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THE ORGANISATION OF TRADING IN THE THIRD AND FOURTH MARKETS IN THE USA

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SUMMARY: The main role of financial markets is the determination of prices which represent information about traders interpretations of conditions influencing financial assets. Intermediaries in financial markets exist because they provide concentration and efficient dissemination of information. Technological change has a direct effect on both the ability to concentrate and disseminate information. Just as the introduction of the telegraph and then the telephone changed the nature of market intermediation, the current introduction of computer aided communications technology has brought about changes in the financial markets. In the US these changes represent non-intermediated markets known as the "third" and "fourth" markets. This papers analyses and describes these markets and their implications for the future evolution of price formation in financial markets.

Bologna, 1992

Introduction¹

The causal relation between technological change and market structure is not clear cut. The existence of new methods of operation due to technological change can have a dual effect on markets. It can be a force for increased competition by breaking dominant market positions or barriers to entry by providing lower cost methods of production or technologically improved outputs. However, if the technology is not freely available, or if being the first to introduce new technology creates economies of scale or scope it may simply create new positions of market power and dominance. In this interpretation the causal chain runs from new technology to the change in market organisation. The alternative view would consider changes in market structure as the motive force, rendering existing market organisation inefficient or obsolete and generating demands from market participants for new organisation which may only be achieved by the introduction of new technology. Recent developments in telecommunications and computer technology have raised the possibility of significant changes in the organisation of markets and the way in which securities are traded in financial markets and currently a wide range of organisations co-exist in US financial markets. Since organised markets have traditionally been organised on the basis of restricted entry and monopoly on trading in a class of financial assets, these new technologies and market organisations provide direct competition to the traditional financial markets. This paper describes the major new market forms and assesses the challenge that they raise to existing market structure. Discussion of the impact of technology on competition amongst financial markets has recently been dominated by the prospect of a "global" financial market dominated by a single centre and is concerned with competition between different regional markets: New York, London and Tokyo, or between major centres and their regions, e.g. New York and the US regional markets Boston, Philadelphia, Midwest (Chicago), Pacific (San Francisco). Since regional competition will also concern differences in the organisation of trading and regulation this aspect is implicit in the present discussion.

Currently the US financial markets may be characterised by four different types of organisation. The dominant market, the New York Stock Exchange (NYSE) is based on "assigned dealers" called "specialists" (usually called the "first" market), an over-the-counter (OTC) market in stocks not listed on the NYSE (the second market: this was originally the "curb" market or American Stock Exchange, AMEX, now an organised market also based on the trading of listed stocks via the

¹ The author is indebted to Harlan Flint, Davis Gaynes and David Rothenberg, Instinet; Peter Madoff, Madoff Investment Securities; Steve Wunsch, Wunsch Auction Systems; Sydney Spencer and Mike Earlywine, Investment Technology Group; Jim Cochrane and Jim Shapiro, New York Stock Exchange; and Bill Weil and Bill Bertsch, members NYSE, for helpful discussions and providing information used in the preparation of this study. None is responsible for its final form or content. Parts of this study served as background for Appendix 4 of the *IRS Rapporto sul Mercato Azionario, 1992*. Support for onsite visits from a CNR (92.01868.CT10) grant is gratefully acknowledged.

specialist system and thus a "first" market) which has evolved into a screen-based dealer system comprising members of the National Association of Securities Dealers via an Automated Quotation System (NASDAQ). This system served as the prototype for the London screen-based dual-capacity dealer system. Since members of the National Association of Securities Dealers (NASD) who are not members of the New York or American Exchanges have always had the ability to make markets in stocks listed on the first and second markets over-the-counter, their dealing in these stocks is usually classified as the "third market" and represents competition for the "first market" or organised exchanges. The NASDAQ system thus overlaps the second and third markets in that it provides bid and offer quotes for securities by both market-makers who are members and non-members of the first markets for securities not listed on the organised exchanges and by non-members for securities which are traded in the first market. Recently strong competition has also come from the so-called "fourth market", proprietary electronic trading systems which have sprung up to challenge both the specialist system directly as well as the traditional NASDAQ market in over-the-counter trading.

Current estimates for the combined trade in listed stocks on the third and fourth market amount to as much as an average of 40 million shares per day against the 225 million average volume of the entire National Market System. It is the competition from these new "third" and "fourth" market systems, together with the competition from London trading, which has been one of the forces leading the NYSE to consider extending its trading hours. The original proposals to extend NYSE trading included an earlier open, a later close, the introduction of three discrete "calls" spaced during the night-time hours at 8 pm, midnight and 5 am (10 am London time), as well as the introduction of an after-hours crossing system which is the only proposal which has been actually implemented. The proposals for an earlier opening and a later close have been postponed, while the introduction of night call auctions has been abandoned for lack of member interest.

Thus competition in the US market, which used to be characterised by a division of labour between a major organised market for listed stocks and an unorganised market for non-listed stocks, first took the form of the "third" market in which non-members traded listed stocks in the over-the-counter market and then in which "fourth" market systems started to trade both list and non-listed stocks via electronic systems. The current competition may thus be characterised as that between different forms of market organisation, all of which are subject to the same general regulation by the Security and Exchange Commission, (although the individual exchanges may differ in terms of their self-regulatory organisations). The question to be answered is the rise of the "third" and "fourth" market trading systems. As will be seen below, the evidence seems to suggest that it was not the development of new technology, but inefficiencies in existing market organisation caused by a fundamental change in the structure of the financial industry which brought about the need for new

forms of organisation and provided a fertile ground for the introduction of new technology.

The Rise of the Third and Fourth Market

The expansion of funds under management by institutions such as pension and retirement funds, insurance companies and mutual funds that started in the 1950's soon led to conditions in which these "buy side" players became the dominant force influencing change in US securities markets. These funds were usually fed by contractual savings contributions of individuals and thus their funds under management available for investment grew automatically in size with the expansion of the economy, irrespective of individual investors preferences for different types of financial assets or their savings decisions. The configuration of the market thus changed from one in which there were a large number of small investors to one in which there were a small number of relatively large investors. The investment preferences of the beneficial owners of the funds were thus replaced by the preferences of the funds' portfolio managers and of those who assess and regulate their performance. Throughout the 1950's there was thus a substantial change in the structure of investment funds with very little change in the structure of the securities industry or in the form of market organisation.

The growth of investible funds was also divorced from the growth in supply of financial assets available. Institutional funds were usually managed by professional money managers who sought to maximise the rate of increase in the value of the assets managed because their performance was evaluated according to this criterion. Irrespective of any increase in the size of their portfolios due to success in investing, the simple growth of new contributions to funds available meant that the size of trades and the average number of transactions had to increase over time. Portfolio managers soon found that the then existing fixed commission structure applied to share trading which did not allow discounts for large trades was detrimental to their performance. In order to reduce their commission costs on large trades, many institutions started to make trades "off-market" by giving orders to NASD broker-dealers who were not members of the organised exchanges and who would trade listed securities over-the-counter at negotiated commission rates. Since a 1,000 share trade seldom requires ten times as much time and effort as a 100 share order, institutions felt they were being treated unfairly by having to pay fixed commissions on large trades; they thus provided a ready market for non-member firms willing to arrange trades off market at commission rates lower than officially imposed on the organised exchanges.

The increase in the size of the funds under management also brought an increase in the size of average trades; and funds would often be holding a substantial proportion of the float in any given stock. This brought another cost, for large orders which were a large proportion of existing float required large changes in prices to produce counterparties and these movements in prices eroded the

gains from successful investment strategies. In order to reduce the size impact of a decision to invest in a particular stock, managers started to spread investments over groups of stocks in the same general business category, and then more generally to stocks with similar market characteristics. The standard trading unit thus moved from a single stock to groups or "baskets" of similar stocks. Finally trading was extended to "portfolios" of stocks producing particular aggregate characteristics. The limit of this attempt to reduce trading impact by diversification was to trade all stocks, or better a group of stocks which mirrored the behaviour of the larger group. Some large managers thus started to deal only in the stocks making up major market indices, such as the Standard and Poor 500 Index. This required only balancing the proportions of stocks included in the index when its composition changed. This type of management was made more attractive by the use of such market indices to measure the performance of actively managed funds. The more active the management the higher the commissions, and the larger the trades the higher the execution costs; the more passive the management, the lower the commissions and execution costs and the closer to the average market return.² Thus, the existence of increasingly large managed funds first created the problem of trading in large blocks³, and attempts to reduce market impact first by trading off-Board, second through the use of combinations or baskets of related stocks and finally by means of trading a market index. The responses of the organised exchanges appeared in the mid-1970's and dealt with action to reduce the costs of handling orders and with the reduction in commission charges. The changes will be dealt with in that order.

AUTOMATED ORDER ENTRY AND EXECUTION SYSTEMS

One of the basic forces leading to change in the organisation was thus the growth in the size of single traders and in single trades beyond the efficient capacity of a system which was designed to handle 100 share round-lot trades. The basic role of new technology was primarily in allowing the large institutions to make more sophisticated calculations of the risk and return characteristics of stocks so as to provide alternative combinations of stock to trade in the place of a single stock. Thus, technology was used to try to reduce the size of trades by spreading them across more stocks. This, however, increased transactions costs and also created problems of logistics in trying to organise the

² The increase in index funds was facilitated by the existence of futures contracts on the market indices which allowed managers to buy and sell the entire index without any appreciable market impact on the prices of the underlying stocks, at lower commission costs than actually buying or selling all the components of the index in the physical market and on margin.

³ The NYSE was cognisant of the difficulties caused by large trades already in the early 1950's and the "special offerings, exchange and secondary distribution" setting out exceptional procedures for dealing with such transactions were expanded in 1956. These are Rules 391 to 396. It is interesting to note that Rule 394, which was rescinded when Rule 390 (known as the 'market responsibility' rule was introduced), was part of this group and dealt with "off floor transactions in listed stocks".

simultaneous execution of a large combined or basket order. In an attempt to cut costs, and to allow brokers to concentrate on working the larger orders for institutional clients, in 1976 the NYSE introduced its first automated trading system, the Designated Order Turnaround (DOT) system to facilitate small order execution. An order entered into the system was automatically transmitted to a printer at the specialist post where it was automatically executed at the specialist's bid or ask unless manually traded within a fixed time limit.⁴

These automated order entry and execution systems, originally designed to handle small order volume, were precisely what was required to allow institutions to trade portfolio combinations or baskets in what came to be called "programme" trades, for they provided for the possibility of using a computer to design the portfolio, issue the order and transmit it directly to the Floor of the exchange. The rise in the size of the maximum order accepted in these systems from 199 shares to over 30,000 for market orders (99,999 for limit orders) has not been to accommodate the small retail trader, but the programme trades of the large institutions.⁵

THE ELIMINATION OF FIXED COMMISSIONS

The impact on price of trading large blocks of a single stock has been estimated to be as high as 2 to 4% of price (a fall of 4% when the Dow is at 2000 is an 80 point drop) and represents a substantial cost of executing transactions in addition to brokerage and exchange costs. In an attempt to reduce these costs of "price erosion" institutional fund managers sought cheaper execution by trading off the organised exchanges through third-market NASD over-the-counter dealers who offered to work off the large orders at negotiated prices below the fixed commissions charged on the organised exchanges. Thus, the third market expanded as it attracted more and more business from large institutions seeking cheaper transactions and execution costs, until the organised exchanges finally sought protection against this loss of business. This was achieved in two ways.

The first way to recover business lost to the third market was to respond to the competition by lowering prices. In 1971 competitively negotiated commissions for trades over \$500,000 were introduced and on the 1st of May⁶ 1975 fixed commissions were abolished as being incompatible with

⁴ The Pacific Stock Exchange had already introduced an automated small order execution system in 1969, so the NYSE response was also to regional competition.

⁵ In addition to facilitation in trading baskets, it also opened the way to index arbitrage between the S&P 500 future traded on the CME in Chicago and the "underlying" basket of stocks traded on the NYSE.

⁶ Now known as "Mayday" in financial history. Mayday is also an internationally recognised radiotelephone signal word used as a distress call; the call may be interpreted either as the distress of the institutions seeking rescue for excessive costs or the distress of market makers in anticipation of

a competitive "national market system" (NMS) in securities trading. As a result, the attractiveness of over-the-counter third market trading was sharply reduced and the proportion of listed shares traded "off market" fell from 4.5% in 1976 to less than 2% in 1979. With the disappearance of fixed commissions the attractiveness of trading large blocks of stock in the OTC market was reduced and much of the trading returned to the NYSE member firms.

The second way for first market firms to counter the third market competition would have been to compete directly as market-makers, using their large retail client base to deal outside the organised exchange. It is widely believed that the larger brokerage houses actively considered this possibility in the early 1970's. The implication would have been a sharp fall in the volume on the exchange, extreme difficulties for the smaller firms and the specialist firms. In an attempt to insure the survival of the organised markets and at the same time to try to strengthen the competition between regional markets in the NMS in 1976 New York Stock Exchange Rule 394 dealing with exemptions from trading on the exchange for blocks, was substituted with Rule 390 which allowed member firms to execute customer orders in listed securities off-board on registered exchanges if this meant better execution (which involves an evaluation of both price and size), but not as principal. In effect this prevented member firms from dealing as principal off-Board to make markets continuously in listed stocks.⁷ Foreign markets, then a minimal presence in trading US stocks, were exempt from the Rule. In addition, SEC Rule 19c-3, which took effect in 1981, amended rule 390, suspending its application for securities listed on the Exchange after 26 April, 1979.

The introduction of competitively negotiated commissions was, however, only a short-term solution to the problems caused by the increasingly large blocks of stock traded by the institutions. As the size of the institutional portfolios continued to increase, the size of their average trade continued to increase, as did the proportion of large block trades and baskets or portfolios in total trading. In a system such as the NYSE specialist system, based on order matching, this meant that order imbalances became more and more frequent and started to erode the ability of the specialist to guarantee the same continuity and depth of price quotes, given his capital base. Trading large blocks thus caused increasingly large movements in prices against the institutions which were trading on the floor. This price erosion represented an additional cost of execution, and soon led many institutions to again look to off-market trading to try to reduce trading costs. At this point a vicious circle was initiated in which specialists and brokers had to increase their capital base in order to be able to take the other side of large block orders, but this meant increased earnings and higher commissions to

the changes which would follow.

⁷ Something which they could do on a non-continuous or "special" basis with respect to 'upstairs trading' in large blocks subject to Rule 391.

justify the increased commitment of capital to trading, making large block trading even more costly.

Thus, much of the negotiation of large block trades was moved off the trading floor to the "upstairs" market and the bargains were either crossed on the floor or executed on another regional or in a foreign market on an over-the-counter basis. London became the favoured foreign market, since most brokers had offices there, and this gave rise to the so-called "London Cross" which benefits from the foreign market exemption to Rule 390.⁸ As the basic problem was price erosion, and since commissions had already been cut substantially, the possibility of cutting transactions costs by reducing commissions further was extremely limited. In addition, after the 1987 market break many of the upstairs trading desks were closed or required larger commissions. The problem could only be solved by an alternative means of trading large blocks which reduced price erosion.

FOURTH MARKET CROSSING SYSTEMS

The response was the creation of the "fourth market" using proprietary systems of electronic trading or electronic crossing systems. In a "crossing system" matching buy and sell orders are executed at a price which is determined elsewhere, usually at the closing price on an organised exchange. Such crossing systems were not new. They had been experimented in the early 1970's in an attempt to by-pass the specialist in order to decrease commission costs. A Boston-based broker called Stockcross is reputed to have been the first to offer to match private retail clients' buy and sell orders at the closing price for 1/3 of standard fixed brokerage commissions. At about the same time Instinet (Institutional Networks Corporation) was set up with the backing of some of the major financial institutions (insurance companies and banks) to provide a telex linked trading network; today the company, now owned by Reuters, is one of the most important proprietary electronic trading systems, with its trading volume for NYSE listed stocks reported in the financial press along with the volume of shares traded on the regional US exchanges.

Crossing systems are attractive to large traders because by definition their orders cannot have any impact on price, which is given independently of the size of the transaction. There is, however, no assurance of execution in a crossing system. For a cross to take place equivalent orders on both sides of the market must be present. The majority of fourth-market proprietary systems in operation today are order-matching systems executing trades at prices determined on the organised exchanges

⁸ Although the exemption allowed the trades to be executed in London, although they were usually negotiated in the US among US principals, there was no regulatory reason for them to be done this way as Rule 391 allowed them to be negotiated off the Floor and simply exposed and crossed at the Specialist's post on the Floor. This latter alternative, however, meant in some cases exposing the order to participation from the crowd or from the book, as well as making the order public, something which was not necessary in London, given the lax reporting requirements there.

and catering to the larger institutional traders.

The two most important crossing systems are the Instinet "Crossing Network" and International Technology Group's POSIT. On Instinet's "Crossing Network", created in 1986, orders are entered after the 4.00 pm close on the NYSE. The orders are matched via a size, rather than a time, priority system at prices reported for the NYSE close or at average bid-ask closing prices for OTC issues, by a computer program run at 5.45pm. Transactions costs are \$0.01 per share with a \$20 minimum per trade. The Crossing Network has around 350 users, and around 40 participate in each session. Trading has averaged around 2 million shares a day in 1991, 75% of which is estimated to be in NYSE listed stocks. Volumes of 7-8 million shares have been achieved on particularly heavy trading days.

Orders for single stocks, or baskets of five or more stocks with a minimum size of 5,000 shares, are matched at the average of the current bid-ask prices on the organised markets at 11.00 and 1.30 pm on the POSIT (PORTfolio System for Institutional Trading) system, with costs of about \$0.02 per share (\$0.01 for directed crosses, i.e. shifts of stock from one fund to another within the same management system to generate a record of transaction for regulatory purposes). POSIT has around 150 users, and an average participation of 50-80 users at each crossing session. Trading is estimated to have reached volumes of up to 10 million shares in early 1992, and has doubled in each of the last four years. 75% of which is estimated to be listed NYSE shares. Investment Technology Group also offers Quantex, a service which combines mathematical trading models with an automatic order execution system which routes orders directly to the NYSE SuperDOT system. It averaged about 1 million shares per day in mid 1991. Jeffries also acts as a market maker in about 250 stocks.

To counter order flow which was being lost to these systems as well as to the use of the "London cross" by its own members trying to circumvent Rule 390, the New York Stock Exchange has introduced its own crossing session as the first step in a series of innovations which is eventually meant to lead to 24-hour trading. On June 13, 1991 the NYSE introduced two after-hours crossing sessions which electronically match buy and sell orders at the 4 o'clock closing prices of the continuous trading session on the Exchange floor. Crossing Session I opens for orders when the continuous market has closed and lasts for one hour. It also provides the possibility for traders to cross pre-matched buy and sell orders at prices other than the day's closing prices. Crossing Session II operates an additional 15 minutes, until 5.15, and is designed for institutions undertaking programme trading in portfolios or baskets which contain at least 15 NYSE stocks and have a value of \$1,000,000. These orders are usually pre-matched at "aggregate prices" for the basket traded, and there is no reporting of individual trades or individual stock prices. In this way it is hoped that trades which would have been made in the upstairs market, by "fourth market" crossing systems or executed via the London cross can be retained for execution on the New York Stock Exchange. From its initiation

to December 31, 1991 Session I was executed an average of 139,711 shares and has tended to decline as the year progressed. The daily average for Session II, which has high variation in volume, was 1,150,781 shares.

Volume Weighted Average Price (VWAP) Crosses and Participation Orders

In December 1991 a variant of the existing electronic crossing systems was introduced by both Instinet and Posit. Instead of matching orders at the day's closing prices or bid-ask mid-points at particular times during the trading day, bargains are made at the average price for trades in the stock executed during the entire trading day weighted by the volume of each trade. Since the trading performance of the portfolio managers of an increasing number of institutions is evaluated with respect to average prices these average price crossing systems provide an additional advantage to the traditional cross in that trading at the VWAP insures that the portfolio never executes a trade at a price that is worse than the average price which is used in its evaluation. This can be seen as a simple extension of the success of index funds which was caused by the widespread use by evaluators of portfolio performance of the major market indices of stock prices. A manager who wants to avoid a negative performance evaluation will thus invest his funds in the index and only trade stock at VWAP.

--Participation Orders

The New York Stock Exchange already provided traders with the possibility of trading large quantities of shares at prices that have minimum impact on trade prices and provide a general approximation to average prices by means of what are commonly called PNI (participate, but do not initiate) or "participation" orders. Such an order specifies a maximum buy or minimum sell price for a maximum quantity of shares which are to be executed by participating by a given percentage (50%) in the volume of a number of separate trades which are initiated by other traders during the trading day. This type of order cannot be used to match another bid or offer, but if a match takes place at a price within the specified limit price and there is more stock to be traded at that price it becomes a limit order. The appropriate use of such orders, which participate in a number of trades over the day thus provides a rough average of the day's price, as well as minimising the impact of additional volume on execution price.

Participation orders fall under what are defined by Rule 13 of the New York Stock Exchange as "percentage orders". A straight limit percentage order is defined as a limited price order to buy (or sell) 50% of the volume of a specified stock traded once the limit price has been reached. When the limit, or higher (lower for a sell order) price is reached, percentage orders are "elected" and become limit orders at that price in quantity determined by the order which initiated the trade. Percentage

Orders may also be written to be executed at the last sale price or better, or set to be executed only on a price reduction (minus tick) for a buy order or to sell only on a price increase (a plus tick).

A percentage order may carry the additional instruction of "convert" and "parity", and is then called a CAP order. Conversion allows the order to be entered without any actual trading volume occurring within the limit price, while parity permits the specialist to trade from his dealer account on a parity or equal basis with the percentage order, i.e. that the specialist may participate in equal volume with CAP orders. CAP instructions may also be written to be triggered to buy on price reductions (a minus tick) or to sell on price rises (a plus tick), and are called "stabilising conversions". When the order instruction is given as CAP-D, it provides for parity and "D" stabilising conversion, i.e. to sell on minus ticks and to buy on plus ticks. The CAP-D order has become increasingly popular as a method for trading large blocks on the Exchange Floor in the period after the 1987 market break.

--VWAP Systems

In the Instinet VWAP, called Market Match, orders are entered before 8.30 and the numbers of shares that have been crossed is reported back to clients at 9.0, before the opening of the official exchanges. The volume-weighted average price is calculated after the close of trading on the Pacific Exchange at 4.30 Eastern Time and the price at which the cross will take place is reported to users at 5.10 pm. The system operates daily, while the Jeffries system currently operates on demand from users.

The only risk involved in the use of such systems, or of the Cap D order on the NYSE, is that there is no guarantee of the number of shares that will actually be executed at the VWAP cross. In the electronic crossing systems this information is available after the morning cross and before the opening of the exchange, so that if an order is not completely filled the remainder of the order can be traded on the exchange or sent to one of the closing price crossing systems. For a trade executed completely with Cap D orders, the amount of trading is determined by other trading on the floor and the amount not done is only known at the close of the trading day. Any remaining shares may then be sent to one of the NYSE Crossing sessions or one of the proprietary systems.

-- Brokerage costs versus execution costs

It is somewhat paradoxical that the increasing use of VWAP trading and CAP orders on the New York Stock Exchange suggests that the large institutional traders, after acting vigorously throughout the 1960s and 1970s to decrease brokers commissions, arguing that the large commissions paid in terms of producing better price execution, are now apparently increasingly willing to accept average price executions, which are by definition worse than the best possible execution, simply in

order to avoid the price erosion which usually accompanies trading large blocks and would thus produce trade prices which are worse than those for smaller size trades. There are alternative methods of trading large blocks which could assure better price execution; for example a large order could be given to a broker on a "not held" basis and it could then be traded throughout the day taking advantage of the most advantageous prices during the day. The willingness to use VWAP and CAP orders also suggests that large institutions are in fact willing to trade off instant execution against price execution, but in this case not against price improvement or even price certainty. There are thus a substantial number of trades which are not time sensitive and do not require immediate execution; they could therefore get better execution on a crossing system or through a discrete call markets. It is somewhat ironical that after forcing down commission costs on brokerage in order to improve their performance, large traders now seem to be willing to accept suboptimal trade execution, and thus higher execution costs, in order to be able to demonstrate that they have not executed at prices which are inferior to those of any other trader. Keynes admonition that in the financial community it is better to fail conventionally than to succeed unconventionally comes instantly to mind.

FOURTH MARKET PRICE DISCOVERY SYSTEMS

Since crossing systems usually depend on the existence of a price determined on an organised market, they are at best auxiliary to the first and second markets. The relation may be considered as symbiotic or parasitic, depending on how they effect the operation of the official markets. They could be considered symbiotic if they provide for trading which would not normally take place on the organised markets, say because of the difficulties of executing large blocks without moving price, or because of the high transactions costs of intermediated markets.

To the extent that they reduce order flow to the major market they are a detriment to the efficiency of price discovery in these markets and represent an overall deterioration in the efficiency of the financial markets. It is for this reason that the organised exchanges have argued that they represent parasites which threaten the survival of the national market system and should be abolished, or if they exist they should be operated by the official exchanges. For this reason they have offered their own alternatives to the proprietary crossing systems. More recently, however, proprietary systems have been developed which challenge the dominance of the organised markets in providing price discovery. There is no question that these fourth market price discovery system do represent a potential replacement for the systems of trading currently employed on organised markets.

In April 1991 Wunsch Auction Systems' SPAworks started operations under an SEC ruling granting a "limited volume" exemption, as provided in section 5 of the Securities Exchange Act, from registering with the SEC as a national securities exchange as required under section 6 of the Act. This

was the first request for such an exemption in 54 years, and the Act does not give a precise definition of "limited volume". The SEC ruling suggests that it will interpret "limited volume" as the lowest volume on an active, currently registered exchange, which would mean the Cincinnati regional market. The Commission may have considered this comparison appropriate because Cincinnati was the first registered exchange to introduce a fully automated electronic trading system. According to SEC figures the Exchange currently handles less than 800 trades per day and a little over 1,200,000 shares per day. SPAworks has not yet come close to exceeding these figures. The system operated until December, when it suspended operation in order to shift its centre of operations to Phoenix where it will resume operations in 1992 as the Arizona Stock Exchange. During its period of operation SPAworks had its highest average daily volume in July with 141,672 shares traded for an average number of shares (buy and sell orders) entered on the system of 2.5 million and a match rate of over 10%. In only one other month were the results half this size. From an initial 17 trading participants, in December of 1991 the System had 55 active trading participants.

Unlike the crossing systems, SPAworks operates on the basis of a Single Price Auction, much like the old Call system which has recently been abandoned in Paris and Milan. Customers enter their buy or sell orders and prices into personal computers which are connected via modem to a central computer. The personal computer screen of each system user exhibits a graphical representation of the supply and demand curves for the aggregate of all the orders that have been entered up to that time, with the intersection showing the market clearing price. In difference from the diagrams of textbooks, the curves are not smooth and continuous, but step-wise linear. As orders arrive an algorithm is continually recalculating the equilibrium price and the curves adjust in real time showing the new prices. In this way, users can gain an idea of how the size of their orders will affect price and whether or not there is sufficient volume in the market for a large order to be filled without substantial price erosion. At the same time, a customer seeking to trade a large block can enter it at his reserve price to see if there is any interest in terms of counter orders. This process of real time orders determining prices goes on until the deadline for the discrete auction. At the moment of the Call, all further orders are blocked and the market clearing price is determined by the proprietary computer algorithm. While the orders on the system are anonymous, they are nonetheless visible and exposed to all participants in the system.

Currently, auction "calls" occur twice daily, before the open and after the close of the NYSE, to determine the single price or "fix" for that auction. All orders that match at that price, plus any bids above and offers below for which there are counterparties, are executed at the same price, according to time of entry priority. The SPAworks system only calculates the price and identifies the orders which could be executed at that single price; the orders are actually executed by a brokerage unit of

Bankers Trust, either as principal or in London in order to meet the letter of NYSE rule 390.

Customers are charged a commission on executed trades which is inversely related to the amount of time remaining between the time the order is entered and the time the auction takes place. Thus users who enter their orders early and thus provide information to other users are charged a lower commission than those who enter orders at the last minute. Orders may be improved in price or quantity at no cost until the auction. Orders which are withdrawn before the auction are charged double commission rates. Commissions on the system averaged less than \$0.01 compared to an average of \$0.084 for negotiated discounted commissions for large block trades of institutions through brokers on the floor of the New York Stock Exchange. When it commences operation as the Arizona Stock Exchange commissions will be capped at one cent.

The SPAworks system thus provides additional cost advantages to large traders as well as better information on the impact of large trades on execution prices. The reason for the difference in costs is readily apparent. The only fixed costs of SPAworks are the rental of the computer which collects orders and runs the algorithm and the labour costs required for billing. There are no brokers or specialists, nor large buildings to be supported by trading. The system thus satisfies the large institutions call for reduced costs for the so-called "no-brainer" trades which require no particular expertise or effort and could be executed by the institutions directly amongst themselves. The system also provides increased information, by accumulating all the orders available at any point in time, avoids the problem of random order arrival which causes price erosion in a continuous market, and the capital costs of selling to an upstairs trader. Finally, since the system operates without intermediaries among principals, there is virtually no possibility for fraud and thus not need for investor protection from fraud or manipulation of the system such as exists in intermediated trading systems.

In difference from the SPAworks system, which mimics the traditional Call market, the Instinet Trading Book system delivered via a Reuters terminal provides for virtually 24-hour continuous trading. Subscribers are provided with an information screen showing current trading and prices and quotes on the major exchanges and the Instinet Book where users have entered the prices and amounts of stock which they are willing to buy and sell. Any orders which have been entered in the Crossing System and have not been executed because of a lack of a counterparty are also automatically listed at the closing price on the electronic Book. All entries represent live bids and offers which may be hit automatically via the proper entry on the customer's computer console.

Alternatively, subscribers may contact other subscribers who have posted live orders to make counter-offers, for example within the book spread, or to negotiate for higher volume. Thus, two subscribers can negotiate a trade via computer much as two brokers might negotiate price or explore

size directly on the trading floor. It is clear that this process does not quite directly mimic floor trading for all such screen negotiations are bilateral, while on the floor of an organised exchange such auctions are open to the competition of the crowd of brokers located around the specialist post and to the limit orders on the specialist's book. While the Instinet system has no intermediaries and does not take position, it does employ individuals who provide instructions to participants on how to use the system and who monitor performance on the system full time, including offering advice on how participants might best take advantage of current price and quantity conditions on the system.

A basic advantage of such a system is the increased possibility of trading "inside" the official bid-ask quote. If a stock is quoted at bid $10\frac{1}{4}$ - ask $10\frac{1}{2}$ on the screen a buyer can directly contact the seller and bid $10\frac{3}{8}$, saving himself an eighth of a point and providing the seller an additional eighth than if the bargain had eventually been made at the official price. However, this argument only works for prices which are quoted with large spreads. Since a majority of the large capitalisation NYSE stocks are quoted at spreads equal to an eighth, an inside quote would have to move to sixteenths. This does in fact occur for some trades on the system, but the tighter the quote on the official market, the lower the savings available to traders on the Instinet book.

It is also usually the case that the degree of competition amongst brokers on the exchange would usually insure that a customer's market order would be negotiated inside the spread if the specialist quote exceeds an eighth, or a limit order inside the spread would be executed. The advantages of screen negotiation over the specialist system would then appear to be marginal. However, as a result of this type of competition the official exchanges are now actively considering the reduction of the size of the minimum tick, i.e. the minimum price variation, from eighths to sixteenths.

This is not the case for the over-the-counter (OTC) market which is a pure dealer market where spreads are usually larger than in broker-dealer markets. In the OTC market it is common for limit orders which are inside the dealers' spread not to be executed, even when broker-dealer trading takes place inside the spread. This is because customer orders are not shown by market makers on the NASDAQ electronic quote system, only their own bid and ask quotes. Customer limit orders will usually not trade until the quote reaches the limit price, while market-makers reserve the right to trade for their own dealing account at prices equal to or better than the limit order and not to execute the order against incoming orders from other customers. Thus if the dealer is quoting bid 10 - ask $10\frac{1}{4}$ and there is a limit order to sell for $10\frac{3}{8}$, this order may remain unexecuted while the dealer trades for its own account, selling at $10\frac{3}{8}$ or above. In such conditions there is a clear advantage to trading through the electronic book where all trades are visible and there is time priority.

All Instinet systems trade as much as 13 million shares per day. It is estimated that 35% of

these are NYSE listed shares. Its market share of NYSE stocks was estimated at 0.2% in 1990 with volume of approximately 300,000 shares. The Instinet system is thus not a major threat to the first and second market, but a real competitor for the OTC NASDAQ dealer system. It also is active internationally, particularly in the London market, which is a pure dealer market fashioned on the US NASDAQ trading system, and offers a Global Automatic Trade Execution Service (GATES) guaranteeing automatic best execution for dealing worldwide and to set standing limit orders up to 900,000 shares in 1,000 share multiples.

Like POSIT, Instinet also offers subscribers an automatic portfolio management program, the Order Management System (OMS) containing electronic trading strategies which when linked to the standard information provided on the Reuters service can produce automatic programme orders into the System as well as providing status monitoring and other real-time information. Instinet also provides for clearing and settlement of orders completed on the system. Wunsch is not a registered broker, and the trades negotiated on the SPAworks system have to be executed by a broker; Instinet, on the other hand is a registered broker-dealer and requires no brokerage, since the system handles all clearing and settlement.

THE AUTOMATION OF THE OTC MARKET

One of the first applications of communications technology was the National Association of Securities Dealers Automated Quotation (NASDAQ) system, which offered the possibility for broker-dealers making markets in the over-the-counter market to quote their bid and ask prices via computer screens rather than via the daily pink sheets. Trading was still arranged by direct telephone contact. After the 1987 market break participation in the automated quotation system became mandatory and enhancements were made to the Small Order Execution System (SOES) in which small sized trades (1,000 shares for 3,000 actively traded issues and 500 for 2,700 less actively traded stocks) can be executed automatically via computer without telephone contact. The system was initially restricted to retail orders and excludes "professional trading accounts" defined as accounts with five or more trades per day. In 1991 the National Association of Security Dealers (NASD) introduced an electronic interactive trading system, SelectNet, within its NASDAQ screen based system for the over the counter market which is similar to the Instinet Book, but is reserved to trading by broker-dealers and reveals the identity of the orders. It had volume of about 7 million shares per day in the first quarter of 1991. NASDAQ is also preparing to trade international and US securities on a 24 hour basis, starting with an early 3.30 am opening.

THIRD MARKET ELECTRONIC MARKET MAKER SYSTEMS

Ever since Merrill Lynch considered the possibility of becoming a market maker in the mid-1970's, brokerages have attempted to offer market-making services to their clients. Unable to do this on the major exchanges in which they were members, many bought or created specialist units to operate on the regional exchanges which after the introduction of the ITS system under the National Market System meant that they had effectively become market-makers since an order could always be routed through its specialist unit on a regional exchange. After the market break of 1987 many brokers were called upon to save specialist firms which were in difficulty, providing them the opening to market-making which had been denied 20 years earlier, although not in all stocks traded on the Exchange. Aside from these possibilities, the regulations governing the National Market system and Rule 390 which requires members to trade NYSE listed issues on the Exchange floor represents a major obstacle to the larger brokers to act generally as market-makers in the operation of their overall investment activity.

Trader market-makers are thus generally limited to non-member firms who are not subject to Rule 390. There are a number of these, the most successful of which is Bernard L. Madoff Investment Securities, which makes markets in over 400 securities. Madoff operates its own proprietary automated trade execution system to make markets by quoting bid-ask prices for 275 NYSE listed stocks, 100 over-the-counter stocks and over 300 convertible bonds and preferred stocks on customers' screens and on regional markets. As a registered NASD broker-dealer, Madoff can make deals over the counter and has access to the National Market System via the ITS (Intermarket Trading System), through the NASDAQ system, and as a member of the Cincinnati Exchange. Madoff quotes are reported on both the Cincinnati and Midwest Exchanges and through NASDAQ. A customer receives a guaranteed fill on orders entered electronically for up to 5,000 shares at the best bid or offer quoted in any public marketplace.

Madoff also offers a novel pricing structure. Customers are not charged for limit orders of up to 5,000 shares, and brokers are paid \$0.01 for market orders of 5,000 shares or less made electronically through his system. Madoff's volume amounts to as much as 5% of NYSE daily volume and has gone as high as 7%. About 95% of total volume is through Madoff's proprietary system and 90% of the trades find counter-parties either from other Madoff customer orders or from hedging or own account trading. The Madoff system differs from SPAworks and Instinet in that it does virtually no institutional trading, instead specialising in small size electronic orders. There are, however, a number of third-market firms who do specialise in institutional trading. Able-Noser, Jeffries and Cantor-Fitzgerald have all maintained large block trading units which deal directly with institutions seeking brokers to work off large positions.

The logic behind the Madoff system is rather different from that of Instinet or SPAworks, who

provide only the market organisation for trades executed by third parties, and from the specialist firm, which commits own capital to provide market organisation and market making services in single stocks assigned to individual members of the firm. Madoff is best understood as a private trader dealing for its own account, attempting to reduce its transactions and execution costs for adjustments to its trading position. Since there are no regulations which prevent private individuals from trading outside the organised exchanges in any security they desire at terms and conditions which they determine amongst themselves, Madoff may be viewed as an investor who seeks to adjust his portfolio by means of such private exchanges, thereby avoiding the costs of such transactions on the organised exchanges.

However, organised markets exist because they provide centralised information concerning the identity of potential traders and their willingness to trade. Private trading off the market will only be more cost efficient if the problem of finding individuals who are willing to trade outside the official market costs less than trading on the market. In order to reduce the problem of searching for counterparties for his trades, Madoff offers to trade privately with any and all comers, simply in order to be able to trade in those securities in which the firm seeks to change its investment position. It is thus willing to offer incentives to generate this information, such as paying for orders and guaranteeing automatic execution at the best price available on any public market in size up to 5,000 shares, irrespective of the size quotes on those markets. To be credible and successful, it thus has to guarantee to take orders from all comers within its size specifications and the stocks it trades.

It is thus possible for a round lot trade on an organised exchange to require Madoff to commit 5,000 shares at that price. Electronic trading allows the firm to do this at low cost, thus reducing its own transaction and execution costs. At the same time, this policy will generate order flow that the firm doesn't need for its own investment policy. This "excess order flow" may thus be seen as representing the cost of information which the firm acquires by intermediating a large order flow. To the extent that excess order flow can be offset electronically against other orders, these costs are negligible; to the extent that they require the firm to take position that is not part of the desired investment decisions, they can be offset by hedging or covered through a wide variety of strategies. In this respect the low maximum order limit exists because it is easier to hedge small positions without moving prices than large one. To the extent that the orders are part of trading strategy, they are not "excess" and Madoff is still only paying 1 cent for them, which is the lowest execution cost currently reported in the industry.

The Madoff system also offers limited price discovery features via its "Price Improvement System". Since the Madoff guarantee of execution is only against the best quoted price on an organised exchange, a customer may be trading at the best available "quoted" price, but in illiquid markets this may involve a very large spread. Thus, for orders where the best available bid-ask spread

exceeds one tick (\$0.12.5) the order will be "stopped" at that price and exposed for one minute on all US public trading systems (effectively the ITS) at a "better" or improved price within the spread. If there is no counterbid after one minute the trade will take place at the bid or ask which prevailed when it was entered. About 15% of all Madoff order arrivals are for stocks with a spread greater than one tick and thus qualify for "price improvement". Price improvement is in fact obtained for about 50% of the qualifying orders. The best price guarantee thus also carries a guarantee of the lowest possible spread.

One of the most important aspects of the proprietary electronic trading system employed by Madoff is the way it employs oversize IBM flat panel screens to provide information to its traders. A Madoff trader sees a combination of up to four separate displays on his screen providing information on multiple markets, the OTC, general financial/political information, and most important of all futures and options markets available for hedging position. The system automatically calculates for the trader his net position in a stock, the costs of hedging that position in the various alternative markets as well as the implicit costs of carrying the position open. In this way, the "excess order flow" is carried at low costs, and provides a source of additional market-making revenue to the firm when dealing is done at the bid-ask spread. But, it is important to recognise this activity and the associated revenue is only a by-product of its basic investment activity. In addition, the operating system provides the managers of the firm with an overall view of the positions taken, which can then be hedged so that the general investment strategy of the firm is controlled and risk/return evaluated at the aggregate level.

Around 95% of Madoff's trading is in NYSE securities, for a trade with Madoff offers the guarantee of a price which is as good as the official quote, and saves not only the commission of a broker, but also the payment for dealing on the Exchange. Thus, Madoff makes its own trades more cheaply and provides a way for others to join in. This could not have been achieved without the introduction of computer electronic telecommunications which reduce the manpower and paperwork costs of executing trades and which permit the "excess order flow" to be hedged efficiently and at low cost. It should also be noted that Madoff only deals in small size, of what are primarily called retail trades, avoiding large blocks which would require taking position in stocks which are not part of the firm's overall investment strategy. Among Madoff's clients are the major discount brokers which specialise in small investor orders.

Trading Organisation and Exchange Regulations

The Security Exchange Act requires that all agency trading in securities take place on registered exchanges. The third and fourth market proprietary trading systems are not considered as

"exchanges", so that, with the exception of Wunsch Auction Systems, they have registered as broker-dealers and received "no-action" letters from the SEC stating that the Agency will not take action to require them to register under section 6. Currently the Agency has issued 20 such letters, but only 12 systems are still active: RMJ-Delta Government Options, POSIT, Instinet, NAPEX, Petroleum Information Corp., NYSAC, Investex Investment Exchange, Real Estate Financing Partnership, Troy Capital Services, Inc, Farmland Industries Inc, Portfolio Trading Services. The SEC has recently notified market participants that it intends to revise Rule 15c2-10 in order to provide a comprehensive regulatory structure for electronic trading systems. The draft of this revised regulation would not require registration by the operators of electronic trading systems, but would place the operators under more direct supervision by the SEC.

Regional Market Competition

The existence of the National Market System, linked by the ITS, Intermarket Trading System, means that there is little competition amongst the major and the regional exchanges. The ITS routes orders to the regional exchanges when they offer better prices for orders entered in the NYSE electronic order system. On the other hand, regional exchanges do compete in other ways. The Pacific Exchange, being open a half-hour after the NYSE provides an active specialist price discovery market which competes with the NYSE crossing systems. It has applied for extended hours. The importance of price discovery to traders was seen in the fact that although volume on the Pacific Exchange dropped sharply when the NYSE crossing systems were first introduced, it quickly recovered and gained additional volume in the half-hour in which it trades after the NYSE close in competition with the NYSE Crossing Sessions. The Cincinnati Exchange is now virtually identical with the Madoff system, while the Midwest exchange, which has specialised in trading large blocks is in the process of introducing an "intelligent" electronic trading system to provide automatic best-execution trading for small orders in national market system stocks (it is part of ITS) in order to compete with Madoff. All of the regional exchanges with the exception of Midwest and Boston have plans for an after-hours crossing session based on the closing prices on the NMS closing tape. As noted above, the SPAworks system will in 1992 become the organisational structure for the newly created Arizona stock exchange.

The Future of Proprietary Electronic Trading Systems and European Markets

It is clear that the basic threat to the organised exchanges using the specialist system in the US financial market comes from the fourth market price discovery systems such as SPAworks and from third market trading networks such as Madoff Investment Securities, while the NASDAQ OTC dealer market is under more direct competition from the Instinet Electronic Book. This is because both

the third and fourth market type systems eliminate the intermediary function of the broker-dealer in the price discovery and trading process. The two differ in that the fourth market systems provide an alternative market framework, while the third market networks operate through the existing national market system of integrated exchanges, although they need not do so.

The SPAworks alternative represents the introduction of an electronic call system in which principals trade at discrete intervals, while Instinet introduces an electronic version of continuous floor trading on a bilateral level between both principals and brokers. Neither requires either the existence of dealer-brokers, nor relies on the existence of other markets. Since crossing systems require externally determined prices, they can only be electronic versions of the upstairs market trading of large blocks which has always existed in the US market. Indeed, this is the main attraction of such systems, for by definition they have no impact on market price and are hidden from the market process of price formation.

The third-market network systems, of which Madoff is the largest, represents a change, not in market organisation, but in the operation of an investment house. Indeed, Madoff may be seen as an electronic specialist with electronic access to the Chicago derivative markets (something which until recently was expressly denied to the NYSE specialist, and is still practically denied because of the way trade is organised at the NYSE post).

The logic behind these changes can best be understood by recalling the origins of English merchant banks which originated as commodity merchants trading internationally that had to arrange payments for uneven trade flows by means of bills of exchange. They eventually became as efficient at moving money as commodities and other commodity traders started to seek their services in arranging payments, at which point the merchants counting houses became payments clearing houses for international transactions. What started out as a byproduct of trade in goods, became their principal function.

The investor market-makers like Madoff are primarily investors, but operating a strategic portfolio requires buying and selling. The costs of transaction and execution through organised intermediated markets is costly and inefficient, and can be reduced by arranging bilateral trading outside the market, or in the end by offering to make a market in order to always have a trading opportunity available, indeed to pay for some types of order flow, rather than to charge for the market making service. But to do this means accepting all trades, generating a flow of orders excess to portfolio needs. Electronics allows Madoff to accept all these orders at low risk and to reduce his own trading costs sufficiently to pay customers for their orders. This is a new type of organisation of investing, rather than a new market structure offered by the new computer and telecommunications technology.

Both the SPAworks and the Instinet price discovery systems offer cheaper execution than the organised exchange systems. However, they can only offer superior price discovery and efficiency if they attract a sufficiently large number of users to generate order flow large enough to ensure order matching. An order flow of a size which is likely to seriously compromise the survival of the first and second markets. The New York Stock Exchange considered the threat from the fourth market sufficiently seriously to justify consideration of as many as three single-price auctions during the time when the exchange is closed. Such a 24-hour system composed of a normal continuous trading during the day and calls during the nighttime hours would provide competition for both the US fourth market and the competition from international markets for trading in US listed stocks.

The third market network systems do not really offer new forms of price discovery, indeed they interact with existing systems and compete by guaranteeing order fills at prices which are at least as good as those available on other markets. They thus preserve the bid-ask spreads of dealer markets, but substantially reduce the formal costs associated with the regulated exchange and the costs of intermediation. Since these systems are fully integrated with all other markets they appear to satisfy the intention of the national market system and do not require the same monopoly of order flow as either the SPAworks or Instinet to succeed. For this reason they represent a much more potent threat to the survival of the organised exchanges. Indeed, they may represent the form of electronic organisation that must be adopted if the specialist system is to survive. Since many of these systems work in conjunction with regional exchanges they may be seen to represent competition amongst the centre and the regional exchanges, but it is also clear that this is not geographical competition, but rather competition amongst alternative forms of trading organisation.

The same is true of competition on an international level. The NASDAQ electronic quotation system was the first to be used internationally, forming the basis for the London SEAQ system. But, this system is simply the substitution of the mechanically printed pink sheets of OTC stocks bid-ask prices with a computer screen. It represented no change of trading organisation. NASDAQ is now actively competing in London and the rest of Europe to attract dealers' quotations on the system. In order to respond to competition from proprietary trading systems such as Instinet, the NASD has recently installed its own SelectNet for use by broker-dealers.

Most other European markets have adopted some form of small order automatic execution system operating on a continuous basis. Like the SEAQ Automated Execution Facility (SAEF) system and the SOES system of NASDAQ, these systems operate for only small retail trades, but create substantial losses in terms of transparency and efficiency when operated by dealers and professional traders. (see Rapporto, 1990). On the other hand, the SuperDOT system introduced on the NYSE, which was originally introduced to deal with small retail orders, is now an integral part of programme

trading by large portfolio managers on the exchange. But, none of these systems change the role of the intermediary in the trading of stocks. Indeed, some European systems have had to create new intermediaries in order to introduce such systems, while in the US the third and fourth markets have been active in trying to eliminate them. It is for this reason that the third and fourth market innovations discussed represent a competitive threat to the existing organisation of European markets.

Today both Instinet and Madoff operate in Europe through London offices and there is nothing to prevent their offering their systems to principals and brokers operating in European stocks in any European market. They both offer a distinct advantage over the SEAQ system in that they provide the possibility of automatic execution at best price in the case of Madoff, or negotiation within the inside spread (touch on the SEAQ system) in the case of Instinet Electronic Book. Although the SPAworks system is not active in Europe, there is nothing to prevent European stocks from being listed and traded on the system with execution in either the London or the home market. Thus, the major competition in Europe in the near future would not appear to be between London and the regional European exchanges, but between the new forms of proprietary electronic trading systems already present in the US and the systems operated on the organised exchanges in the US and on most European exchanges which have recently adopted systems similar to the US NASDAQ system.

The situation in most European countries, and in Italy in particular is, however, rather different from that in the US where the introduction of new trading techniques has been driven by the buy side, i.e. by the needs of the large institutional investors such as pension funds, insurance companies and mutual funds and unit trusts. These institutions play a much smaller role in Europe. On the other hand, in the US commercial banks are virtually excluded from direct operation in securities markets because of the 1930's banking legislation, while in Europe one of the major problems is how banks and brokers can coexist in the market. In Italy, before the introduction of the SIM, banks were primarily operating on the buy side of the market, investing for clients, for their mutual funds and for their own account. With the creation of the SIM, banks will now acquire some market making interests, which should make operation such as those represented by Madoff an attractive alternative to those banks who have not formed SIM. In any event, conditions in the US suggest that the current changes which have taken place in the Milan market are but a first step, and perhaps one step behind, towards a trading system which is fully automated and based on available computer calculation technology and telecommunications capabilities.