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**AUTOMATION OF INFORMATION DISSEMINATION  
AND TRADING IN U.S. SECURITIES MARKETS**

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The views expressed herein are those of Chairman Ruder and do not necessarily reflect those of the Commission, other Commissioners, or the staff, except for Alden S. Adkins, Special Counsel, whose name will appear as author on the published version.

Automation of Information Dissemination and Trading  
in the U.S. Securities Markets

by David S. Ruder and Alden S. Adkins \*/

I. Introduction

The topic of this conference -- Technology and Financial Markets -- suggests attention to a wide number of fascinating subjects. Recognizing that technological changes have resulted in enormous increases in the amount of data that can be communicated and processed in very short periods of time, this paper will concentrate on one aspect of technology in our financial markets -- the development of automated securities information dissemination and trading systems in the United States securities markets. 1/

Automated information dissemination and trading systems have developed during the last three decades at an accelerated pace. In 1963, the Securities and Exchange Commission's Special Study of the Securities Markets noted the possibility

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1/ An appendix is attached describing the principal information dissemination and order execution and routing systems in use in U.S. markets today, as well as some notable systems in use in futures markets and in foreign markets.

that trading in the over-the-counter markets could benefit from automation and that exchange markets could be improved by introduction of automated systems. 2/ In 1975, Congress directed the Commission to "facilitate the establishment of a national market system for securities". 3/ It found that:

New data processing and communications techniques create the opportunity for more efficient and effective market operations; 4/ and

The linking of all markets for qualified securities through communication and data processing facilities will foster efficiency, enhance competition, increase the information available to brokers, dealers and investors, facilitate the offsetting of investors' orders, and contribute to the best execution of such orders.5/

Developments since 1975 have resulted in automated systems in the United States securities markets for:

1. Dissemination of current quotation and last price information;
2. Routing of orders to selected markets;
3. Execution of securities transactions;
4. Market surveillance; and
5. Clearance, settlement, and payment.

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2/ See Special Study of Securities Markets, Report of the Special Study of the Securities and Exchange Commission (1963), Reprinted in H.R. Doc. No. 95, 88th Cong., 1st Sess. (1963), Pt. 2 at 358 and 678.

3/ See Section 11A(a)(2) of the Securities Exchange Act of 1934 (Act).

4/ Section 11A(a)(1)(B) of the Act.

5/ Section 11A(a)(1)(D) of the Act.

Not only do such automated securities systems exist, but they are connected to and affected by other important markets in the United States and abroad. For instance, development of a futures market for trading derivative index products has made the connection between futures and stock markets both obvious and important. 6/ Likewise, market linkages between United States securities markets and similar markets in Canada, Europe, and Asia emphasize the coming development of truly global trading systems.

The topic permits a useful analysis of the way in which the SEC regulates automation. The Commission must review automation developments to see that investor protection exists and that the structural soundness of our markets is maintained. It also must exercise its regulatory authority in ways that will accommodate growing innovation in automated securities markets.

## II. Automation in the United States Securities Markets

### A. Automated Information Dissemination

Prior to the late 1960's, the principal information concerning securities trading available on a "real-time" basis 7/ was the trade information disseminated through the stock

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6/ See "The October 1987 Market Break," A Report by the Division of Market Regulation, U.S. Securities and Exchange Commission (February 1988) ("SEC Staff Report"), Chapter Three.

7/ "Real-time" information is information about a trading event available immediately or soon after the event, rather than at the end of the trading day or later.

tickers of the American (Amex) and New York (NYSE) Stock Exchanges. Real-time price information 8/ was not available from regional exchanges or the over-the-counter market, and real-time quotation 9/ information was not available from either the exchanges or from the over-the-counter market.

In 1968, acting in part in response to the recommendations of the Commission's 1963 Special Study, the National Association of Securities Dealers, Inc. (NASD) began to develop an automated quotation dissemination system. 10/ This system, implemented in 1971 as the NASDAQ (National Association of Securities Dealers Automated Quotation) System, provides for the real-time electronic entry and dissemination through video display screens of market maker quotations in over-the-counter securities. With Commission prodding, the system has evolved to include real-time price information for the larger, more active OTC stocks. 11/ The NASD also is currently considering providing for real-time quotation information for smaller "pink

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8/ "Price" information or a "trade report" consists of an indication of the actual price at which a trade is executed, without adjusting for commissions or mark-ups and mark-downs.

9/ A "quotation" consists of an indication of the price at which a dealer is willing to buy (bid) or sell (offer).

10/ See M. Simon and R.L.D. Colby, "The National Market System for Over-The-Counter Stocks," 55 Geo. Wash. L. Rev. 17, 34-38 (1986).

11/ See Securities and Exchange Act Release Nos. 17549 (February 17, 1981) (adopting Rule 11Aa2-1 under the Act).

sheet" stocks. 12/ NASDAQ is now linked internationally with the Stock Exchange Automated Quotation (SEAO) system of the International Stock Exchange (ISE) and with Singapore's automated quotation system. 13/

Concurrent with development of the NASDAQ system, the nation's securities exchanges began to install automated systems for display of price and quotation information, the Consolidated Transaction Reporting and Quotation Systems. 14/ Today current prices and quotations from the floors of all United States securities exchanges are displayed electronically both on exchange floors and on video display screens available to brokers and other users. As will be noted later, despite the availability of automated display systems, trading techniques on most exchanges continue to utilize the traditional personal auction trading method, in combination with automated trading for smaller orders. 15/

The Consolidated Transaction Reporting System, which became operational in 1974 and is governed by an intermarket agreement promulgated under Commission rules, 16/ consolidates

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12/ See Securities Exchange Act Release No2. 25949 and 26545 (August 2, 1988 and February 14, 1989).

13/ See Appendix, at II.I.

14/ See Appendix, at I.B.

15/ See, infra, Section II.E.

16/ See Restatement and Amendment of Plan Submitted to the Securities and Exchange Commission pursuant to Rule 17a-15 (continued...)

real-time trade reports from all markets, including the regional exchanges and the OTC market. The reports cover all securities listed on the NYSE and the Amex and certain securities listed on regional stock exchanges. Reports from each market are collected immediately after execution, transmitted electronically to a central processor, and promptly disseminated. Reports from the various trading markets regarding each security are disseminated in the sequence received. This system improved upon the stock tickers of the NYSE and the Amex not only by consolidating trade reports but also by providing for a "high speed line" 17/ that disseminates real-time information without delays even during periods of very high volume.

In 1978, again under an intermarket agreement and Commission rules, 18/ the Consolidated Quotation System became operational. This system consolidates quotations from among all markets trading NYSE and Amex securities and certain regional listings, identifies the best bid and offer in each

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16/ (...continued)

under the Securities and Exchange Act of 1934 (available on file at the Commission); and Rule 11Aa3-1 and 11Aa3-2 under the Act.

17/ See Appendix, at I.B.

18/ See Plan submitted to the Securities and Exchange Commission for the purpose of implementing Rule 11Ac1-1 under the Securities and Exchange Act of 1934 (available on file at the Commission); and Rules 11Aa3-2 and 11Ac1-1 under the Act.

security from among all these markets, and disseminates that information.

While options price and quotation information dissemination is not subject to the Commission's consolidated trade and quotation rules, the Commission has insisted upon real-time options price and quotation reporting. As a result, in 1975 an options quotation and trade reporting system was established by the options exchanges under an intermarket agreement promulgated under Commission rules. 19/ The system is governed by a group consisting of exchange representatives called the Options Price Reporting Authority (OPRA).

Today, thanks to NASDAQ, the Consolidated Transaction Reporting and Quotation Systems, and OPRA, our equity and options markets provide excellent real-time information and are regarded as being as "transparent" as any in the world. 20/

B. Automated Order Routing

In addition to providing information to the public, the information dissemination systems have provided the base necessary for the efficient operation of automated order routing systems. Until the late 1960's, order routing was accomplished by telephone and pneumatic tube, and execution was

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19/ See Plan for Reporting of Consolidated Options Reports and Quotation Information (available on file at the Commission); and Rule 11Aa3-2 under the Act. See Appendix, at I.C.

20/ "Transparency" is the degree to which current market information is publicly available.



effected by voice -- either over the telephone, as in the over-the-counter market, or in person, as on an exchange. 21/

Beginning in 1969 with the creation of the Pacific Stock Exchange's automated order routing and execution system, U.S. markets have developed a variety of systems for the automated, electronic routing of orders directly from off the floor to a location on the floor where execution can take place, or, in the case of OTC markets, order routing from brokers directly to dealers or to a centralized execution facility.

In addition to the internal order routing systems of the various markets, the Intermarket Trading System (ITS) facilitates the routing of orders between markets. By providing each market with the capability of routing orders to other markets, this system allows orders to be routed to the market having the best quotes. 22/ ITS also enhances the ability of regional exchange specialists to compete with the primary markets by providing them with an efficient method for transmitting excess positions to other exchanges.

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21/ While the technology developments described in this paper are truly revolutionary, the telephone and the telegraph were equally dramatic changes in their own times. Thus, a paper published in 1922 could say in reference to international arbitrage: "Few features of Wall Street life so irresistibly appeal to the imagination as this extraordinary business, conducted in the various world markets over the flashing cables with a speed vastly more rapid than the roll of the earth." "The Stock Exchange as an International Market," quoted by James M. Davin in his chapter, From National to International, in the NASDAQ Handbook (NASDAQ, 1987).

22/ See Appendix, at II.C.

Limited international order routing arrangements also exist between U.S. and foreign markets, but the systems have not prospered. The Toronto Stock Exchange has terminated its link with the Midwest Stock Exchange (MSE) and Amex. An order routing link between the Boston Stock Exchange and the Montreal Stock Exchange also exists, but the volume of trading is small. 23/

Order routing systems have brought efficiencies to our markets primarily because they permit speedy transmission of orders. The most significant of the exchange systems is the NYSE's system for automated routing through its Designated Order Turnaround (DOT) System. 24/ In the 1970's the NYSE developed DOT for the purpose of routing small orders electronically from brokers off the exchange to the specialist. 25/ To accommodate program trading, 26/ the NYSE in 1982 adapted the DOT system to allow for the instantaneous routing of orders to the floor in a large number of different securities. 27/

Execution difficulties for both small and large orders have sometimes resulted when specialists have been confronted

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23/ See Appendix, at II.I.

24/ See Appendix, at II.A.2.a.

25/ Id.

26/ The term "program trading" as used here means trading in portfolios of securities rather than in a particular security. See Sec Staff Report, supra note 6, Chapter Three.

27/ Id., at 7-19 - 7-20.

with waves of program orders, as occurred on October 19 and 20, 1987. 28/ In response to these concerns the NYSE has instituted procedures to provide for the preferential routing of small customer orders if the Dow Jones Industrial Average (DJIA) moves 25 points. 29/ In addition, the NYSE has implemented an application of DOT that provides for the withholding of program trade orders in an electronic "sidecar" for five minutes if the DJIA moves approximately 75 points. 30/

C. Automated Order Execution

Starting with the Pacific Stock Exchange's Comex System, which was developed in 1969, regional exchanges have begun to compete with the primary markets by developing small order execution systems that provide automated routing and computerized execution of small customer orders, generally at the best intermarket quote for a security. 31/ When a broker off the floor of an exchange sends small customer orders (e.g. 1,099 shares) to the specialist on the floor of the regional exchange, the specialist is usually given an opportunity to

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28/ Id., Chapter Three.

29/ See Appendix, at II.A.2.b.

30/ Id. At the same time as the NYSE instituted these new DOT applications, the NYSE also adopted coordinated intermarket "circuit breaker" procedures that call for the NYSE and other securities and futures markets to halt trading for one hour if the DJIA falls 250 points. See Securities Exchange Act Release No. 26198 (October 19, 1988).

31/ See Appendix, at II.A.1.

improve upon the best intermarket quotation. 32/ If the specialist chooses not to improve upon the best intermarket quotation, the system automatically executes the order at the best ITS quotation, generates trade comparison reports, and transmits last price reports to the consolidated tape system.

In the over-the-counter market, volume surges in 1982 drove the NASD to add to its NASDAQ system a Small Order Execution System (SOES). SOES was put into operation in 1985, and has recently been supplemented with a limit order execution capacity. 33/ Surges in index options volume and competition in multiple listings of options have spurred similar innovations in the options markets. 34/ As a result of these developments, small order execution on equity and options markets is now largely automated.

The Cincinnati Stock Exchange (CSE) and the NASD have extended automation to orders of all sizes. The CSE system, called the National Security Trading System (NSTS) was initiated in 1978, is linked with other markets in ITS, and is the only fully automated U.S. exchange. 35/ The NASD recently has implemented its Order Confirmation Transaction System (OCT)

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32/ The Philadelphia Stock Exchange's PACE System for stocks and the options automatic execution systems do not provide this opportunity. Id.

33/ See Appendix, at II.B.1. and 2.

34/ Id., at II.D.

35/ Id., at II.A.3.

which provides the opportunity for computerized automated negotiation. Following the computerized exchange of information a broker-dealer can now execute a trade with a market maker through a keyboard stroke. 36/ Significantly, however, the volume on the CSE remains low, and NASD's keyboard execution still requires the market maker to agree to the size of the transaction. 37/

D. Other Developments

In addition to these automated information, routing, and execution systems, other notable automation developments have occurred. First, there has been the increasing development of so-called "proprietary trading systems," which are information dissemination and trading systems developed by private entities that are not registered as self-regulatory organizations. The first major operational proprietary trading system was Instinet which came into existence in the late 1960's. 38/ Instinet was a response to the institutionalization of markets and increasing institutional demand for means of trading directly, without the intervention of a broker-dealer. Instinet has now evolved to the point where it provides automated trading capabilities as well as information

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36/ Id., at II.B.3.

37/ See discussion of size concerns infra, II.E.

38/ Autex, a system for disseminating indications of trading interest in block transactions, also was developed at this time.

dissemination. 39/ In addition, Instinet has a Crossing Network that provides for the automated entry of orders for baskets of stocks and for the automated matching and execution of such orders against orders entered into the system on the other side of the market, to the extent they exist. Jefferies and Company has developed a similar system, called POSIT. 40/

Another example of a proprietary trading system is the Delta Options system, which recently received a no-action letter from the Commission allowing it to operate without registering as an exchange. 41/ The Delta Options system involves the electronic collection and dissemination of quotations, and the clearance and settlement of trades. Delta Options is in large part a blind brokering system, which allows users of the system to input quotes on an anonymous basis through an intermediary or so-called blind broker, to see the quotes of other users of the system, and to execute against those quotes through the blind broker. The system also allows

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39/ See Appendix, at II.F.

40/ Id.

41/ See letter from Richard G. Ketchum, Director, Division of Market Regulation, Securities and Exchange Commission, to Robert A. McTameney, Esq., Carter, Ledyard & Milburn, dated January 12, 1989.

The Division's no-action letter has been challenged in District Court. See Board of Trade of the City of Chicago and Chicago Mercantile Exchange v. SEC, No. 89-0332 (D.D.C. Feb. 7, 1989).

direct negotiation of trades by system users. The system does not involve automated or computer-generated executions. 42/

In addition, the Amex and the NASD are developing automated systems to accommodate active secondary trading among institutions in securities that are not registered with the SEC. 43/ These systems, which would not initially provide for automated routing or execution, respond to increasing institutional demands for active trading markets for privately placed securities. The Commission has proposed a rule that would formalize the legal treatment of such trading. 44/

Finally, other developments are occurring both internationally and in other United States markets that may have competitive effects on U.S. securities markets. Most recently, the Chicago Mercantile Exchange received approval for an after hours automated futures trading system. 45/ The Chicago Board of Trade has indicated it is likely to follow suit, and, as a result, it appears that futures markets in the U.S. will consist of a combination of open outcry, physically centralized markets during normal hours, coupled with after-hours computerized trading.

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42/ Id.

43/ Id., at II.E.

44/ See Proposed Rule 144A, Securities Act Release No. 6806 (November 11, 1988).

45/ See Appendix, at II.G.

Internationally, automation has also taken hold. The 1986 Big Bang conversion of the U.K. markets to screen trading is the most visible symbol of these developments. 46/ The ISE has just introduced an automated small order execution system. 47/ Automation is also an increasingly significant aspect of other foreign markets, most notably the Toronto Stock Exchange, the Tokyo Stock Exchange, and foreign derivative markets. 48/

E. Summary and Comment

Automated information dissemination systems, order routing systems, and small order execution systems are firmly established in our securities markets. These developments have improved the informational efficiency of our markets, increased the speed with which customer orders are executed, and expanded market capacity. While the October 1987 market break exposed weaknesses in the capacities of these systems, the various automated systems have been enhanced, and more enhancements, particularly in the program trading area, are in prospect. 49/

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46/ Id., at II.H.

47/ Id.

48/ Id.

49/ For a description of the capacity problems encountered by the markets during the October market break, see SEC Staff Report supra note 6, Chapters 7-9. For a discussion of the ways in which the markets have improved their capacities, see October 19, 1988 Memorandum from Richard G. Ketchum, Director, Division of Market Regulation, to Chairman David S. Ruder, on file at the Securities and Exchange Commission.



While there is evidence of some movement toward fully automated systems, particularly abroad and particularly in derivative markets abroad, 50/ it seems unlikely that either U.S. or world markets will move toward a totally automated trading system. Despite automation developments, trading on the NYSE, with its physically centralized auction market, has proven to be very durable, and even in Japan, with its highly automated Second Section, 51/ most of the Tokyo Stock Exchange's total volume is in the stocks that are still traded in the more traditional First Section, located on the exchange floor. 52/ The reasons for the durability of face to face and telephonic trading are not obscure. Simply put, the primary explanation is that traders are not willing to guarantee firm prices for orders of large size. The size problem is exacerbated by the fact that automated execution allows professionals to react quickly to news regarding a stock or the market and to "pick off" a dealer before it can revise its quotations. Fully automated trading systems are not likely to attract substantial order flow in active trading markets, unless the size problem and its automated aspects can be solved.

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50/ See Appendix, at II.H.

51/ Id.

52/ In 1988, approximately 98% of the share volume on the Tokyo Stock Exchange occurred on the First Section.

If there is a trend, it would seem to be in the direction of the combination of automation with more traditional systems, as exemplified by the integration of DOT into the NYSE's auction processes, and the integration of SOES and OCT with telephone negotiation in the NASDAQ market. Perhaps the most interesting question for the future of U.S. securities markets is not whether our markets will be fully automated, but whether the exchanges and the NASD will institute after-hours trading systems in response to increasing demand for global, 24 hour trading systems for world class debt and equity securities. While it is likely that automated information dissemination and order systems will continue to evolve to meet this demand, the same size problem that exists in the U.S. markets makes it likely that global systems will not include substantial automated execution components.

### III. The SEC's Regulation of Automation

#### A. Regulatory Framework

##### 1. Process

In the United States, the Securities and Exchange Commission has played and continues to play a vital role in facilitating market automation. As a matter of process, suggested changes by securities exchanges or the NASD (generally referred to as self-regulatory organizations -- "SRO's") to their internal automated systems are submitted to the Commission, which publishes the proposals for comment, and reviews and approves, or disapproves, the proposals pursuant to

its authority under Section 19(b) of the Act. Links between a U.S. SRO and a foreign exchange are processed in the same way, since these links involve a U.S. SRO's operation. Intermarket systems, such as ITS, generally are governed by intermarket plans established pursuant to Commission Rules 11Aa3-1 and 3-2. The process for changes for these systems is similar to that for SRO's, involving notice and comment, Commission review, and Commission approval or disapproval. The Commission also has the authority to amend SRO rules and intermarket plans. 53/

The Commission consistently has been responsive to desires for procedural speed and flexibility in introducing automation. 54/ The principal procedural issue has been the opportunity the Section 19(b) process affords to the competing exchange and NASDAQ markets to copy proposed automation changes of their competitors. Thus far the Commission has not deferred approval of an automation proposal by these competitors for the purpose of giving the originator lead-time in introducing an innovation. 55/ Its policy is that innovation will be stifled, not enhanced, by such delay.

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53/ See Section 19(c)(3) of the Act and Rule 11Aa3-2(c) under the Act.

54/ See letter from Richard T. Chase, Assistant Director, Division of Market Regulation, Securities and Exchange Commission, to the SRO's, dated February 4, 1983.

55/ See, e.g., Id.

## 2. Substantive Standards

Section 19 of the Act requires the Commission to approve rule change proposals that are consistent with the requirements of the Act, and it draws primarily upon Section 6 (National Securities Exchanges), Section 15A (Registered Securities Association) and Section 11A (National Market System) for these requirements.

Sections 6 and 15A require that an SRO be able to enforce its members compliance with its rules and with the federal securities laws and rules, provide fair representation to members, protect investors, impose no unnecessary burdens on competition, and "perfect the mechanism of a free and open market and a national market system." 56/

In Section 11A, Congress found that new data processing and communications techniques can make markets more efficient, established as affirmative goals "fair competition" among and within markets and the availability of quotation and transaction information, and mandated the Commission to facilitate the establishment of a national market system. While Congress evidenced a desire that the national market system for securities involve the "linking of markets through data communication and processing facilities," Section 11A does not dictate the specific contours of the national market system. Instead, Section 11A gives to the Commission the

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56/ Sections 6(b)(5) and 15A(b)(6) of the Act.

general task of facilitating the establishment of a national market system for securities, in a general way, without setting the desired characteristics of that system in detail.

Taken together, several principles emerge. Importantly, the Commission should not be extreme in its attitudes towards technology advances. It cannot be entirely passive towards technology changes, because the federal securities laws require the Commission to protect investors and to foster fair, orderly, and competitive markets. At the same time the task of facilitating a national market system with "new data processing and communication techniques" suggests that it should support technological innovation. Use of the word "facilitate" also suggests that the Commission should avoid attempting actively to design and impose technology on markets. Thus, while centralization through information dissemination and intermarket order routing seems a clear minimum ingredient of a national market system, imposing specific technologies and trading systems on the markets seems to be inconsistent with the contemplation of Section 11A that the national market system should encompass diverse systems and enhance competition.

What is called for is a pragmatic approach in which the Commission fosters, encourages, and cooperates with the securities industry in developing new technological developments that improve the market's efficiency, while taking

steps to see that these developments do not threaten the structural soundness, competitiveness, or fairness of markets.

B. Application of Standards

1. Assuring Soundness

Section 11A's admonition that "the securities markets are an important national asset which must be preserved and strengthened" identifies the Commission's obligation to see that technological change introduced into the market is functionally sound and workable. Thus, in reviewing automation proposals, the SEC seeks to ensure that introduction of new systems and products will not overwhelm the capacity of our markets. The breakdown of some of the order routing and execution systems during the October 1987 market break illustrates the desirability of continued Commission attention to systems capacity matters. 57/

Similarly, in reviewing proposals for links with foreign markets, the Commission has focused on regulatory soundness by requiring that surveillance sharing agreements with foreign markets accompany such links. Similarly, the Commission has worked out Memoranda of Understanding with the regulatory

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57/ For the capacity recommendations of the Commission after the market break, see SEC Staff Report, supra, note 6 and "Recommendations of the Securities and Exchange Commission in Response to the October 19, 1987 Market Break", contained in February 3, 1988, testimony of Chairman David S. Ruder before the Senate Banking, Housing and Urban Affairs Committee ("SEC Market Break Recommendations").

authorities for the foreign nations where the linked markets are located. 58/

In addition to capacity and surveillance questions, the Commission encounters public protection issues in its review of automation proposals. The Commission has considered issues in automated systems regarding: the lack of protection of public limit orders; 59/ the ability of public customer limit orders to be executed against each other; 60/ the failure of Phlx's automated system to provide the specialist an opportunity to improve upon the current ITS best bid; 61/ the effect on overall price efficiency of having small orders executed at the quotes; 62/ and the effect on competition of allowing regional exchanges to provide executions based upon primary market quotes. 63/

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58/ For a description of these agreements, see B. Becker, "Global Securities Markets," 6 International Tax & Business Lawyer, 242 (1988).

59/ See Securities Exchange Act Release No. 21695 (January 28, 1985) (order approving CBOE's automated execution system pilot).

60/ See Appendix at II.B.2., and Securities Exchange Act Release No. 26476 (January 19, 1989) (order approving NASD limit order system pilot).

61/ See Appendix at II.A.1., and Securities Exchange Act Release No. 19859 (June 9, 1983).

62/ Id.

63/ Id.

2. Accommodating and Promoting Change

Consistent with the statutory goals, the Commission has been flexible and responsive in reviewing automated system enhancements proposed by the markets, while at the same time indicating its willingness to use its power to force implementation of desirable changes. In general, the introduction of automated trading systems by SRO's, while subject to the review and approval of the Commission under the same standards as any other changes by the self-regulatory organizations, has been accomplished in an accommodating manner. When substantive issues have emerged, the Commission has worked with the SRO's to address these issues in a manner to avoid interference with the rapid introduction of change.

For instance, in 1988, in reaction to concerns with increased volatility attributed by some to index arbitrage, the NYSE sought Commission approval for a pilot rule that would prohibit the use of its automated order routing system for index arbitrage if the DJIA moved 50 points in a day. The Commission expressed serious concerns about the effectiveness of this pilot, 64/ as well as the intermarket effects on pricing efficiency of seeking to inhibit arbitrage in this way. Nonetheless, the Commission accommodated the NYSE's judgment that it was appropriate to seek to reduce volatility by

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64/ Index arbitrage is possible without automated order routing, and indeed during the NYSE's pilot considerable arbitrage occurred even at times after the NYSE invoked its rule.



limiting automated index arbitrage order routing temporarily, concluding that such an SRO judgment is permitted by the Act. 65/ With the encouragement of the Commission, the NYSE replaced this approach with preferential order routing for small orders, "sidecar" procedures for program trades, and coordinated circuit breaker rules. 66/

Recently the Commission manifested a flexible approach to technological change when it discussed at a public meeting a proposal that it adopt a Rule (15c2-10) dealing with proprietary trading systems. Under the Commission's tentative proposals, these systems would be required to submit rules and procedures for Commission review, as exchanges do, and, like exchanges, would be subject to Commission oversight over any limitation on access to their services that might be anti-competitive. The rule review process, however, would be streamlined, and these systems would not have the same governance structures that the Act requires of exchanges. 67/

The Commission also has an important role to play in promoting technological change. A recent example of the

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65/ See Securities Exchange Act Release No. 25599 (April 19, 1988). Another recent example of the Commission accommodating an SRO's reduction of the availability of an automation system is the Commission's approval of the NASD's proposal to prohibit professional traders from using SOES. See Securities Exchange Act Release No. 26361 (December 15, 1988).

66/ See supra, text accompanying notes 28 - 30.

67/ The Commission will soon publish this rule proposal for public comment.

Commission's willingness to suggest such change can be seen in its recommendations in response to the market break. 68/ The Commission recommended, among other things, the creation of basket trading products and procedures and the automated dissemination of real-time program trade information.

The Commission's recommendation that the NYSE create systems or products for trading baskets is designed to promote a more liquid market for portfolio trades and to relieve specialists in individual stocks of the large liquidity demands created by occasional waves of portfolio related orders. 69/ Automated technologies undoubtedly will be a part of these procedures, particularly in light of the need to facilitate the participation of upstairs firms in the NYSE's basket trading market. Upstairs firms' capital will be as important to the liquidity of these markets as it is to the block trading market. Automation technologies will be needed in order to obtain the maximum degree of involvement in the NYSE's basket markets by the upstairs firms.

The Commission has also recommended that real-time information about the amount of portfolio trading be publicly available in order to alert market participants to price movements caused by decisions to adjust entire portfolios rather than by information strategies relevant to a particular

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68/ See SEC Market Break Recommendations, supra note 49.

69/ Id. at 12.

security. 70/ The dissemination of this information can occur through the Consolidated Trade System.

Another application of existing automation technologies that could bring more useful information to the market would be the electronic dissemination of information regarding the price and size of limit orders contained in the NYSE's specialist book. The specialists' limit order books are the aggregation of limit orders -- orders to buy or sell at specific prices -- left with the specialist for execution at various prices away from the current market. The availability of automated information dissemination technologies and systems makes the dissemination of information on the specialist book technically feasible today. In particular, the automated dissemination systems exist and most of the limit order books on the NYSE are now kept in electronic format. Thus, as a technical matter it would be relatively easy to disseminate information regarding the contents of the book. The dissemination of such information at and prior to the opening would be particularly helpful. Such dissemination could induce market participants to send in orders to absorb imbalances that often exist at the opening. Thus, the pre-opening publication of limit order imbalances could be a supplement to the pre-opening and reopening market order imbalance dissemination procedures in use on the NYSE today. 71/

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70/ Id.

71/ See Appendix, at II.A.2.b.

While market forces might eventually lead the exchanges in these directions, the Commission's leadership in this area can be a very constructive force. Using a combination of public statements and its rulemaking power, the Commission played an important role in the 1970's in requiring consolidated trade and quotation reporting, 72/ and in the 1980's in prohibiting the dissemination of representative best bid and ask quotations 73/ and mandating last sale reporting to the over-the-counter market. 74/ Although at the time the Commission's suggestions were perceived by some broker-dealer commentators as intrusive and unnecessarily burdensome government regulation, ultimately these innovations have proved to be a tremendous benefit to the markets.

These examples of the Commission's positive approach to technological change not only demonstrate its special interest in the dissemination of information, but also suggest that ultimately the Commission can be expected to use its rulemaking power to accomplish desirable change. 75/ While the Commission

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72/ See supra, notes 16 and 18.

73/ See Rule 11Aa1-2(c)(2)(vi).

74/ See supra note 11. In addition, the SEC encouraged the creation of NASDAQ, see supra note 2.

75/ Another example is the Commission's recent endorsement of automated consolidated trade and quotation information as a goal of international markets. See "Regulation of International Securities Markets." Policy Statement of the United States Securities and Exchange Commission, November, 1988.

has an interest in the trading systems used by the markets, in the past Commission efforts to promote new trading systems have not always proved very successful. 76/ One important question for the future will be the role to be played by the Commission in developing automated trading systems.

As a practical matter there are, of course, ultimate limits on the technological changes the SEC can or should force upon markets. Indeed, the real genius of the federal securities laws and particularly Section 11A, as implemented by the Commission, resides not in the authority it provides to force change, but in the flexibility that it permits and promotes. This attitude of flexibility reflects the fact that the real strength of our securities markets comes from the peaceful, albeit competitive, coexistence of diverse systems. Thus, under 11A and other sections of the Act, all of the various automated systems and trading approaches described above are tolerated and indeed encouraged, from exchange auction principles, to over-the-counter dealer systems, to automated small order systems, to automated confirmation systems, and even to black box systems where particular markets

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76/ For example, in 1976 the SEC requested comment on the possible characteristics of a composite limit order book ("CLOB"). See Securities Exchange Act Release No. 12159 (March 10, 1976). In 1978 urged the markets to submit a plan to create such a system. See Securities Exchange Act Release No. 14416 (January 1978). Due to resistance from the markets, the Commission eventually abandoned this initiative. See J. Seligman, "The Transformation of Wall Street," (Houghton, Mifflin, 1982), at 527-530.

and participants are comfortable with such systems. While there may be circumstances that justify the Commission's use of its authority under Section 11A to require certain systems, such circumstances will be the extraordinary exception, not the rule.

IV. Conclusion

Markets in the U.S. and abroad over the last 20 years have rapidly become increasingly automated and this trend is likely to quicken and increase rather than diminish. This has been a largely positive development, with customer executions and overall market capacity greatly enhanced. The SEC's chief role will continue to be assuring the soundness and fairness of technological systems and encouraging and facilitating the markets in moving forward.

APPENDIX TO  
AUTOMATION OF INFORMATION DISSEMINATION  
AND TRADING IN U.S. SECURITIES MARKETS

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**TABLE OF CONTENTS**

I.	<u>Information Dissemination Systems</u> .....	1
A.	<u>NASD</u> .....	1
B.	<u>Consolidated Transaction Reporting and Quotation Systems</u> .....	3
C.	<u>OPRA</u> .....	5
II.	<u>Order Routing and Execution</u> .....	6
A.	<u>Exchanges</u> .....	6
1.	<u>Regional Exchanges</u> .....	6
2.	<u>AMEX and NYSE</u> .....	9
(a)	<u>DOT and PER</u> .....	9
(b)	<u>Program Trading/LIST Application of DOT</u> .....	12
3.	<u>The National Securities Trading System</u> .....	13
B.	<u>NASD</u> .....	14
1.	<u>SOES</u> .....	14
2.	<u>Limit Order File</u> .....	17
3.	<u>Order Confirmation Transactions</u> .....	18
C.	<u>ITS</u> .....	19
D.	<u>Options</u> .....	20
E.	<u>PORTAL and SITUS</u> .....	22
F.	<u>Proprietary Trading Systems</u> .....	23
G.	<u>Futures Markets</u> .....	25
H.	<u>Foreign Markets</u> .....	26
I.	<u>International Links</u> .....	32



## APPENDIX

### I. Information Dissemination Systems 1/

#### A. NASD

The National Association of Securities Dealers, Inc. ("NASD") implemented its automated quotation dissemination system called NASDAQ in 1971 in response to recommendations of the SEC's 1963 Special Study. 2/ While NASDAQ has changed over the years since its introduction, 3/ the system currently consists of three basic services. 4/ Level I, which is disseminated through independent vendors to registered representatives and the general public, provides the best bid and ask quotation for each security quoted in the system. Level II provides a complete display of all market maker quotations. Level III provides for dissemination of the same quotation information as Level II as well as the ability to enter and update quotations.

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- 1/ A comprehensive overview of U.S. and Canadian securities information dissemination systems is contained in "The Creation and Distribution of Securities-Related Information in North America," Information Industry Association (1988).
- 2/ See Special Study of Securities Markets, Report of the Special Study of the Securities and Exchange Commission (1963), reprinted in H.R. Doc. No. 95, 88th Cong., 1st Sess. (1963), Pt. 2, at 678.
- 3/ For a good history of NASDAQ, see M. Simon and R.L.D. Colby, "The National Market System for Over-The-Counter Stocks," 55 Geo. Wash. L. Rev., 17 (1986).
- 4/ For a complete description of NASDAQ, see The NASDAQ Handbook (NASDAQ 1987).

NASDAQ, Inc., a subsidiary of the NASD, maintains the facilities that collect the quotations, which are electronically entered by brokers from computer terminals in their offices and then disseminated by NASDAQ to vendors and to the market makers and other subscribers for display on their video screens. In addition to establishing rules regarding quotation practices, NASDAQ prescribes the types of companies whose stocks can be quoted on NASDAQ. Thus, NASDAQ has a set of rules setting forth various financial, volume, and price criteria that determine which securities can be quoted on NASDAQ. 5/ The NASD has proposed to allow the real-time electronic dissemination through its system of information concerning NASDAQ securities that do not meet NASDAQ listing standards. 6/

The largest and most actively traded NASDAQ companies are designated as "NASDAQ/National Market System securities." 7/ For these securities, the NASD also provides for the dissemination of real-time last sale reports. 8/ These reports

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5/ See Schedule D of NASD's By-laws, CCH ¶ 1754.

6/ See Securities Exchange Act Release Nos. 25949 and 26545 (August 2, 1988 and February 14, 1989). The NASD currently requires end-of-day volume and price reports for non-NASDAQ securities. See Securities Exchange Act Release No. 25637 (May 2, 1988).

7/ See Rule 11Aa2-1 and Schedule D of NASD By-laws, ¶ 1754.

8/ The Securities and Exchange Commission by rule requires such trade reporting. See Securities Exchange Act Release No. 17549 (February 17, 1981) (adopting Rule 11Aa2-1).

are transmitted to NASDAQ by the market makers. The market maker enters a price determined by subtracting or adding the markup or markdown implicit in the actual trade price. Trade reports must be submitted within 90 seconds of execution, are collected by the NASD, and are then disseminated to vendors and to NASDAQ subscribers. 9/

B. Consolidated Transaction Reporting and Quotation Systems

The Consolidated Transaction Reporting System and the Consolidated Quotation System were established in 1974 and 1978, respectively, 10/ and provide for the electronic collection and dissemination of real-time trade and quotation reports in New York Stock Exchange (NYSE) and American Stock Exchange (Amex) securities, as well as certain regional securities. These systems are governed by plans agreed to by participating markets and submitted for approval to the Securities and Exchange Commission. 11/ Any changes to the plan over time are also submitted to the Commission for its review and approval under Rules 11Aa3-1 and 3-2. Participating

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9/ Schedule D of NASD By-laws.

10/ See Securities Exchange Act Release Nos. 10787 (May 10, 1974) (approving the Consolidated Tape Plan) and 14415 (adopting Rule 11Ac1-1).

11/ See Restatement and Amendment of Plan submitted to the Securities and Exchange Commission pursuant to Rule 17a-15 under the Securities Exchange Act of 1934 (on file at the Commission); and Plan submitted to the Securities and Exchange Commission for the purpose of implementing Rule 11Ac1-1 under the Securities Exchange Act of 1934 (on file at the Commission).

markets are the NYSE, Amex, Boston (BSE), Cincinnati (CSE), Midwest (MSE), Philadelphia (Phlx), and Pacific (PSE) Stock Exchanges, and the NASD. 12/ These systems' plans set forth the securities for which trade and quotation reporting is provided, as well as procedures for the governance of these systems.

Under these plans, quotations and trade reports are submitted by participating markets electronically from the floors to a central processor, which is the Securities Industry Automation Corporation (SIAC) located in New York City. SIAC receives these reports electronically and then, in the case of trade reports, transmits them in sequence electronically through so-called high-speed and low-speed lines. The high-speed line is the retransmission instantaneously of the trade reports to vendors and the direct subscribers. This data can be accessed security-by-security by interrogation of a computer terminal. The low-speed line, or ticker, is the retransmission of the same price information at a speed readable by human eyes, and the ticker is displayed on screens as a moving display of prices. 13/ There are separate

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12/ Instinet, while not a participant in the Plan, submits trade reports directly to the CTA.

13/ There was some confusion concerning the operation of these systems during the October 1987 market break. During this time, the high-speed lines experienced only two brief outages so that, with these two exceptions, current trade reports could be obtained at all times. Due to volume, the low-speed line was running several hours late. See (continued...)

high and low-speed lines for NYSE securities (Network A) and Amex and eligible regional securities (Network B). In the case of quotation information, SIAC collects the quotations from each market, calculates the best bid and offer based upon price, size and time of entry, and retransmits the information to vendors.

C. OPRA

All of the options exchanges are participants in the national market system plan for the collection and dissemination of quotation and last sale information for options. 14/ The plan is administered by the Options Price Reporting Authority (OPRA), an organization composed of representatives of the various options exchanges. Each exchange collects 15/ and transmits to the OPRA system bids and offers at stated prices or limits with respect to options in which it provides a market, "sufficient in number and

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13/(...continued)

"The October 1987 Market Break," A Report by the Division of Market Regulation, U.S. Securities and Exchange Commission (February 1988) ("SEC Staff Report), at 7-4 - 7-5.

14/ See Plan for Reporting of Consolidated Options Reports and Quotation Information (on file at the Commission).

15/ The mechanics of this process differ according to whether the exchange uses a specialist system or competing market maker system. Markets using the specialist system rely upon the specialists for establishing quotations. Markets using competing market makers rely upon an exchange employee who is responsible for monitoring and publishing quotations as they are made from among competing market makers, floor brokers, and the order book official.

timeliness to reflect the current state of the market of such options." OPRA, in turn, makes its quotation information available to securities vendors electronically and instantaneously. Changes to the plan are governed by Rule 11Aa3-2.

## II. Order Routing and Execution

### A. Exchanges

#### 1. Regional Exchanges

The regional exchanges have been leaders in developing automated small order execution systems, principally because automated service is a good way to offer competition with the primary markets. Four of the regional exchanges -- the BSE, Phlx, MSE, and PSE -- offer similar but slightly different systems. 16/

The PSE was the first market to introduce an automated trading system. Its Comex system began in 1969 and is now called SCOREX. 17/ The SCOREX system automatically executes up to 1099 shares at the Intermarket Trading System best bid or offer. 18/ Brokers can route orders electronically to the PSE

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16/ CSE is treated separately below.

17/ SCOREX is the acronym for "Securities Communication Order Routing and Execution."

18/ The ITS is an intermarket communications system through which the exchanges and the NASD communicate orders (called commitments to trade) in eligible stocks to one another. Separately each market disseminates through the Consolidated Quotation System (CQS) its best bid and offer in securities it trades, including securities eligible for  
(continued...)

specialist through the system. Once the order reaches the specialist, it is displayed in order to provide the specialist a 15-second opportunity to execute the order at a price better than the best ITS bid or offer. If the specialist fails to do so, the system automatically executes the order for the account of the specialist at the best ITS bid (if the order is a sell order) or offer (if the order is a buy order). 19/ The system generates trade reports to the specialist, the broker, and the consolidated tape. Thus, the system provides locked-in trade comparison. Specialists and individual brokers also can and often do agree to process orders larger than 1099 shares through the system.

The Phlx's system is called PACE, 20/ and provides automated executions at the best ITS bid or offer for orders of

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18/(...continued)

trading through ITS. Thus, the best ITS bid or offer is the best bid or offer in an ITS eligible security disseminated by a participant in CQS. ITS is discussed infra at II.C.

19/ This is a simplified example of the execution of a market order in SCOREX. Non-ITS stocks also can be routed and executed through SCOREX, as can limit orders, i.e. orders to buy or sell at specified prices, or better. The PSE specialist has discretion whether to accept limit orders, although his evaluation by the Exchange depends in part on what percentage of limit orders he accepts. Limit orders a specialist accepts that are not priced at the market (i.e. at current quotations) are stored and executed automatically when a transaction takes place in the primary market (generally the NYSE) at or through the limit order price.

20/ This system was introduced in 1976 as the Centramarket System. "PACE" stands for "Philadelphia Stock Exchange Automated Communication and Execution."

599 shares or less. PACE also can be used to route orders up to 1,099 shares, and to route even larger orders by agreement between the specialist and the broker. The PACE System, unlike SCOREX, 21/ has no exposure time, so that the system automatically executes the order without providing the specialist an opportunity to improve upon the best ITS bid or offer, even if a superior price is available on the Phlx trading floor at the time the order is received. 22/

The MSE's system, called MAX, was introduced in 1981. 23/ Its operation is very similar to SCOREX. Guaranteed execution size at the best ITS bid or offer is 1099 shares, and there is a 15-second exposure period. 24/ Specialists can agree to larger execution guarantees on an individual basis.

In 1988, the BSE instituted an automated order routing and execution system called the "BEACON". 25/ BEACON is similar to SCOREX and MAX. Execution size guarantees are 1299 for ITS

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21/ PACE also differs from SCOREX in its treatment of limit orders. PACE only requires the execution of 500 shares for every 1000 shares that trade at or through the limit price on the primary market.

22/ The SEC has expressed concern about this aspect of the PACE System. See Securities Exchange Act Release No. 19858 (June 9, 1983).

23/ MAX stands for "Midwest Automatic Execution."

24/ Limit orders can be routed through MAX but execution is manual. The specialist is required to execute 300 shares of a limit order for every 500 shares that trade at or through the limit on the primary market.

25/ "BEACON" stands for "Boston Stock Exchange Automated Communications Order-routing Network."



stocks and 599 for certain other securities, and exposure time is 15 seconds. 26/

2. AMEX and NYSE

(a) DOT and PER

In 1976, the NYSE instituted its automated order routing system, called DOT (for Designated Order Turnaround System). Initially, DOT was a system for routing orders electronically from brokers off the exchange to the specialist, and it retains that basic function. Currently, member firms may route market and marketable limit orders 27/ of up to 30,099 shares through DOT.

DOT has expanded beyond a simple order routing system to include additional applications. The Opening Automated Report Service (OARS) is an application of DOT that allows orders of up to 30,099 shares to be sent to the specialist prior to the opening. OARS stores these orders, then automatically and continuously pairs buy and sell orders and presents the imbalance to each specialist up to the time the specialist opens the stock for trading. After the specialist determines the opening price, in part based upon any OARS imbalances, OARS automatically distributes within seconds execution reports to brokers for each order stored in OARS.

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26/ For a complete description, see Securities Exchange Act Release No. 25918 (August 25, 1988).

27/ A limit order is marketable if it is priced at the current quotation. For example, a limit order to buy at 20 is marketable if the current offer in the market is 20.

DOT also has execution capabilities. The specialist is expected to execute orders up to 2,099 shares within 2 minutes. If the specialist has not executed the order within 3 minutes, the system generates an execution for the account of the specialist at the NYSE quotation at the time the order was received by the system. 28/ For orders between 2,099 and 30,099 shares, no such execution capability is available. 29/

In addition to DOT, the NYSE has installed electronic order display books for many stocks. Market orders electronically routed through DOT are displayed on a screen, and either stored or executed and reported back to the firm, all electronically. 30/ One of the corollary benefits of the electronic display book is that it frees up NYSE printers for

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28/ Although few orders are executed automatically in this manner because the specialist rarely fails to act within the requisite three minutes, the Commission has expressed concern about the NYSE using the NYSE quotation instead of the ITS quotation for pricing these executions. See Securities Exchange Act Release No. 22498 (October 2, 1985).

29/ The DOT system also can be used to route non-marketable limit orders, and to route and automatically execute at the NYSE quotation market odd-lot orders. Additional applications of DOT are available for program trades. See infra II.A.2.b.

30/ Although the execution is electronic, it is not machine generated except where the execution is one of the few automated executions provided by DOT. Thus, in most cases the specialist must affirmatively act, for example by touching the screen to enter the execution price to generate an execution.

ITS commitments, so that queuing and delay problems associated with heavy traffic on NYSE printers are reduced. 31/

DOT has proven to be a very positive technological improvement for the NYSE. It has contributed to the trading efficiency of that market, and has permitted the exchange to handle greatly increased volume. On an average day, DOT handles over 70% of NYSE trading, and since the October 1987 market break the system has been enhanced so it now should be able to handle volumes of 600 million shares per day.

The Amex began operating its Post Execution Reporting (PER) System in 1977. The system is generally similar to DOT although unlike the DOT system, PER has no automatic execution capabilities. PER electronically routes market and limit orders of up to 2,000 shares from brokers off the floor to Amex specialists. The specialist executes each trade, and the system then automatically routes execution reports back to the initiating broker. 32/

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31/ In its report on the October market break, the Division of Market Regulation recommended increased use of electronic display books to avoid the substantial delays and cancellations experienced in ITS during the market break due to printer queues. See SEC Staff Report, supra note 13, at 7-48.

32/ The Amex also has instituted the AUTOPER System to facilitate the execution of orders by use of touch screen terminals through which the specialist can enter execution data. Id. at 7-24 - 7-25.

(b) Program Trading/LIST Application of DOT

One of the more widely publicized automated routing applications in recent years has been the program trading application of the DOT system called LIST. 33/ In order to facilitate the increasing use of portfolio trading by institutional customers of its members and by its members 34/, the exchange adapted the DOT order routing system to permit the entry from a brokerage firm office of simultaneous orders of up to 3,000 shares in over 450 different stocks. Thus, a broker located off the floor can at the push of a button electronically and almost instantaneously transmit to separate specialist posts on the NYSE floor orders of up to 3000 shares in over 450 different stocks. These orders, as indicated, go to each separate specialist in the stock, and are executed individually in the normal NYSE's auction process.

In response to problems it has encountered with program trading, the NYSE in October 1988 instituted preferential order routing for small orders and "side-car" procedures that use DOT capabilities. 35/ The small order procedures provide

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33/ LIST stands for "List Order Processing."

34/ For a discussion of portfolio trading, see SEC Staff Report, supra, note 13, at Chapter Three.

35/ See Securities Exchange Act Release No. 26198 (October 19, 1988). Prior to this program, in April, 1988, the NYSE had a six-month pilot that prohibited use of DOT to send index arbitrage orders after a 50 point DJIA move. See Securities Exchange Act Release No. 25599 (April 19, 1988). This pilot expired on October 19, 1988.

for preferential routing to the specialist of orders of 2,099 shares or less after a 25-point Dow Jones Industrial Average (DJIA) move. The "side-car" procedures call for the withholding of program trade orders from the market for five minutes after a 12-point movement in the Standard & Poor's (S&P) 500 Index. 36/ The orders are held aside by the specialist and after five minutes the specialist determines with the help of DOT whether imbalances exist and whether the orders can be executed in an orderly way. If they cannot, the specialist will halt trading in the stock, disseminate the imbalances and indications of interest, 37/ and reopen the stock. 38/

### 3. The National Securities Trading System

The National Securities Trading System (NSTS) was put into operation by the CSE in 1978. It is the only wholly automated exchange in the United States. NSTS permits CSE members to enter agency or principal orders electronically into the

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36/ A 12-point S&P 500 Index movement is approximately equal to a 76-point DJIA movement.

37/ An indication of interest is a range of prices within which a specialist may open trading in a stock.

38/ The NYSE previously has implemented procedures to address volatility problems associated with program trading on expiration Fridays. On these days, order imbalances, both pre-opening and pre-closing, are collected (largely through DOT), and publicly disseminated. The dissemination of these imbalances together with other procedures has helped reduce volatility formerly associated with expiration Fridays. See Securities Exchange Act Release Nos. 25804 (June 15, 1988) and 26408 (December 29, 1988).

system. Once entered, orders are stored, queued, and executed by the system's computer according to price and time priority. 39/

The markets reflected in the system are updated and displayed instantaneously upon the entry of new or revised orders, cancellations, or executions. The system employs competitive market makers, although each security traded in the system has an assigned "designated dealer" who is responsible for automatic execution of public agency market orders and marketable limit orders up to 2,099 shares (the order size at which a guaranteed price exists), at the ITS best bid and offer. The designated dealer also must guarantee executions of public agency limit orders when the limit order price is penetrated by a transaction on another ITS market. 40/

B. NASD

1. SOES

When the NASD instituted NASDAQ, its automated quotation dissemination system, in 1971, executions were still effected over the telephone. In 1982, a surge in trading volume made apparent the need for greater automation of the order execution process in the over-the-counter market. 41/ With the increase in trading volume, the handling of routine small orders became

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39/ Public agency orders have priority over other orders at the same price, regardless of time of entry.

40/ For a more complete description, see Securities Exchange Act Release No. 19315 (December 9, 1982).

41/ See M. Simon and R.L.D. Colby, supra note 3, at 74.

an increasing burden for market makers. Consequently, in 1985 the NASD implemented SOES, or the "Small Order Execution System." 42/ SOES provides automatic execution for retail customers of certain sizes at the best available NASDAQ quotation. 43/ SOES is restricted to orders entered by a

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42/ In 1984, the NASD had implemented the Computer Assisted Execution Service ("CAES") principally to facilitate the link between the OTC market for listed securities and ITS. CAES, which also can be used to trade non-listed, National Market System securities, allows firms to route market or limit orders to specific market makers quoting the best bid or offer. Market orders are executed automatically at the best bid or offer, and limit orders are printed and stored as day limit orders. CAES has not been used greatly, either to route ITS orders to other markets or to execute OTC orders. See Simon and Colby, supra note 3, at 52 and 73-74.

43/ There currently are three order-size limits for SOES: 1,000, 500, 250, which vary per stock depending upon its average daily non-block volume, bid price and number of market makers. In addition to limits on the size of orders that can be entered into the system, the NASD establishes an exposure limit which requires that market makers commit to execute a certain number of the maximum-sized orders if the market maker is quoting the best bid (or offer) or if an order specifies ("preferences") a particular market maker for execution. The exposure limit currently is one, that is a market maker is required to execute only one maximum-sized order. A market maker is free to elect higher exposure limits. The exposure limit had been increased to five in response to execution difficulties experienced during the October market break, but was lowered for a six-month pilot starting in October 1988 in response to concerted efforts by so-called "professional traders" to use SOES to hit the quotations of market makers who had not had time to change their quotations in response to news announcements. See Securities Exchange Act Release No. 25291 (June 9, 1988) for a description of the post market break reforms to SOES, and Securities Exchange Act Release No. 26361 (December 15, 1989) for subsequent modifications.

broker on behalf of a non-broker customer ("agency orders"). 44/ In response to the difficulties customers experienced getting orders executed during the October 1987 market break, participation in SOES was made mandatory for market makers in NASDAQ/NMS securities. 45/ If a market maker withdraws from SOES without an excuse, for example by failing to change its quotations after its order exposure has been exhausted, it is not allowed to act as a market maker in the security for 20 days. Participation in SOES is voluntary for market makers in other NASDAQ securities.

Executions for SOES orders that do not specify the market maker to whom the execution should be assigned (preferenced orders) are assigned to market makers at the best bid or offer on a rotating basis. 46/ In addition to executing the orders,

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44/ Agency orders include orders entered into SOES on a riskless principal basis by a broker that is not a market maker in the security.

45/ NMS securities are the securities of the largest and generally the most actively traded OTC companies for which real-time last sale reporting is required. In addition to mandatory participation for NMS securities, the NASD modified SOES in response to the market break to allow executions against locked or crossed quotations. See Securities Exchange Act Release No. 25291 (June 9, 1988). A locked market exists when the bid price of one market maker equals the asked price of another market maker. A crossed market occurs when one market maker's bid exceeds another market maker's ask. Prior to this modification, SOES executions would cease whenever quotes were crossed or locked, a situation which occurred frequently during the market break.

46/ Approximately 40% of SOES orders are preferenced.



SOES automatically reports the trade data to the clearing corporation. 47/

2. Limit Order File

In February, 1989 the NASD took another significant step in automating trading in its market by instituting an automated, centralized limit order file. This file stores all limit orders that are not immediately executable in SOES because they are not priced at the NASDAQ best bid or offer, and then executes them automatically based upon time of entry if the best NASDAQ bid or offer for the security reaches the limit order price. Like SOES the system rotates executions among market makers at the best bid or offer (unless an order is preferenced), and also sends reports of trades to the clearing corporation. 48/

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47/ Another significant aspect of the treatment of small customer orders in the OTC market is the in-house systems most large integrated (i.e. acting as both broker and market maker) broker-dealers developed to automate their executions of customer orders. These systems are described in the SEC Staff Report, supra note 13, at 7-8 - 7-10.

48/ For a description of this system, see Securities Exchange Act Release No. 26476 (January 19, 1989). As currently designed, this system does not allow customer orders to be executed against each other between the current best bid and offer. Thus, if the best bid and offer is 10-11 and two customers separately sent in limit orders to buy and sell, respectively, at 10 1/2, they would not be executed against each other but be filed to be executed against a market maker if the inside market moved to that price. The Commission has expressed concern about this aspect of the system. Id.

### 3. Order Confirmation Transactions

The NASD has also introduced a system called the Order Confirmation Transaction (OCT) System. 49/ This system would permit the negotiation through screen terminals of trades of all sizes between market makers and brokers and the automated, locked-in comparison of those trades once agreed upon. For example, through these systems market makers can send orders to one another at their displayed quotations in NASDAQ and the system will permit the receiving market maker automatically, through a keyboard response, to accept or reject that order. This system in effect replaces telephone negotiation with negotiation through computer links and screens. If the order is accepted, the system will then generate locked-in comparison reports as well as trade reporting for public dissemination. 50/

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49/ See Securities Exchange Act Release No. 25263 (January 11, 1988).

50/ The NASD also is developing a complementary system, called Automated Confirmation Transaction (ACT), that will facilitate the automated clearing of pre-negotiated trades.

C. ITS

The Intermarket Trading System, introduced in 1978, 51/ is perhaps the most visible by-product of the 1975 Congressional mandate to establish an NMS. The ITS is a communications system designed to facilitate trading among competing markets by providing each market with order routing capabilities based on current quotation information. ITS links the exchanges and the NASD 52/ and provides procedures for: (1) display of composite quotation information at each of the participant markets so that brokers are able to determine readily the best bid and offer available from any ITS market for a multiply-traded security; (2) efficient routing of orders and administrative messages; (3) measures to coordinate opening of trading on ITS markets; (4) trade-through protections designed to provide price priority for all orders entered in ITS

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51/ See Securities Exchange Act Release No. 14661 (April 14, 1978) (approving temporarily the Plan for the purpose of creating and operating an Intermarket Communications Linkage pursuant to Section 11A(a)(3)(B) of the Securities Exchange Act of 1934) (the Plan is available on file at the Commission). After a series of temporary approvals, the ITS plan was permanently approved in 1983. See Securities Exchange Act Release No. 19456 (January 27, 1983).

52/ The link with the NASD operates with respect to so-called "19c-3 securities," that is securities listed on an exchange after April 26, 1979, that exchange members may also trade over-the-counter pursuant to Rule 19c-3 under the Act.

markets; 53/ and (5) procedures for the governance of the system. 54/

D. Options

The Chicago Board Options Exchange (CBOE) and the Amex employ automated execution systems. 55/ CBOE's Retail Automatic Execution ("RAES") system, instituted in 1985, provides for the automatic routing and execution of trades of 20 contracts or less in the CBOE 100 and S&P 500 index options and 10 contracts or less in stock options. The Amex's Auto-Ex system, which was put into operation in 1985, 56/ provides automated executions for orders of 20 contracts or less in Major Market Index options and individual stock options, and up to 100 contracts of Institutional Index Options. Orders routed

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53/ For example, if a customer leaves a limit order with the PSE specialist to buy at 20, the PSE specialist will display a bid of at least 20. If 20 is the best ITS bid, an ITS market generally will not execute trades at a price superior to 20 without satisfying the limit order left with the PSE specialist. The system does not provide time priority so that a limit order at 20 entered on the PSE at 10:00 a.m. has no priority over a limit order at 20 entered on the NYSE at 10:05 a.m.

54/ The ITS Plan, supra note 51, sets forth these rules and procedures.

55/ The PSE and NYSE do not have automated systems for options order routing or execution. In April, 1989, the Phlx implemented an automated options order routing system (called "AUTOM", for "Automated Options Market") that it expects to expand to provide for automated executions. See Securities Exchange Act Release No. 26354 (December 13, 1988).

56/ Prior to the implementation of their automated execution systems, both Amex and CBOE had automated options order routing systems.

through RAES are executed at the displayed best bid or ask against market makers who elect voluntarily to participate as contra-brokers to RAES orders, while orders sent through Auto-Ex are executed at the displayed quotation against either the specialist or a registered options trader (ROT) in the crowd. 57/

Both CBOE and Amex impose certain obligations on participating market makers in order to ensure executions are on a continuous basis. CBOE requires that market makers who sign onto RAES in groups participate in the system on a continuous basis for the duration of the week in which they sign on, and throughout the following expiration week. The Amex imposes somewhat less stringent obligations, requiring registered options traders to remain in the trading crowd for the majority of any business day in which they sign onto the system and on the following expiration if the ROT has participated in Auto-Ex on any day of that week.

Because of substantial decreases in market maker participation in these systems during the October 1987 market break, 58/ Amex and CBOE have recently toughened their

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57/ Limit orders on the book at the same price as incoming system orders are guaranteed executions at the same price as system orders in all options in which Auto-Ex is available, and in all equity options except IBM in which RAES operates. RAES does not protect public customer limit orders on the CBOE 100 index options book, or in IBM options.

58/ See SEC Staff Report, supra note 13 at 8-8 - 8-10.

participation rules. Among other things, CBOE now may require market makers who are members of a trading crowd to sign onto RAES anytime there is inadequate RAES participation, absent reasonable excuse. 59/ Amex now requires the specialist to participate in Auto-Ex at all times the system is in use, and requires ROTS (1) to remain in the trading crowd for an option once they have signed onto RAES and (2) to sign off and back onto RAES only once during a trading day. 60/

E. PORTAL and SITUS

The Amex and the NASD are also working on automated systems that would accommodate the institutional secondary trading of certain securities. These systems, called SITUS and PORTAL, respectively, 61/ are designed in anticipation of the culmination of Commission rulemaking initiatives now ongoing that would permit the active resale of unregistered securities among institutions. 62/ These systems would be quotation dissemination systems combined with captive clearing operations in order to assure that the securities traded through the

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59/ See Securities Exchange Act Release Nos. 25995 (August 15, 1988) and 26373 (December 20, 1988).

60/ See Securities Exchange Act Release No. 25996 (August 15, 1988).

61/ SITUS stands for "System for Institutional Trading of Unregistered Securities." PORTAL stands for "Private Offerings, Resales, and Trading Through Automated Linkages."

62/ See e.g. Proposed Rule 144A, Securities Act Release No. 6806 (November 11, 1988).

system remain only in institutional hands. For the most part, however, these systems do not at present provide for automated execution.

F. Proprietary Trading Systems

In the United States, in addition to the automated systems run by the self-regulatory organizations, non-SROs have developed proprietary trading systems. The most notable of these systems is Instinet, which was developed in 1969 as an information system to permit institutions to negotiate trades with one another. Since its initiation in 1969 it has grown and developed more elaborate automated execution functions.

Currently, Instinet consists of a network of computer terminals that permits the entry by institutions or broker-dealers of indications of trading interest and the execution against those indications of interest by other subscribers to Instinet automatically through a computerized system. Instinet now also operates internationally and has terminals in several foreign countries. 63/ In addition to facilitating trading among Instinet subscribers, the system can be used by subscribers to trade against established exchange and NASDAQ quotations. This function was automated for smaller orders, but after the October 1987 market break Instinet discontinued

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63/ For a more detailed description of Instinet, see letter from Richard G. Ketchum, Director, Division of Market Regulation, Securities and Exchange Commission to Daniel T. Brooks, Cadwalader, Wickersham and Taft, dated August 8, 1986.

automated small order executions against exchange and NASDAQ dealers.

Instinet also has a Crossing Network for basket trading by institutions. 64/ Through this system institutions electronically enter orders in portfolios of stocks. The system pairs off buy and sell orders against each other, and then sends any unmatched orders to an exchange for execution or executes the residue against Instinet as principal. Jefferies and Company operates a similar system called POSIT. 65/

In the 1980's there was increasing growth in proprietary trading systems of a great variety. Some of these systems consisted largely of the automation of the execution function of two or more brokers. A municipal securities system also was designed, but never made operational. More recently, the SEC has considered a system to trade options on government securities, the Delta Options system. The Delta Options system involves the electronic collection and dissemination of quotations, and the clearance and settlement of trades. Delta Options is in large part a blind brokering system, which allows for users of the system to input quotes on an anonymous basis

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64/ Broker-dealers currently cannot participate in this aspect of Instinet.

65/ POSIT is described in a letter from Brandon Becker, Associate Director, Division of Market Regulation, Securities and Exchange Commission, to Lloyd Feller, Morgan Lewis & Bockius, dated July 28, 1987.



through an intermediary or so-called blind broker, to see the quotes of other users of the system, and to execute against those quotes through the blind broker. The system also allows for direct negotiation of trades by system users. The system does not involve automated or computer-generated executions. 66/

G. Futures Markets

Although futures markets are not the focus of this paper, there has been an automation development recently in the futures markets that bears noting, the Chicago Mercantile Exchange's recently approved Globex system. The futures markets traditionally have been physically centralized markets that use an open outcry system in which brokers and dealers, called locals, congregate in a pit and effect trades directly by voice. The markets have developed some automated routing capabilities but not automated execution systems.

The Chicago Mercantile Exchange has worked with Reuters Information Systems to develop an electronic automated futures trading system that would operate during the hours when the CME open outcry market is not available. The system would operate internationally, and would rely upon computer terminals in

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66/ For a more complete description, see letter from Richard G. Ketchum, Director, Division of Market Regulation, Securities and Exchange Commission, to Robert A. McTamane, Esq., Carter, Ledyard & Milburn, dated January 12, 1989. In response to the proliferation of these systems the Commission recently voted to propose Rule 15c2-10, discussed in the paper at III.B.2.

traders' offices into which traders could enter orders. The system would collect orders, calculate and disseminate a best bid and offer, and execute orders against each other based upon time and price priority. The New York Mercantile Exchange and Sydney Futures Exchange intend to participate in this system. 67/ The Board of Trade of the City of Chicago has decided to establish its own system. 68/

#### H. Foreign Markets

Several significant foreign developments also should be noted. First, in 1986 the U.K. adopted a NASDAQ-like screen-based quotation and trading system, called the SEAQ (Stock Exchange Automation Quotation) System. The system entirely supplanted the physical exchange almost immediately upon its introduction. Although the SEAQ system began with dissemination of large quotation sizes (as much as 100,000 shares), 69/ the quotation sizes recently were reduced substantially because market makers did not want to trade with

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67/ See "Electronic Futures Trading Cleared," New York Times, February 3, 1989, D-6. While Globex is the first automated trading system to be proposed by a major U.S. futures exchange, the Intex Futures Exchange was a fully automated electronic futures trading system based in Bermuda but with terminals located in the United States. The system never proved successful and went out of business. For a description of Intex, see Securities Exchange Act Release No. 23795 (1986).

68/ "Chicago Board Discussing Link with London," New York Times, February 21, 1989, at D.6.

69/ By way of comparison, in the U.S. the displayed size of most NASDAQ quotations is only 100 shares.

other market makers at these displayed sizes. In addition, SEAQ is also eliminating real-time reporting of large trades. 70/

The ISE recently supplemented its SEAQ system with an automated execution capability for small orders, called Stock Exchange Automated Facility (SAEF). SAEF provides automated execution in up to 1,000 shares at the best SEAQ bid or offer. Executions are assigned to participating SEAQ market makers on a rotating basis. SAEF competes with automated private systems of two U.K. broker-dealers, Kleinwort Benson and Barclays de Zoete. These systems, called Best and Trade, respectively, provide for automated executions by their sponsors at the best SEAQ quotations in up to 5,000 shares. 71/

One of the more notable foreign automated execution systems was instituted in Canada at the Toronto Stock Exchange in 1977. The CATS, or Computer Assisted Trading System is an automated trading system with a public central limit order book for the 800 stocks that are traded. This system operates in addition to the more traditional physically centralized auction market at the Toronto Stock Exchange. However, stocks trading on CATS are not traded on the floor. CATS guarantees the price

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70/ See "Stickier Wickets," the Economist, January 14, 1989, p. 74.

71/ See "Electronic Stock Market Takes a Leap Nearer," Financial Times, February 13, 1989, at 8.

and time priority of orders absolutely. It has no specialist, but rather market makers acting as both agents and principals.

CATS provides not only automated information dissemination, but also automated execution and limit order protection. Its closest analog in the United States is the NSTS system of the Cincinnati Stock Exchange. Since its introduction in 1977, CATS has grown and taken an increasing portion of the market in Toronto. It has proven to be so successful that other markets in Europe have bought the system for use there. For instance, the Paris, Belgium, Madrid, and Sao Paulo Stock Exchanges have licensed the CATS system for use in their markets. 72/

Another important foreign automated system is the so-called second section on the Tokyo Stock Exchange. This system was instituted in 1982 and, like CATS in Toronto, operates in addition to the physically centralized and traditional auction market. However, stocks that trade in the second section do not trade on the floor. 73/

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72/ For a good description and discussion of CATS, see "The Toronto Stock Exchange," D. Unruh, Vice-President, International Markets, Toronto Stock Exchange, paper submitted to SEC for SEC's February, 1987, Roundtable on Internationalization of Securities Markets.

73/ The first section of Tokyo is the marketplace for stocks of larger more actively traded companies, while the second section is for the smaller, newly listed companies. In 1988, 98% of total Tokyo Stock Exchange trading occurred on the First Section.

The second section in Tokyo is automated through a system called Computer Assisted Order Routing and Execution System (CORES). Orders for customer or member accounts are fed into the system from terminals located in the members' offices. In Tokyo, the CORES system relies upon the use of Saitori members, who are the intermediaries on the Tokyo Stock Exchange. Saitori act solely as middlemen in transactions between members of the Exchange effected on the Exchange. The intermediary function of the Saitori in CORES is accomplished by having them match orders put into the system by brokers through keyboard operation. Where the market situation and trading pattern of a stock seem to assure a stable price formation, Saitori may instruct the system to match buy and sell orders automatically within a pre-determined price range. The system has an order book function which operates on a time and price priority basis. Orders in the book can be seen in member firm offices. The system also provides automated trade comparison as well as reporting to the market information system of the Tokyo Stock Exchange. 74/

Foreign derivative markets also tend to be highly automated. The Tokyo Stock Exchange's yen bond futures and

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74/ Japan's over-the-counter market also intends to introduce by 1992 a computerized system based upon NASDAQ technology. See NASDAQ Notes, February, 1989.

stock index futures markets are automated. 75/ In 1988, Switzerland instituted an automated options and futures market called SOFFEX ("Swiss Options and Financial Futures Exchange"), which also has been very successful. 76/ Likewise, the London Futures and Options Exchange and the New Zealand Futures Exchange are automated. 77/

A recent and intriguing automated trading development in prospect abroad is a London International Futures Exchange system which is not yet in operation. This system, called the Automated Pit Trading (APT) system, attempts to replicate electronically the open outcry trading that occurs in the pit. The system involves a video display screen that displays a pit

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75/ See "Japan, Derivative Financial Products Markets," 7 International Finance Law Review, December 1988, at 27. Interestingly, in response to volatility experienced on the days stock index futures expire due to index arbitrage activity, the Japanese markets have instituted expiration day procedures similar to those in use on the NYSE. See supra, note 37, and "Japanese Regulators Want to Hold Down Volatility Caused by Stock Index Futures," Wall St. J., January 26, 1989, at C13.

76/ See "Swiss Options and Futures via Computer May Offer Glimpse of Future in Chicago", Wall Street Journal, January 25, 1989, p. C15; and "Trades on Swiss Options Exchange Soar Beyond Sponsors' Initial Expectations," American Banker, July 11, 1988. The German Exchanges expect to use the SOFFEX system in introducing financial futures and options to German markets. See "Germany Exchange's Cost Set to Top Dollars, 32M," Financial Times, September 8, 1988, p. 36.

77/ See "London Could Fox Them All", The Economist, December 3, 1988. The Swedish Option Market, launched in 1985, was the first completely electric options marketplace. See "Founder of Stockholder Options Exchange Pushes to Expand Operations in Europe," Wall Street Journal, November 18, 1988, p. A18.

split in half with buyers on one side and sellers on another. Traders are marked as boxes on the screen with identifying numbers and with numbers of contracts of traders bidding for or offering also indicated. The best bid and offer is displayed in the middle of the screen, as is the number of contracts that are offered at that price. Bids or offers entered into this system are good only for five seconds, much like bids and offers made in a pit on a trading floor, which are good only if accepted immediately (In industry parlance, the quote is good only as long "as the breath is warm"). To execute trades the trader would move a "mouse" to the bottom of the screen to an area designating price and then punch in the number of desired purchase or sale contracts. 78/

The Eurobond markets also are experiencing increased automation. The Association of International Bond Dealers (AIBD), a self-regulatory organization for Eurobond markets, has recently developed the TRAX (Automated Transaction Exchange) System, an automated trade comparison process designed to facilitate the trading process in the Eurobond market. Through TRAX, all Eurobond dealers, regardless of geographic location, enter transaction information electronically. The system performs trade comparison within minutes. In addition, the system provides end-of-day

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78/ See "LIFFE Plans to Put Open Outcry Pits on the Screen," Financial Times, February 2, 1989, p. 23.

transaction reports to the Securities and Investment Board in the United Kingdom. 79/

I. International Links

Starting in 1984 with a trading link between the Montreal Stock Exchange and the Boston Stock Exchange, 80/ U.S. markets have developed several international electronic trading and quotation links. In addition to the Montreal-Boston link, trading linkages between the American and Toronto Stock Exchanges and the Midwest and Toronto Stock Exchanges were established in 1985 and 1986, respectively. 81/ The Toronto links, however, were disconnected in October 1988 due to lack of use.

There also are quotation links between NASDAQ and SEAQ and between NASDAQ and the Singapore's automated quotation dissemination system, and a joint listing agreement and mutual

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79/ For a good description of TRAX, see TRAX brochure, available from AIBD. At one point the AIBD considered the creation of a NASDAQ-style real-time trade and quotation dissemination system, in part in anticipation that the U.K. securities market regulator, the Securities and Investments Board (SIB), would require such a system as a condition to registration of the AIBD under the Financial Services Act of 1986. See "Dealers' Group Taming Eurobond Market," Wall St. J., May 22, 1986, p.24. Due to member resistance, the AIBD moved to the TRAX system instead, and SIB approved the AIBD's registration in April, 1988. See "Bond Dealers Association Gains Designated Stock Exchange Status," Financial Times, April 15, 1988, p.13.

80/ See Securities Exchange Act Release No. 21449 (November 1, 1984).

81/ See Securities Exchange Act Release Nos. 22442 (September 20, 1985) and 23075 (March 28, 1986).



offset arrangement for the Major Market Index Options between the Amex and the European Options Exchange in Amsterdam. 82/

The concept of the trading links is fairly simple. Orders in individually listed securities are routed electronically between the floors of the linked markets. Best bids and offers in linked securities on each market are displayed on the floors of the other linked market. Orders are executed in the receiving market's auction process. Thus, trading is not automated. Some best execution protection also exists. For example, orders are typically guaranteed a price at the best quotation up to a specified number of shares.

The quotation links involve the exchange of quotations from linked markets. NASDAQ sends to ISE quotations in approximately 300 NASDAQ stocks for limited distribution to SEAQ market makers active in the securities, and ISE sends to NASDAQ quotations for approximately 300 SEAQ stocks, again for limited distribution to NASDAQ market makers active in those stocks or ADR's on those stocks. 83/

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82/ For a good description of these links, see Internationalization of the Securities Markets, Report of the Staff of the U.S. Securities and Exchange Commission to the Senate Committee on Banking, Housing and Urban Affairs and the House Committee on Energy and Commerce (1987), V 49-56.

83/ For a more complete description see Securities Exchange Act Release No. 24979 (October 2, 1987) (approving the link as a two year pilot). The NASDAQ/Singapore link currently is limited to an exchange of end-of-day quotations. See Securities Exchange Act Release No. 25457 (March 14, 1988).

The Amex/EOE licensing arrangement permits the EOE to list and trade XMI options that are fungible with Amex's options. Thus, a contract acquired in the Amex can be closed out on the EOE. There is no direct quotation or trading link between the markets. 84/

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84/ In 1984 the CME established a similar mutual offset arrangement for currency futures with the Singapore International Monetary Exchange markets. See B. Becker, 6 International Tax & Business Lawyer, 242 (1988).