Chapter Seven

EXCHANGE OPERATIONAL PERFORMANCE

During and subsequent to the October market break, concerns have been expressed regarding the adequacy and capability of securities industry systems to process record transaction and share volume. This chapter examines these concerns. The first section discusses the accuracy of last sale and quotation information in providing investors and market professionals with an accurate picture of market developments. The second section describes the handling of customer orders during the market break. The third section reviews the performance of various exchange small order execution systems, including the New York Stock Exchange's Designated Order Turnaround ("DOT") system. Finally, the fourth section describes use of the Intermarket Trading System ("ITS") during the market break.

A. Market Information Systems

Market participants (e.g., regional exchange specialists, derivative product traders, broker-dealer firms, and clearing agents) have suggested that trade and quote information was delayed or inaccurate during the market break. 1/ There were frequent complaints that quotes were unreliable. There are several possible explanations for the deterioration of quote information or for the perception that quotes were "bad," which we discuss below.

1. Background

Pursuant to Rules 11Aa3-1 2/ and 11Ac1-1 3/ under the Securities Exchange Act of 1934 ("Act") and joint plans filed thereunder, 4/ most national securities exchanges are required to collect transaction and quotation information on a real-time basis for equity securities substantially meeting New York Stock Exchange ("NYSE") or American

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1/ Customer complaints received by the Commission and self-regulatory organizations allege instances of inaccurate quote information and poor executions. See Chapter Twelve.

2/ 17 C.F.R. 240.11Aa3-1 ("Transaction Reporting Rule").

3/ 17 C.F.R. 240.11Ac1-1 ("Quote Rule").

4/ See Plan Submitted to the Securities and Exchange Commission Pursuant to Rule 17a-15 [11Aa3-1] under the Securities Exchange Act of 1934 ("Consolidated Tape Association Plan"), Securities Exchange Act Release No. 10787 (May 10, 1974) (declaring plan effective); Plan Submitted to the Securities and Exchange Commission for the Purpose of Implementing Rule 11Ac1-1 under the Securities Exchange Act of 1934 ("Consolidated Quotation Plan"), Securities Exchange Act Release No. 16518 (January 22, 1980), 45 FR 6521 (permanent approval of plan).

Stock Exchange ("Amex") listing criteria ("Reported Securities"). 5/ Similarly, options exchanges collect and forward transaction information, pursuant to a Plan filed under Section 11A(a)(3)(B) of the Act. The exchanges have various systems for collecting and disseminating this information. For example, at the NYSE, exchange employees known as reporters record trade information and quote updates on so-called mark-sense cards and feed these cards into optical card readers. The information is then transmitted to the NYSE's Market Data System ("MDS") for processing. The MDS then transmits the data to the Securities Industry Automation Corporation ("SIAC") which is the central processor for last sale and quote information from all exchanges. 6/ Each exchange reports to SIAC all transactions in Reported Securities and the highest bid and lowest offer communicated on their facilities for these securities.

In the over-the-counter ("OTC") market, the National Association of Securities Dealers ("NASD"), through its National Association of Securities Dealers Automated Quotations ("NASDAQ") system, collects from its members transaction and quotation information for those OTC securities that are subject to real-time transaction reporting (i.e., OTC/NMS Securities) and exchange-listed NMS Securities that are also traded OTC. 7/ Small order trades that are executed through the NASD's Small Order Execution System ("SOES") are reported automatically. As discussed in more detail in Chapter Nine, trades that are not executed through SOES are reported by NASDAQ market makers (who are able to transmit trade information through their NASDAQ computer terminals), or, in the rare case that a NASDAQ market maker is not involved in the transaction, by the broker-dealer by telephone or telex.

After processing the information they receive, SIAC and NASDAQ disseminate the information to entities known as securities information vendors. Securities information vendors are firms that provide current and continuous information with respect to transactions in and quotations for securities to broker-dealers, investors and others. 8/ Typically, vendors' subscribers receive this information on computer terminals or on a moving ticker.

5/   The equity securities for which there is last sale transaction reporting, both on exchanges and in the over-the-counter market, are known as National Market System ("NMS") Securities. In addition, regional exchanges voluntarily collect and forward to securities information vendors transaction and quotation information for other solely-listed issues.

6/   SIAC is a jointly-owned subsidiary of the NYSE and Amex.

7/   In addition, the Commission has granted the Midwest Stock Exchange ("MSE") unlisted trading privileges ("UTP") in 25 OTC/NMS Securities. See Securities Exchange Act Release No. 24406 (April 29, 1987), 52 FR 17495. Under the interim UTP reporting plan applicable to this arrangement, the MSE now reports transaction and quotation data to the NASD through NASDAQ terminals. See Securities Exchange Act Release No. 24407 (April 29, 1987), 52 FR 17349.

8/   In addition to providing transaction and quotation information, some vendors also provide their subscribers with so-called "analytic" information, such as comparisons of index futures and equity index options prices to the prices of the underlying component stocks.

SIAC provides a stream of transaction and quotation information to vendors over high speed lines (the "high-speed tape"). 9/ NASDAQ's information is disseminated directly to subscribers to the NASDAQ system. In addition, two services, one supplying a best bid and offer for all NASDAQ securities and transaction information for OTC/NMS Securities ("Level 1 Service"), and the other a complete stream of transaction and quotation information ("NQDS Service"), are fed to vendors.

2. Performance During the Market Break

It does not appear that there were many delays in the NYSE's systems used for collecting and routing transaction and quotation information, or in the processing and dissemination of this information by SIAC. NYSE personnel reported that the exchange deployed emergency reporter staff where needed, and that there were no documentable delays in collecting and routing transaction and quotation information through the MDS. As discussed below, securities information vendors also did not report many significant delays in providing transaction and quotation data to their subscribers

There were, however, some delays at several of the regional exchanges in routing trade information to SIAC. 10/ The dissemination of delayed trade information from regional exchanges led to discrepancies between quote and last sale information. If delayed trade information was not identified as being delayed, such discrepancies gave rise to uncertainty as to the accuracy of quotes.

Moreover, even where the technological procedures for collecting and disseminating information were not appreciably delayed, it is possible that the speed with which the dissemination took place, coupled with the extremely fast-moving markets of the week of October 19 and delayed order executions, created the false impression of "inaccurate" quotes. What may have been occurring was that the quotes were no longer a "reliable" predictor of the price at which an order would, in fact, be executed. 11/ If market participants were not able to "hit" the quotes they saw displayed for a particular exchange, they may have concluded that the quotes were "bad." The inability to have trades executed at displayed quotes may not have been due to specialists failing to honor or update quotes, but rather to fast-moving markets and problems with some order routing and execution systems.

9/ When providing last sale information on a moving ticker, vendors have to slow down the high speed tape so that the information will be readable on the ticker.

10/ For example, the Boston Stock Exchange reported that it was not able to transmit trade information on a timely basis during much of the week of October 19. Delays were particularly acute on October 19 and 20, when trade reporting was two to three hours late by the end of trading sessions. On October 19, despite the fact that SIAC agreed to accept trade data until 5:45 p.m. some Boston Stock Exchange trades could not be reported and had to be entered the next day. See discussion of Boston Stock Exchange infra.

As discussed in more detail in Chapter Nine, NASDAQ also experienced an unusually high number of transactions reported "out of sequence," i.e., later than 90 seconds after execution.

11/ See Chapter Eight, n. 5 infra.

During the week of October 19, a number of quotes by NYSE and regional specialists were designated "non-firm." 12/ Although this may have contributed to the general dissatisfaction with the quality of quotes, not many stocks were affected. 13/

Delays in ticker displays also may have contributed to a perception that quotes were not current. During times of increased trading volume, the stream of transaction information displayed on moving tickers is necessarily late, so that the data are readable on a ticker. During the market break, ticker display devices were often well behind the market, with delays of as much as two hours toward the end of trading sessions on October 19 and 20. Thus, it is likely that prices shown on tickers on those days were quite different from the more current quotes available by way of the high speed line. 14/

12/   Non-firm quotes are an exception to the Quote Rule which, subject to limited exceptions, requires exchange specialists to honor their quotes. Specialists are relieved of this obligation if their exchange has determined and notified appropriate parties that the level of trading activity or the existence of unusual market conditions in a security is such that the exchange is incapable of collecting, processing and making available quotation information.

13/   Non-firm quotes by NYSE specialists during the week of October 19 (expressed in absolute numbers and as an approximate percentage of the total number of NYSE quotes for each issue) were, at least, as follows:

October 19 - IBM (527/99%); IC Industries (9/4%); Allegis (2/1%)

October 20 - E.F. Hutton (411/92%); IBM (214/81%); Eastman Kodak (185/83%); National Semiconductor (168/89%); Textron (148/85%); Ford (69/20%); MCA, Inc. (9/2%)

October 21 - Eli Lilly (195/98%); National Semiconductor (149/99%); Lockheed (77/21%); Ford (67/22%); Norfolk Southern (17/11%); JWP, Inc. (14/61%); Par Pharmaceutical (10/13%); Ohio Mattress Co. (3/12%); Nicor, Inc. (2/5%)

October 22 - IBM (780/98%); National Semiconductor (172/68%); Ford (33/8%); Pepsico (10/4%); Digital Equipment (1/1%)

October 23 - MCA, Inc. (11/5%).

Source: SEC Directorate of Economic and Policy Analysis.

14/   While these delays in the ticker may have led to doubts as to the accuracy of quotes, it is important to note that ticker display devices are a secondary source of last sale information.

The Division conducted an informal survey of eight broker-dealer firms and seven of the major securities information vendors 15/ to determine the extent of any difficulties in providing securities information during the market break. The Division staff also spoke with personnel at SIAC, the Options Price Reporting Authority ("OPRA"), 16/ NASDAQ, and the NYSE.

Overall, the vendors reported that they did not experience many significant interruptions or delays in providing service. Where problems did occur, they were sometimes caused by brief outages in SIAC's high-speed tape for transaction information or by vendors' computer programming elements that had been designed to identify and query or reject aberrational information (e.g., unusually large price changes).

All vendors were affected by brief outages on October 19 and 20 in SIAC's high-speed line for reporting last sale data in equity securities. As a result of computer hardware problems, SIAC's line was not operational from 1:57 p.m. to 2:06 p.m. on October 19, and from 11:47 a.m. to 11:51 a.m. on October 20. Vendors would not have been able to provide their subscribers with last sale information during these two periods. In addition, one vendor reported that it experienced a 45 minute delay in disseminating last sale information as a result of SIAC's nine minute outage on October 19. Under normal circumstances, the last sale data that it receives from SIAC is accompanied by consecutive message sequence numbers, thus enabling it to determine when there has been a break in the stream of transaction reports. According to this vendor, when SIAC resumed equity last sale transmission at 2:06 p.m. on October 19,

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15/ ADP Financial Information Services, Inc. ("ADP"), Bridge Data, Inc. ("Bridge"), Instinet Corporation ("Instinet"), PC Quote, Inc. ("PC Quote"), Quotron Systems, Inc. ("Quotron"), Reuters Information Services, Inc. ("Reuters") and Teletext of Pricing Information by Computer ("TOPIC").

TOPIC, the real-time market price information service developed by the International Stock Exchange, provides quotations for International Stock Exchange-listed stocks. It currently leases only approximately 160 terminals in the United States. It reported that it did not experience any delays in transmission or any faults in data from the International Stock Exchange.

Instinet also operates a trading system that disseminates market information to subscribers, enabling subscribers to enter buy and sell orders and indications of interest, negotiate with other subscribers in the system, and to execute trades. Instinet stated that generally its trading system (other than the guaranteed execution feature discussed in Chapter Eight) operated normally, except that: (1) the system was unavailable for trading and market information for brief periods on October 16 (between 9:45 a.m. and 10:04 a.m.), on October 19 (between 9:31 a.m. and 9:36 a.m.), and on October 20 (between 9:05 a.m. and 9:07 a.m., 10:13 a.m. and 10:17 a.m., and 3:17 p.m. and 3:38 p.m.) because of system overloads in the amount of message traffic; (2) Instinet curtailed the normal operating hours of its system, pursuant to the Division's request; (3) one subscriber suspended its participation in the system commencing October 19, 1987, because of the subscriber's need to reformulate its trading algorithms.

16/ OPRA is the registered processor for options information; however, the actual processing of this information is done by SIAC, under contract with OPRA.

without notifying the vendor, it assigned message sequence numbers to the data flow that were arbitrary and bore no relation to the last numbers transmitted before the data flow ceased at 1:57 p.m. As a result, the vendor's computer began to reject the entire stream of last sale information.

The NASD reported that there were no interruptions or delays in providing information to NASDAQ subscribers. The NASDAQ system experienced a sharp increase in the number of queries 17/ by subscribers and quote updates by NASDAQ market makers on October 19 and 20. For example, the number of queries rose from 1,416,303 on October 13 to 1,994,546 on October 19 (an increase of 41%), and the number of quote updates rose from 69,709 to 221,492 (an increase of 218%). The average response time for queries by NASDAQ subscribers rose from approximately 2.75 seconds on October 13 to approximately 3.25 seconds on October 19.

There were, however, some delays on October 19 and 20 in NASDAQ's provision of transaction and quotation data to some of the other vendors over the NQDS Service due to insufficient line capacity. Bridge and Instinet stated that their services were affected by such delays. Although the NASD has not been able to measure the duration of the delays, Instinet stated that they were at times as long as half an hour or more. The NASD has completed an upgrade in the NQDS line capacity to vendors from 4,800 to 9,600 bits per second ("BPS").

OPRA reported that there were no interruptions or delays in the dissemination of transaction and quotation information for options. There were, however, two areas in which several of the vendors experienced difficulties. First, as the values of underlying securities and indexes changed dramatically, the number of new options series that were created was much greater than normal. ADP, Bridge, Quotron and Reuters explained that the introduction of new options series into their data bases was delayed because this process has to be done manually. One vendor reported that its entire securities information service shut down for about 5 minutes on October 21 and again on October 22 due to a systems overload caused by the addition of 15,000 to 20,000 new options series to the 80,000 items already in its data base. That vendor has indicated that it has undertaken systems modifications to avoid the possibility of another breakdown. Furthermore, during the weeks of October 19 and 26, the addition of thousands of new options series forced at least one of these vendors to delete some existing options series from its computer files to make room for the new series.

The second problem relating to the provision of options information occurred when premiums (i.e., prices) reached three digits (i.e., $100 or more). The options information message format, which OPRA had specified that SIAC use, only allowed for two digit price information. When premiums reached three digit figures, only the last two digits were disseminated by SIAC. For example, when the premium for a particular option reached $110, SIAC disseminated to vendors a price of $10. According to OPRA, most of the complaints that it received regarding this problem came from broker-dealer "back office" personnel who rely on this information for automated margin computations. Generally, traders who monitor market information throughout the day and who know

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17/   A query occurs whenever a NASDAQ subscriber keys a command for market information into a NASDAQ terminal. The query message is relayed to NASDAQ's central processing site, and the market information is then broadcast back to the subscriber's terminal.

the correct three-digit price even where only the last two digits are displayed, were not as adversely affected. One firm, however, indicated that in some instances registered representatives may not have realized that certain options quotes were defective and accepted customer transactions on the basis of erroneous two-digit quotes. OPRA has corrected the problem and modified the options information message format to accommodate three-digit premiums.

Several of the vendors experienced further temporary difficulties, in addition to those described above. For example, on October 19, Quotron's display of the value for the Dow Jones Industrial Average ("DJIA") was at times incorrect. The inaccuracy was, however, so great as to be obvious (e.g., a decline of several hundred points was shown as an advance of several hundred points). Bridge, which calculates the value of the Value Line Index, 18/ was unable to perform those calculations between approximately 10:30 a.m. and 1 p.m. on October 19. ADP reported that it experienced delays in quote query response times, because lines to subscriber terminals are used to transmit both market information and back office (e.g., margin) information to its clients. In addition, ADP's provision of quotation information was impaired for about 30 minutes on the morning of October 19, because its systems were programmed to reject as inaccurate large price fluctuations.

The broker-dealers that were contacted did not, as a whole, experience many major problems with the receipt of accurate and reasonably timely market information. The broker-dealers' responses also did not reveal any particular patterns of inferior or superior performance by individual vendors.

3. Analysis

The foregoing discussion focuses largely on the delays and inaccuracies in market information that occurred. These difficulties, however, were mostly isolated incidents that were quickly remedied. They should not detract from the larger picture, which shows that market information systems generally performed well during the week of October 19. The Division believes that at least some of the disenchantment with the quality of market information may have been due to the difficulties of trading in fast-moving markets, rather than to the performance of information systems. Finally, the staff is encouraged that the securities information processors and many of the vendors have taken corrective measures, such as rewriting computer programs, and updating processing and line capacity, to avoid a repetition of the problems that were encountered.

At the same time, there were problems that warrant further attention. First, there were significant numbers of late trade reports from stock exchanges and the OTC market. Second, the proliferation of options series strained vendor systems and there was no uniform system for determining which series to delete when necessary. Third, the NYSE should review whether it has adequate personnel and facilities to maintain accurate trade and quote reporting capabilities during periods of sustained high volume.

18/   The Value Line Index is a composite of prices of approximately 1,700 equity securities. Options on this index are traded on the Philadelphia Stock Exchange. Trading these options had to be suspended during the period when Bridge could not update the index calculation. See discussion of trading halts, Chapter Eight, infra.

B. Order Handling

The process of entering orders to buy and sell securities varies depending on the type of order and brokerage firm. In particular, the level of automation at any firm plays an important role in determining the number of steps necessary to complete an order.

Typically, a retail investor calls or visits his or her broker who, in accordance with the investor's instructions, completes an order ticket. The order ticket is time stamped and the order to buy or sell is conveyed to the firm's order room for processing. 19/ At the firm's order room, the order room clerk directs the ticket to either the listed trading desk, option trading desk or OTC trading desk, depending on the type of security. 20/ As a general matter, if the order is for a listed stock, the order either is transmitted to an exchange small order routing or execution system, such as DOT on the NYSE, or to a floor broker 21/ on an appropriate exchange. 22/ Options orders are entered in a manner similar to that used for orders for listed equity securities.

If the order is for an OTC security, the entry process is different. If the firm is a market maker in the particular security involved, 23/ the order entry process involves routing the order to the OTC trading desk where the firm generally trades with the customer as principal and provides an immediate execution. If the firm does not make a

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19/ For example, a small firm might rely on telephones whereas a large firm would use an automated delivery system, which might in turn automatically route some orders to a particular market and route other orders to the firm's order desk for special handling.

20/ Of course, this function of the order desk may be performed by the firm's internal automated order routing system.

21/ Three types of brokers typically can be found on an exchange floor. They are commonly referred to as floor brokers, two-dollar brokers, and bond floor brokers. Floor brokers execute orders sent to the floor by their own firms. Two-dollar brokers transact orders for member firms when the firm's floor broker is unavailable. Bond floor brokers complete bond transactions. The remaining members of an exchange generally consist of competitive traders, who buy and sell for their own account; specialists, who are registered by the exchange to execute orders left with them and to maintain fair and orderly markets in the securities in which they specialize; or competing market makers who, on the options exchange, make markets in a range of securities, but are not obligated to specialize in any one security.

22/ This transmission occurs through a message switch established by each exchange which permits the exchange's computerized order delivery system to interface with the varying order routing systems of its member firms. (See discussion infra.)

23/ A market maker for a NASDAQ security is required to buy or sell 100 shares of that security at the dealer's stated price. The stated price refers to the firm's inside quote consisting of a bid and asked price.

market in the security, however, the trader must query the NASDAQ terminal,24/ locate a market maker, and negotiate the order execution by telephone. 25/

The process changes when a firm has automated routing capabilities. Generally, firms with extensive retail business are more highly automated. For example, a registered representative dealing with a retail investor might have available a desk terminal displaying a format screen. This screen enables the representative to type the retail investor's buy or sell order instruction into the computer terminal, which interfaces with the firm's mainframe computer to route the order directly to the exchange floor if a listed transaction, or to the appropriate market maker if an OTC transaction. This automation reduces the need for telephone contact. Moreover, some firms' internal wire systems are directly linked to the NYSE's DOT system or the regional exchanges' various automatic execution systems. Thus, the broker can quickly survey the terminal to determine which system is qualified for the particular order, and transmit it accordingly.

The order entry process for institutional investors differs from that of retail investors. Institutional investors typically have access to current market information through computer terminals in their offices. Thus, unlike most retail investors, they need not contact their broker to obtain price and volume information before deciding whether to place an order. Institutional customers often will contact a broker, however, to obtain additional information regarding the price at which a particularly large transaction may be effected. Further, whereas retail investors must access a branch office of a firm through commercial telephone lines, or visit their broker's offices in person, institutional investors often have direct telephone or computer links with their brokerage firm's trading room, thus enabling them to by-pass a number of the steps associated with the retail order entry process.

In addition to firm proprietary order routing systems, non-proprietary order routing systems are provided to broker-dealers by a number of companies known as service bureaus. The largest service bureau is ADP. Approximately 25% of the order flow to the NYSE's DOT system is delivered via ADP's "order match service." According to ADP, about 100 of its 350 broker-dealer clients 26/ subscribe to an ADP order routing service as an alternative to maintaining their own systems or to telephoning orders directly to the floor. In contrast, two other service bureaus, Phase III and Securities Industry Software, currently have one firm and three firms, respectively, using their order routing service on NYSE's DOT system.

24/ NASDAQ terminals, used by firms trading OTC issues, centralize quotation information from all market makers.

25/ The order also can be transacted automatically by computer assuming the transaction is within the parameters of the small order execution system. The NASD's small order execution system ("SOES") is for order entries of 1,000 shares or fewer of NASDAQ/NMS securities or 500 shares or fewer of all other NASDAQ issues. Orders outside these limits are negotiated by phone. See Chapter Nine.

26/ ADP also provides financial accounting and recordkeeping services to its securities industry clients.

By subscribing to the ADP order routing service, broker-dealers are able to transmit buy or sell orders through an ADP terminal line directly to the DOT system at the NYSE, or to the electronic routing and execution systems available on the Amex, the Chicago Board Options Exchange, Midwest Stock Exchange, Pacific Stock Exchange, Philadelphia Stock Exchange and NASDAQ.

1. Performance of Routing Systems During the Market Break

In response to the problems experienced during the week of the market break, the Division sent questionnaires to 25 large broker-dealers, 27/ seeking information regarding the order routing systems utilized by these firms, 28/ the capacity of these systems, and any operational difficulties encountered during the period October 13-30, 1987. 29/ In addition, the Division's staff telephoned several other brokerage firms (those with more than 50 branch offices dispersed throughout the world) to request similar data. 30/

a. Proprietary Systems

Of the firms that responded, most represented that they had some type of in-house automated order routing and matching systems. 31/ More than 75% of the firms indicated that their systems functioned well during the week of October 19 in terms of intake but that the external systems used to route and execute orders on exchanges presented problems. One large discount broker, however, indicated that its proprietary system failed several times on October 19 and 20 due to the high level of data traffic

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27/ See Appendix E.

28/ It is important to distinguish between automated order routing systems and automated execution systems. The former routes the order either to one of the various automated execution systems, the floor of an appropriate exchange or the OTC trading desk. The latter executes the order. Some systems perform both functions. Thus, at times, these terms encompass both aspects. Furthermore, there are internal (i.e., proprietary) order routing and execution systems and external order routing and execution systems.

29/ Because many of the responding firms did not focus on their own internal order routing systems, but rather the external systems they employ, follow-up phones calls were made regarding the performance of their in-house procedures.

30/ For purposes of this portion of the study, the phone calls were limited to questions concerning the firms' internal automated and non-automated order routing systems during the period October 13-30, 1987.

31/ For example, one firm has its own internal system for basket trades of approximately 2,000 shares or fewer which feeds the orders directly to DOT on the NYSE; others have their own proprietary systems used to route orders automatically to external systems for execution. Firms that do not have their own automated systems rely on automatic routing systems provided by outside service bureaus such as ADP or Brokerage Transaction Services, Inc. ("BTSI") (a subsidiary of ADP), or use non-automated means to transmit orders to the floor of an exchange or market maker in the case of an OTC issue.

over transmission lines. As a result, many orders that normally would have been routed within seconds were delayed substantially when they had to be routed manually or negotiated by telephone. A few of the firms indicated that their branch offices had more business than they could handle. Nevertheless, few firms indicated that there were problems in delivering orders to the firm's trading desk on a timely basis from regional offices. 32/

The data collected evidenced a wide range in delay time in routing customer orders to exchanges and market makers. While some firms indicated no delay, other firms had delays of up to 2 hours; the average was approximately 20-30 minutes. In the case of firms having to route orders manually due to systems failures, the delay increased substantially as firms with direct access to the exchange floor indicated that certain exchange posts were unable to receive the traffic and firms without direct access were unable to reach other firms to transact their orders.

Most of the firms stated that incoming orders did not exceed system volume intake capacity, but if systems were overloaded, firms resorted to back-up internal systems, which reportedly alleviated any prior internal order routing problems. Moreover, many of these firms represented that they forfeited timely out-bound execution reports to facilitate the mass input of orders. 33/ While queues in the systems were noted, most were with execution reports rather than in the order routing process. Because of the external routing and execution systems' breakdowns,34/ however, some firms stated that orders entered into their internal interface systems were sometimes not reported as executed until a number of days later, and, in certain instances, were never reported.

Despite the generally positive assessment of the performance of firm's internal order routing systems, almost all the firms either increased the frequency at which orders could be entered ("line speed") or added more lines to feed into the external systems used to access exchanges during the week of October 19. 35/ Moreover, storage capacity and processing power were often enhanced, either during the week of

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32/   We were unable to measure the difficulties that customers encountered in reaching their registered representatives on the phone. As noted in Chapter Twelve, however, the Commission and the SROs did receive a substantial number of customer complaints regarding this problem.

33/   Few firms represented that they had lost orders. If orders were lost, firms maintained that external execution systems were responsible and losses were unrelated to the firms' internal order routing procedures. In fact, only one firm assumed part of the responsibility for lost orders and identified voluminous order entry as the cause.

34/   For example, system breakdowns occurred in DOT, SCOREX, PACE and other exchange automatic execution systems. See discussion infra.

35/   There were very few firms that indicated no future plans to upgrade their in-house order routing systems to prepare for a time of even higher volume than during the week of the market break. These few firms represented that no problems had occurred with respect to their internal systems and that they had stayed within their systems' volume capacity.

October 19 or in subsequent weeks. 36/ The firms that were able to respond immediately by increasing line speed, using by-pass emergency modes, and/or other back-up systems, advised that internal problems, particularly with respect to back-up in branch offices, were reduced. 37/

b.   Non-Proprietary Systems

Many firms are dependent on outside automated systems to route orders to exchanges. Some firms represented that they had sufficient terminals and wire operators to handle incoming order volume significantly in excess of average volume, but that they encountered problems when their customer orders were dispatched through service bureau systems. 38/ Those firms that use external systems, or service bureaus, cited problems with delays in order routing and severe disruption in reports of order execution.

The largest service bureau, ADP, experienced queuing delays and backlogs caused by the unprecedented order volume during the market break. In addition to its extensive back office processing systems, ADP has two systems that provide order routing services, Data Network Service ("DNS") and the Message and Order Processing System ("MOPS"). On October 19, there were queues intermittently on DNS and on October 20 and 21, DNS continued to have queues that varied in duration. Delays ranging from 15 to 30 minutes occurred on DNS twice on October 20 and 21, when the capacity of the equipment had to be expanded due to full data files. These short shutdowns affected a maximum of 30 broker-dealers at any one time.

There were no queues on MOPS on October 19. On October 20, however, queues built up on MOPS resulting in a two-hour waiting period. As a consequence, ADP notified firms that no new orders should be entered after 2:30 p.m.. This affected 22 firms. MOPS also was closed to new orders between 12:15 p.m. and 1:45 p.m. on October 21 due to queues. On October 22, MOPS had an equipment problem at the market open but was operational as of 9:40 a.m.. On Friday, October 23, there were no order delays in either system.

The bottlenecks ADP encountered were attributed to two factors. First, there were unanticipated surges in order flow by firms that had never before experienced

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36/   None of the firms indicated an intention to increase staff or phone lines to the exchanges While some firms did acknowledge that more phone lines to the floor or more staff would have been helpful in terms of order input, they also recognized the limited space available on the floors of the exchanges. In this respect, firms placed priority on enhancements to their own internal automated systems.

37/   A few responding firms, however, stated that such upgrades were not necessary and that they were implemented as precautionary measures.

38/   Because the intake capacity of these firms is contingent on the total volume received by the outside systems, however, most of the firms surveyed could not accurately determine their own order routing capacity during the market break. Three firms, however, reported that orders arrived at destinations up to 90 minutes after they were sent through ADP.

multiple increases in their order flow. According to ADP, these increases were particularly great for discount firms and regional clearing firms using their systems. Second, the configuration of ADP's DNS system did not allow for immediate flexibility in responding to rapid volume increases by some user firms. Broker-dealers using the DNS order routing service are assigned a certain number of computer lines connected to "ports" on front-end computers, based on their expected demand for order flow. During the week of October 19, some firms experienced three to five times their normal use of the system, which far exceeded the firms' prior business estimates and disrupted access of other firms sharing their group of ports. ADP modified the DNS front-end groupings over the weekend of October 24-25 to accommodate changing patterns of demand by firms using the system. In addition, ADP has expanded overall capacity of both the DNS and MOPS order routing systems by 100% since the market break. 39/

2. Experience of Retail and Institutional Investors

The 25 broker-dealer firms with customer accounts responding to the Division's questionnaire 40/ reported having received a total of 2,768 customer complaints41/ concerning the period from October 14 to 30. Of this total, 182 complaints dealt with the inability to contact broker-dealers, 269 with the lack of verbal confirmations, and 1,243 with poor quality of executions. 42/ In large part, the difficulty that retail customers experienced in reaching brokers on the telephone was due to the inability of brokerage personnel and communications systems to handle the large increase in the number of telephone calls received from customers. For example, one large discount broker reported that the volume of telephone calls more than tripled on October 19. In addition, brokerage personnel who would otherwise have been available to respond to customer inquiries and take trade orders were required to perform some order routing and execution functions manually, as automated systems became overloaded. 43/

The Division also sent questionnaires to 23 institutional investors, requesting information concerning the methods which these institutions use to communicate orders to their brokers and whether they experienced delays in entering orders and receiving execution reports on certain days in October. 44/ Of the 20 institutional investors that responded to the questionnaire, only one reported that it relies exclusively on commercial telephone lines to communicate with its brokers; all of the others reported that, in addition to commercial lines, they use direct telephone lines (i.e., "dedicated

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39/ ADP added 10 front-end computers, 48 disk drives, 16 tape cartridge drives, 4 laser printers and 1 mainframe computer which increased CPU capacity by 30%.

40/ See Appendix E.

41/ The data from some firms included only written customer complaints.

42/ For a discussion of customer complaints received by the Commission and self-regulatory organizations, see Chapter Twelve.

43/ Several brokerage firms extended the hours of their branches nationwide into the weekend of October 24-25, 1987, to clear back office work and to respond to retail investors' inquiries.

44/ See Appendix E.

lines") and, in some cases, computer links with their brokers. Although several of the institutions stated that they experienced some delays in communicating orders on October 19, 20 and 26, overall the institutions surveyed stated that the delays were not significant in the context of the record volume. 45/ Many of the institutions, however, stated that they experienced delays in receiving trade execution reports for transactions on October 19 and 20. These delays ranged from several hours to, in one case, several weeks.

While it appears that institutional investors did not encounter as many delays or other difficulties in entering orders as did retail investors, there is no indication that broker-dealers ignored retail investors in favor of institutional clients during the market break. Rather, institutional investors may have fared better because their relationship and methods of communicating orders to their brokers are quite different from those of most retail investors. Even in normal times, institutional investors maintain direct telephone or computer links with their brokerage firms and tend to trade much more frequently than do retail investors.

3. Analysis

The review of order entry and routing procedures during the market break highlights at least two areas of concern. First, many broker-dealers were nearly overwhelmed by the surge in order flow. Although firms should not be faulted for not having been prepared for 600 million share days, some firms may not be routinely reviewing and assessing their capacities to accept orders from their clients and to route the orders to the appropriate destination. In-house systems, from telephone capacity to computer programs, should be evaluated routinely, so that investor needs, even in abnormally high volume periods, may be more adequately addressed. Firms should develop contingency plans to cope with excessive volume which should include back-up computer systems, cross-training of personnel and better communication with public customers. To ensure that these reviews regularly take place, the self-regulatory organizations and the Division should review operational capacity during broker-dealer examinations.

Second, it is apparent that at least one major service bureau suffered operational problems that resulted in delays in order routing and execution reporting for a large number of firms. Because firms rely on service bureaus to perform external order routing functions and because these systems interlock and are dependent on the operations of the routing and execution systems of the exchanges, the entire network must be examined to determine the causes of inefficient operations during the market break. It is apparent that modifications to remedy the delays and queuing problems throughout the systems are needed. However, the Act does not specifically provide for regulation of service bureaus. Thus, they are not regulated by the Commission or subject to oversight by any of the self-regulatory organizations. The staff, therefore,

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45/ Only one institution reported that "[t]he chaos on October 19 and 20 made communications and execution extremely difficult."

intends to consider whether some degree of regulatory oversight of service bureaus is desirable, and, if so, whether this would require legislation to amend the Act. 46/

C. Automated Order Routing and Execution Systems

1. Introduction

Automated order routing and execution systems provide the primary means of executing the vast majority of small-sized trades both for listed and OTC stocks. With the exception of program trades, most of these orders are for retail customers. This section describes the performance of these systems in routing and executing orders for listed securities on the NYSE and regional exchanges. 47/ Although the NYSE's DOT system has a very limited automatic execution function, the order routing function accounts for over two-thirds of average daily order volume at the NYSE. 48/

Small order routing and execution systems are designed to receive smaller sized orders electronically from broker-dealers and route them to the appropriate stock exchange floor for automatic execution or for manual handling by the specialist. These systems include the MSE's MAX system, the PSE's SCOREX system, the NYSE's DOT system, the Amex's PER system, and the Phlx's PACE system. 49/

During the market break, these systems were under severe operational strain. The record volume and number of transactions during the week of October 19 caused several failures and problems. The particular operational problems varied among the markets. While some of the markets, such as the MSE, were able to make certain adjustments in their systems to continue operations, two markets, the PSE and the Phlx, asked members to refrain from using their automated systems for several periods of time during the week of October 19 because the systems were overloaded.

To some extent, all of the markets experienced queuing or turnaround problems in their automated systems. Because of the large number of orders, many delays occurred

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46/ One of the Commission's rules, Rule 17a-4(i) under the Act, affects service bureaus, but it does not address their order routing operations. Rule 17a-4(i) provides that service bureaus used by broker-dealers for the preparation or maintenance of records must file with the Commission an undertaking acknowledging that these broker-dealer records are subject to examination by the Commission and that the records are the property of the broker-dealer. The rule was adopted to ensure the accessibility of broker-dealer records in situations where, for example, a service bureau refuses to surrender the records due to the nonpayment of its fees. See Securities Exchange Act Release No. 13962 (September 15, 1977), 42 FR 47552.

47/ The discussion of option and OTC automatic routing and execution systems appears in Chapters Eight and Nine, respectively.

48/ For example, in September 1987, the average daily volume on the NYSE reached 175 million shares; 128 million shares (73%) were routed through DOT.

49/ The BSE and CSE do not have automated routing or execution systems.

in delivering the orders to the specialist post, the "front-end" of the system where all orders enter and are queued based on their time of receipt. Front-end problems were particularly troublesome on October 19, 20, and 21, because so many orders entered the systems at the same time causing queues and delays in routing the orders to the specialist post. Because of the extreme price volatility, the queues and routing delays often drastically affected the execution prices that the orders received. Generally, once the orders reached the specialist post at most exchanges (where the systems were operational), there were no significant delays in execution. Even more substantial delays occurred, however, in issuing execution reports back to member firms and ultimately to customers. A description of each system at the NYSE, Amex and regional exchanges and the problems encountered are set forth in detail below. 50/

2. NYSE's DOT System

a. Development of DOT

To understand the systems problems caused by the volume of transactions during the market break, it is helpful to understand the development of order processing technologies on the floor of the NYSE. In the 1960s, orders were received at the NYSE in the following manner. An order received by a broker-dealer's registered representative at a branch office would be telephoned to the firm's order desk; the firm's order desk would in turn telephone the order (or route it by pneumatic tubes) to the firm's booth on the floor of the NYSE (the member firm booths are located around the perimeter of the NYSE trading floor) and a firm representative (the floor broker) would take the order (a physical paper ticket) to the specialist location for the particular stock and execute a trade with either the specialist or other trading interest represented in the crowd. The process of reporting the transaction back to the customer was substantially the same in reverse.

This manually intensive process could not handle the increasing order volume. Accordingly, new methods were developed for order delivery and execution. In large part, these new technologies were designed to minimize the number of times an order had to be handled manually. As a first step, the large broker-dealer firms, wire houses (so named because they used to have "wire" communications from their branch offices to their home offices), developed data communications facilities for automatically routing orders from their branch offices to their order desks. As this process was occurring, the NYSE, in conjunction with Amex, developed the Common Message Switch ("CMS") in 1976. The CMS is a data communications application that accommodates a wide variety of member firm computer and technical connections, enabling a member firm to send orders directly to the appropriate floor booth on either the Amex or NYSE for execution by the firm's floor broker or to the appropriate specialist post. While these two steps -- the enhancement of firm order routing capabilities and the development of the CMS -- greatly increased the efficiency by which orders could be routed from a customer to the floor booth of the firm, the rising volume of transactions continued to

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50/ See chart at the end of this chapter, which sets forth the volume and number of trades on each automatic routing and execution system for October 16, 19, 20 and 26.

strain the resources of firms and the NYSE. Accordingly, also in 1976, to facilitate the routing of small transactions in particular, the NYSE implemented its DOT System. 51/

Initially, DOT was designed to provide a method of by-passing the member firm floor booth for small customer orders. 52/ Instead, DOT provided a mechanism whereby small market orders could be directly routed from the member firm branch office to the applicable specialist post. 53/ The specialist would then represent the order within the trading crowd and report back an execution to the member firm. This application of DOT provided several benefits. First, it provided a competitive response to the regional stock exchanges that were developing their own small order execution systems. 54/ Second, it provided a facility whereby order traffic could be directed away from the floor broker so that the floor broker could use his time to execute large orders, which usually require more attention. Third, it provided a better system of internal controls to ensure the timely execution and reporting of transactions.

b. **Enhancements to DOT**

Since the introduction of DOT, its applications have increased. In 1980, the NYSE developed a new application of DOT called the Opening Automated Report Service ("OARS"). OARS facilitates the efficient and accurate processing of eligible orders received by the NYSE through DOT prior to the opening of trading, when an estimated 20% of daily order flow reaches the trading floor. OARS stores individual pre-opening market orders of up to 5,099 shares entered through DOT prior to the opening. Then OARS 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.

51/ DOT also was a competitive response to the automated small order execution systems already being developed and operated by regional stock exchanges. The Pacific Stock Exchange has operated its SCOREX (originally called COMEX) system since 1969. The Philadelphia Stock Exchange began operation of its PACE system in 1976, and the Midwest Stock Exchange began its MAX system in 1981. These three automatic execution systems are very similar in operation, in large part, as a result of the exchanges' sharp competition with one another for order flow, which caused them to adopt similar pricing parameters for market orders, assure similar response times, and offer similar execution costs.

52/ In 1976, the DOT order eligibility size was 199 shares, 36% of the average size of a trade on the NYSE (559 shares). In September 1987, both the average trade size and DOT order eligibility size were 2,099 shares. In October 1987, the average size trade was 2,455 shares, and DOT order eligibility at 2,099 shares represented 85% of this figure.

53/ A market order is an order to buy or sell a stated amount of a security at the most advantageous price obtainable after the order is represented in the trading crowd at the post. By contrast, a limit order is an order to buy or sell a stated amount of a security at a specified price -- or a better price, if possible -- after the order is represented in the trading crowd. A marketable limit order is a limit order that is immediately executable because the price of the subject security at the time the order is entered is equal to or better than the limit price on the order.

54/ See discussion of regional systems, infra.

thereby assisting the specialist in determining the opening price. In addition, after the specialist determines the opening price, OARS automatically distributes within seconds execution reports to member firms for each stored order in that stock. 55/

The DOT limit order system ("LMT") assigns a limit order an identifying number, and routes the order to the specialist's post where it is entered into the limit order book. 56/ When an order is executed by the specialist, he reports the identifying number on a mark sense card and the system sends the execution report to the entering member and to clearing. The LMT system also has begun to handle odd-lot orders that are routed through DOT. 57/

In 1984, the NYSE further implemented certain enhancements to the DOT system, including an automatic execution feature. If the NYSE quote equals the best quote disseminated by any participant in the Intermarket Trading System and the spread between the bid and asked is no more than one eighth of one point (e.g., when the quote is 20 bid to 20 1/8 asked), the DOT system will automatically execute the order and immediately report the trade back to the member firm. 58/

In addition, the NYSE developed the Request Status Reporting feature, which generates an execution at a reference price of an order that has not received an execution report within three minutes. 59/ The reference price currently is the NYSE

55/ The NYSE has proposed to increase the size of order eligibility for OARS from 5,099 to 30,099 shares. See Securities Exchange Act Release No. 24993 (October 5, 1987), 52 FR 37862.

56/ In addition, the LMT system allows broker-dealer firms to choose to have limit orders near the prevailing market routed to their own booths, and the others directly to the specialist.

57/ During October 1987, and until December 1987, standard odd-lot market orders (an odd-lot is an order to purchase or sell a security in an amount less than 100 shares) went through the CMS to be routed to the NYSE's Automated Pricing and Reporting System ("APARS"). APARS automatically priced the orders, based on the next round-lot sale in the stock. APARS, an older computer system, was designed to keep specialists advised of their odd-lot inventories and return execution reports to the member firm offices originating the orders. The NYSE now is changing its procedures for handling odd-lots, and standard market odd-lot orders now are being routed through the LMT system, and receive an execution based on the prevailing NYSE quote, with no odd-lot differential charged on the order. After execution, the odd-lot trades are included in specialist inventory accumulations. The new odd-lot reporting system, APARS II, provides comparison reports and sends a direct input of the trades to the appropriate clearing systems. See Securities Exchange Act Release No. 25177 (December 7, 1987), 52 FR 47472.

58/ Orders of up to 1,099 shares are eligible for the Immediate Reporting Service; currently, the feature is available for only about 50 stocks, none of which is traded in the electronic display book environment (see infra).

59/ The specialist rarely fails to act within the requisite three minutes, so only a very small percentage of orders are executed at the reference price.

quotation at the time the DOT order was received by the system. 60/ However, a specialist must make every effort to execute orders in two minutes or less, and, in its evaluations of specialists to determine allocations of stock, the NYSE takes into account such turnaround performance. 61/

Order-size eligibility for DOT also has increased since its inception. In 1984, DOT capacity for market orders increased from 599 to 1,099 shares and marketable limit orders were handled as market orders for the purposes of DOT. Also in 1984, the order-size eligibility in LMT was increased to 5,099 shares for all LMT orders. 62/ Now, the LMT system accepts both day limit and "good 'til cancelled" orders of up to 99,900 shares.

Currently, member firms may route orders of up to 2,099 shares through DOT in market and marketable limit orders. DOT also may accept order sizes larger than 2,099 shares, up to 30,099 shares in the more liquid stocks, but there are no guarantees as to the timing of the execution of such orders. 63/

As discussed in Chapter One, in response to increased use of derivative products, such as index options and futures, the NYSE developed the List system to facilitate instantaneous transmission of large orders from member firms. The DOT List is an application of DOT that allows member firms to send orders through DOT in, as its name implies, a list of securities. Primarily used for so-called "program" trading strategies such as index arbitrage and portfolio insurance, DOT List processing enables

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60/ Originally, in 1984, a DOT market order had been assigned a reference price based on the NYSE's most recent last sale price in the subject stock preceding the order, and, if not executed within the specified time after receipt, the DOT order would be automatically executed at this reference price. See Securities Exchange Act Release No. 21197 (August 2, 1984), 49 FR 31792 ("1984 DOT Release"). In 1985, the Commission approved the NYSE's modification of the reference price assigned to a DOT order from the previous last sale price to the NYSE quotation at the time the DOT order is printed on the floor. See Securities Exchange Act Release No. 22498 (October 2, 1985), 50 FR 41082 ("1985 DOT Release"). The Commission, however, expressed concern regarding the use of the NYSE quote (or, for that matter, the NYSE last sale, see 1984 DOT Release) as the reference price, instead of the best bid and offer of all ITS participants (see 1985 DOT Release).

61/ The NYSE estimated that in 1986, 92% of all DOT orders were executed and reported back to the originating firm within two minutes. For the first quarter of 1987, that figure remained at 92%; for the second quarter of 1987, the figure was 94%. See letter from Santo Famularo, Assistant Vice President, NYSE, to Brandon Becker, Associate Director, Division of Market Regulation, SEC, dated October 6, 1987.

62/ Until 1984, the order eligibility size had been 599 shares for "day" limit orders-- those limit orders in effect only for the day on which they are placed -- and 5,099 shares for "good 'til cancelled" limit orders -- those limit orders in effect indefinitely, or until cancelled by the order-entry firm.

63/ Firms must make special arrangements with specialists for these larger orders.

members to enter buy or sell orders quickly in a large number of securities by having previously identified the specific securities to be included as a part of the package. Indeed, member firms, through personal computers located in their offices, can modify their particular package of securities for execution on an intra-day basis.

Parallel to the development of enhanced systems for routing orders to the NYSE, the Exchange also has undertaken to automate the procedures for handling orders received by the specialist. For the majority of stocks listed on the NYSE, each specialist maintains a so-called "limit order book." This book is a physical book for recording limit orders received at particular prices. As such, using this book is manually intensive because a specialist must receive orders on paper and physically record the order tickets received. Moreover, when an order is executed out of the limit order book, the order must be manually reported back to the member firm. The NYSE, however, has been expanding the use of electronic display books, replacing handwritten limit order books. 64/ With the use of the electronic display books, orders are electronically received through DOT, 65/ displayed on the electronic book, stored or executed (as the case may be), and electronically reported back to firms with limited manual intervention by the specialist other than to enter the execution price. Such electronic systems greatly increase the efficiency of order execution, helping eliminate paperwork and processing errors.

c.   How DOT Operates

Before discussing the processing difficulties that occurred during the market break, we detail the specific mechanical procedures used for orders received through DOT. After a DOT order goes through the CMS, it is validated and assigned a unique turnaround number bypassing the member firm's booth. First, if a market order is for a security with an electronic display book, it will be directed to the Post Support System ("PSS"), which will then route the order to the appropriate display book. In contrast, a market order for a stock still traded in the paper environment, and any limit order or ITS commitment to trade (regardless of whether the stock is traded in the display or paper environment) must be routed through a Universal Floor Device Controller ("UFDC") printer on the exchange floor. A card printer at the appropriate specialist post prints an incoming order on a machine readable mark-sense card. The order is handled by a clerk, passed to the specialist who executes the order and returns it to the clerk; the clerk marks on a mark-sense card the turnaround code, price, number of shares, and the name of the broker on the other side of the trade. The card is then placed in a card reader connected to the CMS. Using the turnaround number, the system retrieves the original order data, and generates and transmits an execution report to the member firm.

The card printer can print out only a limited number of messages per second; thus it is a critical stress point in a busy market. At each of the 14 trading posts, there are eight active printers and two emergency printers (the emergency printers generally are used to print queues that may develop or to replace any active printers

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64/   As of December 1987, approximately 600 of the 2,000 NYSE issues, including 190 to 200 of the most active stocks, were on electronic display books.

65/   Currently limit and ITS orders still must be printed and manually delivered to the specialist posts.

that stop functioning, for example, because they temporarily have run out of paper). Each printer, which generally supports two or three specialists, is capable of printing only 10 to 12 messages per minute, depending on the length and type of message. The NYSE indicated that, before October 19, the queuing of orders and messages on the printers only occasionally created short delays at the printers.

d.   DOT Operations During the Market Break

The average NYSE daily trading volume in September 1987 was 175 million shares;[66] by comparison, on Monday and Tuesday, October 19 and 20, the volume was 608.3 million and 613.7 million shares, respectively. [67]   For purposes of analyzing the performance of order routing and execution on the NYSE, it is important to focus on statistics regarding numbers of orders, [68] and, accordingly, the amount of message traffic that DOT was required to handle.

In September 1987, DOT processed an average of 138,600 orders daily; on October 19 and 20, 1987, DOT processed 471,513 orders and 584,992 orders, respectively. Each of the various DOT components could handle only finite numbers of messages generated by these orders, including any related administrative messages: delays occurred when the numbers of messages exceeded the maximum capacity. In general, the UFDC printer message traffic exceeded the limit. The UFDC printers collectively can handle 68 messages per second, but the printer capacity was exceeded during high order

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[66]   In September 1987 the volume of trading through DOT averaged 128,500,000 shares daily, contributing to about 73% of the trading.

[67]   On October 19 and 20, the volume figures for trading through DOT were 324 million and 419 million shares, respectively, contributing to about 54% and 70% of the trading volume, respectively.

[68]   Because reported trades may involve the execution of two or more separate orders or transactions, particularly at the opening, and because of the "active stock" feature of DOT that groups small market orders and prints out a "bunched" order, reported trade statistics are a significant factor in an evaluation of how the NYSE handled post-trade activity.

periods, 69/ therefore delaying market orders in paper environment stocks, 70/ and all limit and ITS orders. 71/

Market orders, particularly in the stocks still traded in the paper environment, were delayed due to the message traffic at the printers. 72/ The average number of messages fluctuated more broadly on October 19; accordingly, there were more peaks at certain times to cause queuing at the printers. By noon on October 19, close to one of these peak periods, the NYSE reported that the printers created delays of 45 to 75 minutes in both market and limit orders. Even during the periods of heaviest trading, according to the NYSE, on average, 80% of incoming orders were executed in three minutes or less, and 95% were executed in ten minutes or less. 73/

The NYSE reported that the only market orders not executed were those to sell short. 74/ Specialists were unable to fill orders to sell stock short because the prices

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69/ It has been difficult for the NYSE and the Division to ascertain the times or lengths of delays in the routing of market or limit orders that resulted from excess traffic at the printers. The printers in different areas of the trading floor were affected at different times, and no specific records set forth information about the times or lengths of delays.

70/ Although the printing queues created the most significant problems, the voluminous order flow also caused other related difficulties. For example, disk space for the storing of information was exhausted. In addition, the heavy volume demonstrated the shortcomings of certain software, which had to be corrected. Therefore, there were some delays in order execution even in market orders in display stocks.

71/ As discussed infra, ITS orders also had an impact on DOT activity because all ITS orders must be printed. The printing queues at the UFDC paper switch were frequently so large that the majority of incoming ITS commitments to trade expired before they were routed to the appropriate specialist. Because of the fast market conditions, ITS orders continued to pour into the NYSE. Because the commitments already had expired by the time they reached the appropriate specialist's post, these commitments and any other accompanying messages such as queries or error messages were a further burden on the UFDC.

72/ The NYSE has indicated that there were no problems with OARS (the component of DOT that handles orders received prior to the opening). Any difficulties in opening individual stocks resulted from order imbalances.

73/ The NYSE indicated that once market orders were printed, there was no excess message traffic to create any further delays in order execution.

74/ The NYSE has stated that it cannot substantiate any "rumors" of missing orders.

were falling consistently throughout most of October 19 and 20 and short sales are not permitted while the price, or last "tick," is falling. 75/

With limit orders there were delays that lasted for over an hour, in both paper and display book stocks, 76/ again due to message traffic at the printers. In general, the delays in limit orders were more extensive than those in market orders, because the specific software mechanism enabling firms to cancel limit orders or to cancel and replace limit orders did not function properly. 77/ Although normally there is more market order traffic than limit order traffic, on October 19 and 20, DOT handled twice as many limit orders as market orders. Because all limit orders must go through the UFDC, all of this extensive limit order traffic was subject to delays. The LMT system stopped receiving orders one half hour before the market closed on October 20, because the system's memory capability had been exceeded.

e. Execution Reports

Although there were few system difficulties, interviews with member firms clearly indicate that the heavy trading volume contributed to problems in specialists' disseminating execution reports on a timely basis. 78/ On October 19, trade reports in certain electronic display book stocks, such as General Electric Corporation, American Telephone and Telegraph Company, and Union Carbide Corporation, were either delayed

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75/ Rule 10a-1 under the Act generally provides that a person may sell a stock short only at: (1) a price above the price of the last sale (at a "plus tick") or (2) the same price, if such price is above the next preceding different price (at a "zero-plus tick").

76/ In particular, specialist posts 8 through 11 were delayed on the limit side, because a number of active issues, (such as American Express Company, Ford Motor Company, General Electric Company, International Business Machines Corporation, and Johnson & Johnson) traded at those four posts.

77/ The NYSE was in the process of converting the handling of odd-lot orders from the older APARS to the new APARS II before the market break. See supra. The APARS system for odd-lots was not able to handle the more than 13 messages a minute that it received; the frequent excess capacity created significant queues. The APARS feature that was designed to keep specialists advised of the extent to which they had bought or sold stock did not work adequately. For example, specialists did not receive reports of their positions as of the close of the day on October 19 until 2:00 p.m. on the next day. Thus, specialists who had been required to buy the many odd-lots of stock that investors offered to sell because of the declining market, lacked important information about their inventory accumulations, and, specifically, they had to make determinations as to how to open their stocks on October 20 without knowing how much stock they owned. In addition, the odd-lot system failed to execute and report many orders on October 20.

78/ NYSE member firms responding to the Division survey indicated that the firms had experienced numerous and sometimes severe delays in receiving execution reports from DOT, regardless of the kind of order -- market, limit, or odd-lot.

or not sent out at first; approximately 5,000 to 9,000 reports of executions were lost and had to be recreated on paper and dispatched to the member firms.

f. Proscriptions on Members' Program Trading

Starting on October 20, in an attempt to alleviate order execution problems, the NYSE requested that its members not use the DOT List processing feature for any program trades. This request was a response to the fact that List orders on October 19 accounted for approximately 25% of total DOT orders. While DOT orders actually increased on October 20, the staff believes that without the NYSE's action, queuing of DOT public orders would have been much greater.

As of November 3, the NYSE permitted members to execute program trades over DOT prior to the opening, whether for their own accounts or for customers. On November 9, members were allowed to use DOT to execute orders for program trades throughout the day.

3. Amex's PER System

The Amex's Post Execution Reporting ("PER") System uses the same computer hardware and is generally similar to DOT. PER electronically routes market and marketable limit orders of up to 1,000 shares 79/ from participating member firms80/ to the post on the floor where the security is traded. Once executed by the specialist, a transaction report is automatically routed back to the initiating member firm. Unlike some exchanges' automated systems, Amex's PER does not have the ability to execute trades automatically. The Amex has instituted "AUTOPER," however, to facilitate execution upon the order's arrival at the post. AUTOPER enables specialists to enter execution data into PER by using touch screen terminals, 81/ rather than executing by manual reporting on mark cards.

Normally, PER delivers orders and execution reports for 10,000 trades a day. Although PER averaged approximately 25,000 trades on October 19 and 20, 82/ it

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79/ In July 1987, the Commission approved a proposal by the Amex to increase the size of eligible market and marketable limit orders from 1,000 to 2,000 shares. See Securities Exchange Act Release No. 24668, 52 FR 25677. As of December 1987, however, the Amex had not implemented these increased trading parameters.

80/ Approximately 80 Amex member firms utilize PER. All specialists on the Amex floor are included on the PER system and all issues are eligible for PER routing unless quotes become lower than 1/16th.

81/ "Touch screen" terminals display the incoming PER orders and, as the name implies, permit each order to be executed by the specialist touching the screen where the order is displayed.

82/ On October 19, PER facilitated the execution of 23,583 orders representing 8,599,907 shares of the day's volume. On October 20, PER facilitated the execution of 26,002 orders representing 8,994,440 shares. In comparison, the September 1987 daily average of executed orders facilitated by PER was 8,329 and volume reached 2,760,133 shares.

experienced relatively few problems. On the front-end, orders entered the PER system from the participating member firms with no reported problems. Once in the system there was no queuing of orders, with one exception. On October 19, at 3:49 p.m., the PER system was shut down for the remainder of the trading day while the computer disk was changed. Orders queued in the system were returned unexecuted to the member firms initiating the orders.

Volume-related problems that may have caused delays in turnaround time, i.e., the time from which the order is entered into PER to the time when the order is executed, arose at the point of execution with AUTOPER. The problems involved the priority of orders on the system and the temporary elimination of the use of AUTOPER touch screens to execute orders by some specialists. The specialist's AUTOPER screen displays up to six orders entered through PER at a time. When the screen is full because orders are entering the system faster than they can be executed, orders begin printing out on paper tickets in the order they are received by the PER system. After an order is executed on the screen, the next order not already printed in hard copy is displayed on the screen. Thus, the specialist must rely not only on the screen but on the paper tickets to ensure that orders are executed in proper priority and sequence. Many specialists turned off their screens during the week of October 19 so that all orders were printed in hard copy, creating less chance of error. 83/

Although switching off AUTOPER so that all orders were printed on hard copy alleviated potential errors, it resulted in execution delays because all orders then had to be manually executed without the use of the touch screen. During this time, the specialist was required to mark transaction cards manually to execute orders, that were then inputted into the PER system by a clerk, rather than executing orders by simply touching the screens. Although the Amex does not have statistics on the delays this may have caused in execution, it is clear that the time for execution of PER orders increased. This delay is reflected in a comparison of turnaround times between normal days and the days of extremely heavy volume, such as October 19 and 20. 84/ For the month of September, 88% of the orders entered through PER were turned around within three minutes. On October 16, the turnaround percentage was 88.1%. On the 19th, 20th and 26th, the three minute turnaround percentages were 68.7%, 64.7%, and 72.1%, respectively. In comparison, the turnaround percentage from the time the order entered the system and a report was received by the member firm, measured by a fifteen minute interval, was 71%, 67%, and 72% for the 19th, 20th, and 26th, respectively. The switch from AUTOPER touch screens to manually marked cards for execution entailed the use of clerks and resulted in the elimination of automatic transmission of execution data, and probably resulted in an increase in uncompared trades. 85/ Amex has indicated it has no plans to deal with the problems caused by switching to a manual system without AUTOPER and believes that PER generally worked well during the weeks of October 19 and 26.

83/ The Amex has no statistics on how many specialists chose to execute trades manually during the week of October 19.

84/ The standard by which turnaround time is rated is three minutes from the time the order enters the PER system.

85/ See analysis on uncompared trades in Chapter Ten.

4. Analysis of DOT and PER Performance

The Division believes that although the NYSE's automated systems generally work well to ensure prompt and effective order routing and execution services under normal market conditions, they were not adequate to respond to the increased message traffic in October. Although this conclusion is obvious in hindsight, the important point for the future is for the NYSE to redouble its efforts to improve the processing of message traffic. Specifically, the NYSE must undertake further efforts to upgrade its order-handling equipment to prevent the problems described above from recurring during periods of high volume. 86/ The Division is aware that the NYSE has appointed an Operations Advisory Committee to examine whether new systems and technological upgrades are appropriate, and we encourage the activities of this committee and any other efforts to advance the efficiency of the NYSE order-routing systems.

In particular, the Division encourages the increased movement of stocks to electronic display books. We note that 190 to 200 of the NYSE's most active stocks are now traded in the display environment and that, by mid 1988, there will be 350 display books, covering 1,000 stocks. In addition, by that time the NYSE anticipates that it will have completed a connection between the electronic display books and the LMT system, so that limit orders no longer will have to be printed at the UFDC. We also stress that, to improve the flow of order traffic for stocks in the paper environment, the Exchange needs more printers that can operate at higher speeds. The Division believes that the DOT system as a whole should be able to process high volume efficiently and effectively as more stocks are electronically displayed. Other modifications, such as default executions of ITS orders in fast market conditions, discussed _infra_, should improve DOT operations overall.

Amex's PER system, which only routes orders, generally worked well, although the system did evidence the problem discussed above. As noted, the switch off AUTOPER caused execution delays. We believe Amex should examine the systems problems that caused the specialists to shut off AUTOPER and the resulting delays. Amex should address these problems so that it can deal effectively with future volume surges.

The Division is also considering expanding its oversight program to include periodic review of NYSE and Amex order-routing, execution, and support systems in general, to ensure that these critical exchange operations may perform more efficiently and effectively in the future.

5. MSE's MAX System

The MSE's Midwest Automatic Execution ("MAX") System routes market and limit orders of up to 1,099 shares to specialist posts, and guarantees execution of orders up

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86/   In early 1987, the NYSE had decided to accelerate its technological developments, and anticipated that its automated equipment would be prepared to handle trading days of 500 million by the end of 1988, 600 million by the end of 1989, 700 million by the end of 1990, and 750 million by the end of 1991.

to 1,099 shares at the ITS best bid and offer. 87/ In general, under the MAX system, an order is entered electronically into the system from the office of an MSE member firm. 88/ After entry, the MAX system automatically determines a price at which a MAX market order would be executed based on the ITS best bid and offer available at the time the order was received by the system, and then routes the order to the trading post of the MSE specialist responsible for handling trading in the particular security. The order, together with its projected MAX execution price, is then displayed on a video terminal at the specialist post for 15 seconds to permit the specialist to improve upon the execution price. 89/ If the specialist does not intervene within this 15 second period, the order will be automatically executed against the specialist at the previously determined MAX system price. 90/

During the week of October 19, the MSE handled nearly triple the number of transactions of an average week. 91/ The MSE experienced a similar dramatic increase in the number of transactions executed on the MAX system, 92/ with preliminary MSE

87/ The MAX system allows individual specialists to increase the maximum size limit for orders that will be eligible for routing and automatic execution under the MAX system. All MSE specialists are on the MAX system. In addition, currently 1,225 issues are MAX eligible.

88/ Currently, 60 MSE member firms are directly connected into the MAX system. In addition to orders entered on the MAX system from the offices of member firms, 15 floor brokers, employed by member firms that use the MAX system, have terminals on the MSE floor that permit them to enter orders directly into the MAX system. These terminals also may be used to enter orders from any other MSE member firm.

89/ If a MAX order is a market order and the ITS best quotation spread between the bid and the offer is 1/8 of a point and the stock is quoted with a minimum variation of 1/8 of a point, the order will be immediately executed without first being displayed at the specialist's post because the market price cannot be bettered

90/ Limit orders entered on the MAX system are executed automatically for their full amount when the limit order price is penetrated in the primary market for the particular security. Where such primary market trades occur at the limit price MSE specialists are only required to execute 300 shares of the limit order at the limit price for every 500 shares traded on the primary market. This function is not automatic on MAX and must be done manually by the specialist. See Securities Exchange Act Release No. 22073, (May 23, 1985), 50 FR 23216.

91/ See note 96, infra. See also Chapter Four and Appendix F which discusses trading on the regional stock exchanges.

92/ MSE specialists and floor brokers stated that they believe one reason for the increased order flow on the exchange during this period was that their regular customers, who normally route only a fraction of their order flow to the MSE, sent MSE up to 100% of their orders because of the difficulty and delays encountered in executing orders on the NYSE. These specialists also stated that the type of orders that were executed on the exchange during this period were mostly smaller retail orders rather than the larger block trades that generally

data showing 25,653 trades being executed on MAX on October 19, 30,203 on October 20, and 31,056 on October 21, compared to 8,982 as the daily average trades for September. MSE officials also stated that, because of perceived slowness in updating quotes at the primary market 93/ and the inability of specialists to obtain access the primary market at many times on October 19, they decided to reduce the MAX automatic execution limits for all stocks to a maximum of 1,099 shares irrespective of whether a specialist had a previous agreement to guarantee larger size orders. When this condition worsened as the day progressed, the MSE dropped the MAX automatic execution limit again, this time to 599 shares. MSE officials stated that they felt these steps were necessary in order to reduce the risk to specialists. This level was kept in place until October 26 when the MAX automatic execution limit was raised back to its normal levels of 1,099 shares for all specialists. 94/

MSE officials estimated that their computer system can handle a total capacity of 30,000 to 40,000 transactions a day. 95/ That capacity was exceeded on October 19, 20, and 21. 96/ As a result of the increased order flow, and the increases in the number of last sale transactions and quote changes received on the system, the MAX system experienced system delays on October 19, 20 and 21 for as long as 41 minutes during peak periods, with average delays ranging from 15 to 20 minutes. 97/ The delays were experienced in the time it took for orders to be transmitted from the front-end portion

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account for the majority of the volume on the MSE. While some block trades were executed on the MSE during this period, the specialists stated that these trades tended to be from regular customers and were not routed away from the NYSE.

93/ See Section A of this chapter discussing Market Information Systems.

94/ From October 20 through October 30, no MAX specialist went higher than 1,099 shares. In addition, as of November 6 only 132 issues were above the 1,099 minimum limit as compared to 604 issues with limits higher than 1,099 on October 16.

95/ Because the MSE's front-end computers receive both MAX and non-MAX orders, the capacity figure noted above represents total order capacity, not just MAX order capacity.

96/ MSE handled a total of 37,424 trades, 46,722 trades and 48,771 trades on October 19, 20, and 21, respectively. MAX executions represented more than half of these trades. See the chart at the end of this chapter which sets forth the number of MAX trades executed on the 16, 19, 20 and 26.

97/ MSE also had similar system delays on October 26. No further delays were encountered in the system after Wednesday, October 28. In addition to delays encountered with MAX, MSE officials stated that some MSE member firms using ADP service lines for entering orders into the MAX system encountered queuing delays of several hours over the ADP lines before their orders reached MAX on October 19, 20 and 21. Those member firms were also unable to receive reports of orders executed on the MAX system and transmitted over ADP on these same dates. See discussion of ADP related problems in the section on order entry systems, supra.

of the system, where orders are received from member firms, 98/ to the back-end part of the system where orders are executed based on the ITS best bid and offer. Once an order reached the back-end portion of the system, however, it was priced within two to three seconds and then was subject to automatic execution within 15 seconds if it fell within the reduced automatic execution limits for MAX. If the size of the order was higher than the reduced MAX limits, it was delayed approximately four to five minutes to be manually executed by the specialist.

Because orders are not priced until they reach the back-end part of the system, the front-end delay can result in an execution price significantly different from what would have been received if there had been no delay. For example, an order to sell 100 shares of IBM entered at 3:00 p.m. on October 19, would have received an execution price of approximately 116 if priced immediately, but a price of 107 if executed at 3:40 p.m.

In an effort to reduce delays, the MSE took a number of steps during the week of October 19 to speed up the system by removing some normal checks and backups from the front-end system. These steps included eliminating the normal logging for ITS transactions, CQS quotes, and CTS last sale reports, 99/ and shutting down the Backup Order Delivery System ("BODS") which would have been used to provide a backup record of orders in the system in case of a hardware failure in the main front-end system. 100/ MSE operations officials stated that all these systems were restored to service on October 28. In addition to the temporary elimination of some checks and backups, in order to increase the front-end system's capacity, by October 26 the MSE was able to add a third computer to the two already in use for the system. 101/ MSE

98/ The front-end system functions basically as a communications processor. It has three main functions: (1) it receives MAX orders and sends the orders to the back-end system for pricing and execution; (2) it receives last sale reports from SIAC, logs them in, and sends them to MAX; and (3) it receives quotes from SIAC, logs them in, and then sends them to MAX where they are used to calculate the ITS best bid and offer on a continuous basis. In addition, once a MAX order has been executed, the front-end system transmits a report of the completed order to the MSE member firm that entered the order.

99/ The MSE stated, however, that they did not eliminate logging of MAX orders from the front-end system.

100/ MSE officials stated that if a hardware failure had occurred on the main front-end system during the period when BODS was shut down, approximately four minutes of orders would have been lost. They pointed out, however, that if such a loss had occurred it would have been possible (in about one day) to reconstruct the lost orders from logged order entry records from the front-end system.

101/ In addition to the delays encountered on the MAX system, beginning on October 19 the MSE also exceeded the capacity of the computerized files that maintain the records of executed trades. As a result of this, the MSE was forced to add additional trade file storage capacity to their system, increasing its capacity from 40,000 records on October 19 to 50,000 records by October 26, and 55,000 records by October 28. MSE officials stated that they are in the process of adding additional capacity to this computerized file system.

operations officials stated that as a result of the improvements made to the MAX system since October 19, the system now has the capacity to handle approximately 50,000 MAX and non-MAX transactions daily. 102/

According to the MSE, on October 19 five large MAX users were contacted by MSE staff and informed of the reduction in MAX automatic execution limits. The firms were advised that the MSE's computerized order file was approaching capacity and that, if its capacity were exceeded, they would be required to input trades manually and that the MAX system would not be able to send execution reports automatically. Firms were told that if they were unwilling to accept that risk, they should route their orders to another market. In response to this notification, one firm chose to reroute orders for a short period. The other firms continued to route to the MSE. Due to MSE's efforts to expand its computerized files during this period no firm was required to input manually during this period.

The MSE also stated that when it received quotes from a stock's primary market that had been designated as "non-firm" or "fast market quotes" by that exchange, and thus were not binding on the quoting market and could not be used in the calculation of best bid and offer for the MAX system, it dropped the automatic execution limit for such stocks to zero. 103/

Further, because of their concern with the accuracy of quote information received during the weeks of October 19 and 26, MSE officials deleted suspect quotes from the MAX system. According to MSE officials, when they received administrative messages from SIAC or an ITS participant indicating quotation system delays or ITS delays from a particular exchange, they purged all quotes from that exchange for the period indicated in the administrative message. 104/ Purged quotes, however, continued to be displayed

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102/ The major capacity increases did not occur until the week of October 26, when the third computer was added to the front-end system. Although there were some slight improvements in MAX's capacity on October 20 and 21 due to the enhancements on October 19, these did not have a significant effect on queuing and delay problems because of continued increased order flow. The MSE did indicate, however, that it could have handled the order flow of October 19, 20, and 21 without significant delays with the capacity enhancements they had installed over the weekend on October 24 and 25.

103/ MSE data indicate that MAX automatic execution limits were reduced to zero for 2 stocks on the 19th, 9 stocks on the 20th, 7 stocks on the 21st and the 22nd, no stocks on the 23rd and 26th and 9 stocks on the 27th.

104/ MSE officials stated that quotes from a stock's primary market are never purged from the MAX system for best bid and offer calculation; only regional market quotes are purged under such circumstances. Where quotes from a primary market were suspect, or were the subject of such administrative messages, the MSE would simply drop the MAX automatic execution limit for the effected stocks to 0 and allow MSE specialists to manually price MAX trades in some stocks. MSE officials stated that quotes suspected to be inaccurate from other regional exchanges or NASDAQ were purged nine times during the weeks of October 19 and 26. Specifically: on October 19 quotes were purged four times, once from BSE and Phlx and twice from NASDAQ; on October 20 NASDAQ quotes were

on the MSE's other floor display systems and thus were available to specialists and members on the floor.

Suspect quotes also can be purged under a second method in which a specialist complains to MSE floor officials that quotes on a particular stock continue to be bad. Under such circumstances, if MSE floor officials can confirm that a quote from a regional exchange in a particular stock is substantially out of line with the primary market quote and that MAX automatic executions have occurred based on such a quote, MSE officials can purge the quote. 105/ After a quote has been purged under this method, MSE will contact the regional exchange and request an updated quote.

Since the market break, MSE officials stated that they have continued their efforts to increase the capacity of the MAX system, including the ability to increase peak capacity with existing hardware, and to improve the communications capacity with firms from which MAX orders are transmitted. In 1988, the MSE intends to add additional disk drives for data and communications backup and faster computer processors. By year end 1988, MSE hopes to be able to handle a maximum of 50 million shares per day and 60,000-70,000 transactions per day. In addition, the MSE has developed a better system for measuring the capacity of its equipment, allowing it to predict more accurately the capacity of its computer and data network.

6. Phlx's PACE System

Phlx's Philadelphia Stock Exchange Automated Communication and Execution ("PACE") System 106/ automatically executes orders of up to 599 shares at the ITS best bid and offer and routes up to 1,099 shares or higher by agreement between specialists or member firms. 107/ According to exchange officials, the unusually heavy volume of

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purged twice; on October 21 PSE quotes were purged twice; and on October 26 NASDAQ quotes were purged once for over a three hour period.

105/ MSE officials stated that although quotes for some stocks were purged under these circumstances during the week of October 19, they had no written records of what quotes were purged, the affected stocks, or the date and time of such purges.

106/ There are 27 member firms that participate in the PACE system. Twenty four specialists participate on PACE and 950 stocks are eligible for PACE executions.

107/ The PACE system is a non-order exposure system; that is, an order transmitted to the Phlx trading floor via PACE is not displayed to a specialist before execution. Thus, the specialist cannot intervene to improve the price at which the order is executed in the system, even if a superior price is available on the Phlx trading floor at the time the order is received by the system. After an order is executed, the system automatically generates an execution report which is then sent to the entering firm. We note that the Commission has expressed concern over the PACE system's lack of order exposure to specialists prior to automatic execution and has encouraged the Phlx to modify the system to permit an exposure period similar to those of SCOREX and MAX that would allow for the price of orders to be bettered for some minimum period of time. See Securities Exchange Act Release No. 19858 (June 9, 1983), 48 FR 27872, n. 13 and accompanying text.

orders routed to specialists through PACE disrupted the system's automatic execution and execution reporting features, resulting in delayed order executions and delayed execution reports. In addition, Phlx specialists and officials complained that PACE orders were being executed at incorrect prices due to what they believed to be stale quotes from the NYSE. 108/ This resulted in Phlx moving to manual execution. As discussed in more detail below, queuing problems in the PACE system, which prices orders before the specialists see the order, also caused specialists to be concerned about their exposure and risk and to request a switch to manual execution.

On October 19, the system encountered substantial delays in the execution of orders. Exchange officials attributed the execution delays to queuing, which developed as a result of a rapid increase in the volume of orders entering the system. 109/ Normally, market orders routed to PACE are executed within 30 seconds. Shortly after execution, under normal conditions, the order and the price at which it is executed is "shown" to the specialist on a terminal screen through a system called PACE View. Due to the increase in the number of orders entering the system on the 19th, however, queues and delays occurred in two places. First, orders being routed by member firms for automatic execution into the system were delayed in being priced and executed due to queues. In some instances, orders were queued for up to 75 minutes before actually entering PACE and being priced. Second, there were significant queuing delays in moving the executed order and its price through PACE View to the specialist post. These delays ran up to one hour. As a result the specialist would not know what orders he had executed at a given price for a substantial period of time, by which time the market may have moved down drastically. In addition, the Phlx specialists believed that they were required to take larger principal positions than they normally would, because of the high volume of orders. 110/ The risk resulting from these positions was exacerbated, in the opinion of Phlx specialists, by their uncertainty regarding NYSE quotes. Therefore, they believe that the execution prices called for under the PACE algorithm often did not reflect current market conditions. Finally, as discussed in the section on ITS, the ability of Phlx specialists to lay off principal positions on the NYSE was made more difficult by delays on ITS. 111/ Despite these problems on October 19, PACE remained fully engaged on automatic execution throughout the day.

At approximately 3:00 p.m. on October 19, however, Phlx officials requested all firms to reroute orders to other exchanges in an effort to relieve traffic that had accumulated in PACE. According to Phlx, this request was based on concern that the system's file space would be exhausted prior to the 4:00 p.m. close, which would have resulted in system failure and the loss of orders. All PACE users complied immediately,

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108/ See section on Market Information Systems, supra, which discusses quotes.

109/ Exchange officials noted that queuing was a major problem throughout the week of October 19. See chart at the end of this chapter showing volume on PACE and other systems.

110/ But see Section A(3) in Chapter Four on regional specialist performance which discusses specialist positions.

111/ As discussed above, the ability to lay off their positions, to the extent possible over ITS, was also reduced by the fact that the specialists may not have known what positions they had taken due to the delays in PACE View.

except for one local affiliate which remained on PACE somewhat longer than the other users because it had no ability to route orders to an alternate market. Because order flow into the PACE system was substantially reduced due to this request, Phlx believes it avoided a potential system failure.

The heavy system traffic also resulted in firms receiving late execution reports. As a consequence, firms using PACE on October 19 could not provide their retail customers with the status of their orders. One Phlx official noted that execution report delays varied from 10 minutes up to two hours on October 19.

On Tuesday, October 20, the traffic encountered by PACE was heavier than during the prior trading session. In addition, queuing problems persisted. At approximately 10:00 a.m. on October 20, Phlx officials decided to disengage PACE and convert to manual order executions. The conversion to manual execution was done essentially for two reasons. First, Phlx officials and specialists continued to question NYSE quotes and believed that automatic executions were occurring at different prices than the actual markets on the NYSE. Second, and perhaps most important, the conversion to manual execution was done to ease specialists' concerns and fears about their exposure and risk which were exacerbated both by ITS and PACE system delays. Because of the increased orders entering the PACE system, which, as noted above, automatically executes orders and then subsequently "shows" the execution and price to the specialist, the specialists believed they were required to take larger and larger positions and increase their risk. 112/ Nevertheless, specialists believed they would have difficulty in laying off these larger positions through ITS. Moreover, even if the specialists had been able to lay off some of their long positions, the queuing delays between the PACE system and PACE View made it difficult for them to accurately ascertain what their increasingly larger positions were on a timely basis.

Under manual mode, orders still were guaranteed execution at the ITS best bid or offer. 113/ Orders were priced, however, at the time the order was received by the specialist. Accordingly, manual execution allowed specialists to see the orders they were receiving and at what price they would be executed. The disengagement increased the workload for Phlx specialists and discussions with Phlx indicated that queuing delays for pricing and executing orders of up to an hour continued throughout the period PACE was on manual mode. Moreover, switching to manual mode disengaged the automatic reporting feature that sends execution reports to member firms. As a result, Phlx decided to dispense with reporting executions to PACE users until the close of business on the days the system was disengaged. 114/ Phlx believes this was necessary because manually issuing the execution reports during the trading day would have been

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112/ We note that although our data indicates that some specialists bought and sold large amounts of stock on October 19 and 20, particularly in the blue chip issues we examined, closing positions were not particularly long on those days. See Chapter Four and Appendix F.

113/ Phlx noted, however, that in some cases orders did not receive executions at the best displayed markets in those instances where Phlx specialists believed quotes were questionable.

114/ The Phlx stated that specialists continued to report to CTA on a timely basis while the system was on manual.

work intensive and required additional personnel. The Division notes that, although other markets had delays in issuing execution reports, no other market refrained from making an effort to issue the reports during the day.

Despite the disengagement on October 20, Phlx officials indicated that the system continued to experience strains in handling the heavy order flow. Accordingly, at 11:30 a.m., Phlx requested the PACE users that send order flow through ADP to reroute. 115/ Because queues still remained after ADP rerouted their orders, by 12:30 p.m. Phlx had requested that all other users reroute their orders from PACE. Because PACE users rerouted their orders to other markets, Phlx noted that queues were somewhat reduced but still continued throughout the rest of the day on October 20.

Phlx officials continued to operate in the manual mode until Friday, October 23, at which time they switched back to the automatic execution mode. Because the reporting feature also was disengaged, the member firm execution reporting process began after 4:00 p.m. on the 21st and 22nd and continued until 12:00 midnight and 11:00 p.m., respectively, on those days. As noted above, on October 23, Phlx reverted back to its automatic mode even though there continued to be sporadic increased activity that caused queuing from 5 to 8 minutes. Finally, although on October 26 PACE experienced heavier than usual pre-opening order flow, the system was able to handle the strain and operate normally throughout the day and the rest of the week.

In response to problems during the market break, Phlx has developed a method that will enable the exchange to disengage the automatic order execution feature of PACE without disengaging the automatic execution reporting feature. Accordingly, in the future, if the volume of orders entered into PACE overloads the system resulting in a backlog of orders, stale quotes and delayed executions, Phlx officials can convert to the manual mode without disengaging the automatic reporting feature of PACE. This should ensure that PACE will provide an uninterrupted flow of execution reports to member firms and retail customers.

During the week of October 19, Phlx was unable to increase its systems capacity to reduce the queuing problems and delays that were occurring. The switch from automatic to manual execution did not cause significantly more orders to be executed faster, but simply allowed the specialist to see the order before it was priced and executed. Currently, the PACE system can handle only up to 10,000 orders per day. Phlx officials indicated that PACE had not experienced queuing problems prior to October 19. Nevertheless, at the time of the market break, Phlx was in the process of changing its computer systems to increase their maximum capacity. Phlx claims that, if the enhancements had been in place, it would have been able to increase the system's capacity when needed and could easily have handled the increased order flow during the week of October 19. Since the week of October 19, Phlx has accelerated its schedule for enhancing the PACE system and hopes to increase its capacity to 30,000 orders per day by the end of 1988.

115/ Phlx first requested ADP not to send orders through PACE because ADP represents about 17 firms and sends a substantial amount of order flow through the system. It was thought that removing ADP from the system would reduce order flow sufficiently to reduce queues. As noted above, however, this did not prove sufficient.

7. PSE's SCOREX System

PSE's Securities Communication Order Routing and Execution ("SCOREX") System routes orders from member firms to the PSE floor, and automatically executes customer agency orders of up to 1,099 shares at the ITS best bid or offer. 116/ The maximum order size for routing purposes is determined pursuant to agreements between specialists and member firms. 117/

During the week of October 19, SCOREX experienced severe operational problems due to increased equity volume. For example, on October 19, 22,410 trades were executed on SCOREX compared to an average of fewer than 6,000 per day in September 1987. The overloading was particularly acute at the opening because of the huge amount of information, including quotations, entering the PSE computer systems relating to the 1,000 SCOREX stocks and many other stocks not even traded on the PSE. 118/ PSE officials claimed that the heavy order flow was exacerbated because many firms started sending order flow to PSE once the NYSE's DOT system and other exchange routing and execution systems encountered delays. 119/ As a result, SCOREX was

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116/ SCOREX orders are fed from member firm lines into one of the PSE's two CC-80 computers. The CC-80 is a communication processor that takes messages and routes orders into the SCOREX computer. Once in SCOREX the order is routed to the specialist post where it is assigned a price and "displayed" to the specialist for 15 seconds so that he has an opportunity to better the price. If no message is received back from the specialist to SCOREX in two minutes the order is executed at the assigned price. The executed order is then routed through SCOREX back to the CC-80, which sends execution reports back to firms via the firm's incoming lines and a hard copy of the executed order back through SCOREX to the specialist so he can confirm how many shares were executed and at what price.

117/ Approximately 32 firms are wired directly into the SCOREX system. Additional member firms use SCOREX through their floor brokers. Of the 1,300 stocks traded on the PSE, 1,000 are eligible to be traded through SCOREX. Any order entering SCOREX, other than for a "local" stock (i.e., those stocks not listed on the NYSE or Amex), is directed to the San Francisco or the Los Angeles trading floors on an alternating basis. SCOREX is only used for routing purposes for local issues, and because there is only one PSE market maker in a local issue, the order is sent directly to the applicable floor.

118/ PSE's system receives information on stocks not traded on the exchange which then is filtered out. According to PSE, this non-usable information further clogged its computer systems.

119/ For example, as noted above, at 3:00 on the afternoon of October 19, Phlx asked member firms not to use its PACE system. According to officials at various exchanges, this resulted in order flow being transferred to other regional markets, such as the PSE. From our sample of firms, however, we have been unable to verify that as one system got overloaded, the firm switched its order flow to another regional system. The firms we contacted about this issue stated that they sent order flow to the NYSE's DOT system rather than another regional exchange when regional systems malfunctioned.

handling 250 orders per minute at some points on October 19, compared to an average for September 1987 of fewer than 25 per minute. The overload of orders in the "front-end" of SCOREX prevented orders from arriving at the "back-end" for execution by the specialists in a timely manner. PSE officials were unable to quantify those delays. They believe, however, that the delays varied considerably depending on the time of day and to which floor, Los Angeles or San Francisco, the order was being routed. PSE noted that orders routed to San Francisco were delayed more than orders routed to Los Angeles.

At the opening on October 19, 7,000 trades, the number often received in a full day, were queued. Due to systems overload, orders were lost at various times during the October 19 trading session because queues built up and orders started to "wrap" over other orders. Wrapping is much like recording over what already has been recorded on a cassette because the available tape has run out. Information lost due to wrapping either can be order information, that is, orders newly arriving in the system and not yet "logged in," or trade confirmation information ("retrieval information") on its way back out of the system to be processed. In addition, at one point during the day, the order retrieval portion of SCOREX was closed and had to be restarted, causing some retrieval information to be lost until later in the day. In addition, some orders were sent to San Francisco specialists even after they had been executed in Los Angeles. Although PSE has been unable to quantify the delays in receiving executions, we believe that for those orders that got through the system and were not lost due to wrapping, queuing problems significantly delayed their execution. PSE has indicated that, once an order was executed, delays in the receipt of execution reports by member firms ran up to one hour.

On Monday night, the Exchange relieved some of the strain on the PSE computer systems by eliminating the ticker that disseminates PSE trades to its floor. In addition, SCOREX was reprogrammed not to perform limit order alerts. These alerts are designed to warn specialists that the primary market quotes for a stock are approaching the bid or offer of a limit order on the specialist's book. It later was discovered that, due to a programming oversight, only half of the limit order alerts had been eliminated.

During the first three hours of trading on October 20, queues again built up, wrapping occurred, and order and retrieval information was lost. [120/] During the day, PSE officials began calling some of the larger users of SCOREX and asked them to refrain from using the system. The firms' general reaction was that they would not remove themselves from the system unless everyone did. They argued that they needed to use SCOREX because DOT was backed up and because their floor brokers were swamped with orders.

By October 21, the Exchange had eliminated all limit order alerts from SCOREX. During the morning, the same queuing problems started to develop. PSE officials, in an

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120/ PSE noted that there were delays on the incoming lines bringing in orders from the member firms to the CC-80 communication processor. For example, during the first 3 hours of trading on October 20, delays, depending on the firm, ranged from 10 to 90 minutes. According to PSE, the delays varied depending on how much order flow the firm was sending to SCOREX.

effort to avoid any wrapping, called all firms that use SCOREX between 10:30 and 12:00 EST and told them not to use the system for order routing and execution or they would risk having their lines into SCOREX disconnected completely. Member firms complied with this "request," and due to a reduction in volume, 121/ the Exchange permitted firms to come back onto the system late in the trading day or the next morning. 122/

Due to a unique systems problem, SCOREX went down for about 14 minutes before the opening on October 22. At 9:01 a.m. EST, a large number of pre-opening orders entered the system at the same time, causing primary and back-up systems to fail. The Exchange officials who operate SCOREX had thought SCOREX had been programmed not to allow such a sudden rush of incoming orders. The system was brought back up at 9:15 a.m. Because the orders already had been "logged in," they were retrieved and later executed at the opening price.

By October 23, most firms still were not using SCOREX. 123/ The firms that earlier had been asked not to use SCOREX had decided to stay with other exchanges' systems and still were experiencing back office problems arising from their use of SCOREX earlier in the week (i.e., missing trade reports). Most of these firms had rerouted orders to DOT. Over the weekend and during the week of October 26, the PSE worked with firms to reconstruct orders lost because of wrapping and to research and report unreported trades. Using the firms' computer tapes indicating what trades had been sent to SCOREX, the PSE was able to execute the vast majority of orders lost due to wrapping at the price at which the trades would have been executed had the system not wrapped. In addition, using a combination of National Securities Clearing Corporation, firm, and PSE records, trades executed but not reported due to wrapping were reported. 124/ Many of the major firms were back on SCOREX by the last week in October or the first week in November, but average daily SCOREX order executions for the first and second weeks of November remained relatively low at 2,358 and 3,142 trades, respectively.

121/ SCOREX executed 8,700 trades, representing 2,257,100 shares. This is significantly less than the trades and volume for October 19 and 20, but still higher than the September daily average. See chart at the end of this chapter.

122/ After October 21, the PSE also established the so-called "five minute rule." This rule allowed PSE to "disable" broker lines if their San Francisco trade reporting printers backed up more than 5 minutes. Broker lines would be reactivated once processing returned to acceptable levels. PSE has indicated that this rule is no longer in effect and all lines are now active.

123/ On October 22 and 23, SCOREX only executed 965 trades representing 245,500 shares and 763 trades representing 282,500 shares, respectively.

124/ According to the PSE, some firms, rather than working with the PSE, simply filled outstanding customer orders themselves and took any loss. In addition, some firms were able on their own to reconstruct fills through a clearing report or clearing ledger entry. PSE claims that because they did not hear back from some firms it is impossible for them to estimate how many orders never were filled. PSE assumes that most orders were filled eventually, either from them or the firm directly.

In light of the problems experienced during the heavy volume periods, PSE officials have begun to upgrade and replace outmoded system components in order to enhance the capacity of SCOREX and PSE systems in general. PSE had estimated SCOREX's maximum capacity at approximately 25,000 trades. PSE officials noted that SCOREX had handled 25,000 transactions without problems on one day in the past and they were unsure if the system could handle a higher number of trades. PSE is currently in the early stages of a two year program to phase-in updated equipment that will increase capacity. PSE projects that by the end of the two year period SCOREX should be able to handle 50,000 trades under normal volume levels and up to 100,000 transactions on peak days. Further, until recently, there were two lines connecting the Los Angeles and San Francisco trading floors. In anticipation of increased volume and as part of an overall effort to upgrade PSE systems, a third line that was being added at the time of the October market break is now in place. A fourth line was installed in December 1987. In addition, systems officials have begun efforts to cope better with future volume surges by making it easier and less disruptive to exclude certain non-essential incoming data (e.g., information on stocks not traded on the PSE), to eliminate limit order alerts and to restart system components more quickly after they are closed unexpectedly. Finally, PSE officials claimed that they could have reduced significantly the strain on SCOREX by stopping it from calculating the best bids and offers. This would have required specialists receiving SCOREX orders to execute the orders manually using the best bids and offers displayed on their Quotron screens. 125/

8. Other Systems - BSE and CSE

a. BSE - Manual System

The BSE is unique among the regional stock exchanges because the majority of its systems are still manual and the exchange lacks an automated order routing and execution system. 126/ Without an automated system, the exchange attempts to draw order flow by requiring its specialists to guarantee trades up to 1,299 shares (or 2,500 if the issue is among the 100 most active or has been designated by its Market Performance Committee) at the ITS best bid and offer. 127/ Orders are routed to the BSE floor by BSE members, to a floor broker or the BSE "front desk." The front desk serves as an official floor broker, where employees of the exchange receive orders from BSE members and deliver them to the appropriate specialist for execution. There is also a small number of floor brokers, both affiliated and independent, that can receive orders from BSE members. Orders are routed to the floor either electronically or by

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125/ This procedure would have been similar to the manual execution procedures adopted at the Phlx. See discussion of Phlx's PACE system, supra, in this chapter.

126/ The BSE is in the initial phases of introducing an automated system, BEACON (Boston Exchange Automated Communication and Order-routing Network), which will provide routing, execution and trade reporting functions. The proposal has been noticed for comment by the Commission but has yet to be approved. BEACON, however, currently receives, processes and distributes quotes and last sales to the BSE floor. See Securities Exchange Act Release No. 24187 (March 6, 1987), 52 FR 26612.

127/ See BSE Rules Chapter 2, Section 33.

telephone. 128/ Executed trade reports are delivered manually to the BSE Clearing Corporation for settlement, and to SIAC terminals on the floor for manual entry onto the Consolidated Transaction Reporting System.

Because it has a manual system, the BSE did not experience many of the problems suffered by other exchanges in order routing. When volume surged, the exchange was able to increase its staffing on the floor to accommodate the order flow. It was much easier to increase staffing quickly than to upgrade an automatic execution system on short notice.

The exchange and its specialists, however, did experience some problems due to the record volume received on October 19-23. 129/ First, as discussed in more detail in the ITS and specialist performance sections, the BSE specialists believed there were difficulties in laying off positions due to delays in the execution of ITS orders. Accordingly, BSE Floor Officials determined on October 19 at about 1:00 p.m. EST to suspend the 1299/2500 execution guarantee. From the 19th through the 22nd, specialists operated on a "best efforts" basis; that is they were not held to any execution guarantee limit. 130/ The BSE indicated that this policy was not officially communicated to member firms.

Second, the BSE experienced significant problems in reporting trades to the Consolidated Tape Reporting System and in issuing trade execution reports. As discussed above under Market Information Systems, because trade data from BSE must be entered manually on one of three terminals and accepted by SIAC before another trade can be entered, the large volume of trades caused the system to back up. According to BSE officials, these problems caused BSE entries to the Consolidated Transaction Reporting System to be 2 to 3 hours late on October 19 and 20.

The BSE also experienced significant delays in reporting executions to the upstairs firms. Even though the BSE was continually trying to key in the necessary information so that reports could be sent to the upstairs firms, input operators, entering trade report information, were backed up throughout the week of October 19 because of the extremely heavy volume. Accordingly, the BSE stated that execution reports to some member firms did not reach the firms until the end of the trading day or after. BSE further indicated that it tried to confirm executions for those firms that inquired during the trading day and some firms were able to get quicker confirmations through their floor brokers.

128/ Currently, six firms direct order flow to the trading floor through electronic transmission. The systems used to provided this service are not owned by BSE but are owned by the member firm or their vendors.

129/ For example, trading volume approximately doubled on October 19, (5,189,105) when compared to the average daily volume for September 87 (3,030,406). The same dramatic increases were also seen in the number of trades on the BSE. For the week of October 19 the average number of trades more than tripled (10,023) as compared to average daily trades for September 1987 (3,107).

130/ The BSE claimed that many specialists still guaranteed execution within the limit of 1299 shares even though they were permitted to operate on a best efforts basis.

b. CSE's - NSTS

The CSE executes orders automatically through its National Securities Trading System ("NSTS"). The NSTS is a system of users linked electronically. All CSE proprietary members have access to NSTS, as do access participants, who may utilize the system through the facilities of a member. Designated dealers are assigned one or more issues and every issue traded through NSTS has at least one designated dealer. The designated dealer is responsible for the automatic execution of public agency market orders and marketable limit orders, up to 2,099 shares, at the ITS best bid and offer. The designated dealer also is responsible for the limit order guarantee in his issues, which means that he must guarantee an execution of public agency limit orders when the limit order price is penetrated by a transaction on another (usually the primary) market. 131/ If an issue has two or more designated dealers, they rotate the responsibility for the small order execution guarantee on a daily basis.

CSE experienced substantially increased order flow during the week of October 19. According to the CSE, with two exceptions, the volume increase did not prevent the public from obtaining immediate executions at the ITS best bid and offer throughout the weeks of October 19 and October 26. CSE's small order execution system was non-operational for two hours on October 28 and three hours on October 29 due to a communications hardware problem. 132/ According to CSE, at all other times during the weeks of October 19 and 26 the public received immediate automated execution of orders. CSE, however, did encounter some pricing problems on October 19 and 20. According to CSE, for reasons it has not yet determined, NSTS executed orders at prices that did not appear to reflect the current NYSE market as reported over the consolidated tape. As a result, CSE designated dealers manually adjusted the prices of some agency executions.

9. Analysis of Regional Systems' Performance

The week of October 19 highlighted some significant flaws in the small order routing and execution systems of the regional stock exchanges. Obviously, these flaws have to be examined in the context of a level of trade volume on the regional exchanges that few could have anticipated. In addition, the volatile conditions in the primary market added a degree of uncertainty to the problems the regional exchanges were faced with during the week. Nevertheless, even considering these circumstances, most of the systems did not perform particularly well. The level of performance, however, varied across systems, and some exchanges responded more quickly to system problems that arose than others.

Although MAX had some queues and delays throughout most of the week of October 19, the MAX system appears to have performed the best of the regional small order systems. This may be due, in part, to the fact that MAX had the highest capacity going into the week of October 19 when compared to the other regional

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131/ Away from the market limit orders are not executed automatically, but are executed manually upon the occurrence of a penetrating price transaction.

132/ CSE noted that the problem has since been corrected.

systems. 133/ In addition, the MSE proved most adept at quickly increasing the capacity of its system.

The SCOREX system performed particularly poorly, losing both orders and trade reports. In addition, the PSE asked members not to use its system on October 21. Essentially SCOREX was not a reliable or functioning system for most of the week of October 19.

The Phlx's PACE system also had significant problems. Phlx's decision to move to manual execution may have been unavoidable given the queues existing between the time of execution and the time the specialist became aware of the trade. Nevertheless, the decision to dispense with all execution reporting to member firms until after hours raises troubling questions. Although the manual mode disengaged the automatic reporting feature, Phlx was the only market to dispense totally with issuing trade reports to member firms until after trading hours. Even BSE, with an entirely manual system, continued to issue execution reports throughout the day, although its system was backed-up and had significant delays.

The MSE, PSE and PHLX have made or are in the process of making capacity enhancements to their systems so they can better handle the volume experienced the week of October 19 in the future. Quick implementation of these enhancements is critical, particularly for the PSE and Phlx. The week of October 19 demonstrated that those enhancements need to be implemented as soon as possible to accommodate unexpected volume surges. Indeed, the Division believes that, in light of the serious problems both these exchanges experienced, the Commission should consider whether to request both exchanges to refrain from adding any new firms to their systems until they have made progress in increasing system capacity. In addition, before adding new firms, regional exchanges should develop plans to ensure that firms using their systems or sending order flow to the floor are adequately informed in a timely manner of any problems, including reductions in guarantee limits and delays encountered on the exchange for executing orders and issuing trade reports. 134/

D. Intermarket Trading System

1. ITS Operations

The Intermarket Trading System ("ITS") is a communication system designed to facilitate trading among competing markets by providing each market with order routing capabilities based on current quotation information. Specifically, ITS links the

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133/ During the week of October 19, MAX maximum capacity was 30,000 to 40,000 transactions a day for both MAX and non-MAX orders. SCOREX maximum capacity was estimated to be about 25,000 transactions per day and PACE's maximum capacity was about 10,000 orders per day.

134/ In addition, all of the exchanges should work on improving coordination among markets when their small order systems are down. Although difficult to confirm, many markets believed their problems were exacerbated when other markets told system users to use another market. Accordingly, we believe the exchanges should develop means of informing other markets when they decide to send their users elsewhere.

participant markets 135/ and provides facilities and 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 participant for a multiply-traded security; (2) efficient routing of orders and administrative messages between market participants; and (3) participation, under certain conditions, by members of all participating markets in opening transactions in those markets.

Authorized in 1978, the ITS was a step in the creation of the national market system ("NMS") because it increased the opportunities for brokers to secure the best execution of their customers' orders. 136/ In addition, it enhanced market making competition by permitting regional specialists to attract orders from other markets by providing superior quotations and to more efficiently, and at a lower cost, lay off risk positions by selling stocks on primary markets. All major exchanges and the NASD are participating members. By the end of 1984, there were 1,169 stocks traded through the system; by the end of November 1987, the number reached 1,523. 137/

2.   ITS Transactions

As a general matter, when a floor broker receives an order to buy or sell stock that is traded on several exchanges, he will attempt to execute that order in the marketplace where the order is received, but he will compare the quoted market for the stock at his market location with the ITS quotation display that is continuously updated. If the ITS display indicates that a competing market is disseminating a superior bid or offer, the broker may send the order through ITS. Orders sent through ITS are referred to as "commitments to trade" 138/ and contain information such as the destination market, the name of the clearing corporation through which the trade shall be settled, specifications as to whether the commitment is to buy or sell, the number of shares, the price of execution and the time period during which the commitment is irrevocable. The commitment to trade is firm only for a fixed period of time. When most market participants receive a commitment, the specialist or market maker may either accept the commitment, which would result in an execution, or reject that

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135/   The parties to the plan, or participants, are the Amex, BSE, CSE, MSE, NYSE, PSE, Phlx and the NASD.

136/   The ITS Plan ("Plan"), which governs the ITS operations, was first authorized by the SEC on a provisional basis on April 14, 1978, (Securities Exchange Act Release No. 14661 (April 14, 1978), 43 FR 17419) and permanently approved on May 6, 1982 (Securities Exchange Act Release No. 18713 (May 6, 1982), 47 FR 20413).

137/   The average daily volume of executed trades increased from 5,404 in 1984 to 8,612 in 1987, with 4,692,200 and 8,781,600 shares traded, respectively.

138/   Commitments sent to another market are referred to as "outgoing commitments" by the sending market and referred to as "incoming commitments" by the market that receives the commitment.

commitment. 139/ If the specialist or market maker does not act on the commitment, it will expire automatically within one or two minutes, depending on which market originated the order. 140/ Generally, commitments sent by regional exchanges are irrevocable for two minutes, whereas those sent by the NYSE expire after only one minute. NYSE typically receives 33% of the ITS commitments to trade from the regional exchanges and is responsible for sending out approximately 50% of the commitments. 141/

3.   Pre-opening Procedures

In contrast to the routine procedures regarding ITS commitments sent or received during the trading day, special procedures apply at the opening. A pre-opening application must be sent through ITS whenever a market maker anticipates that the opening transaction will be at a price that represents a change from the stock's "previous day's consolidated closing price" 142/ of more than the "applicable price change." 143/ For example, if a stock's consolidated closing price was 34 and the market maker anticipates the opening price to be 34 3/8, that market maker will have to send a pre-opening notification because the price change of 3/8 is more than the applicable price change of 1/4 for a stock of such value, as provided in the Plan.

139/ Rule 11Ac1-1 under the Act generally requires that quotations must be firm for the price and size disseminated. Thus, unless a market maker had just effected a transaction at his quote or was in the process of revising that quotation, he is required to accept the commitment. When the market is moving rapidly, however, specialists may indicate that their quotes are not firm and thus will not be held to their quotes.

140/ This expiration procedure applies to most participants except for the CSE and Bernard L. Madoff, Investment Securities ("Madoff") who have automated execution systems that will guarantee order execution. Madoff is the only third market maker and member of the NASD that uses ITS, and thus is the only representative of the NASD. Madoff trades for its own account; it does not deal with retail customers but services institutional clients. Madoff's access to ITS is through the NASD's Computer Assisted Execution System ("CAES"), an NASD order routing system. As for the CSE, when a commitment to trade is sent through ITS, the order will be routed through CSE's National Securities Trading System ("NSTS") switch, which will generate an acceptance (or rejection) on behalf of the designated dealer (the primary market maker on the CSE as defined in CSE Rule 11.9) for the ITS security being traded.

141/ In September 1987, for instance, out of a total of 216,819 commitments to trades sent through ITS, NYSE sent out 106,684 and received 77,666 from the other participants.

142/ The "previous day's consolidated closing price" is the last price at which a transaction in the stock was reported by SIAC on the last previous day on which transactions in the stock were reported by SIAC.

143/ "Applicable price changes" vary between 1/8 and 1/4 point depending upon the price of the stock.

Thus, to offset a pre-opening imbalance in a stock, a market maker will notify other participant markets of the situation by sending a "pre-opening notification" through ITS, and cannot open the particular stock until three minutes have elapsed. The pre-opening notification must include the following information: (1) a designation that the message is a pre-opening notification; (2) the identity of the exchange, the exchange specialist and the security; and (3) the applicable price range of the anticipated opening, which is not to exceed 1/2 to 1 point, depending on the price of the security.

Market makers from other participant markets will send "pre-opening responses," containing obligations to trade, including the number of shares and price that they are willing to trade. Based on the pre-opening responses, the market maker will allocate stock to the regional exchanges at the opening and set the opening quotations. 144/

4. Trade-through Rule

Since each participant may see the current bid and offer from every other member on the ITS terminal, it is also possible to see when a trade has been executed at a better price. The ITS trade-through rule states that, absent reasonable justification or excuse, a market maker should not purchase (sell) any security at a price that is higher (lower) than the price at which that security, at the time of such purchase (sale), is offered (bid) in one or more other participant's markets. The rule requires anyone who "trades through" another market's quotation to either break the trade or satisfy the other market's quotation. The rule does not apply under certain conditions, such as (1) when the size of the offer or bid traded through is posted at 100 shares, (2) when the trade-through is caused by a systems/equipment malfunction, (3) when the trade-through occurs during "unusual" market conditions, 145/ and (4) when a complaint is not received within 5 or 10 minutes (depending on whether the trade-through was an exchange or third market trade-through) after the trade-through transaction appeared on the tape. 146/

144/ The pre-opening rule also applies whenever a security that was subject to a "regulatory halt" resumes trading. "Regulatory halts," as defined in Part X of the CTA Plan, occur whenever the primary market halts or suspends trading for a security in the exercise of its regulatory functions. The primary market will halt or suspend trading if it determines that: (1) certain matters relating to the security or the issuer thereof have not been disclosed to the public, or (2) certain regulatory problems relating to the security should be clarified before trading is permitted to continue. The primary market shall notify other participant markets of such halts or suspensions. ITS Plan, Pre-Opening Application Rule, Section (b)(ii).

145/ Unusual market conditions are defined in Rules 11Ac1-1(b)(3) and 11Ac1-1(c)(3).

146/ See ITS Plan, Trade-Through Rule, Section (b)(3). In addition, the trade-through rule block application policy requires a person executing a block trade to send each participant that displays a better bid or offer a commitment to trade at the execution price and for the number of shares displayed, before the remainder of the block is executed.

5.   Specific Problems and Members' Responses

During the October market break, the ITS experienced severe problems, most of which resulted from operational difficulties. 147/ ITS participants were concerned with the substantial number of expired commitments due to queuing problems, as well as with the lack of compliance with the pre-opening requirements of the Plan.

One of the major consequences of the unusually high volume of trades was the inordinate number of expirations of commitments. 148/ Because of the queuing problems (e.g., printer delays), 149/ the routing of ITS commitments from the regional exchanges through the UFDC 150/ to NYSE specialists often was delayed beyond the two minute expiration period during which ITS commitments may be executed. Therefore, during the high volume periods on October 19 and 20, some NYSE specialists never had the opportunity to accept regional commitments to trade because the orders had expired before they arrived at the post. Some regional exchange specialists, as a reaction to continuous expirations of commitments, turned to alternative methods to offset their exposure. 151/

147/   During the October market break, however, ITS participants generally did not complain about trade-through and block trade policy violations. Based upon statistical information received from the various participants, it appears that the increased number of trade-through and block trade complaints during the market break was approximately proportionate to the increased volume of trades, unlike the unusually high number of opening and expiration complaints. While the number of complaints dealing with openings increased from a total of 27 for the entire month of September to 106 and 116 on October 19 and 20, respectively, the number of complaints dealing with block trades increased only from an average of about 6 per day in September to 8 and 11 on October 19 and 20, respectively. With respect to trade-throughs, the number of complaints increased from an average of 2 to 3 per day in September to 13 and 24 on October 19 and 20, respectively.

148/   Tables 7-1 and 7-2 demonstrate that the regional exchanges substantially increased the number of commitments sent to the NYSE (from a September daily average of 5,080 to a daily average of 12,616 on October 16, 19 and 20), while the number of commitments sent by the NYSE actually declined. Furthermore, as a percentage matter, the number of expired commitments increased substantially on both the NYSE and regional exchanges. But from a market making perspective, however, the NYSE expirations were far more significant to the regional specialists than the regional expirations were to the NYSE specialists.

149/   See discussion of DOT, supra.

150/   ITS orders sent to the NYSE are generally routed through a UFDC switch where they are printed out by a card printer and routed to the specialist.

151/   PSE specialists, for example, used floor brokers on the NYSE and executed trades manually. During the month of September, the average daily number of shares executed on the PSE through ITS was about 1,374,600. From October 19 through October 26, however, the average daily number was under 1,000,000, which indicates a higher number of unexecuted commitments, as well as a reluctance to use the system as a whole. At Madoff, trades were also executed through brokers on the NYSE floor. BSE specialists indicated their reluctance to use ITS (because they believed that the commitments sent to the NYSE would expire) and disregarded ITS for the week of October 19.

TABLE 7-1 NUMBER OF OUTGOING COMMITMENTS TO TRADE

	BSE TOTAL	BSE TO NYSE	CSE TOTAL	CSE TO NYSE	NSE TOTAL	NSE TO NYSE	PSE TOTAL	PSE TO NYSE	PHLX TOTAL	PHLX TO NYSE	NYSE *	AMEX *	NASD ** TOTAL	NASD ** TO NYSE
SEPT DAILY AVG	895	647	90	66	1,940	1,566	2,510	1,964	1,022	831	3,698	160	9	6
OCT. DAILY AVG	1,142	883	107	80	2,873	2,455	3,120	2,567	1,366	1,164	3,214	160	11	9
10/16	1,707	1,324	151	119	4,364	3,768	5,659	4,725	2,413	2,155	4,394	242	23	17
10/19	1,747	1,472	114	99	5,447	4,832	5,357	4,582	2,050	1,803	1,735	148	9	9
10/20	1,710	1,457	126	107	5,693	5,133	5,282	4,700	1,661	1,440	1,688	128	6	6
10/21	993	765	93	73	3,120	2,620	2,591	2,095	1,459	1,197	1,984	152	7	6

* NO ITS TRANSACTIONS TAKE PLACE BETWEEN AMEX AND NYSE
** THE FLUCTUATIONS IN THE NUMBER OF COMMITMENTS FROM THE NASD DO NOT ACCURATELY REFLECT THE FLUCTUATIONS IN THE MARKET

Source: NYSE

TABLE 7-2 PERCENTAGES OF EXPIRED COMMITMENTS TO TRADE

	BSE TOTAL	BSE FROM NY	CSE TOTAL	CSE FROM NY	NSE TOTAL	NSE FROM NY	PSE TOTAL	PSE FROM NY	PHLX TOTAL	PHLX FROM NY	NYSE *	AMEX *	NASD ** TOTAL	NASD ** FROM NY
SEPT AVG	4.5	5.7	2.6	3.3	5.8	6.6	5.5	6.2	5.4	6.2	1.3	1.2	0.5	0.7
OCT. AVG	14.0	17.3	7.6	9.6	16.4	18.8	14.3	16.6	14.0	16.0	3.0	2.3	3.3	4.2
10/16	8.4	10.4	5.5	5.9	9.4	10.5	10.2	11.5	10.3	10.8	4.0	4.5	4.7	5.9
10/19	54.0	63.0	33.0	38.0	58.0	65.0	55.0	62.0	56.0	62.9	14.0	8.8	0.0	0.0
10/20	34.0	39.0	26.0	29.0	35.0	38.0	32.0	35.6	32.0	36.5	8.7	2.3	33.0	33.0
10/21	24.0	29.0	15.0	15.0	21.5	25.0	22.0	25.0	23.0	27.0	16.6	7.2	0.0	0.0

* NO ITS TRANSACTIONS TAKE PLACE BETWEEN AMEX AND NYSE
** FLUCTUATIONS OF NASD FIGURES DO NOT CONFORM TO THOSE OF THE OTHER PARTICIPANTS

Source: NYSE

Furthermore, the NYSE partially shut down ITS on the NYSE floor (ITS was shut down on posts 1 through 7 which service, among others, American Telephone and Telegraph, International Business Machines, General Motors, Eastman Kodak, Chrysler, U.S. Steel, and Union Carbide) on October 19, 1987, between 2:13 p.m. and 3:27 p.m., and, on October 21, 1987, ITS was shut down on the entire floor of the NYSE from 10:33 a.m. to 12:36 p.m. 152/ The NYSE's decision reflected the fact that system delays caused ITS commitments not to reach the specialists in time for them to respond, and that the incoming ITS traffic at the UFDC switch and the printers on the floor was slowing down other order processing systems, such as DOT. 153/

The regional exchanges also experienced delays in their ITS support systems. The MSE, for instance, experienced delays of approximately 15-45 seconds within its own Regional Computer Interface, 154/ which only left 15-45 seconds for the specialists to act on the commitments prior to their expiration. Therefore, specialists found it difficult to respond to the NYSE's outgoing commitments to trade that expired within one minute.

Several participants complained to the staff about the failure of other ITS members to comply with the pre-opening requirements as defined in the ITS Plan. 155/ For example, on October 19 and 20, the NYSE ITS Service Center 156/ indicated that it received 106 and 116 complaints, respectively, dealing with openings, as opposed to 27 received during the entire month of September. Regional exchanges also indicated concern over the absence of any requirement in the ITS Plan that NYSE specialists issue pre-opening notifications prior to resuming trading after an order imbalance halt. As discussed above, the present provisions of the ITS Plan only require notifications after a "regulatory" halt.

Furthermore, PSE specialists stated that, on October 19 and 20, they did not receive any indication as to whether their pre-opening responses had been accepted until one and one-half days later, as opposed to one and one-half hours during "normal" busy days. Similarly, the CSE indicated that, on those same dates, no reports were received on pre-opening responses until late during the day, in spite of the continuous requests for such reports. On the other hand, the Phlx indicated that it intentionally ignored pre-opening notifications because of the delays already experienced throughout the system.

152/ During this period, other participants could not access the NYSE through ITS, but still could communicate among one another through the system.

153/ See discussion, supra.

154/ See discussion of regional exchanges order routing systems, supra.

155/ ITS Plan, Pre-Opening Application Rule, Section (b)(i).

156/ ITS complaints are handled at three different levels at the NYSE. Complaints are first sent through the system from specialist to specialist. If the specialists cannot resolve the matter, the complaint is sent through a "hot line," to the post supervisor. If no resolution is reached, then it is sent to the ITS Service Center.

6.   Analysis

The staff is concerned that the present configuration of ITS is not designed to perform efficiently in high volume periods. During the market break, the lack of flexibility of ITS fragmented further the markets, reduced substantially market making capability on the regional exchanges, and caused upstairs firms to place even more pressure on NYSE order processing systems. The unavailability of ITS greatly increased financial risks to regional specialists because it reduced their ability to lay off their inventory positions acquired from market making activities. This unavailability contributed to decisions by certain regional exchanges to reduce their volume guarantees in regional automatic execution systems, which, in turn caused firms to reroute more orders to the NYSE, placing even more pressure on its order handling systems. 157/ In short, for periods of time, ITS essentially ceased to function when additional order handling and market making capacity were critical. The staff believes that steps must be explored to develop a faster and more efficient intermarket linkage. At the same time, however, it should be recognized that while on October 19 and 20, 32% and 55%, respectively, of NYSE commitments to trade were executed on the regional exchanges, 75% and 80% of the regional exchanges commitments to trade sent to NYSE were executed on those same dates.

First, considering the large number of expired commitments during the week of October 19, the Division believes that the NYSE, along with the other ITS participants, should examine the operational problems encountered in order to plan possible modifications in the system during peak volume times. For example, the NYSE should consider separating its ITS terminals from the printing functions of other NYSE systems, such as DOT, in order to facilitate the printing of ITS commitments before the two minute expiration period. 158/

In addition, the staff believes that it may be appropriate for all participants to consider adopting default procedures to provide that, when a commitment to trade is not accepted or rejected within the applicable two minute time frame, an execution report will be automatically generated by the system based on the commitment price or the then current quotation for the security (whichever is better) in the receiving market.

The staff is also concerned with the apparent failure of the NYSE to investigate and resolve many ITS complaints received during the market break. Some regional exchanges (notably MSE and BSE) alleged that the NYSE refused to investigate any complaints lodged pursuant to the ITS procedures during the week of October 19. The NYSE indicated to the staff, however, that, except for complaints with respect to expirations, all other complaints had been investigated. The NYSE explained that from October 19 until mid-day on October 21 expiration complaints had not been investigated

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157/   During the month of October, the NYSE received approximately 60% (157,462 out of 263,854) of the commitments sent through ITS as opposed to 50% during normal days, but sent out only about 25% of the total (or 70,709 commitments to trade), as opposed to 33%, to the other participants. See Table 7-1.

158/   It appears that UFDC queuing problems had been discussed at previous meeting of ITS User Committee members. The NYSE subsequently had added electronic display books and anticipates adding more by the first quarter of 1988, in order to decrease the use of the UFDC switch, and reduce the queues on ITS.

because of fast market conditions and the queuing problems with respect to the UFDC switch and the printers on the floor. Nevertheless, queuing problems were not floor-wide through most of these time periods, and many specialists were responding to ITS commitments in a timely manner. While the Division certainly appreciates the intense pressure on NYSE resources during the market break, the Division does not believe the wholesale refusal to investigate expired commitment problems is appropriate.

The Division also believes that ITS participants should consider the regional exchanges' concerns with the lack of pre-opening messages sent after order imbalance halts on the NYSE floor. Although the ITS rules do not require specialists to send pre-opening notifications when trading resumes, it appears that such practice should be encouraged in order to facilitate orderly resumption of trading and allow specialists to attempt to balance their positions after order imbalance halts. Indeed, the Division understands that, in large part, NYSE specialists did, in practice, seek to provide pre-opening notifications following order imbalance halts.

Finally, the Division intends to review with the ITS participants the need for clearly defined procedures for communications among themselves. The Division found that during the week of October 19, there generally were satisfactory communications among the stock exchanges. Nevertheless, some exchange officials have suggested to the Division that they had difficulty reaching responsible officials at the NYSE to discuss trading halts and ITS problems. This is in large part understandable, because of the need for senior NYSE officials to respond to the operational and trading difficulties in their market. Thus, the Division believes that steps should be taken to identify contact persons at each exchange who will be available during market emergencies.

Volume & Trades on Automatic Execution Systems 1/

	Trades 10-16	Volume 10-16	Trades 10-19	Volume 10-19	Trades 10-20	Volume 10-20
DOT	241,616	226,921,387	471,513	324,109,693	584,992	419,248,012
PER	11,616	4,086,860	23,583	8,599,907	26,002	8,994,440
MAX	18,211	4,530,923	25,653	6,691,603	30,203	7,146,280
PACE	7,735	1,878,862	14,927	3,563,404	12,519	2,927,105
SCOREX	9,109	2,517,000	22,410	6,228,800	21,196	5,599,600
NSTS 2/	118	28,360	256	84,239	592	134,632

	Trades 10-26	Volume 10-26	September daily Average Trades	September daily Average Volume
DOT	270,699	210,167,412	138,600	128,500,000
PER	14,007	5,031,105	8,329	2,760,133
MAX	19,130	4,871,774	8,982	2,094,693
PACE	5,898	1,397,257	4,024	920,515
SCOREX	2,631	809,800	5,258	1,425,581
NSTS	148	37,506	82	17,900

1/   On DOT, the "trade" figure actually represents the number of orders entered in the system. The other systems data represent the number of trades automatically executed in their systems.

2/   Although the figures provided by CSE contain some trades over 2,099 shares, the majority, over 99%, represent trades of 2,099 shares or less executed pursuant to the guarantee.