The Automation of Capital Markets

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Abstract

The aim of the research project EMIWA (elektronische Markte und institutioneller Wandel) is to achieve a better understanding of technology-induced changes of markets. For this purpose, the
capital market and its exchanges are studied as one of the most prominent installations of electronic markets. A noticeable gap between the postulated rationalization potential of computer exchanges on the one hand and the existing technological support on the other can be observed. Reasons for this installation gap are supplied and conclusions are drawn for a more differentiated discussion of the impact of information technology on the market as a coordination mechanism.

About the Research Project EMIWA

Since March of 1994, the German Science Foundation has been sponsoring the research project “EMIWA: Electronic markets and institutional change”. In this project, research is conducted on changes in the capital market and its exchanges due to their increasing automation. The project will continue until March of 1996. During this period, the most important financial centers in the western hemisphere have been visited and formal interviews with market organizers and market participants have been held.

Research Object: The Capital Market

Before focusing on the automation process of the capital market, an explanation will be given as to why this market was chosen for research purposes. Principally, other markets such as the market for transportation services (e.g. Anner, 1993; Berlage and Buellinger, 1994) or waste (e.g. Meyer, Schober, and Siefert, 1994) also would have been suitable. But the following attributes predetermine the capital market as the appropriate research object:

- The capital market is regarded as the best approach to the neoclassical ideal of a perfect market and holds an inherent fascination for economists. (Hintner, 1961, p. 12)
- The substitution of market objects through securities makes the physical exchange of goods obsolete. Only abstract property rights are dealt with (Hubman, 1989, p. 30).
- At least on exchanges, the transaction procedure is widely standardized.
- The need for highly efficient execution of securities transactions grows with the professionalization of the capital market (see Keim and Madhavan, 1994)[1].
- The intense competition between different market organizations (central exchange, regional exchange, proprietary trading systems and internalization of order flow [2]) is mainly created through information technology (Lucas and Schwartz, 1989)
- The universal application of information technology by all important capital market participants facilitates the introduction of innovative trading systems.[3]
- The requirements for worldwide information and trading possibilities are leading the industry towards a 24-hour, around-the-globe-by-fingertip system (see Freund, 1991, for a discussion of international securities trading).
- So-called computer exchanges and airline reservation systems are considered as the most prominent installations of electronic markets (Copeland and McKenney, 1988).

Stock, currency, and derivative markets in Germany, Switzerland, Great Britain, Canada and the United States were chosen as research units. The selection of these countries was primarily based on the trailblazing role that Anglo-Saxon capital markets play in the development of innovative transaction systems. The selection of market objects covers the broad continuum from quoted ones (shares) to non-quoted ones (swaps) (see Brady, 1990 for a distinction between exchange-executed vs. over-the-counter transactions). Market organizations (exchanges, proprietary trading systems and over-the-counter markets) serve as survey units. For survey method purposes, interviews with experts support the exploration of the automation process of the capital market.

The Classic Transaction Arena: Trading Floor

The first exchanges came about in the middle ages on those days when goods were traded in central locations and the settlement of payments followed at the end of the fair (see Pohl, 1992 for the
history of German exchanges). Settlement days became more independent, eventually forming a sovereign market place. Today's market organizations have been submitted to an ongoing institutionalization process. This began with the erection of trading buildings and the growing regulation of trading. Meanwhile, exchanges have accumulated a vast store of knowledge concerning the organization of their specific markets. Within this evolution, it seems to be important to not merely distinguish planned structures and processes. In the course of their evolution, in order to increase efficiency, the exchanges have standardized not only their market objects but also the transactions themselves (Schmidt, 1988, p. 7).

Figure 1: Exchange as a Market Organizer

The exchanges formed different trading processes, whose merits are still debated (Rottenbacher, 1991, p. 33). Two fundamental types of exchange organizations can be distinguished: the market maker system (practiced e.g. on the London Stock Exchange) and the auction system (Chicago Mercantile Exchange) (Cohen et al., 1986, p. 15; Stoll, 1992). The major difference lies in that two orders may directly meet in the auction-system, whereas in the market maker system, direct order matching is impossible. Here the market maker always intermediates and is bound to quote bids and asks. His revenues result from the spread between bid and ask. Between these two trading forms there is a continuum of hybrid forms such as the specialist at the New York Stock Exchange (Schmidt, 1971) or the Kursmakler in Germany (Bruns, 1965, p. 60). There the intermediary temporarily functions as market maker if the market condition requires a stabilizing intervention or if a slight intervention by the intermediary can cause a significantly higher matching quote. Even a voluntary market making by the crowd in an auction exchange allows for balancing a market disequilibrium.

Figure 2: Price Discovery Processes

When examining exchanges it is especially striking that despite the heterogeneity of trading processes there exists a homogenous governance structure. Exchanges, often understood as the embodiment of capitalism, distinguish themselves from an organization-theoretical point of view by the fact that they are non-profit membership organizations. Their task is the organization and the operation of a trading arena in which their members can achieve profits.

A security transaction on a traditional trading floor is well illustrated by the trading procedure of the New York Stock Exchange (see Hasbrouck et al., 1993 for a full description).

Figure 3: Transaction Procedure on the New York Stock Exchange's Trading Floor
A wealthy investor calls his or her broker and orders the sale of 25,000 IBM shares per limit actual course plus 2%. The broker notes the order and calls his or her colleague at the New York Stock Exchange who is sitting in a booth just off the trading floor. He or she notes the order and pages the relevant trader. As soon as the floor trader receives the page, he or she walks to a phone, picks it up and calls a booth colleague who supplies the order to be executed. The floor trader goes to the pit where IBM shares are traded and delivers the order to the specialist for execution or offers it by shouting to the crowd. When a counterparty is found, the execution has taken place. Both parties note the transaction in their trading book and the buyer reports the transaction to the trade reporting system. The trader again makes a call to the booth with the information about the sale. The booth informs the broker, who in turn informs the client about the execution. This procedure typically lasts about 5-15 minutes.

Only through the agreement of two corresponding orders can the settlement of the transaction be covered. The transfer of securities is managed by clearing and settlement, in which the alignment of the tickets of both trading parties takes place. The automation of the clearing and settlement procedure started in the 1970s, leading to a reduction in paperwork. Today, a physical transfer of securities has largely become obsolete.

The transaction procedure described above is marked by a threefold intermediation together with several media disruptions within the internal and external interfaces. Because the investor is not entitled to deal directly at the exchange, he or she has to hire an agent, the broker, to get access to a security market arena. The second step of intermediation is the exchange itself, which organizes and controls the transaction arena. The third step of intermediation takes place through the price discovery process, which adjusts the orders of the investors through the interaction of trading participants.

Figure 4: Threefold Intermediation of an Exchange Transaction
Through the application of information technology, the rationalization of floor trading can be achieved by:
- reducing interfaces
- avoiding media disruptions
- disintermediation

**The Vision: Computer Exchange**

Before specifying the automation process of the capital market with respect to its exchanges, a theoretical excursion will add some taxonomy. Simultaneously, the foundation for the understanding of the automation process of capital markets will be set (see Bakos, 1992 for a discussion of the economic reasons for institutional change following the introduction of information technology).

There are two fundamental coordination mechanisms for the organization of economic transaction: market and hierarchy (Coase, 1937; Williamson, 1975, 1985). Between these poles there is a continuum of hybrid forms, such as network organizations. Depending upon the characteristics of an economic transaction, one coordination mechanism will prove more efficient than the others. While hierarchical coordination is for the most part efficient for highly specific and strategically important transactions, market coordination is mainly applied to standardized transactions. The most widely used application of transaction cost theory is the make-or-buy decision (Picot, 1991).

In hierarchies, markets and hybrid forms of communication take place between the participants. Because this communication is not frictionless and the participants act strategically, the use of the coordination mechanisms incurs costs, known as transaction costs (Picot and Dietl, 1990). An exchange as a market organizer attempts to optimize these transaction costs by providing an appropriate transaction environment (Schmidt, 1988, p. 3). The provision of this service causes costs for the market provider, who covers these costs by demanding fees from the market participants. These fees, which are in turn carried by the investors, are also called transaction costs.[11]

An important and increasing cost block for a market provider is the information technology support of the securities trading. From the transaction cost theory point of view, those investments alter the framework of the transaction arena. Properly used, the investments in information technology allow for a more efficient communication (Ernst, 1990) and a potentially greater coordination of the market participants (Himberger, 1994). As a result transaction costs are reduced.

Before 1980, information technology was predominantly used for the reduction of hierarchical, intraorganizational transaction costs. In the last decade, the focus shifted to the electronic support of
interorganizational division of labor (Cash and Konsynski, 1985; Kubicek, 1991). First the electronic integration of hybrid coordination mechanisms (subcontractors and network organizations) was managed. In the meantime, a further shift in academic and economic interest towards the electronic market can be observed. The interest in Internet is a prime example of this phenomenon.

Figure 5: Diffusion Path of Electronic Support

Malone, Yates, and Benjamin (1987), inspired by the development of airline reservation systems, realized this trend and developed a scenario for the steps in implementation of information technology. The impact of information technology on the coordination mechanisms are outlined as follows (Malone et al., 1987; Picot, 1986, p. 9):

* electronic communication effect
* electronic integration effect
* electronic brokerage effect

The electronic communication effect allows for a faster, wider and less costly application of information. The electronic integration effect combines different, previously separated functions into a single one by avoiding media disruptions. The electronic brokerage effect leads to a disintermediation of middlemen. Positions like wholesaler, travel agencies or even agents on an exchange (specialists and market makers) are supplanted by information technology. There is a growing tendency towards a direct connection between original transaction partners (Picot, 1986, p. 9).

The three effects accumulate to a relative advantage of the market mechanism in comparison to hierarchy. Using a Darwinian "ecology of coordination mechanisms," the hypothesized superiority and ease of market mechanisms has encouraged the "move to the market" thesis supported by Malone and others. [12]

After explaining coordination mechanisms and their electronic support, we turn to a discussion of process organization. This allows for the realization of the processual character of a security transaction chain. Process organization as well as transaction cost theory considers information technology as an enabler in determining the framework for the process management (Picot and Franck, 1995). A fundamental design recommendation is the creation of transaction chains which surpass company boundaries. This has to be realized with as little media disruption as possible.

Combining these two perspectives results in a distinct call for action: the fundamental reorganization of the transaction chain should take place without media disruption and without human intermediation. This process vision goes far beyond the mere support of the common transactions by adequate communication technology, for example the substitution of a runner by a handy. It requires
more than the mere one-to-one translation of existing structures. A complete new definition of the
transaction chain becomes necessary (Kaplan and Murdock, 1991, p. 35; Picot, Neuburger, and
Niggl, 1993, p 243; see also Neuburger, 1994, p.37, for an application to EDI). Following this vision,
a computer exchange is a market which electronically coordinates investors.

Figure 6: Computer Exchange

It is necessary to emphasize that a computer exchange with such features no longer requires human
interaction in the price discovery process. The transformation function of the price discovery
interaction of the market intermediaries (matching, risk, time, place, and information transformation)
is instead supplied by a computer. [13] This computer would independently quote the spread in a
market maker system, balance out order disequilibria in a hybrid system and assure, within the
auction system, a deliberate market making for the provision of liquidity.

A computer exchange as characterized above incarnates a process vision. Searching for such
computer exchanges in the practical world, one is first confronted with a terminological problem:
The expression "computer exchange" is used in a very undifferentiated manner (Gerke, 1993, p.
726). In order to define computer exchanges, a two-step approach is used (Schmid, 1993, p. 468):

• A computer exchange in a broad sense is a market for securities, realized through the support of
information technology, automating parts of the market transaction.
• A computer exchange in the true sense is a market for securities, realized through the support of
information technology, automating the entire market transaction.

Figure 7: Computer Exchange in a Broad Sense

This figure represents an incomplete automation of the transaction phases. The price discovery
process is not shaded due to the fact that this phase has proven to be the one most difficult to
automate.

Figure 8: Computer Exchange in a True Sense

http://www.ascusc.org/jcmc/vol1/issue3/picot.html 11/10/01
In the next section, the automation process of capital markets will be evaluated based on the process vision.

**The Reality: Survey of Installations**

The capital market is a complex social-economic configuration with a very high information sensitivity. Due to its influence on the interaction of the market participants, automation is a difficult task. If this alteration of the transaction arena intervenes too much in the information processing, unexpected market reactions can result. A prime example for the intricate information process of the capital market is seen in the problem of insider trading regulation. In this case, it was recognized that a healthy balance between information production and legitimate use of gathered information is essential (Picot and Dietl, 1994).

With the installation of the telegraph, information technology made its first heavy impact on the capital market. Garbade and Silber (1978) examined the intermarket price differences between several US exchanges before and after the installation of the telegraph between major eastern cities in the US in 1840. They also examined changes after the laying of the transatlantic cable between London and New York in 1866, which reduced the time lag of a transatlantic transaction from six weeks to one day. They found that intermarket price differences equaled the costs of transportation plus a risk surcharge in case of an alteration in prices during transportation. The introduction of information technology reduced the intermarket price differences according to the new transmitting time of information (see also Jassawalla, 1989, p. 87, for the immediate use of new information technology in the financial industry).

With the reduction of communication costs the tendency towards a centralization of exchanges began. At the turn of the century, about 100 exchanges existed in the US. By 1935, this number was cut down to 35; in 1965, 15 exchanges were counted. Today only 5 regional exchanges and the New York Stock Exchange and the American Stock Exchange remain (Blume and Goldstein, 1995, p. 4).

A classification of the automation of exchanges can be based on the conversion level of the classical transaction chain over to a computerized one. In conformance with the phases of a capital market transaction (information, order routing, execution, clearing and settlement phases) the systems can be classified as follows (United States General Accounting Office, 1991, p. 4):

- information systems
- order routing systems
- execution systems
- clearing and settlement systems

**Figure 9: Automation of a Security Transaction**
First, information systems were supported by information technology. A prime example is NASDAQ (National Association of Securities Dealers Automated Quotation) (Pieseler, 1990).[14] The impulse for the development of an electronic information system came from the Securities and Exchange Commission (SEC). They demanded in 1970 that NASD replace the quotation by “pink sheets” with an electronic information system (Pieseler, 1990, p. 196). The pink sheets were inefficient because the papers had to be printed and distributed after every trading day. Timely price information was impossible. When NASDAQ was introduced in 1971, the quotation from the different market makers could be observed in real time on the screen. Therefore transparency, reaction time, and efficiency of the market greatly increased (Hamilton, 1978).[15]

In addition to pre-trade information systems, post-trade systems exist which publish details about executed transactions, such as prices and volumes.[16] These systems are well known from TV where a ticker tape runs at the bottom of the screen.

Order routing systems are responsible for the electronic transmission of an order to the relevant receiver. First, the order transmission was rationalized through the substitution of a runner by a pager or by hand signals from a handy.[17] In a further rationalization step, order routing systems were connected to an execution system which allows for the automatic or partly automatic execution of small orders. A well-known order routing system is SuperDot (Super Designated Order Turnaround) at the New York Stock Exchange which substantially increased the volume of institutional trading.[18]

Clearing and settlement systems are prime applications for information technology since these procedures are very time consuming and error-prone. Therefore all the major exchanges have invested large sums in the automation of their clearing and settlement systems. The shorter the clearing and settlement process is, the less interest has to be paid by the investors until their transactions are fully completed.

A further classification of execution systems can be made in reference to the automation of the price discovery process. This criterion emphasizes the most important function of the market as a coordination system, the price discovery. The price discovery process adjusts the transaction plans of the investors. Only those electronic securities markets which reproduce this essential function can be called computer exchanges in the true sense (Gerke and Aignesberger, 1986, p. 16). The different stages of the electronic support of the price discovery process can be systematized as shown in Figure 10 (from Domowitz, 1992). The price discovery process contains the priority rules of execution and the matching algorithm.

Figure 10: Automation of the Price Discovery Process
The simplest form of price discovery is to take it from another market, meaning no independent price discovery exists. Those systems are mainly appropriate for retail trading and for passive index traders.[19] RAES (Retail Automation Execution System) at the Chicago Board of Options Exchange, for example, offers an automatic execution function for retail orders guaranteeing actual pit prices (Domowitz, 1992, p. 308). Some exchanges even compare the prices from other exchanges and offer the best available price. This function exists mainly for retail trading intermediaries who provide their customers with a best execution guarantee. The Midwest Stock Exchange offers such a system called Supermax (Domowitz, 1992, p. 309).

A further improvement is the integration of a negotiation function which is very important for blocktraders. They face the problem of adverse selection as a result of insider information (see Berkowitz et al., 1988 and Lakonishok et al., 1992 for empirical analyses of the importance of these market reactions). The problem of asymmetric information dissemination can only be solved by two-sided negotiation (Grossman, 1992; Stoll, 1992, p. 87). Therefore, the SOFFEX (Swiss Options and Futures Exchange) offers an announcement function, so that the interest of fellow market participants can be scrutinized.

A further technique is the order selection directly from an electronic bulletin board using a mouse as the input device. This is the principle of Globex, a derivatives trading system, operated by Reuters, the Chicago Mercantile Exchange (CME), and Marchea Terme International de France (MATIF) (Globex, 1994, p. 100). These systems do not have an automated intermediation function for balancing order disequilibriums. This must still be done by an intermediary.[20]

The next step is continuous trading with permanent order placement. Transactions occur when two orders match. In this case, the price discovery is endogenous. Such a system is Project A from the Chicago Board of Trade (Chicago Board of Trade, 1994, p. 5-4 5). There is no automatic intermediation function which ensures the matching of orders that are only slightly mismatched. Furthermore, it does not enable market orders trading as do conventional trading systems.[21] More computerized are auction trading systems which collect orders and execute them in intervals according to a turnover maximizing principle. The Arizona Stock Exchange offers such a system, providing transaction possibilities for institutional investors (see Securities and Exchange Commission, 1994, p. A-IV-10, for a description). This system does not include an intermediary function for non-matching orders. Consequently, the level of matching quotes and liquidity are often very low in these systems.

It is very important to recognize that all the above described systems replace only the first two steps of intermediation but not the third. The price discovery process is not completely automated. None of those systems endogenously calculates the spreads for the market maker, balances out mismatching orders like a specialist or simulates the liquidity of the crowd. Therefore, a computer exchange in the true sense has not yet been realized.

With respect to the phase model of a market transaction, it is obvious that only parts of the transaction are electronically supported. These are mainly the information, order routing, and the clearing and settlement phases which are at least partly automated at most exchanges. The heart of a market transaction, the execution phase with the price discovery process, is only minimally automated. In accordance with those findings, the process of automation of the market arena can be described as a diffusion from the borders to the core of market functions.
Reasons for the Vision - Reality Discrepancy

What factors are responsible for the evolution of such a heterogeneous spectrum of electronic trading systems? The coexistence of different automation steps is noteworthy, due to the previous identification of the capital market as the ideal object for automation. This discrepancy is also amplified through the fierce competition between the suppliers of trading systems. Given this, we should by now have experienced a strong technology-induced shakeout of less efficient market organizers, but this has not taken place.

Differing perspectives are used to explain the discrepancy between the postulated rationalization potential on the one hand and the incomplete automation of securities trading on the other (see, for example, Berlage and Buellinger, 1994, p. 2, for research on logistics markets). The employed perspectives partly overlap, but cover a wide range due to the vast number of influence factors (Himberger et al., 1991, p. 21; Kraehenmann, 1991).

Market process theory and microstructure theory both focus on the interaction of market participants under the assumption of transaction costs. These two perspectives lead to a better understanding of the interaction on the exchanges. Micropolicy scrutinizes the reorganization process from the perspective and power position of the involved participants. A study of the institutional framework concludes this section.

Market Process Theory

In contrast to neoclassical theory, the core of market process theory is not the efficiency of the market mechanism but the actions which take place in the market arena (Kirzner, 1978). The information and communication behavior of the participants is crucial in this analysis. The market is understood as a discovery and learning process which rewards the best informed participant with the greatest knowledge arbitrage profits. Market process theory is therefore the antipode to neoclassical theory, which does not endogenize information but neglects the information problems of markets (Holleis, 1985, p. 26).

The design of market transparency is the most important issue of market process theory. Following the ideal of the perfect market, this would be a maximization problem: the more transparent a market is, the more efficient is the market mechanism. This design goal follows neoclassical theory, which studies the market under the assumptions of costless information and atomistic market structures. But reality has proven that designing market transparency is not a question of maximization because of the strategic reactions of market participants when full transparency is provided (Rudolph, 1994, p. 426).

This problem is very important for institutional trading. If blocktraders had to report a trade immediately, they could not achieve the same price compared to discrete trading due to the strategic actions of other market participants. This problem parallels the purchase of a car, when the dealer tells his potential customer of his unusually large stock. With this knowledge the customer's bargaining power is strengthened, resulting in a price reduction.

The upstairs traders' refusal to report their trades immediately is understandable. The market makers on the London Stock Exchange have therefore been granted a time span of 90 minutes to report their trades (Rottenbacher, 1991, p. 37). This results in a loss of market transparency due to heterogeneously informed traders. The fine tuning of pre- and post-trade reporting proves to be a delicate process and the outcome significantly influences the efficiency of a market.

It is important to stress that institutional trading covers an ever-increasing volume of exchanges' transactions. Therefore the market providers have to pay close attention to the trading demands of institutional traders and to decide where to position their own trading system in the trade-off...
between wholesale and retail trading. [26]

The question of anonymity arises in the light of market process theory as well. Floor trading is conducted face-to-face and therefore not in an anonymous manner. Screen trading systems normally allow for anonymous trading. Experienced floor traders find fault with the lack of information, as the orders in an anonymous trading system have no discernible background and interpretation of the market reactions is hardly possible. Institutional traders therefore prefer anonymous trading because they are afraid of the strategic behavior of the other market participants who observe their actions very carefully. [27]

Looking at the problem of designing optimal market transparency leads to the assumption that the paradigm of neoclassical theory was at work. One of the most prominent claims of computer exchange supporters is the approximation of the capital markets to the ideal of perfect markets with the help of information technology. Only after a trial-and-error process was it apparent that the strategic behavior of the market participants has to be recognized when designing electronic trading systems. The design of a computer exchange is therefore shaped by the trade-off between market transparency and market efficiency.

Figure 11: Market Transparency and Market Efficiency

The vision of computer exchanges can be compared with the discussion of the introduction of management information systems in the late 1960s and early 1970s. There was great enthusiasm about the capabilities of those systems for management support. Only after the understanding of the information, communication and decision processes changed from a decision logic point of view to a more realistic one, was it realized that a complete collection of information through electronic systems is not possible (Ciborra, 1987, p. 18). If a parallel exists between the introduction of intra- and interorganizational information systems, then a coexistence of transaction systems, accommodating different transaction demands, will exist in the foreseeable future. This will mean a further automation for retail trading, whereas wholesale trading will still be based on human interaction.

Microstructure Theory

As shown above, it is of great importance to have a profound knowledge of the markets in order to automate them. A major obstacle to the creation of an electronic market is the lack of detailed market knowledge from both a practical as well as theoretical point of view.

The branch of capital market research which works on the organization of securities markets is called microstructure theory (Cohen et al., 1986; Franke, 1993, p. 396). This theory attempts to understand the trading processes of organized markets by modeling the participants’ decisions (Berkman, 1992;
Copeland and Galei, 1983; Demsetz, 1968; Mildenstein, 1982; and Neuburger, 1992), from which researchers attempt to develop design alternatives (Cohen et al., 1986, p. 195).

The models are extremely intricate and very seldom represent an adequate approximation to reality (e.g. Hakansson et al., 1985). It seems that the processes are so complex that they are hardly reproducible (Cohen et al., 1987, p. 190). One of the reasons is that the participants' interactions are deeply affected by their tacit knowledge. The difficulties of reproducing tacit knowledge are known from the software engineering of artificial intelligence (see, for example, Winograd and Flores, 1987). At this time it is only possible to program well-structured, describable decisions. As soon as decisions become unstructured and characterized by tacit knowledge, the replacement of human decision makers is not realistic (Franck, 1991, p. 214).

**Micropolicy**

The micropolicy perspective tries to see the decision processes within enterprises from the point of view of each individual's rationality and power position (Bosetzky and Heinrich, 1980, p. 180). This strategic organizational analysis has been predominantly employed for the automation of intraorganizational coordination instruments (Ortman et al., 1990) but seems to be adequate for the analysis of the interorganizational reorganization processes as well.[28]

At this point light must be shed on the governance structure of exchanges. A membership organization allows the participation of each member in the politics of the exchange. But this participation is a tedious decision process requiring many compromises (Stoll, 1992, p. 88). When members anticipate significant changes, they fear a loss of their traditional position. Influential members in the automation of securities dealing can be split up into three groups: locals, brokerage houses and investment banks, and market intermediaries.

The locals display aversion to further automation. They fear an increasing institutionalization of securities trading and are afraid of losing trading volume due to their lack of capital.[29] In addition they try to prevent direct access by institutional investors who could, at least theoretically, gain direct access to an electronic trading system. Their specific human capital is bound to floor trading and because of the impending devaluation of their specific abilities, they fear screen trading Hubman, 1989, p. 289).[30] Furthermore, the costs of automation are allocated amongst the members, meaning the locals would be financing their own disadvantages. The degree to which they can successfully defend traditional trading depends upon their power position on the exchange.[31]

The market intermediaries (specialists and market makers) also generally try to prevent a complete automation of securities trading. They are afraid of losing their trading privileges which are a result of their monopoly (Blume et al., 1993, p. 181). [32] Additionally they fear the shrinkage of their brokerage commission which would result from an improved market transparency. Their fees could no longer be justified due to the changes in the intermediation service. [33]

The brokerage houses and investment banks would like to separate securities trading as much as possible into retail and wholesale trading. In their opinion, the standard transactions should be automated as much as possible to curtail handling costs. Institutional trading should remain non-transparent (non-electronic), preventing a disintermediation of upstairs trading, because they would like to retain their discrete scope of action. They would also like to internalize trading as much as possible. In so doing they can keep a larger portion of the commission charged to their customers. Only those orders not matched in-house would be sent to an exchange. Whether they can impose their strategies does not depend on their formal voting power but on the volume they attract to an exchange.

It is not in the interest of any party mentioned above to open access to the exchange to non-members. They will not choose to bring about their own disintermediation but simply rationalize the
This survey of the important members' positions illustrates the intricate decision making process with respect to the automation of the transaction arena. Proprietary trading systems, on the contrary, have differing governance structures and do not encounter such complicated decisions. Their objective is to earn income through providing a transaction arena, compared to an exchange whose objective is to organize a transaction arena allowing the members to experience financial gain. Proprietary trading systems prove to be innovators for transaction systems that take advantage of information technology capabilities. Therefore they accommodate an increasing securities transaction volume and have become a relevant source of competition to the established exchanges in offering custom-made transaction services.

Institutional Framework

The change in the technological framework of the transaction arena can result in a modification of other framework factors. The most important is surely the redefinition of the regulatory frame of the capital market including the exchanges, as well as other forms of securities trading arenas. This has become necessary because the old regulatory regime focused on floortrading on established exchanges and not on the capabilities of electronic trading (Becker et al., 1992; Domowitz, 1992, p. 320; Saunders and White, 1986). Important problems to be solved are:

- regulation of exchange competition
- allocation of regulation costs
- regulation of cross-border trading
- regulation of property rights on exchange products
- guarantee of technical integrity of the trading systems

The quest for an appropriate regulatory regime can be characterized as the conflict between concentration and competition (Schmidt, 1977; Securities and Exchange Commission, 1994, p. III; Stoll, 1992, p. 92). Supporters of exchange competition see the competition as an innovation and incentive potential for the provision of a minimal transaction cost market arena. Critics argue that a myriad of transaction systems reduces market liquidity.

The allocation of regulation costs results from the fact that exchanges are in general self-regulating organizations, meaning they organize and pay for their own regulation. In contrast, proprietary trading systems are not classified as exchanges and therefore do not have to bear any regulation costs. If exchanges compete against proprietary trading systems the playing field is not equal.

International trading has to be regulated as well as national securities trading. Through the growing use of proprietary trading systems, a larger share of securities trading is being dealt cross-border. Important regulatory questions include access, listing of securities, and responsibility for market surveillance (International Organization of Securities Commissions, 1994; White, 1993).

A further problem with the emergence of computer exchanges is the definition of property rights on the price discovery of an exchange (Alchian and Demsetz, 1973). If exchanges and proprietary trading systems free-ride on the price discovery process of the dominant market, they can offer a transaction service with similar quality but do not have to bear the costs of operating the transaction arena. Considering that the price discovery is one of the major products of an exchange, it is necessary to concentrate the property rights on the price discovery process.

The market objects require a concentration of property rights as well. Only when derivatives are exclusively traded on an exchange are sufficient incentives provided for the invention and marketing of new derivatives (Mulherin et al., 1992).

Another important regulation question is the safeguarding of the technical integrity of the trading
systems (Mechler and Niedereichholz, 1991). This point has not yet been sufficiently emphasized due to the focus on regulation of the trading floor.

Transfer to Other Markets

The capital market and its exchanges still have a long way to go for complete automation. Though a trend towards further automation is apparent, the price discovery process will not be fully automated in the foreseeable future.

All important exchanges are planning to install more information technology for the rationalization of their trading arenas (United States General Accounting Office, 1991, p. 4.). The New York Stock Exchange and the Futures Exchanges of Chicago, for example, are introducing hand-held devices which allow direct order routing to the floor traders and the substitution of their trading books. At this time an abolition of the trading floor is out of question for the dominant marketplaces. As an example in support of this, the Chicago Board of Trade plans to add on a new trading floor for $170 million because the existing floors can no longer accommodate the exploding trading volume. In comparison the $1 million investment for Project A (an electronic after-hours trading system) is trivial. An imaginable scenario for the capital market is characterized by the coexistence and interaction of a variety of transaction systems. An integrated global computer exchange in the narrow sense with 24-hour trading is not in sight.

The automation of capital markets can be characterized as an evolutionary process. This process is predominantly marked by a growing understanding of the securities market process. The parallels to the evolution of management systems are evident: only when the understanding of the participants' interactions of the coordination mechanism is improved can a modeling of an electronic coordination mechanism be successful (Gerke and Bienert, 1991).

Application of these observations to other markets is difficult to conduct due to the specific features of the capital market. The most striking observation is the discrepancy between the mechanistic market concept of the proponents of electronic commerce and the real-life market process which is deeply characterized by the strategic behavior of the actors. To understand how markets behave, the proponents of electronic commerce should take a closer look at market microstructure. In so doing, it will most likely be observed that market processes are difficult to explain, and therefore the organization of markets is an intricate task, whether with the support of electronic devices or not. To extend the first findings of our research project to other markets the following cautious observations can be made.

- The automation of the price discovery process is the most difficult task in designing and running electronic markets. This is especially true for highly standardized products because the only remaining variable for the actors gaming in order to maximize profit from the market transactions is the price at which a transaction takes place. For this game the actors guard their information jealously in conducting order exposure management in order to outplay the other traders. In markets for less standardized goods such as for clothing and furniture, etc., the actors have more gaming variables in conducting a market transaction for the maximization of their profits. Therefore, the revelation of price information may not be so crucial in these types of markets.

- The automation of highly organized markets is difficult due to vested interests. Organized markets are designed to accommodate the economic demands of the actors and as soon as reorganization jeopardizes the interests of the actors, technological rationalization potential is difficult to realize.

- The competition between different market organizations is mainly influenced by traders' inertia. Liquidity attracts further liquidity, which means that traders always want to trade where others are already trading. This is a network effect, which makes it difficult for competing start ups to attract enough orders to reach the critical mass of orders in order to produce a liquid market. This liquidity
inertia is a major barrier for innovative market organizations that are attempting to compete against established ones.

- Complete replacement of human intermediaries will not take place. But it is likely that there will be an unbundling of the activities of intermediaries so that consultative and pure order handling activities are separated. Standard transactions will become more and more automated, even their price discovery, as long as the orders are atomistic and one order has no significant impact on the price. Intricate transactions will still need human intermediaries but may be conducted with electronic support.

References


http://www.ascusc.org/jcmc/vol1/issue3/picot.html 11/10/01


Footnotes

1. In 1975, only 30% of US securities were privately held; by 1992 this had increased to 50% (see Securities and Exchange Commission, 1994, Exhibit 1).

2. See for example Schmidt (1977). As an example, the New York Stock Exchange only executes 70% of the volume and 79% of the orders of their listed securities (Securities and Exchange Commission, 1994, p.8.). Proprietary trading systems are defined as screen-supported trading systems, which are privately organized by a profit maximizing enterprise. For a definition and a survey on installations see Securities and Exchange Commission (1994), pp.AIV-1. Finally, by internalization of order flow, we refer to the internal execution of orders in banks or brokerage houses (e.g., Hasbrouck et al., 1993, pp.19; Mulherin et al., 1991, pp.627).

3. When introducing electronic freight-trading-systems the limited information technological know-how in this industry turned out to be an obstacle (Berlage and Buellinger, 1994, p.30). For the technological support of treasury functions see Chorafas (1992).

4. In the first year after its official founding by the Buttonwood Agreement, the New York Stock Exchange moved into a building in Wall Street (Teweles et al., 1992, p.95).

5. This is illustrated in the following history, by which the emergence of specialists in the New York Stock Exchange is explained. In 1870 a broker named Boyd broke his leg and was unable to walk around the floor, which used to be the traders' habit. So he sat on a chair and exclusively dealt with shares of Western Union. His success with this new form of trading was so spectacular that thi