The Effects of Technology on the Securities Market

An Honors Thesis (ID 499)

by

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Muncie, Indiana

August, 1989

August 18, 1989
This is the "age of information." As computers become ubiquitous in the business world, the changes that accompany such technological advancement are evident in many industries. In the travel services industry, for instance, computers provide instantaneous availability and pricing information and can link buyers and sellers within seconds. In banking, automated teller machines allow 24-hour access to basic financial services. These applications of technology are not dissimilar to those in the securities industry. Computers have fundamentally altered the way traders, dealers, and brokers conduct business. This paper is an attempt to identify the effects of technological changes on the securities markets.

Technology has changed the securities markets in several ways. The introduction of a computer system that allows trading of over-the-counter stocks (NASDAQ) has created a powerful market, where one was previously virtually non-existent. Other major systems, including ITS and Reuter's, have established their presence in the industry due to the monumental roles that they play in the dissemination of market information. They help to illustrate why the current era has been termed the "age of information." Other applications of technology in the securities markets include computer systems that expedite processing and routing. In addition, the costs of
disseminating real-time information have decreased, which has allowed more traders access to this information.

Increased information dissemination has also allowed the linkage of geographically disparate exchange floors. This application fulfills some of the SEC's objectives in establishing a National Market System. Another major change in the industry is about to emerge as certain exchanges seek to implement automated trading on an after-hours basis. As certain as "change begets change," new regulatory issues will arise as technology continues to alter the structure of the markets. In addition, the struggle between increased automation and resistance to change will continue. The future structure of the securities markets will depend on the outcome of this struggle.

Computerized Systems and Information Dissemination: NASDAQ, ITS, Reuters

One of the most obvious manifestations of increased technology in the securities markets is an automated quotation system that has fundamentally altered the structure of the over-the-counter market. The National Association of Securities Dealers' Automated Quotations (NASDAQ) system facilitates the communication of quotations from dealers to other dealers and the public throughout the United States. Through this system, dealers can compete for orders without the use of an exchange floor. NASDAQ's emergence in 1971 drastically changed the competitive environment of the U.S. and world securities markets. The
information is disseminated on a real-time basis through its state-of-the-art communications technology, one of NASDAQ's competitive strengths. NASDAQ invested upwards of $30 million in its sophisticated central computers, the terminals of financial institutions and market makers, and network controls. Its nationwide communications system operates at 99 percent uptime. (Amihud, Ho, and Schwartz, p. 137)

Another one of NASDAQ's strengths is its multimarket maker system. According to John T. Wall, executive vice president of the NASD, NASDAQ is partially comprised of many companies who stay on NASDAQ because "they would rather have competitive market makers than a single exchange specialist." (Amihud, Ho, and Schwartz, p.132) The result of this combination of unique strengths is that NASDAQ is the second-largest and fastest growing United States stock market. It exceeds by far the dollar volume of the London Stock Exchange; it is the third in size of equity markets only to the New York Stock Exchange and the Tokyo Stock Exchange. Before NASDAQ's emergence in 1971, the over-the-counter market had been somewhat chaotic and, for the most part, unrecognized. The presence of this system has allowed smaller companies easier access to larger amounts of capital through a securities market liquid enough to attract large numbers of investors. (Amihud, Ho, and Schwartz, pp. 131, 138)
The NASDAQ National Market System also disseminates trade information through computers. This system provides qualifying investors, market makers, and companies with up to the minute information on volume, competing market makers, and the last sale. The coupling of technology with competition is also responsible for its huge success. Introduced in 1982, two years later it was the United States' second-largest continuous reporting service. (Amihud, Ho, and Schwartz, p.138)

Another important source of information that has changed the securities markets is the Intermarket Trading System. This system, introduced in 1978, connects the geographically disparate exchange floors of the two national and five regional exchanges. It also provides a source of competition between the exchanges for those securities that are cross-listed. In addition, it has allowed some OTC stocks access to other market centers by its linkage to NASDAQ. (Amihud, Ho, and Schwartz, p. 2)

Although it was not regarded seriously at its inception, ITS has increased the number of shares traded on the system from a few hundred thousand to over a billion. It has become an important market participant; the speed of consummation of trades across long distances illustrates its powerful electronic capability and provides tremendous market liquidity. This market liquidity assures that new
capital will continue to be attracted. (Amihud, Ho, and Schwartz, 114)

Reuters' renowned technological contributions to the information system of the world's foreign currency market have been so significant that the company's name is almost synonymous with the market itself. Approximately a third of the world's foreign-exchange trade is transacted solely through the company's 9500 dealing screens. Perhaps another third is transacted over the telephone after consulting a Reuters screen. The market has been dominated by a duopoly of Reuters and Telerate because it is costly for would-be competitors to develop new systems. Though Reuters denies that it wants to become an exchange for any market, in effect, that is what it has become in dealings of foreign currency. ("From Foreign Desk...," pp. 63-64)

Other Uses of Technology: Processing, Routing, Increasing Access to Information

In addition to its importance in information dissemination, technology has also played a major role in the economization of paperwork and processing costs. In one survey of financial analysts, it was found that the number one use of the computer was the development of financial ratios. (Weber, p. 6) Computers are also easily used to develop and apply complex trading strategies. They can be utilized to quickly solve complicated mathematical models that are used in these strategies. In addition, they can
give the execution signal to buy or sell at the appropriate moment. (Hill and Jones, pp. 37-38)

Technology is also utilized in the handling and the routing of orders. For instance, it is on the NYSE's Designated Order Turnaround system that orders are sent to the specialist to be executed. This use of computers in trading decreases the time lag between the decision to execute and the trade execution.

Technology's role in expediting the transfer of information has led to a decrease in the impediments to trading. There is a broader access to the information at a lower cost. Computerized investing allows traders to keep up with a market that moves quickly. A PC can help a trader to select from thousands of stocks according to specified criteria, and it can track a portfolio daily.

Subscribing to corporate and stock-price databases is the answer for many heavy traders. For $180 a month Lotus' Signal will tie FM radio waves that transmit instantaneous price quotes from trading floors to a PC. The computer then can be programmed to feed the values directly into the Lotus spreadsheet where price relationships can be examined. Telemet America is for investors in the 17 designated cities who, for a lesser price, don't mind a 15-minute delay in price quotes. Up to 328 securities can be selected from the NYSE, NASDAQ, National Market, Amex, and the option exchanges. Prices are updated on the computer screen, and
the computer prompts the investor when there is news on a company.

With the Dow Jones News/Retrieval, one can obtain reports on market performance, growth rates, and financial ratios of selected companies. (Kichen, p. 196) The process can be completed within minutes. Although, in the past, retrieving this on-line information has been a complex ordeal, Dow Jones News/Retrieval has attempted to simplify the process of ordering magazine and newspaper articles, historical and current financials, industry surveys and corporate analyses. The new supercomputers will allow News/Retrieval subscribers to converse with the system in plain English. Alternately, investors may subscribe to services that update information weekly, such as Lotus Development Corp's One Source, which are used in libraries and corporate research departments. (Rothfeder, p. 92)

Another example of the type of information available at one's fingertips is Telescan. Telescan is for those investors interested in technical analysis. For system hardware costs of $80, Telescan produces company price charts. A 15-year chart on a stock would cost about 30 cents during nonprime time and the fulfillment of the order would take about 15 seconds. "Indeed, the day may not be far away when computers are as basic to trading as the telephone is." (Kichen, p. 198) This is beneficial to the securities markets because when broader access to timely
information occurs, "transactional volume increases, and arbitrage takes place between various financial instruments as investors search for an edge." (Amihud, Ho, and Schwartz, pp. 151-152)

Technological Components of the National Market System: CQS and ITS

The technology that links exchanges and disseminates real-time information has played a major role in the progress toward the development of a National Market System. Congress stated in the Securities Act Amendments of 1975 that an NMS was an important national objective. The SEC, who was charged with bringing about this central market system, saw the system as a solution to fragmented markets, disparate pricing, and insufficient market-making capacity. They sought an NMS on the premise that the linkage of all markets in a stock would provide competition among market makers, and it would increase aggregate market-making capital. (Amihud, Ho, and Schwartz, p.258)

Two of the five main components of the National Market System have been fulfilled by the Consolidated Quotation System and the Intermarket Trading System. The Consolidated Quotation System was developed in 1978 by the NASD and the exchanges. It disseminates the bids and offers, and their size, for each security in each market. It also calculates the BBO (best bid and best offer) from all bids and offers that are available. CQS provides the consolidated quotation
reporting system that the SEC stated as a necessary component of the NMS.

The SEC also stated a market linkage system (or systems) was necessary. This objective spurred the development of the previously mentioned ITS. The Intermarket Trading System provides a means for specialists or brokers to take advantage of a bid or offer received through CQS from a participant in any other market during regular trading hours. The number of securities in ITS now includes almost all listed securities that have specialists at different exchanges. These systems, CQS and ITS, were developed in order to link the markets and to provide the fairest competition. The trade-through rule adopted by all ITS participants, mandates that the best bids and offers must be filled before transactions at inferior prices are executed. "Systems have been built that arguably provide most, if not all, of the features envisioned for the SEC's National Market System components." (Amihud, Ho, and Schwartz, pp. 258, 260-261)

After Hours Trading at the CBOT, Merc, and NYSE

The implementation of automated trading on an after-hours basis is finally edging toward reality. The two dominant forces in futures, the Chicago Board of Trade and the Chicago Mercantile Exchange, are developing automated trading systems called Aurora and Globex, respectively.
These systems are intended to counteract the loss of global market share to exchanges in Tokyo, Zurich, and London. International customers would have around-the-clock access to Chicago, and they would boost the exchanges' annual revenues up to $40 million. (Behof, p. 93).

The Chicago Board of Trade's system, Aurora, is very similar to the current system, in that buyers and sellers can interact and make bid and price changes until the trade is complete. Color-coded icons represent buyers' offers and sellers' bids (the time they're made and at what price) on the screen. A mouse is used to move the buyer's icon onto the seller's and a click of the button completes the trade. Aurora is expected to be completed in 1990. (Behof, p. 93)

In contrast, the Chicago Mercantile Exchange's system, Globex, differs in procedure from the current system. There is no buyer-seller interaction; the buy and sell orders are instantly matched anonymously and automatically. Three other exchanges will join Globex when it begins operating later this year: the New York Mercantile Exchange, the Marche à Terme International de France (MATIF), and the Sydney Futures Exchange. (Behof, p. 93). The Merc is also targeting Japan as a major customer for its after-hours futures market. The Merc's executive committee chairman, Leo Melamed, prognosticates that as many as one-third of the exchange's trades will originate from Japanese institutions.
in as soon as three years. (McMurray, p. CI). The Merc and
Reuters finalized their agreement to develop this electronic
trading network for futures in June of 1988, and the system
should be operating before the end of 1989. ("From Foreign
Desk...", p. 64)

The possibility of 24 hour access to the Big Board has,
up to now, been mostly talk. The NYSE has spent hundreds of
millions of dollars on technology that reduces costs,
increases the speed of the order flow, and allows a huge
capacity for the number of trades, but it has not attempted
to change the system drastically with electronic execution.
In the absence of a pressing need to extend trading hours,
the NYSE has had no reason to change. But the exchange can
no longer ignore the growing trend to internationalize
equity portfolios. In March, 1989, Instinet and its parent
company Reuters Holdings, made public their goal of trading
both options and stocks electronically around the clock.
The system to perform this function is being developed with
the Chicago Board of Options Exchange and the Cincinnati
Stock Exchange. ("Stock Around...", p. A14)

At last, the NYSE is considering trading its stocks
electronically during the exchange's off-hours. The Big
Board would be able to retain control of its approximately
2,000 stocks if it had a system that would allow trading
when the floor is closed. On the other hand, such a system
would threaten the autonomy of the many specialists that
make the markets for those stocks. According to Richard Grasso, Big Board president and chief operating officer, it will be anywhere from October of this year to April of 1991 before the model for trading is announced to the public. People who are involved with the NYSE’s deliberations have disclosed that the Big Board is discussing the possibility of using trading systems similar to Aurora and Globex. ("Big Board considers Trading...," pp. C1, C16)

Regulatory Issues

Although there is some opposition to such a radical change in the way the Big Board and other exchanges transact their business, one positive aspect of automation would be in respect to regulation. These systems, like Aurora and Globex, could provide audit trails that would allow regulators to determine if trading abuses have occurred. Some of the abuses that might be deterred or prevented include the altering of trading records and cheating of customers out of the best prices. Customers, in general, favor computerization because of record-keeping and market surveillance advantages. (Behof, p. 94) In fact, the recent federal investigation of trading abuses at the CBOT and the Merc provided new impetus to the computerized trading proposals. Critics have called for a system that decreases the opportunities for fraud. However, it is on
this issue that the Board of Trade has publicly criticized the Merc's Globex. The CBOT claims that Globex would not make prearranged trading work more difficult, but easier. Traders could use the telephone to prearrange and, on an electronic system, there would be virtually no risk of being observed, as there would be in the pits. The Board of Trade didn't elaborate on how its system would avoid these pitfalls. (Shellenbarger, p. C1,) Despite these allegations, the Chicago Commodity Futures Trading Commission approved what is the first major attempt to trade futures world-wide by computer. (Ricks, p. C1)

The automated systems may help in detecting infractions of regulations, but the changes in the securities market due to technology are also likely to effect new regulation. For instance, the increased accessibility of market information has allowed the SEC to decrease the requirements of "hard copy" or paper information. (Weber, p.6) Reuters' move into automated systems could create new regulatory requirements for the company itself. According to Mr. David Ure, Reuters' European managing director, "We are now in a position to provide a whole spectrum of services at one workstation, from anonymous prices, to generally held news and quotes, to filtered news, backing into historical databases" which, in effect, means "we can provide all financial information and services for all clients." (Economist, p. 64) If Reuters becomes an organized exchange
in futures or stocks in London as it already is in foreign currency trading, then it would have to comply with the Financial Services Act and be regulated by Britain's Securities and Investments Board. Currently, Reuters is considered simply a supplier of information. ("From Foreign Desk...," p.64)

As the aforementioned examples of applied technology illustrate, the securities market has been changed dramatically in nature and scope. Although many of technology's effects have been anticipated, some of the results have been unintended. For example, the NASD's Small Order Execution System has been abused in what the NASD claims is a misuse of the real-time information. Harvey Houtkin has built a business on the information and the ability to perform split-second executions on the computerized SOES. "Compared to this, the New York ticker tape is like yesterday's newspaper." (Donlan, p. 13)  Houtkin will SOES any dealer (that is, make an automated trade with someone) by forcing him/her to make good on his/her quotes for its maximum trade of 1,000 shares. However, the NASD says that "heavy automated trade in 1,000-share lots is too much risk for its members to have to take." (Donlan, p. 13) John Wall, executive vice president of the NASD, explains that, "We designed it as a small-customer order system, not as a trading system." Traders are to negotiate over the phone such details as
quantities and price. (Donlan, p. 22) "Professional traders are using a system that wasn't designed for them," says Walls. A market maker can end up with a lot of stock he didn't want, because the SOES executes orders automatically. (Donlan, p. 28)

"The NASD believes that these trading practices are undermining the integrity of the system and contravening SOES' major purpose, that is, the facilitation of small public customer orders." (Donlan, p. 28) On one hand, the issue involves an audacious trader exploiting technology to his advantage. On the other hand, the issue is an illustration of how technology is slowly replacing dealers, specialists, and exchanges with a computerized marketplace.

Problems: Increased Automation vs. Resistance to Change

The degree to which the marketplace should be automated is a source of debate. The use of technology and the breakdown of the systems played a major role in the stock market crash of October, 1987. Computers are a fundamental tool of the trade in a system where, according to the Presidential Task Force on Market Mechanisms, the market segments' failure to act as one has been identified as the crux of problem. ("Computers and the Crash II...," p.8)

The breakdown of the Intermarket Trading System caused the market to become fragmented. Regional exchanges lost their market-making ability, which, in turn, placed more
pressure on the NYSE to handle the orders. ("Computers and the Crash II...", p.10) Traders utilize ITS in order to find a potential buyer or seller in any of the regional markets or the NYSE. However, the specialist must make the decision to accept a commitment displayed on the terminal or to offer a better price and consummate the deal locally. This manual work that currently must be handled by the specialist resulted in inefficiencies that became significant during the period of hectic trading. (Kull, p. 47)

First of all, the specialists sometimes have difficulties monitoring the ITS screen while also working with local bids. During periods of normal trading activity, about 1.3 percent of ITS commitments sent to NYSE expire before they are executed. But on October 19, 14 percent went unexecuted. This was partially due to the fact that many commitments had expired before they even reached the NYSE specialists, which was a result of the computer delays. Some individuals contend that eliminating some of the manual work done by the specialists would allow for a more efficient marketplace. (Kull, p.49)

Critics believe the Big Board should do more to reduce the bottlenecks that the specialists caused, especially since the NYSE has made a commitment to create a capacity for billion-share days by 1990. Not only will this require an upgrading of systems, but also an automation of functions
that are now performed manually. The exchange is, in fact, thinking of implementing a system that would link specialists to the booths that receive the orders from member firms. This would allow a floor trader to obtain information from the specialist without having to run to the specialist's post. However, critics have charged that the NYSE is holding back on automation of this sort in order to prevent the specialists' loss of floor brokerage fees. "Efficient systems can interfere with people making money." The NYSE denies that this is their ulterior motive; the Big Board states that the specialists allow customers to get a better price than other automated-execution systems used by market-maker systems, like NASDAQ. (Hansell, p. 192)

Obviously, an increase in the Big Board's capacity would be useless without an upgrading of back-office systems by the retail firms. They, too, must upgrade their capacity and automate tasks that are now completed manually. In the face of such high trading volume, Wall Street's managers are slowly changing their approach. Heretofore, firms handled changes in trading volume by adjusting the number of employees accordingly. Whereas this is a short-term approach, firms are realizing that capital investments are a more appropriate solution to handling the incredible, yet inevitable, high capacity. (Hansell, p. 193)

Perhaps the gradual change in management style is an indication that other new automated trading procedures will
be accepted and implemented in the future. The weaknesses in the system that were all too evident on October 19 and 20 have given impetus to the development of ideas that could lead to increased market capacity and efficiency. Junius Peake, a financial consultant who has developed an electronic trading system that is used at a number of securities exchanges, proposes that the exchange "substitute computer power for lung power." (Kull, p. 49)

Peake believes that endowing ITS with order but not execution capacity, in effect, makes it little more than "inefficient electronic mail." The specialists' role has limited the system's usefulness; although the markets are indeed linked theoretically, the floor trader is in the position to make a better offer that would take precedence over those on the screen. In other words, those on the outside don't really compete. (Kull, p. 55)

Peake also believes that buyers and sellers are the ultimate providers of liquidity. A fully automated trading system could increase the market's liquidity by quickly and efficiently bringing the two sides together on a strict price-time priority basis. The bids and offers with the best prices would be matched; equal bids and offers would be processed in the order received. Under this system everyone has equal opportunity to conduct trades, and no trader would have privileged information that another did not have. (Kull, pp.55)
Alternately, Haim Mendelson of the University of Rochester has designed an automated trading system that functions differently than Peake's. Yakov Amihud of the New York University School of Business believes a system that combines the continuous auction market with a "clearinghouse" or call market would provide the optimal market setting. In a call market, the computer periodically generates a price that will satisfy the most buy and sell orders; it also allows investors to place orders based on contingent conditions. (i.e. If IBM falls below $X and Lilly rises above $Y, then sell 20,000 shares of Lilly and buy IBM.) The Amihud-Mendelson system, named the Integrated Computerized Trading System (ICTS) would also allow the specialist to retain his position. Traders would have the option of going through the clearinghouse or the specialist. Mendelson believes that this type of system could have been beneficial on Oct. 19 because investors could have placed the contingency orders instead of being afraid to enter the market due to lack of information. (Kull, p. 56)

Information availability has effected many changes. In certain instances, individuals believe their livelihood is being threatened by these changes. Some dealers on the exchanges have even gone so far as to oppose providing customers with research information through a telephone-TV hookup (videotex system), because they are afraid clients would utilize that data to make their own decisions, and
then buy or sell the securities through a discount broker. (Weber, p. 7) The availability of home computers allows almost any investor to analyze current corporate and financial information from the convenience of his home or office. However, the computer is still a tool, and it is the decision based on this data that is important. Many brokers believe that the informed customers are the best customers, and the computer saves time in relaying the quotes and other data. In addition, the abundance and variety of new securities on the market and new legal and regulatory requirements help to keep the broker's advice a necessity for some. Others wouldn't even bother doing the in-depth analysis for making a final decision, as it is too time-consuming. (Weber, p. 8) For these reasons, the initial fear that this new technology would alleviate the need for analysts and brokers has subsided. (Weber, p. 21)

Conclusion

The securities markets are replete with examples of technological advancements. NASDAQ, ITS, Reuters, CQS, and DOT, to name a few, all have important roles in today's markets. They provide information, expedite transactions, and have served to link the many exchanges. In fact, these exchanges realize they are no longer markets unto themselves
but are nodes of a geographically dispersed system. This national competition is likely to hasten the markets' utilization of new technology in order to remain ahead of rival exchanges. In addition, the technology is helping to establish a global marketplace. The Merc, with its automated after hours system, is even targeting Japan as a major customer. The other exchanges seeking to implement after-hours trading also realize the importance of international trading.

Technology is an important part of the exchanges' and firms' preparation for a billion-share day. The systems that buckled under the phenomenal transactional share volume during the crash will be upgraded and re-programmed for increased capacity. It is likely that many jobs now performed manually will be automated to eliminate mistakes and increase efficiency. However, there is likely to be resistance to extensive changes in the system. Individuals' vested interests will, perhaps, slow the implementation of new automation but computerization is not likely to be halted. Change is inevitable in light of the improvements that could be made to the system. As Leo Melamed, Chairman of the Merc's executive committee, stated, "Technology is dictating the future."
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