spot bond markets suggest that it could take substantial market share away from the CME. In response, the CME recently decided to allow their bond contract to trade electronically.

When floor-based trading systems and electronic trading systems compete head-on-head with each other, the results have often favored the electronic trading systems. In the 1980's, the London Stock Exchange was the most important market for large French stocks. In 1989, the Paris Bourse introduced an electronic trading system. Following the repeal of a transaction stamp tax in 1994 and a change in block trading procedures, much of the trading in French stocks migrated from London to Paris. More recently, the electronic German DTB futures exchange has wrest trading in German T-bond futures from the floor-based London International Financial Futures Exchange (LIFFE).

Floor-based oral auctions and automated rule-based auctions are very similar. Both are order-driven markets that match buy orders to sell orders using essentially the same rules. Their primary difference lies in the technologies they use to do these matches. In oral auctions, traders arrange the trades by exchanging information among themselves. In automated markets, computers arrange the trades.

Since the two market structures are so similar, exchange officials, regulators and traders naturally consider which is the best market structure. There is no simple answer. Each system has its strengths and weaknesses.

In this article, we will examine the arguments for and against these two trading systems. We will consider how the systems differ in fairness, convenience, capacity, speed, efficiency and cost.

2. Fairness

Two concepts of market fairness concern traders. Traders want their markets to operate fairly and they want fair access to those markets. In *operational fairness*, trading rules are uniformly applied and no cheating occurs. In *access fairness*, all traders have an equal chance to take advantage of any opportunities that arise.

2.1 Operational Fairness

Many traders believe that fully automated trading systems are the fairest of all market structures. Automated systems do only what they are programmed to do. They implement their trading

rules exactly and without exception. They expose orders only as instructed and only to those traders to whom orders may be exposed.

In contrast, fairness in oral auctions depends on the skill and honesty of the traders who arrange the trades. Traders must be highly skilled to follow the trading rules faultlessly when the market is active and when prices are moving quickly. They must honestly follow those rules even when doing so may cause them to lose an advantage.

Although most oral auctions are quite fair, all oral auction markets have suffered from well-documented trading scandals. These scandals usually involve front-running, inappropriate order exposure, fraudulent trade assignment or prearranged trading.

occurs when a broker improperly allows one order to trade ahead of another order. The order that goes first usually profits from the price impact of the following order.

Front-Running Example

Doug is a dishonest broker, Sue is Doug's friend and John is a large client of Doug's. Both John and Sue have given Doug market buy orders to execute. John's order is quite large and will likely move the market up. Sue's order arrived after John's order but before Doug has executed John's order. The time precedence rules of the market require that Doug execute John's order before Sue's order.

Doug trades Sue's order first so that her order front-runs John's order. She then profits from the price impact of John's order. The average fill price of John's order is worse because Sue takes some of the liquidity that otherwise would have gone to John. As a rule, front running harms the trader whose order is front-run.

occurs when a broker shows an order to another trader for the other trader's benefit rather than for his client's benefit. The other trader will typically act on the information, either by trading ahead of the order or by refusing to trade with it. Brokers must expose orders only for their client's benefit.

Inappropriate Order Exposure Example

Suppose that Doug shows John's buy order to his friend Rick. Rick is a small trader. Since Doug knows Rick cannot fill John's order, it is inappropriate for him to expose it to Rick. Rick then front-runs John's order by buying before Doug fills John's order. The inappropriate order exposure allows Rick to make a profitable trade that hurts John.

Doug also exposes the full size of John's order to his friend Todd, who is a dealer. Todd then moves his offer price up to avoid filling John's order at a low price. John expects that his broker will price discriminate to obtain the best price. Doug should not have exposed the full size of John's order to Todd since he easily could have predicted Todd's reaction. He instead should have only revealed a portion of the order to Todd. The inappropriate order exposure will cause John to pay more to fill his order than he otherwise would have had to pay.

can occur when a broker executes orders on the same side of the market for more than one client. Each client should get the price at which his or her order filled. A dishonest broker, however, may assign the best prices to his favored clients.

Fraudulent Trade Assignment Example

Suppose that after Doug fills John's order, he receives another buy order of the same size from his friend Alex. Doug fills Alex's order at a higher average price than John's order. To favor his friend, Doug switches the identities of the two traders. He assigns the first purchase to Alex and the second purchase to John. This fraudulent trade assignment hurts John.

occurs when a broker arranges a trade without properly exposing her client's order to other traders who might be willing to offer better prices. Under such circumstances, the client often receives a worse price than what he might have received if the broker properly exposed the order.

Prearranged Trading Example

After Doug receives John's order, he arranges to trade it at a high price with his friend George. Although Doug could have obtained a lower price on the floor, John does not know this. George sells at a higher price than he would otherwise have received.

Although all these problems can also arise in automated markets, they cannot take place within their automated trading systems. Instead, dishonest brokers must conduct their frauds on the side.

Markets prevent these frauds by having officials supervise trading, by investigating suspicious trading practices reported by honest traders, and by maintaining reliable audit trails. An records the submission and disposition of every order. A good audit trail includes detailed information about everything that happens to each order. Regulators use audit trails to determine whether traders have violated the trading rules. An accurate audit trail tends to discourage dishonest brokers.

Most floor-based markets have extensive rules that govern how traders process orders and record trades. Markets design these rules to make the audit trail complete, reliable and accurate. These rules require traders to time-stamp their orders when they receive them and when they fill them, to record trades sequentially and to report trades immediately.

Automated trading systems easily produce complete and flawless audit trails because they process all orders electronically. Many traders and regulators especially like automated trading systems for this reason.

2.2 Fair Access

Markets have fair access when all traders have equal access to the market. In such markets, no traders have special advantages over other traders. Few trading systems provide pure fair access.

In floor-based trading systems, floor traders have an advantage over off-floor traders. Floor traders can see and react to market developments well before off-floor traders can. Off-floor traders must obtain their information through market data systems, and they must respond through order routing systems. The best market data systems report information in less than two seconds. The best order routing systems pass orders from the client to a floor broker in less than five seconds. If the routing system requires a floor runner carry the order, the delay will be substantially longer. These delays allow floor traders to take advantage of opportunities before off-floor traders can.

Floor traders also can observe all market information revealed on an exchange floor, and not just what the market data systems report. In particular, they observe who is trading. Knowing who is trading can be valuable if you can guess why they want to trade or who they represent. Floor traders and off-floor traders whose brokers can give them access to this information therefore have a significant advantage over other traders.

In some floor-based markets, trader anatomy also affects the fairness of the trading. In large, active futures pits, being able to see and be seen, and being able to hear and be heard are very important. Large traders have some advantage over small traders because they can control the “real estate” within the pit that offers the best sight lines. They simply move to where they want to be and plant themselves. Although futures markets do not allow pushing their pits, bumping is common. Big traders tend to get the best spots. Tall traders have some advantage over short traders because they can more easily see and be seen. Traders with loud voices have some advantage over less audible traders because they can more easily attract attention when yelling. Traders with shrill voices (typically women) have an advantage over traders with bass voices because high frequency sounds are highly directional. Their voices penetrate through the noise and easily attract attention. These anatomical characteristics all confer an advantage upon traders in oral markets. They give no advantage to traders who trade in automated markets.

Automated markets favor traders with good keyboard skills and abstract visualization skills. Although most people would not consider these advantages to be unfair, they make some traders anxious when they first start using electronic systems.

Automated markets also favor traders who use computer systems to generate their orders. Such systems can monitor electronic data feeds and respond instantly to new information. Although this advantage is a natural consequence of faster trading technologies, many manual traders resent competing with such automated traders.

3. The Convenience of Distributed Access

A primary advantage of automated trading systems is that they allow traders to trade from desks in their offices rather than on an exchange floor. This convenience allows traders to sit next to their telephones and to consult any data systems they want in support of their trading.

Such facilities are often difficult or impossible to arrange on the floor of an exchange. Floor traders who want instant access to telephone and data services must carry cell phones and portable data terminals with them onto the trading floor. These instruments are often cumbersome and some markets still do not permit them.

Why Doesn't Microsoft Trade at the New York Stock Exchange?

Before the 1990's, most large US corporations listed their stocks at the New York Stock Exchange when they grew large enough to meet their listing standards. Microsoft and some other technology companies have not done so.

Although many reasons may explain why Microsoft has remained a Nasdaq stock, one is of particular note to this discussion. Microsoft's vision for the world revolves around distributed access computing systems. They make their money creating and selling systems that promote this vision. Although the Nasdaq market is not an order-driven exchange, it is a distributed access market. Microsoft may have chosen to stay at Nasdaq for ideological reasons, among others.

The New York Stock Exchange hopes that Microsoft will eventually list its stock there. Many people believe that the NYSE is reserving "M" for Microsoft's ticker symbol.

4. System Capacity

Electronic order matching technologies are much more scaleable than oral order matching technologies. A technology is when it can operate with equal efficiency at small and large scales.

More traders can directly participate in an automated auction than in an oral auction. The number of traders who can effectively communicate with each other at the same time limits the size of an oral auction. When too many traders try to participate in the same auction, they exceed its capacity to process information in an orderly fashion. As the number of traders bidding and offering is large, traders cannot easily keep track of who is quoting the best prices. Traders then arrange trades that violate time precedence or even price priority.

Futures and options markets designate such disorderly markets as . The designation tells brokerage customers that they cannot expect that their orders will fill at the best published trade prices when the market is trading fast. In the confusion of a fast market, brokers may be unaware of the best available trading opportunities.

Great numbers of traders can simultaneously interact with each other in automated trading systems because these systems process order messages much more quickly than people can. Traders who use automated systems do not have to keep track of the best bid and offer. Instead, they let the system do it for them. They also do not have to arrange their trades. The system does it for them according to the market's trading rules. By supporting these functions, automated trading systems allow traders to focus their attention exclusively on the creation and submission of their orders.

5. Negotiation Speed

Some floor dealers believe that they can trade more quickly on a floor than in an electronic market. They claim that they can more quickly shout a bid or offer, or accept a bid or offer than they can enter this information into a computer. Although this probably is true, modern trading systems with graphical interfaces allow traders to enter information almost as quickly as traders can shout it out.

In any event, automated trading systems can arrange trades much more quickly than can individual traders. In an oral auction, traders must manually record the price, size, counterparty and the item traded for each of their trades. In many markets, they must also record the time of the trade. Since trading requires both order entry and trade reporting, traders can complete trades more quickly in electronic markets than in oral markets.

Oral trading, however, is generally faster than screen-based trading when traders want to negotiate their trade sizes. In such negotiations, traders often will not reveal the full size of their order unless they are sure that the other trader will trade the same size. Accordingly, after agreeing on a price, they often take turns proposing successively higher sizes. Negotiations stop when one trader proposes a greater size than the other trader will accept. The trade size is then the last agreed upon size. This back and forth negotiation moves very quickly in oral auctions. When conducted through a computer that only accepts firm orders, the negotiation is much slower since the traders must split their orders into pieces to avoid displaying their full sizes.

Some electronic trading systems solve this order display problem by providing messaging systems that allow a buyer and seller to negotiate their trade size through the exchange of messages on their screens. Reuters' Instinet trading system is one such system.

A second way some automated exchanges solve this order display problem is by allowing large traders to place hidden limit orders. Traders use _____ to restrict the displayed size of their orders. The automated trading system is aware of the remaining size of the order but it does not display it to other trades. When the system arranges a match between a hidden order and another order, the trade size is set to the minimum of the buy and sell order sizes. This procedure accomplishes automatically what oral traders must accomplish through their back and forth negotiations. The Paris Bourse and Globex are markets in which traders can and often do use undisclosed orders.

Undisclosed Order Example

Michael wants to sell 90,000 shares of Alcatel Cable at the Paris Bourse. He is only willing to display 10,000 shares at a time because he is afraid that the display of his full size might move the market down. He places an undisclosed limit order to sell 90,000 shares at 408 francs with instructions to display only 10,000 shares. His order makes a new market.

Liza sees the offer to sell 10,000 shares at 408 francs. She is willing to buy 60,000 shares, but she does not want to reveal this information. She knows that there is some chance that more shares are hidden behind the 10,000 displayed shares. Liza submits a fill or kill limit order to buy 60,000 shares for 408 francs. She can be sure of trading at least 10,000 shares. If she does not trade the full 60,000 shares, the system will cancel the remainder of her order.

When the Bourse's automated trading system receives Liza's order, it immediately fills the entire order. Liza and Michael both will receive reports that they have traded 60,000 shares. The 30,000-share remainder of Michael's sell order will stay in the system with 10,000 shares displayed at 408 francs and another 20,000 shares undisclosed behind it.

6. Exchange of Information on Trading Floors

Floor-based trading systems dominate electronic trading systems when brokers need to exchange information about their clients to arrange their trades. This is especially important when traders want to know about their counterparts before they agree to trade. Most electronic trading systems can not easily provide such information. These issues are most important for traders who want to avoid trading with well-informed traders and with large price-discriminating traders.

All traders want to avoid trading with traders who are well informed about security values. When a well-informed trader wants to sell or buy, prices respectively are either too high or too low. Whoever trades with a well-informed trader therefore will probably later regret trading. Since it usually is better not to trade than to trade at a poor price, traders prefer to trade only with uninformed traders.

Large traders often direct their brokers to trade only with institutions they deem to be uninformed. They prefer to trade with institutions that have no research staffs and which trade only to invest and disinvest rather than to speculate. They often refuse to trade with the proprietary trading desks of investment banks for fear of losing to them. Large traders can issue these instructions to their brokers because they can afford the significant commissions necessary to obtain the personal attention necessary to provide these services. For large block trades, traders and their brokers will audit carefully the motives of their trade counterparts.

Traders also do not want to trade with a large trader if that trader intends to continue trading on the same side. The market impact of the large trader's subsequent trades will generate immediate losses for the first traders who trade with the large trader. Traders therefore instruct

their brokers to ask how much more size the other side wants to do. If traders expect that more size will follow, they will offer less favorable terms of trade to the large trader.

Price Discrimination by a Large Trader

Jim wants to sell 100,000 shares of ABC. He splits his order into two equal parts. The first 50,000 shares he sells to Alice at 50 dollars. He sells the remaining shares to Doug at 49 dollars. Alice suffers an immediate loss of one dollar per share, or 50,000 dollars.

On an exchange floor, a broker who has no additional size to fill will freely offer this information to obtain a better price. Brokers who have substantial additional size usually indicate that they either do not know, or cannot tell, how much additional size remains. If they say that they have no additional size, and then return to do more size, they depreciate their reputations and traders will no longer trust them. Brokers therefore do not like clients who lie to them about the full size of their orders. No similar mechanism in existing electronic trading systems allows traders to credibly indicate to each other how much additional size remains in their orders.

Finally, brokers often know of traders who might be interested in trading but who have not submitted orders. Such traders may not be unwilling to display their orders, or they may simply not know that they want to trade until a broker approaches them with a suitable trading opportunity. Brokers in possession of this information can often arrange trades that otherwise might not be possible in an electronic environment.

A Brokered Trade

Suppose that a buyer wants to buy a large block of General Motors. If no seller is present, he cannot purchase the block. Some traders on the trading floor may know of someone who wanted to sell a large block, but who is not now present. If they pass that information to the buyer's broker, the broker can page that seller and try to arrange a trade.

In summary, brokers introduce their clients to each other several different ways. In addition to guaranteeing that their clients will settle their trades, brokers may also assure traders that their clients are not well informed and that they do not intend to trade more. Brokers can only provide these guarantees and assurances by knowing their clients well. Traders can only rely upon these guarantees and assurances by knowing whether the brokers who offer them are reliable. Brokers acquire reputations for being reliable by honestly sharing information when their clients permit them to do so, and by refusing to represent clients who try to exploit their reputations by misleading them.

Floor-based trading systems are much better at facilitating the exchange of non-price information than are screen-based systems. The information that some brokers want to exchange about their clients cannot be exchanged in systems that operate only on information about order prices and sizes. In addition, the reputations that brokers must cultivate to provide credible characterizations of their clients require that they trade in non-anonymous environments.

Although markets can create screen-based trading systems to facilitate the exchange of non-price information and the cultivation of reputations, the use of telecommunications and computing technologies generally cannot make these activities significantly more efficient because the required messages often are not easily standardized.

7. Comparative Costs

Screen- and floor-based trading systems have different cost structures. Screen-based systems have high initial creation costs but generally low operating costs. Floor-based systems have somewhat lower creation costs, but are often quite costly to operate.

7.1 *Electronic trading systems*

Fully automated trading systems require the construction of extensive data networks and data processing systems. These systems must validate users, accept orders, process orders, report trades and report order status. These functions must all be reliable, secure and fast.

Automated trading systems must be reliable because trading stops when the computer or network is down. If only part of the network is down, the affected traders will be extremely upset. They generally would prefer that all trading should halt if they cannot trade. Traders will not use unreliable systems.

Some Examples of the Risks of Trading through Unreliable Data Networks

A trader submits a limit order to an electronic market. After the order is accepted, but before it trades, the trader's network connection fails. The trader does not know whether she has traded. If she knew that she has not traded, she would do the trade in another market. If she goes elsewhere, however, she risks trading twice.

An arbitrageur uses an electronic market to buy Nasdaq 100 futures contracts and sell S&P 500 futures contracts. The position will profit if the Nasdaq 100 rises or if the S&P 500 falls. The two contract prices are closely correlated because they both depend on US equity prices. Although the contracts separately are quite risky, the hedged position is not very risky. Suppose that the arbitrageur initially buys the Nasdaq 100 contracts. His network connection then fails before he can sell the S&P 500 contracts to establish his hedge. If the Nasdaq 100 falls, he will lose much money. Had he hedged his position, a decrease in the S&P 500 probably would have offset his losses.

A short-term speculator uses an electronic market to buy a stock whose price he believes was depressed momentarily by a large uninformed seller. If he is right, he will make money when the price rebounds. He may be wrong, however. If the large seller is well informed, the price probably will continue to fall. The speculator therefore intends to sell his position if it does not show a profit in the next 15 minutes. Suppose that his network connection fails immediately after he buys the stock. If the market then drops significantly before he can sell his position, he will lose money. To protect against this possibility, the speculator might issue a stop loss order immediately after he purchases the stock. The stop order would instruct the market to represent his interests even when he cannot communicate with it. Some electronic markets, however, do not accept stop instructions.

To build reliable trading systems, markets must make substantial investments into redundant hardware and software systems. Since failures are inevitable given current technologies, markets must also invest into systems that allow them to recover from service interruptions.

Steps Automated Markets Take to Create Reliable Trading Systems

Use fault-tolerant computer hardware.

Build redundant computer systems.

Build redundant network connections.

Route network connections through different vendors and through different physical paths.

Provide backup power supplies.

Replicate all systems at a remote “hot disaster recovery site” to which all activity can instantly switch should some disaster affect the primarily processing site.

Build-in significant excess capacity to protect against unexpected surges in demand.

Maintain high quality controls in software development.

Maintain redundant data backup procedures.

Automated trading systems must be secure because traders enter contracts involving large sums of money. They must be confident that no computer hackers can tamper with their contracts and that no impersonators can fraudulently create them. Markets build secure systems by using various data encryption systems and user authentication systems.

Automated trading systems must be fast because traders want instant access to the markets. They want to see everything as it happens and they want everything they do to happen instantly. These are reasonable requests. In active markets, prices may change every second. Traders who do not have the latest information will make poor decisions.

Communications Delays in Globex

Globex is an electronic trading system in which the futures contracts of the Chicago Mercantile Exchange and the MATIF (Marché à Terme International de France) trade after hours. It is located in Chicago. During development, traders who were far from Chicago were concerned that they would have slower access than would traders who are close to Chicago. The system designers therefore designed the system to ensure that all traders would receive equal service quality regardless of where they are in the world.

The issue is particularly important in computerized trading systems that allow their users to submit computer-generated orders. Those computerized traders who can act most quickly on new information take advantage of market opportunities first. When two computerized trading systems employ the same trading strategies, the first to submit its orders will be the more profitable system.

Several vendors sell fully automated trading systems off-the-shelf. These have been particularly popular with emerging markets. These systems typically are pure price-time precedence systems. They cost about five million dollars to purchase and setup.

Most electronic trading systems trade over private data networks. These networks are generally quite secure and they provide high quality of service. They are quite expensive to operate, however, because they usually require dedicated leased lines that traders rarely use to their full capacity. In the future, many electronic trading systems probably will send encrypted data over the Internet. Which traders use Internet connections will depend on the speed that they require and the quality of service that they can obtain from the Internet.

Once set up, electronic trading systems have small operating costs because everything is automated. The main costs are telecommunications costs and the costs of adequately backing up data.

Automated systems report market data to the public much faster and much more accurately than do floor-based trading systems. In floor-based systems, traders and/or market reporters must manually enter quotes and trades into the market information system so to report them to the public. In automated systems, the data are already in electronic form. Automated systems therefore report faster and more accurately.

7.2 Floor-based trading systems

Exchanges that use floor-based trading systems must acquire and/or build suitable trading floors. Trading floors can be quite expensive, especially where real estate is expensive. A floor-based market also must have adequate telecommunications systems to route orders in and market data and trade confirmations out. These systems are comparable to those that electronic trading systems use. Floor-based markets also must invest in various information display systems to assist their floor-based traders. Outside data vendors often provide these systems.

Actively traded floor markets also must employ various automated systems to support their trading. These systems may include electronic limit order books, automatic execution systems, broker paging systems, and electronic reporting systems. The costs of designing and implementing these systems can be quite high. When faced with these costs, some exchanges may choose to switch to electronic trading.

Floor-based trading systems are expensive to operate because they are labor-intensive. Brokers must arrange trades, reporters must report the trades, officials must watch for trading abuses, and runners often must carry messages to and from brokers. Although new electronic floor broker data systems and trade reporting systems are increasing broker productivity in some markets, floor-based trading systems always will be labor-intensive.

Floor-based trading systems are particularly expensive because they require well-trained floor brokers to operate well. The brokers must know and follow the trading rules and procedures. They must also know how to best expose their orders and negotiate their trades. Although floor brokers produce the services that distinguish floor-based trading systems from electronic systems, their substantial training make them quite expensive.

Since floor brokers are often quite busy on the floor, they may not be able to communicate directly with their clients. In which case, their clients give their orders to sales brokers who then

forward them to the floor brokers. The dependence on sales brokers also increases the costs of floor-based trading systems.

In contrast, electronic trading systems do not require well-trained brokers to operate. In many such systems, brokerage clients can access the market themselves without the intermediation of their brokers. In such systems, their brokers merely guarantee and settle their trades. Skilled brokers can provide valuable services to their clients in electronic environments by forming and implementing good order submission strategies. However, they are not necessary to run the system. Electronic trading systems are cheaper to operate because they remove many of the floor brokers and sales brokers.

Some of the costs that are often associated with floor-based trading systems are also incurred in screen-based systems. A simple accounting of the traders present on the floor of an exchange and of the costs necessary to support them there overestimates the costs of trading on a floor relative to trading in a screen-based system. Although screen-based systems may require fewer brokers, they still require some brokers. In addition, most dealers who trade on exchange floors probably otherwise would be employed sitting in front of a screen. These brokers and dealers must be compensated whether they work on the floor of an exchange or on their employer's trading floor. In either event, they also need physical space to do their work and they need good telecommunications systems to link them with their clients.

8. Conclusion and Predictions

Floor-based trading systems and automated trading systems have different strengths and weaknesses. Consequently, they appeal to different clienteles. It is unlikely that one market structure will dominate all trading.

Fully automated systems are very fast and generally cheap to use and operate. These characteristics ensure that active markets and markets that serve small traders will use automated trading systems extensively. In the US equities markets, Knight/Trimark, Bernard L. Madoff Investment Securities and other dealers who offer automated execution systems provide excellent service to high volumes of small traders. Options markets tend to have high order volumes and small transaction sizes. These markets therefore will automate their trading.

Fully automated systems also allow traders to exercise direct control over their orders. They therefore appeal to traders who do not trust their brokers or to traders who do not want to pay for brokerage services. Large institutions that are concerned about how brokers expose their orders often favor automated systems if they are willing to employ their own traders.

Floor systems work best when traders need to exchange information about each other before they trade. They also work best when brokers must actively search for traders to fill their orders. Since these advantages are most important to large traders, floor-based markets will serve primarily large institutional traders. The NYSE increasing is an institutional market. Although people have been predicting the demise of the NYSE floor since the mid sixties, it will not disappear as long as the brokers there provide services that cannot be provided elsewhere.

These services are of first order importance to large traders. The costs of running exchange systems are small compared to the costs of making poor trades.

The communications and computations technologies that have enabled electronic markets to exploit huge economies of scale and thereby reduce operating costs and transactions costs. Consequently, many exchanges will merge to take advantage of the scale economies. Those that do not have scale economies will probably go out of business.

In response to the development of the telegraph and telephone, many mergers among city exchanges occurred between at the end of the 19th century and the mid 20th century. With the introduction of new technologies and with the consolidation of regulatory authorities in Europe, further consolidation is now taking place.

As exchanges consolidate, the most difficult issues that regulators will confront involve electronic linkages between screen-based and floor-based trading systems. The difficulties lie in their different speeds of operation. Screen-based systems are very quick because they typically operate on a reduced set of standardized messages. Floor-based systems are slower because traders must exchange and evaluate more complex messages. Any efforts to force one system to conform to the needs of the other will disadvantage some traders while benefiting others. There can be no best way for all.