

Information Technology in the Major International Financial Markets

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Abstract

Financial markets perform a seemingly simple function: facilitating the transfer of securities into cash, or cash into securities. Closer inspection of the activities and the information intensity of a trading floor or a dealing room reveals great complexity. Information technology (IT) plays a crucial role in supporting market activities, and no trader today could operate without real-time data services, and computer-based analytical tools. Market information — about prices, interest rates, transactions, investor supply and demand, and company and economic news — is at the heart of any trading operation. Consequently, the major international markets from Tokyo to Zurich are making increased use of information technology. While IT is capable of making physical marketplaces and trading floors obsolete, no consensus is emerging on the design of an integrated global financial market, and many technological and regulatory issues remain unsolved. Multiple, fragmented markets may be a consequence of the lack of coordination. This chapter highlights the technologies that are revolutionizing international financial markets. The future direction of financial markets will be charted by automation and systems, and IT's influence on banks, securities firms, and the markets themselves will continue to be a subject of debate and controversy.

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1. Introduction

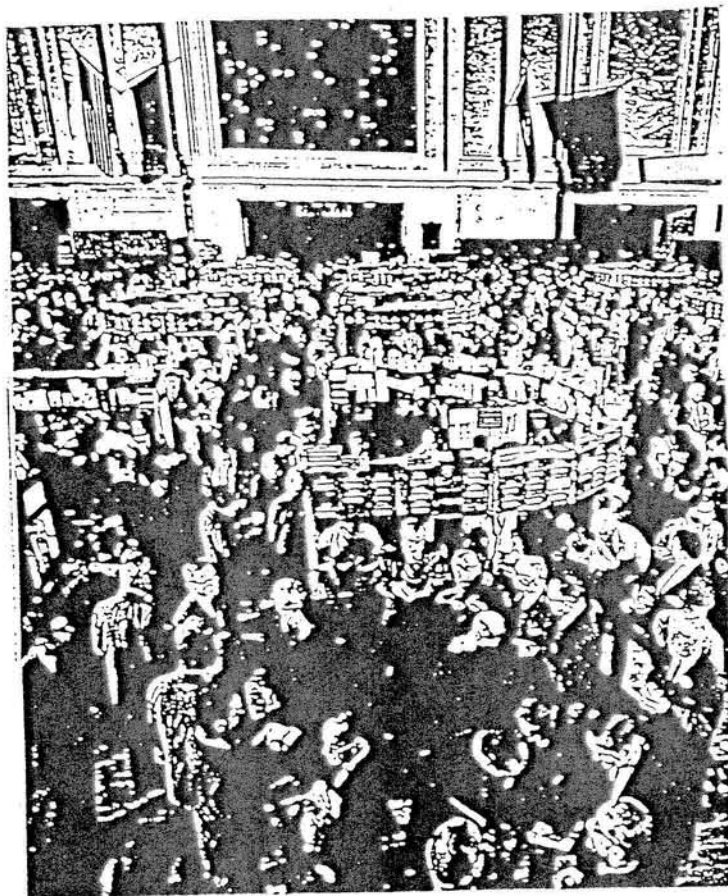
Financial markets around the world are in the midst of a dramatic transformation. Regulatory and market barriers have fallen, and automation continues to restructure trading processes, lowering the costs of transacting and monitoring financial markets. Observers have declared "The End of Geography" in financial markets¹; location plays a greatly diminished role in investors' decisions. International market integration is occurring at a rapid pace, and globalization is no longer a buzzword; it has arrived. It is not unusual to hear of a British broker placing a Japanese conglomerate's Deutschmark-denominated securities with a U.S. pension fund manager as part of an underwriting arranged by a subsidiary of a Swiss bank in Luxembourg. To hedge the risk of adverse shifts in currency values or interest rates, the investor may simultaneously execute trades in a screen-based market, such as Globex. Such activities provide benefits through increased investor diversification, lower costs of company funding, and increased competition across market participants.

Such transformations do not occur without upheaval and discomfort for some market participants. The move to global markets has heightened competition, and financial technology often leads to low-margin, undifferentiated products [CLEM91]. The return on capital for member firms of the London Stock Exchange between 1987-1990 was *negative* 2 percent. Employment in the U.S. securities industry has fallen from 262,000 in 1987 to 224,000 in 1992. Responding effectively to the changes and pressures will be the hallmark of successful firms and expanding market centers in the coming years. While information technology threatens some sources of profits, it also creates opportunities and a means of reacting to market challenges. For instance, episodes of intensified market volatility such as the October 1987 and October 1989 price breaks have led to the development of increasingly sophisticated risk management

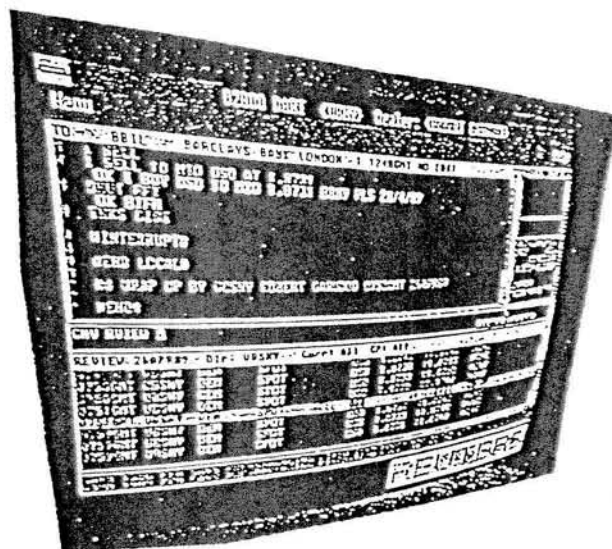
¹ See O'Brien, R. *Global Financial Integration: The End of Geography*, Royal Institute of International Affairs, Pinter Publishers, London, 1992.

systems. Technology has spawned "financial engineering", the packaging of sophisticated, hybrid financial instruments tailored to investor needs.

This chapter surveys the technologies and computer innovations that are transforming financial markets worldwide. Indicative of the changes, the most advanced information technology on the New York Stock Exchange (NYSE) floor in 1964 was a standard annunciator board on the wall, similar to those used in roadside diners to alert waitresses that customer orders were ready. The board notified members by their badge number of incoming telephone orders. In a 5-½ hour trading day, floor traders often walked 15 miles. In contrast, today's foreign exchange market is based on screen price displays and traders operating from well-equipped dealing rooms. Over a third of all foreign exchange trades today are executed on-line via screen "conversations" among between market participants spread across the globe.



NYSE Floor (1964)



Reuters Dealing 2000 (1992)

Figure 1

Although commercial applications of computers expanded rapidly in the 1960s and 1970s, primitive communications systems were unable to handle the intricacies of trading. Markets required face-to-face contact on physical trading floors, or extensive telephone searches of brokers and dealers. Nineteenth century technologies such as the telephone and the stock ticker increased the outside exposure of trading, but until recently the need for floor markets was unquestioned.² Today's more advanced information systems can perform many of the market's informationally intensive functions such as matching buyers and sellers, finding prices at which trades should occur, and processing transactions. Many capital markets today function as networks of linked trader terminals, and a number of firms operate global communications networks for sharing data on positions and activities, and for serving clients without regard to location. Responding to their customers and competitive pressures from information vendors that have established trading networks, traditional floor-based stock exchanges and futures markets have undertaken significant automation projects.

Firms operating in financial markets are among the most intensive and innovative users of information technology. Securities firms in the U.S. spent \$7.5 billion on IT in 1991, or about 20 percent of their noninterest expense. Other types of organizations using IT extensively are investment institutions, information vendors, and the market regulators. Information vendors supply data to market participants, and make use of advanced telecommunications networks and satellites to speed transmissions around the globe. The exchanges themselves spend a large percentage of their operating budgets on technology for information retrieval and trading support. A third of the NYSE's 1990 budget of \$300 million was spent on systems and technology. The London's LIFFE market devotes 35 percent of its operating budget to

² Among the earliest proposals for electronic trading were Fischer Black's "automated specialist", described in 1971, and Mendelson's Automated Trading System [BLAC71] [MEND72]. Researchers have since suggested a number of other electronic means for facilitating markets and securities trading [PEAK79][AH1H85][SCHW89].

information technology. The Securities and Exchange Commission (SEC), the industry regulator in the U.S., is currently phasing in its Electronic Data Gathering, Analysis and Retrieval system (EDGAR) for on-line filing of disclosure documents from corporations and investment managers. EDGAR will cost \$75 million, and by 1997 will replace current paper filings, which total 10 million pages per year.

2. Financial Basics: Instruments, Investment, and Market Infrastructure

Financial markets exist as a complex of securities and instruments, investor decision-making, and a financial infrastructure to support trading and trade processing. These are detailed below.

Instruments. Anything of value can be traded, and merchants, marketplaces, and bazaars have existed since the dawn of civilization. *Financial markets* facilitate the transfer of money into financial instruments, which are *issued*, or sold to investors by companies to raise capital, or by government bodies to borrow funds. Most traded instruments fall into one of several standard categories. While a large company may manufacture many products in various sizes, colors, and configurations, its securities will be standardized into a narrow range by the type of *claim* they represent for the investor.

- *Common stock* or equity is an ownership share in a firm's profits and net worth. Equity holders receive dividends, and vote on corporate actions.
- *Bonds or fixed income obligations* represent loans or contractual claims to a specified stream of repayments. The typical bond pays interest up to the *maturity* date, when the face value or *principal* is returned. Bonds are issued by government bodies and companies. Notes and bills are similar to bonds, but have shorter maturities. Bills mature in a year or less, and notes have an original maturity of 1 to 10 years.
- Markets also exist for *physical commodities* like gold, oil, and agricultural products, and for foreign *currencies*.

Markets differ depending on the timing of the asset's transfer. Often, a transaction occurs today for a financial instrument that the purchaser may not own until some months or years into the future.

- In *cash or spot markets*, ownership of the traded instrument is transferred immediately. Purchasing 100 shares of Intel stock at \$118 today means that 100 Intel shares will be added to the buyer's account and \$11,800 will be credited to the seller's funds on the settlement date (5 days after the trade in the U.S.).
- *Options* contracts confer the right to buy or sell an asset or financial instrument at a specified *strike price* during the contract lifetime, which ends on the option's expiration date. For instance, the purchaser of a *call option* on Intel with a strike price of \$120 expiring in two months has the right to buy 100 Intel shares at \$120 up to the expiration date regardless of Intel market price. If Intel's share price rises, the value of this option will increase. The option expires worthless if Intel's price is below \$120 at expiration.
- In *forward or futures markets*, a price and a *delivery date* sometime in the future are specified. On the delivery or expiration date, ownership transfers and the pre-agreed price is paid by the buyer and received by the seller. For instance, an investor may buy a \$1 million futures contract in April at a yield of 5.0% for December delivery of 90-day Treasury Bills. On the delivery day in April, the seller delivers a T-Bill having 90 days to maturity, and the buyer pays the present value of \$1 million discounted at 5.0%, or: $\$1,000,000 - (0.050 \cdot \$1,000,000) \cdot 90/360 = \$987,500$.

Futures markets developed to meet the needs of farmers and food merchants to protect or *hedge* themselves against fluctuations in agriculture prices caused by weather and crop cycle uncertainties. Trading typically occurs in open outcry trading pits with prices shouted out and good "as long as the breath is warm." Today's largest futures exchange, the Chicago Board of Trade (CBOT), was founded in 1848. With futures, farmers could lock-in a price for crops at the beginning of the growing season, and food producers could be certain of a supply of materials at a fixed cost. *Financial futures* were introduced for foreign currencies in 1972 at the Chicago Mercantile Exchange (CME). Today, financial futures on bonds, interest rates, stock indexes, and currencies are the most heavily traded futures contracts. Future trading has grown in part due to the lower costs of trading futures compared to the cash market instruments.

A study by Prudential Portfolio Managers in London showed the cost of buying and later selling a stock position was 1.9 percent of the position value. For a similar position, a round trip trade in futures cost 0.054 percent.³ With futures, investors can gain exposure to a market, or layoff some of the risk of their positions quickly and cheaply. In order to maintain the exposure, however, the futures contracts need to be *rolled over* at their expiration date (every 3-6 months on average), leading to another trade and set of transaction costs.

Futures and options are called *derivative* securities because their prices are based on, or are derivative of, the cash market price for the *underlying* asset. The derivatives markets are among the most rapidly growing financial markets. Volumes at the CBOT and the CME, the world's two largest futures markets, tripled between 1982 and 1992. In the same time period, the managed futures industry in the U.S. has grown from several million dollars to \$21 billion under management. — Warrants, swaps, commercial paper, rights, convertible bonds, and several other financial instruments are actively traded, but will not be described here.

Investment. Investments are made in expectation of attractive, positive returns, but any investment entails risk. Stock prices fluctuate according to market conditions, and the company's profits and prospects. Bonds prices vary according to interest rates in the economy, and changes in the creditworthiness of the issuer. Bonds are subject to *default* when worsening business conditions make it impossible for an issuer to meet its obligations. Hence, bonds with a greater likelihood of default pay a higher interest rate.

Technology can improve the management of risk, but it will not eliminate market price fluctuations. Some observers believe that financial markets are excessively volatile, and that reducing transactions costs through automation only exacerbates volatility by promoting

³ Waters, R. "U.K Insurance Groups See a Brighter Future in Derivatives", *Financial Times*, 21 December 1992, p. 19.

superfluous trading. The evidence on market inefficiencies and excess volatility is inconclusive. Analysis of NYSE prices since 1840 showed that between 1980 and 1990 prices were only slightly more volatile than in the 1970s, but were less volatile than in the 1920s, 1940s, and 1890s.⁴ Since systems can increase participation and information access, a move toward screen-based 24-hour markets may have the effect of reducing price shocks and volatility.

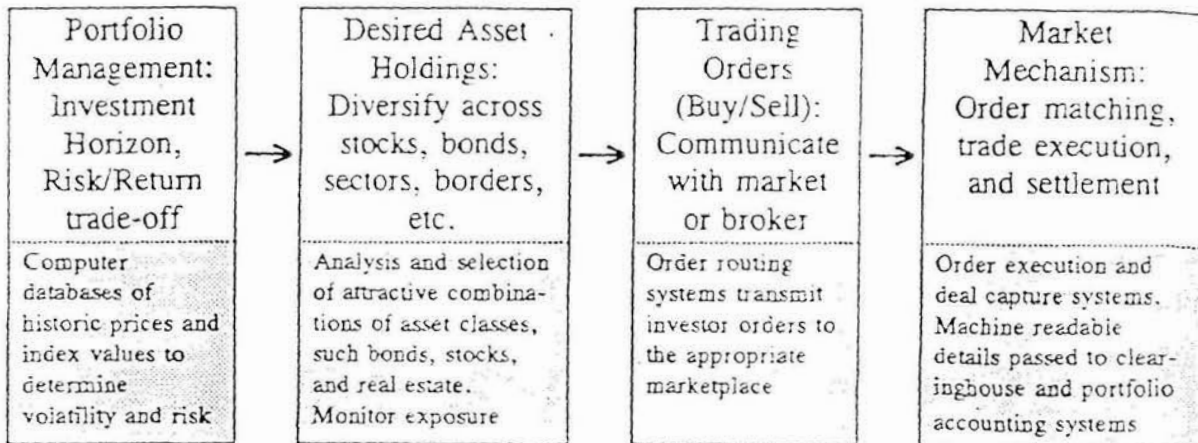
Investors typically *diversify* their investment portfolio by holding a range of securities. The value of diversification was quantified by the Nobel prize-winning economist Harry Markowitz in the 1950s. Markowitz demonstrated that a diversified portfolio had a higher expected rate of return or a lower variance (risk) of return than an undiversified portfolio.⁵ The landmark *Capital Asset Pricing Model* (CAPM)⁶ followed from Portfolio Theory, and established that rational investors will expect a return from any security *i* that is proportional to its risk as measured by its *beta*, β_i . Beta is the *undiversifiable* risk of investing in asset *i*, and is measured by $\beta_i = \text{Cov}(i,M)/\text{Var}(M)$, where $\text{Cov}(i,M)$ is the covariance of returns on security *i* with returns on the entire market, *M*, and $\text{Var}(M)$ is the variance of returns on the market. Beta reflects a stock's volatility, and is the amount that investors expect the stock price to change for each 1 percent change in the market. A beta of 1.5 implies that a 1 percent change in entire market is expected to result in a 1.5 percent change in security *i*'s price.

⁴ "Safer than It Looks", *The Economist*, 4 August 1990, p. 63.

⁵ Markowitz, H.M., "Portfolio Selection", *Journal of Finance*, Vol. 7, pp. 77-91, March 1952.

⁶ Sharpe, W.F., "Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk", *Journal of Finance*, Vol. 19, pp. 425-442, September 1964.

Figure 2: Flow Diagram of Securities Investment Decisions and examples (shaded) of Portfolio Management Technology



Vendors and in-house systems groups have developed information technology to support all stages of the securities investment process.

Market infrastructure. The keys to a well-functioning financial market are *capital*, *people*, and *technology*. Capital in a market is the sum of the financial resources that back the banks and securities firms that participate in the market. Greater levels of capital raise creditworthiness, enable participants to bear greater risks, and lower the chances of that market participants fail to meet their financial obligations. People in a market contribute skill and ingenuity in bringing together those companies and governments seeking to raise funds, with those individuals and institutions seeking to invest wealth. While financial resources are crucial, the adage "the assets walk out the door at the end of the day" applies to firms operating in financial markets.

In only a few advanced expert systems applications is technology used to displace human trading judgment. However, systems have replaced face-to-face and person-to-person contact as the principal conduits of information in modern financial markets. In the past, markets existed only when people gathered in one physical place. Twenty stock exchanges were

operating in Britain in 1900, but in 1973 all trading was consolidated in London. Markets today can reach out to a vast collection of customers, and consolidate diverse opinions from any point on the global, and at any time of day. Technology has also increased the *back-office* efficiency of the securities industry. In many markets, tedious trade settlement paperwork has been replaced by computerized book entry for transferring ownership, and electronic funds transfer for moving payments.

The principal measure of a market's attractiveness is its liquidity. The *liquidity* of a market or a financial instrument is measured by the ease and the economy of transforming cash into the security, and back again at prices that reflect the asset's fair value. Amihud and Mendelson (1991) identified four transactions costs that lower a security's liquidity:

- (1) Bid-ask spread is a cost resulting from the difference between the best price to sell and to buy in the market
- (2) Market impact costs are incurred when a large trade can only be completed with a price concession by the investor
- (3) Delays and search costs are incurred when an investor seeks better trading terms by postponing a trade and trying to find an interested counterparty
- (4) Direct costs commissions are paid as a percentage of the value of a trade. For instance, institutional investors pay 6.5 cents a share on average for trading NYSE stocks.

Low transactions costs improves trading and market liquidity. This allows securities ownership to shift easily so that capital flows efficiently from investors to expanding businesses.

3. Technology in Financial Markets

3.1. History

In 17th century Britain, trading companies such as the East India Company issued securities to finance shipbuilding and dock construction in London, and to pay for long voyages that returned tea, spice, and silk for England's home markets. U.S. financial markets were organized to enable the trading of former colonies' revolutionary war debts. Scandals and frauds were prevalent in the early stock markets. Shares were issued in 1720 in London by the South Sea Company, which proposed to open up trade and markets for new commodities in South America and the Pacific. The price rose from £128 to £1,050 between March and September, but collapsed and the shares were nearly valueless by December when the promised dividends failed to appear.

The London Stock Exchange has its origins in New Jonathan's Coffee House when an entrance fee was imposed on traders in 1748 to keep out "riff-raff". The participating brokers formally established London's Stock Exchange in 1773. The forerunner of the New York Stock Exchange was formed in 1792 by the Buttonwood agreement of twenty-four brokers to establish an orderly market and to share trading information. A minimum commission of 0.25% was set (and maintained until 1975), and members agreed to give preferential treatment to one another. Fixed commissions, along with the restrictions and licensing mandated by the agreement, had the effect of creating a profitable cartel for the traders that took part. An outside, "curb" market remained, and later became the American Stock Exchange.

The formation of organized securities markets led to official market information. Newspaper-published stock prices in New York first appeared in 1815. The telegraph was invented in 1838 by Morse and Vail, and was quickly used to transmit prices between New York and Philadelphia and New Orleans, replacing horse and train journeys that delayed the news

from half a day to a week. As Garbade and Silber (1978) demonstrated, the Transatlantic cable, which in 1866 established telegraph communication between New York and London, affected pricing and changed trading practices in those cities' currency, stock, and bonds markets. Time lags that had been 20 days were reduced to minutes, and the average absolute price differences for securities traded in both markets dropped 69 percent from their previous levels. The electro-mechanical stock ticker (1867) and the telephone (1876) were also rapidly adopted by market participants, and enabled financial markets at the time to extend their reach and their importance in the economy. New York-based brokerage houses that established a presence in other parts of the country to serve retail investors became known as "wirehouses" for their reliance on telegraph communications.

Insider trading takes flight

An early case of windfall profits from trading with *inside, nonpublic information* occurred when Nathan Rothchild received advanced news via carrier pigeon of Wellington's defeat of Napoleon at Waterloo in 1815. Rothchild bought shares at low prices from uninformed and anxiety-racked traders in London, and made his family's fortune from having received the favorable news first. Since the timeliness of a trader's news relative to fellow traders makes the difference between fortunes and losses, technology that speeds the flow of price-sensitive information has always found ready application in financial markets.

The commercialization of computers in the 1950s greatly increased access to financial market information. Quotron introduced on-line interrogation for stock market information in 1960. Brokers anywhere could enter a 4-letter code for a stock, and receive the last trade price, daily volume of shares traded, and the current price quotes. Previously, only reported prices of prevailing trades were available on the ticker, and consolidation and querying of historic prices was not possible. Information systems also made possible the streamlining of the after-trade settlement and clearing process. Archaic, paper-based settlement systems led to the 1967-1968 "back-office crisis", and forced U.S. stock markets to close on Wednesdays during the last

six months of 1968. The subsequent improvements to settlement enabled exchanges to cope with surging trading volumes of the 1970s and 1980s.

3.2. Economic Effects of IT

Microeconomic theories of financial markets are built on the assumption of costless trading and freely available information. In fact, transactions costs are significant. Trading in financial markets may involve paying brokerage commissions and other direct trading costs, subscribing to information and research services, and bearing the risk of price changes during the delay between making an investment decision and the eventual execution of the trade. Information technology, however, lessens the importance of time and distance in securities trading, and has been shown to reduce transactions costs and frictions. In addition, IT has opened up markets to additional participants and has increased competition. Research into the general effects of IT on industries has claimed that electronic markets allow customers to search and compare many products at low cost, thus heightening competitive pressure among suppliers [MALO87][BAKO91]. The overall effect of IT is to bring financial markets closer to microeconomic ideal, and maximize the economic benefits provided by market activities.

Market theory has at its foundation the assumption of market clearing through an equilibrium price formation model. For securities markets, this has meant a frictionless trading mechanism based on a call-type, *Walrasian auction*. In a Walrasian auction, an equilibrium price is reached through an iterative process known as *tâtonnement* in which buyers and seller indicate their net demands for all securities at all combinations of prices. The Walrasian auction is an abstraction, and practical difficulties in operating such a procedure prevent its application in actual securities markets. Instead, markets use trading mechanisms to convert investors' orders to buy and sell into prices and executed trades. An *order* is the basic processing element in trading. It specifies to buy or sell a certain number of securities, contingent perhaps on other

events or conditions in a market. For instance, a *limit order* may specify the purchase 5,000 shares of Motorola at the limit price of \$60 or less. If the shares can only be purchased at a price higher than \$60, the order goes unexecuted. A *market order* instructs the broker to trade at the best available price in the market.

Whitcomb (1985) identified a range of different market structures in use in stock markets around the world. Although details can vary, markets differ on two principal dimensions. First, markets may facilitate *continuous trading*, or *batch or call trading*. In a continuous market, such as the New York Stock Exchange, trades can execute at any time at the quoted bid and offer prices. The bid price in a continuous market is the price at which investors can sell securities, and will be somewhat less than the offer price at which they can purchase securities. The difference between the highest bid quote and the lowest ask or offer quote for a security is called the *bid-ask spread*, and is a transaction cost paid by investors. In a call market, a single price is set at the time of the clearing to most closely equate supply and demand. All orders indicating a willingness to buy at that price or higher, or to sell at that price or lower, are executed. The London gold market operates as a twice daily call market. The second distinction is between *auction markets* and *dealer markets*. In an auction market, investors' orders are "exposed" to the market, and trades occur directly between investors at an agreed price. In a dealer market, competing dealers or market makers post bid and offer prices that investors can trade at. Auction markets are termed *order-driven*, and dealer markets are *quote-driven*.

3.3. Automation Functions in Financial Markets

Automation serves a number of functions in financial markets, yet most markets are incompletely automated, and most retain some manual functions. Listed below are the market functions that can be automated.

- Information systems play an *order collection* role in the processing of trading instructions in investors' and traders' offices. Once an order is entered into an electronic system, order details such as size, limit price, and time are accessible for an investor's control and measurement purposes, and for transmitting to a chosen market system.
- Systems for *order routing* direct an order entered by a trader to the appropriate market. The DOT system (Designated Order Turnaround) was introduced in 1976 for order routing on the NYSE. The system enables NYSE member firms to electronically route market orders and limit orders from their offices anywhere to the specialist post on the market floor, bypassing the floor broker's booth. In 1992, 78 percent of NYSE order arrived via DOT. The remainder arrive via the phone to floor traders' booths.
- *Price determination* is often supported by systems that aggregate the orders submitted to a market. The Arizona Stock Exchange (AZX) is a screen-based market for trading stocks after the close of the New York Stock Exchange floor. The system uses a single price call auction mechanism to find a price at which the quantity to buy equals the quantity to sell.
- *Order execution* systems electronically match buy and sell orders in a market, and *order confirmation* systems route electronic verifications of a trade to the participants involved. Reuters' Dealing 2000 system electronically matches buy and sell orders in the foreign exchange market. Details of executed trades are then transmitted back to the trade participants for confirmation. No more than several seconds elapse between order entry to final trade confirmation.
- Systems are used for *trade reporting* and *surveillance* purposes. In the case of a fraud or market manipulation investigation, an audit trail of trades can speed investigations. The NYSE's StockWatch unit, for example, uses computers to monitor trading activities and to warn of unusual activity, which will be investigated by the staff.
- Systems *disseminate market information* more broadly. The Consolidated Tape System (CTS) was introduced in 1976, and imposed unified trade reporting rules, and facilitated ticker publication of last sale information occurring in any of eight U.S. stock markets. Previously only NYSE and American Stock Exchange (AMEX) trades were reported on the ticker. The CTS informs a far broader audience of all trading activity on the NYSE, AMEX, the five regional stock exchanges, and the OTC market.

Information technology has many benefits in financial markets. First, *visibility* is increased, enabling investors to monitor the market, and to time the execution of their trading strategies. Systems provide the ability to handle increased volumes of business, and contribute

valuable *economies of scale*. In automated markets, greater trading volumes lead to fractional increases in overall costs, and a lowering in per transaction costs. *Integration* and international linkages can be achieved with systems that share information between markets and enable participants to pass their positions from one market to another. A number of markets including the Chicago Mercantile Exchange and the Singapore International Monetary Exchange (SIMEX) have automated facilities for "mutual offset". With mutual offset, a position in one market can be used to offset the margin required in another market. For instance, a 15 contract long position acquired in Chicago in T-bond futures, which is offset by a short position of 10 contracts of the same instrument in Singapore, requires margin to be put up for just the *net* position of 5 contracts. Settlement efficiency is enhanced with systems. The number of questioned trades (QTs), don't knows (DKs), and fails drops when trading is automated and trade details are captured electronically, reducing costly exception processing.

3.4. Constituents in Screen-based Markets

Screen-based securities markets serve many stakeholders including investors, securities firms, and listed companies, as well as the securities exchange or vendor providing the system. The organizations that play operational or informational roles in a screen-based markets are depicted below.

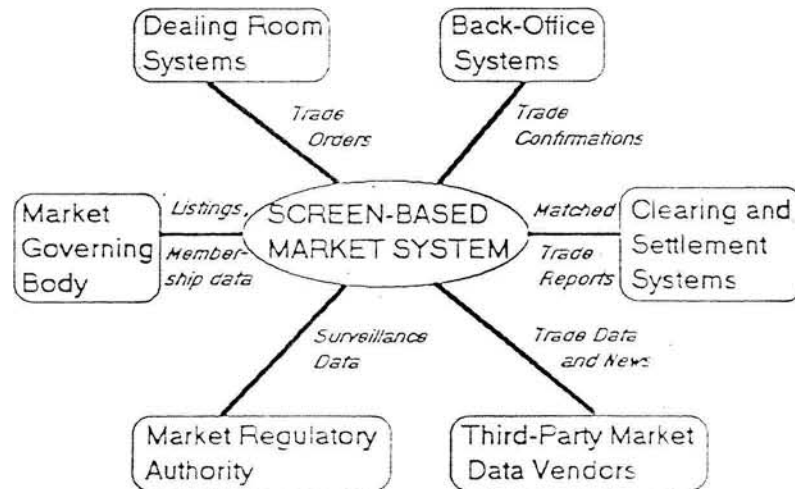


Figure 3: Information Flows in Automated Financial Markets

To succeed, an automated, screen-based market requires cooperation between a number of organizations, the setting of technical standards, and integration of multiple information systems. As markets have globalized and drawn more dispersed participants, achieving cooperation has become more challenging.

4. Screen-based Global Financial Markets: The Foreign Exchange Market

Today's most active and most automated global market is in foreign currencies. Billions of U.S. dollars are exchanged daily for Japanese Yen (¥), British pound sterling (£), Deutschmarks (DM), Swiss Francs, Canadian Dollars, French Francs, and other currencies. A dollar-yen exchange rate of 116.75 means that \$1 buys 116.75 yen, or that ¥1 is worth 0.857¢.

As active as it is, the foreign exchange market has only a 20 year history. To stabilize the world economy after World War II, leaders of major nations met in 1946 in Bretton Woods, New Hampshire and agreed to a system of a fixed exchange rates centered on the dollar with a gold standard that pegged the dollar at \$35 an ounce. The agreement collapsed in August 1971 under the weight of a U.S. balance of payments deficit, and a weakening of the dollar, which made convertibility into gold at \$35 an ounce untenable. Foreign exchange rates were allowed to float, and daily fluctuations were the norm by 1973.

Exchange rates between two currencies are a function of a number of factors including the relative interest rates in the two countries, inflation, and the flow of payments between the two countries. Holding all other factors constant:

- (1) falling interest rates in one country will cause its currency to decline in value
- (2) a nation with a growing balance of payments deficit with another country can expect its currency's value to decline relative to the other nation's currency

- (3) increasing inflation in one country lower the value of its currency

FX Volumes. In 1992, daily turnover in the international foreign exchange (FX) market was estimated at close to \$1 trillion. The three major financial centers are credited with the following daily FX volumes.

(\$ billion)	<u>March 1986</u>	<u>April 1989</u>	<u>April 1992</u>
London	\$90	\$187	\$303
New York	\$58	\$129	\$192
Tokyo	<u>\$48</u>	<u>\$115</u>	<u>\$128</u>
TOTAL	\$196	\$431	\$623

Table 1: Daily Foreign Exchange Trading Volumes

Source: Bank of England, *Quarterly Bulletin*, November 1992

Significant FX trading also occurs in Singapore (fourth with \$80 billion traded daily in 1992), Zurich, Toronto, and Hong Kong.

FX Trading Technology. The FX market is dominated by the world's largest banks, most of whom trade currencies 24 hours a day from technologically sophisticated dealing rooms in the major financial centers. There is no market floor for institutional spot market trading of currencies.

The FX trader's desk contains an abundance of information systems and data feeds, which together have an annual cost of \$30,000 to \$50,000. There are four primary components of the trader's desktop technology.

- (1) The desk will typically house a *high density telephone system* with speed-dialing access to twenty or more outgoing phone lines, display keys for counterparties, and buttons for muting the phone and setting up multiparty conversations.

- (2) *Real-time market data* is provided by screens displaying market information provided by third-party vendors such as Reuters and Telerate.
- (3) *Computer-based analytics* are often used to chart prices, and analyze relationships among financial instruments and economic data. Analytics software is either purchased as a package from a vendor, or is developed in-house.
- (4) Both traders will enter the order into their firm's record keeping or *on-line transactions processing* systems, and later the dollar and yen funds will be electronically transferred from one account to another via an electronic funds transfer system such as FedWire if the traders are U.S.-based, or decide to clear the trade in the U.S.

The 1973 introduction of the Reuters Monitor, which displays competing bank dealers' foreign exchange quotes, spurred the development of the foreign exchange market. The widely scattered market that was emerging after the Bretton Woods breakdown needed some way of posting prices. Banks and other firms fed in their prices to Reuters' central system, and the subscribers received consolidated market information, and news supplied by Reuters correspondents around the globe. Foreign exchange trades have traditionally been effected over the phone. For instance, a bank representing a multinational customer that requires yen to pay a Japanese supplier will phone a dealer that is displaying an attractive offering quote for yen. In a short conversation, the bank's trader will reveal him or herself, confirm the quote for the intended trade, agree to the quantity and price. The dealer will read back details of the trade such as "I sell you 50,000,000 yen at 116.7500 for \$428,265.52."

About 177,000 Reuters terminals were installed around the globe in 1990, up from just 55,000 in 1985. Each terminal has access to 73,000 pages of continuously updated financial news and market prices. In 1981, Reuters introduced Dealing, a conversational electronic dealing system that enables subscribers to negotiate and execute FX trades over their terminals. For the first terminal at a site, Monitor costs \$1,800 a month and Dealing is \$5,400. There

were about 16,000 Dealing terminals in use in 1992. It is estimated that half of world's spot FX trades were executed electronically over the Dealing trading system.⁷

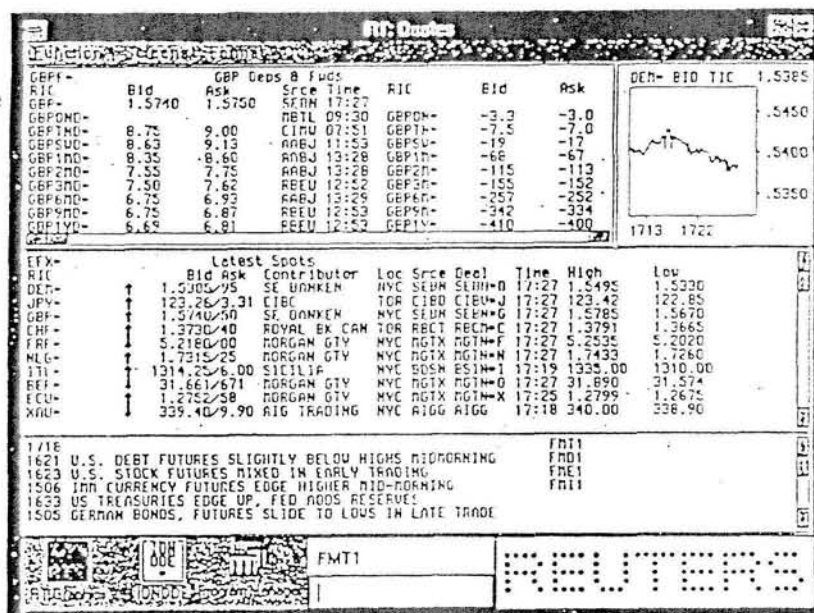


Figure 4: Reuters Terminal with Composite Display of British Money Rates, a Price Chart, Foreign Exchange Rates, and News

Transactions Cost Illustration

Q: How much would be paid in round-trip transactions costs for converting \$100,000 into Deutschmarks, and back to dollars the indicated spot market prices?

A: Reading from the top line of the middle screen, a customer can sell dollars at the bid quote and receive 1.5385 DM for each dollar sold. The customer can buy dollars with Deutsch Marks from a dealer who will pay 1.5395 DM for each dollar purchased.

Buy @ 1.5385: 153,850.00 DM Sell @ (1/1.5395) = \$0.6496: \$99,935.04

Transactions (spread) costs = \$100,000 - \$99,935.04 = \$64.96

By making markets more transparent and accessible, one effect of screen trading is to narrow bid-ask spreads, and reduce transactions costs. In the example above, the spread is

⁷ Gandy, T. "Monopoly Mayhem", *The Banker*, February 1993, pp. 56-59.

$(1.5395 - 1.5385) / 1.5390 = 0.065\%$, which is narrow and reflective of the FX market's size and efficiency.

Assessment. The foreign exchange market has become a successful screen-based market for a number of reasons. FX is a 24-hour market with participants dispersed around the globe. Coming into existence in 1971, it lacked a floor market tradition, and the technology at the time was sufficient to deter attempts to develop a floor market in currencies. Finally, the FX market is an inter-institutional, wholesale market that is only loosely regulated by supranational organizations such as the Bank for International Settlements (BIS). The participants are sophisticated financial institutions, requiring little of the supervision and protection necessary in other markets with greater numbers of individual investors. Hence, the market operates without the extensive cooperative arrangements that would be required in other markets.

5. An International Survey

Financial markets around the globe have introduced technology to enhance the visibility of trading, and extend their reach to global participants. Improved information and market access has fostered the growth in cross-border trading volumes. The activities of non-domestic investors grew dramatically in the 1980s. Between 1980 and 1990, U.S. investors' trading activity increased five-fold in overseas equities, and twenty-fold in overseas bonds. Foreign investors traded fifteen times more U.S. equities in 1990 compared to 1980, and thirty times more U.S. bonds.

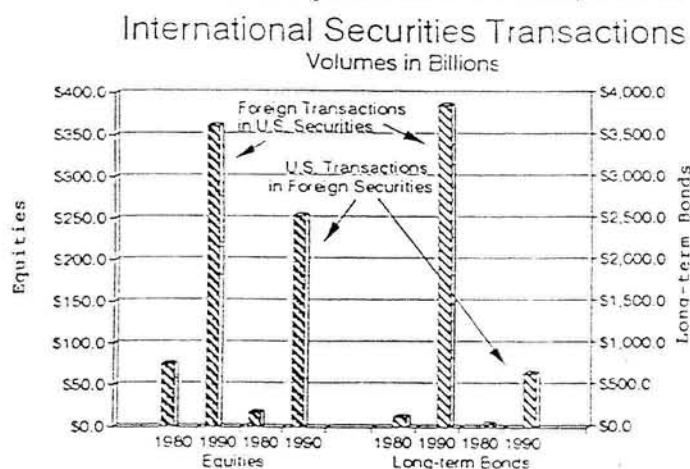


Figure 5: Growth in Cross-Border Securities Trading

Source: New York Federal Reserve Bank

In addition to facilitating the growth in cross-border trading, many markets have been pressured to automate in response to competitive threats from other financial centers. International investors are mobile, and will withdraw from markets with rigid and opaque trading mechanisms. For instance, the 1986 deregulation and opening up of the London Stock Exchange attracted trading in many continental securities to London, and forced other European exchanges to increase the visibility of their markets, and to enhance their trading systems.

5.1. Europe

The six largest European stock markets traded a total of about \$6 billion daily in 1991. This is comparable to the daily volume of \$6.3 billion on the NYSE in 1991.

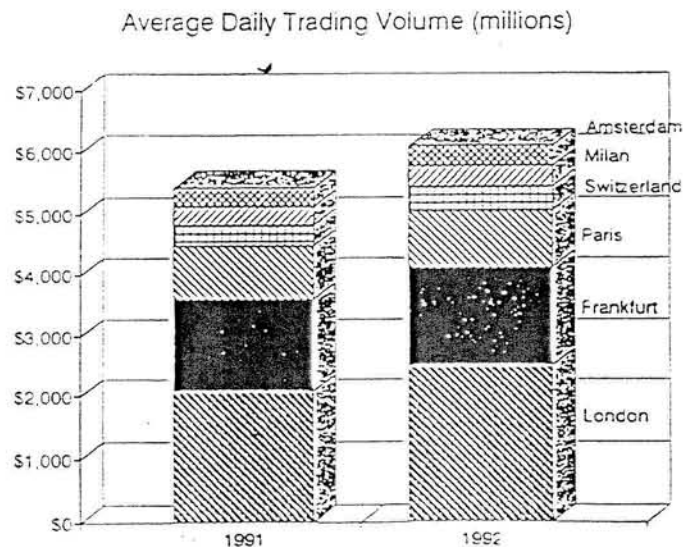


Figure 6: Trading Volumes in Major European Stock Markets

Source: Financial Times (U.K.)

United Kingdom. The U.K. stock market is the largest in Europe, and its trading volume in international (non-U.K.) equities is the largest in the world. London is also the largest currency dealing center in the world with \$303 billion in daily turnover according the Bank of England. London's current status as a leading international money center reflects a reversal from a weakening position between 1950 and 1979. Up to October 1979, government exchange controls

restricted the conversion of pounds to other currencies and prevented most British investment outside of the U.K. At the time, the London Stock Exchange was closed to non-U.K members, and imposed high, fixed commissions. Trading in major British companies was flowing into New York, where they traded as American Depository Receipts (ADRs). Subsequent financial deregulation in Britain and growing trade and financial flows within the European Community have revitalized London's status as a financial hub.

U.K. Domestic Equities. On October 27, 1986, the London Stock Exchange (LSE) was deregulated and restructured by the *Big Bang* reforms [CLEM90]. Big Bang was the result of a 1983 settlement reached with the British Government's Office of Fair Trade to end a lawsuit over restrictive practices and anti-competitive rules by the Exchange. The Big Bang changes abolished a fixed commission rate schedule, and permitted firms to operate in *dual capacity* as a broker-agent *and* as market makers trading for their own account with customers. A 30 percent limit on outside ownership of member firms was removed, and Exchange membership was opened up to overseas firms. Finally, SEAQ, a screen-based market mechanism, was introduced to support the new Exchange operations. In the figure, four of the seventeen market makers are bidding £13.03 to buy ICI shares, and four other market makers are offering £13.08 to sell. The bid-ask spread of 5 pence, or 0.4% is considered tight, and indicative of a liquid and competitive market.

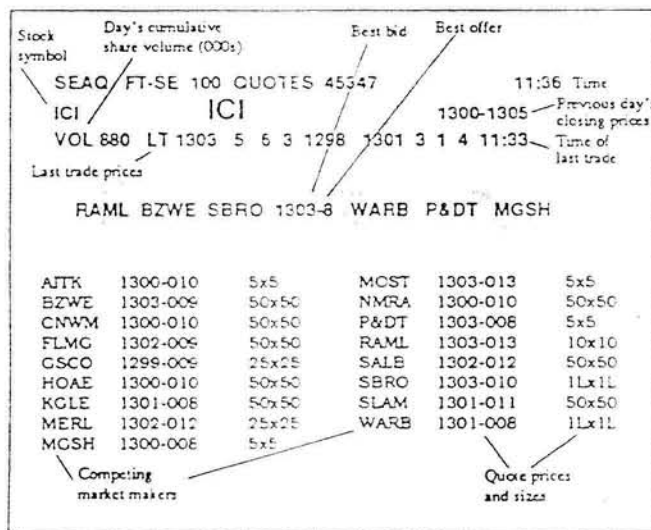


Figure 7: Sample SEAQ Screen Display for Imperial Chemicals Industries

The London Stock Exchange operates as a competing dealer market. In each stock there are a number of dealers, or market makers, that provide bid quotes (the price at which they will buy shares from customers), and ask quotes (the price at which they will sell shares to customers). The SEAQ system has one "page" for each issue that displays all market makers registered in that security with their bid and ask quotes. There is also an indication of the number of shares the market maker is willing to commit to at those prices. For instance, 50×50 means 50,000 shares bid and 50,000 shares offered, and 1L means 100,000 shares. By negotiating over the phone, a trader can usually buy and sell in larger quantities than those shown, and market makers will often agree to trade at prices different than those on the screen.

SEAQ was modeled on the NASDAQ (National Association of Securities Dealers Automated Quotations) market in the U.S., which was introduced in the U.S. in 1971 as a screen display of trading prices for OTC stocks. Prior to NASDAQ, OTC prices were conveyed via "pink sheets" that were distributed daily. The pink sheets listed dealers and their indicative quotes. NASDAQ and SEAQ enable dealers to be geographically dispersed. Several SEAQ market makers are in fact located in Edinburgh, Scotland, and several SEAQ-International market makers operate out of dealing rooms in Paris and Frankfurt. SEAQ information is displayed on computer screens, and investors, or brokers acting on behalf of investors, contact and make trades with dealers over the telephone. The inside quotes displayed on the SEAQ screen — also called the *touch* — represent the best bid and offer available in London, and are prominently displayed, double sized, in a yellow strip at the top of the SEAQ screen for each stock. The intent when SEAQ was implemented was for the yellow strip to give a rapid and accurate indication of the price at which the next trade in any share could be expected to occur. Once a trade is executed the details of price and number of shares are transmitted to the Exchange, which then publishes the stock's cumulative trading volume and the prices of the most recent transactions on the screen above the yellow strip.

London: Overseas Equities. In 1985, the London Stock Exchange introduced SEAQ International, a screen-based dealer market for the shares of foreign companies. The Exchange succeeded in establishing an active international market for trading of non-U.K. securities away from their home exchanges. Trading volume on SEAQ International grew from nothing in 1984 to £400 million a day in 1987, and in 1992 averaged £1.30 billion a day, up from £1.12 billion in 1991. For comparison, in 1992, London trading in U.K. and Irish equities was £1.71 billion daily.

London is the most global stock exchange today, listing about 760 non-U.K. stocks, compared with 121 foreign stocks traded on the NYSE.⁸ London attracts more than two-third of all equities trading that occurs outside of the stock's country of origin, according to the Bank of England. There were 49 firms operating as market makers on SEAQ-International in January 1993.

Although daily trading volume of domestic stocks in New York and Tokyo is far greater than in London, trading volume of overseas securities on the New York Stock Exchange averaged just \$441 million (£250 million) a day in 1991, and on the Tokyo Stock Exchange, it was just \$77 million per day in 1991.

⁸ "Daimler's Arrival Marks New Spirit at U.S. Securities Agency", *Financial Times*, 1 April 1993, p. 17.

	Domestic Listings 1991	Average daily trading volume in domestic shares 1991 (\$ million)	Non-Domestic Listings 1991	Average daily trading volume in non-domestic shares 1991 (\$ million)	As a percentage of total market trading volume
London	2,243	2,318	725	1,992	46.2%
New York	1,678	6,278	108	441	6.6%
NASDAQ	3,917	2,938	278	114	3.7%
Tokyo	1,614	3,384	125	77	2.2%
Germany	649	1,620	570	48	2.9%
Paris	449	468	236	18	3.7%

Table 2: Extent of Cross-Border Trading in Major Stock Markets

Source: London Stock Exchange, Financial Times (U.K.)

The success of SEAQ-I has come mostly at the expense of less liquid and more costly bourses in Continental Europe. SEAQ-I turnover in some shares is often far greater than in the stock's home market. Table 3 indicates the volume of SEAQ-I trading in London relative to totals on the home markets.

Home country of stock	SEAQ-I Trading Volume: Daily Average in 1991 (millions)	As a percentage of the home market's trading volume
Netherlands	\$165.6	50.3%
Sweden	\$100.0	45.0%
France	\$244.8	26.7%
Switzerland	\$125.2	25.8%
Germany	\$500.0	12.2%

Table 3: SEAQ-International Trading Volume in Continental European Stocks

Source: London Stock Exchange, Financial Times (U.K.)

The Paris, Amsterdam, Stockholm, and Frankfurt markets have responded in an effort to regain volume in their domestic shares. Market authorities in those countries have modernized their markets and enacted reforms aimed at lowering costs and repatriating trading volume. For example, in the fourth quarter of 1991, trading volume in the 18 leading Swedish stocks was 8.4 percent higher in London than in Stockholm. A two percent turnover tax

introduced in 1984 on securities transactions in Sweden was repealed in December 1991, and some volume has returned to Stockholm. In 1992, volumes in both markets were up, but the Stockholm exchange had 12 percent more turnover than London in those 18 stocks.

London: Futures and Options. The London International Financial Futures Exchange (LIFFE) opened in September 1982. In November 1989, LIFFE introduced its Automated Pit Trading (APT) system, which simulates open outcry trading on a screen for LIFFE members. APT operates from the close of the floor market at 3:00 p.m. to 6:00 p.m., and averaged 5,000 contracts a day in 1992, or about 4 percent of the LIFFE total.

Germany. The 1989 fall of the Berlin Wall and the reunification of the country have had a massive impact on the economy. The country is undeterred in its plans to establish "Finanzplatz Deutschland", an international financial center in Germany. Reforms have been implemented, and new trading technology has been developed to improve the international competitiveness of the German markets. Screen-based trading has been introduced. In January 1991, a transaction tax of 0.10% to 0.25% of the value of a transaction was repealed. Agreement was reached in October 1992 to launch a centralized German stock exchange, the *Deutsche Börse*, to consolidate trading now spread across Frankfurt and seven regional markets. Trading is planned for the 30-50 most frequently traded equities and bonds in a fully-electronic screen dealing system.

The technological showpiece of the German financial markets is the Deutsche Terminbörse (DTB). Inaugurated in January 1990, the DTB cost \$85 million to develop. It is a fully computerized exchange for futures and options contracts. In November 1990, the DTB launched its Bund (German Government Bond) futures contract to compete with the active, floor-based LIFFE Bund market that opened in 1988. In spite of technological advantages — e.g., 2 second execution turn-around vs. 10 or more seconds on LIFFE — the DTB had just 30% of Bund futures trading volume in early 1993, with the rest remaining on LIFFE. Another

electronic market, IBIS (Interbank Information System) was introduced in December 1989 for screen-based trading of German equities. IBIS cost DM16 million (\$10 million), and extended the three hours of operations of the Frankfurt floor market. IBIS was later acquired by the Frankfurt Stock Exchange. In September 1991, IBIS accounted for 12 percent of the Frankfurt's trading volume in the 30 blue-chip stocks in the DAX index. Overall, trading volume on IBIS averaged just 300,000 shares daily in 1991, or less than 10% of London's SEAQ-I volume in German stocks.

France. The French financial markets underwent a "petit bang" series of reforms in the late 1980s. Commissions were unfixed, and in 1988, banks were allowed to purchase stockbrokers. The Paris Bourse introduced the CAC system (Cotation Assistée en Continu) for electronic trading in July 1989. CAC is based on the CATS system, which was developed in Toronto to provide order-driven trading based on a continuous open order book. In 1990, Relit an advanced, \$105 million settlement system was implemented. Relit "dematerialized" settlement, moving all ownership records to electronic form, and prompting the destruction of 40 tons of French share certificates. A turnover tax of 0.15% to 0.30% of the value of any transaction is expected to be abolished. IBM is among the most active stocks on the automated foreign section of the Paris Bourse, and averaged 3.5B (\$0.5) million a day in trading value in 1991, compared to about \$200 million in daily trading on the NYSE.

Switzerland. SOFFEX (Swiss Options and Financial Futures Exchange), an electronic trading and clearing system for derivative instruments, opened in May 1988. Recognizing the success of SOFFEX and the likely demise of their floor markets, the Basel, Geneva, and Zurich exchanges formed the Association Tripartite Bourses, which is developing a screen-market based on Sun Microsystems SPARCstations.

5.2. North America

Canada. Toronto is Canada's principal financial center. The Toronto Stock Exchange (TSE) handles 75 percent of the total value of trading on Canada's five exchanges. The TSE traded 117 million shares a day (C\$1.2 billion) on average in 1992, up 25.5 per cent from 1991. The second and third largest markets are in Montreal and Vancouver. In 1977, the TSE introduced the Computer Assisted Trading System (CATS).⁹ At the time, the market floor was fully occupied, and CATS provided a means of expanding capacity at low cost. The original plan was to offer screen-based trading in less active stocks. In 1990, 840 of the 1,650 listed securities and 22 percent of the TSE's trading volume were on CATS. Facing the renewal of the lease on the floor market in February 1992, 80 percent of the 72 TSE member firms voted to close the trading floor in late 1993, saving C\$30 million a year.

United States. The U.S. financial markets are among the largest and most advanced in the world. The two largest equities markets in the world are the NYSE and NASDAQ. The U.S. Treasury bond market is the largest securities market in the world.

U.S. Equities. The Securities Exchange Act of 1934 created a regulatory structure for the U.S. securities industry to guard against fraud and the excesses that were exposed in the October 1929 crash. The Securities Exchange Commission (SEC) was established to oversee markets and securities firms. Only minor revisions were made to the industry's regulatory structure until 1975. The Securities Act Amendments of 1975 overhauled the 1934 Act, and provided a Congressional mandate for the SEC to develop a "*National Market System*" (NMS) for transacting and trade settlement. After some initial disagreements, NMS was interpreted as a call for upgrading systems and establishing linkages, but not a call for a fully computerized

⁹ Versions of CATS are now in use in stock markets in Tokyo, Paris, Brussels, and Madrid.

securities market. It has, however, led to the introduction of many important market information systems.

- The National Securities Clearing Corp. (NSCC) was created in 1976 from the merger of the clearinghouses of the NYSE, the AMEX, and the NASD. The NSCC instituted computerized book entry transfer of securities ownership, and electronic payments.
- The Intermarket Trading System (ITS) implemented in 1978 to link the five regional exchanges and the OTC market. Orders can be routed between markets, off-exchange upstairs dealers, and trades can be executed over ITS.

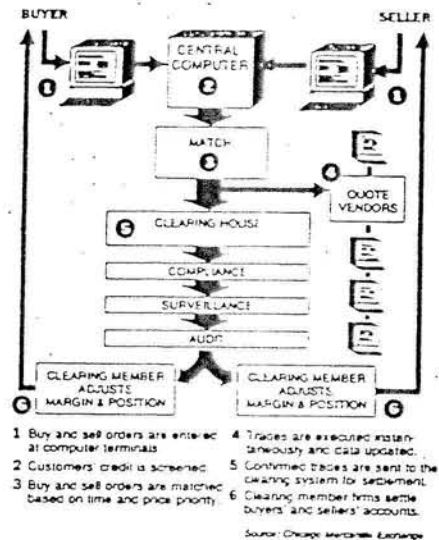
Stock exchanges in the U.S. are competing to attract order flow from each other. Several regional exchanges offer automated execution systems for small orders that guarantee the best ITS price with faster execution time than on the NYSE floor. *SelectNet* allows NASDAQ members to send buy and sell order to other members' terminals, and has begun to offer trading in NYSE-listed stocks. In private, bilateral "conversations", orders can be accepted in part or full, and on-screen price and quantity negotiations can occur between traders.

U.S. Futures and Options. The Chicago Board of Trade and the Chicago Mercantile Exchange are the two largest derivatives exchanges in the world. The CBOT and the CME traded an average of 600,000 and 525,000 contracts daily in 1992. Rapid growth in overseas derivatives exchange is diminishing the dominance of the Chicago markets. Combined CBOT-CME volumes accounted for about 43 percent of the world's exchange-traded derivatives volume in 1992, which is down from 55 percent in 1990.

The Chicago exchanges are using IT to maintain their international position. *Globex* was initiated by Reuters and the CME with tremendous fanfare in September 1987. The CBOT eventually abandoned its competing Aurora project, and joined Globex as a sponsor. Globex was developed at a cost of \$80 million, and opened in June 1992. It is not a 24-hour market,

and only operates after the 2:30 P.M. close of the Chicago floor markets. Trading hours are 6:00 P.M. to 6:00 A.M., but plans exist to add a 2:30 P.M. to 4:00 P.M. session.

Figure 8:
Globex Trading



In March, 1993 Globex was handling 3,500 contracts a day via 300 linked terminals, up from 1,800 contracts daily in the month after the launch. Hence, Globex accounts for just 0.3% of the volume of the two floor markets.

U.S. Off-Exchange Markets. U.S. exchanges have long competed vigorously for trading volume. Most major stocks trade actively in several markets. Market participants refer to the NYSE and the AMEX as the *first market*. The five regional exchanges (Boston, Philadelphia, Cincinnati, Chicago, and San Francisco) are considered the *second market*. The *third market* is made up of dealers trading over the telephone from offices using NASDAQ screen prices. The *fourth market* is direct trading between institutional investors. Technology has led to a proliferation of third and fourth market trading systems, which have proven to be attractive to investors and traders. Equities trading away from the NYSE in NYSE-listed stocks is increasing. In 1980, just 12 percent of *reported* trading in NYSE-listed stocks occurred off the NYSE floor. In 1992, it was 18.2 percent. Reported trade volumes miss an estimated 10-20 million shares a day that are traded in overseas stock markets, or on electronic crossing networks. The distribution of trading below is based on available data and estimates.

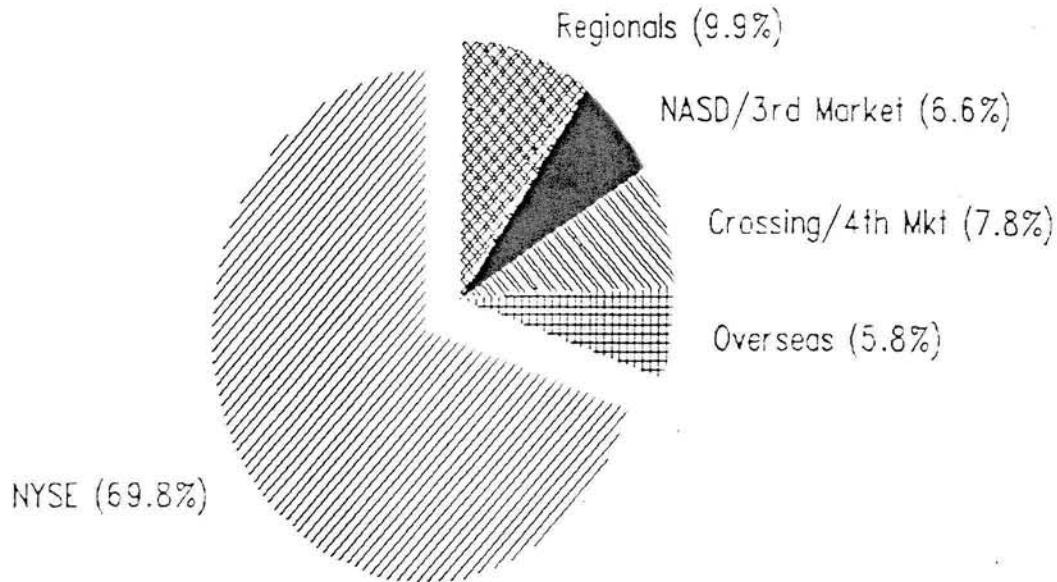


Figure 9: Market Share of Trading Volume
in NYSE-Listed Equities — Third Quarter 1991

Burton Malkiel's *A Random Walk Down Wall Street* (1973) popularized the notion that active stock picking was unlikely to lead to investment performance that is consistently better than the return on the broad market as measured by indexes. Detailed studies of the investment performance of fund managers made clear that the majority were generally unable to achieve even the returns registered on the benchmark unmanaged indexes of the market. As a result, "passive management" and "indexation" have become increasingly popular. Such strategies require holding the securities in an index, and trading baskets of the stocks in an index at as low a cost as possible. Today, estimates are that between 30 and 35 percent of institutional equity holdings in the U.S. are passively managed index matching funds. A September 1989 survey¹⁰ of 36 of the largest U.S. pension funds with assets totaling \$259 billion found 34% of their domestic equities holdings were indexed, a 4% increase from 1986. Passive fund managers have become important users of off-exchange trading systems.

¹⁰ Committee on Investment of Employee Benefits, "Survey of Pension Fund Investment Practices", Financial Executives Institute, Morristown, NJ, 1990.

There are a number of types of third and fourth market trading systems that compete for order with the floor-based exchanges.

Trading System Type	Mechanism/Basis for Trading Price	Examples (Introduction date) - Pricing, Owner, Daily Trading Volume estimates
Crossing Network	Batch trading based on closing prices from NYSE or mid-spread of NASDAQ	The Crossing Network (1986) - Run by Reuters, 1 cent per share, 3.5 million shares
Single Price Auction	Call auction. Price set by intersection of supply and demand curves from submitted orders	Arizona Stock Exchange, AZX, (orig.: SPAworks, 1991) - 0.8 cents per share. 45 institutions, 200,000 shares
Portfolio Crossing	Use volume weighted average price of day's trading. Trades in morning and around noon.	Posit (1986) - 2 cents per share. Run by Jefferies/ITG, used by 80 institutions managing 80% of US pension fund assets. Traders must enter orders for at least 10 stocks. Order not exposed. 3.5 million shares
Order Matching	Continuous open order book for individual shares or portfolios	Instinet (1969) - Run by Reuters, 1 cent per share, 16 million shares Quantex (1990) - Run by Jefferies/ITG, used by 30 institutions, 1 million shares MatchPlus (1991) - Run by Morgan Stanley, 200,000 shares SelectNet (1990) - Run by NASDAQ, 200,000 shares after-hours, 10 million shares during U.S. market hours
International Off-Hours Markets	Screen display of market-makers' quotes for U.S.-listed stocks	SEAO International, U.S. Section (1985) - indicative quotes, 5-10 million shares NASDAQ Intl (Jan 1992) - 3:30 am to 9:00 am N.Y. time, firm quotes, 100,000 shares
<u>NYSE Responses</u> (Began June 1991)		Member firms enter orders from institutional clients, 112,000 shares traded per night. Fill ratio: about 10% of orders execute. Ordinary fees apply.
Crossing (Fixed Price) Session I	Enter orders from 4:15 pm to 5:00 pm, to cross at NYSE closing price at 5:00 pm	
Crossing (Basket) Session II	Paired (prearranged) orders for 15 or more stocks with value greater than \$1 million are executed when received. Operates from 4:00 pm to 5:15 pm.	4 million shares per night with peak of 46 million. No user commissions or fees. NYSE pays SEC fees.

Table 4: Off-Exchange Trading Alternatives in the U.S.

Several lessons are emerging from the U.S. experience with aggressive inter-market competition for order flow. Transactions costs to investors have generally fallen, but the

multiplication of electronic market systems and varied level of information disclosure in some trading mechanisms mean some investors find it difficult to assess the quality of the trade prices. Liquidity and the accuracy price discovery is greatest when trading is centralized, and the growth in trading systems that "bypass" the central marketplace may lead to costly duplication and inefficiencies. The NYSE argues that off-exchange trading systems "free-ride" on the prices discovered in the floor market, but contribute little to the costs of operating the exchange. Some observers fear "competitive fragmentation" and a tiered marketplace with securities trading in different prices in different places, leaving only the most sophisticated traders to know where to obtain the best price. The SEC is currently reviewing these market fragmentation issues.

5.3. Asia

The Asian financial industry is dominated by Japan. Success of Japanese companies in international markets, and a high saving rate have led to vast pool of investment capital. The Japanese financial markets are the largest in Asia, and nine of the world twenty largest banks are Japanese.

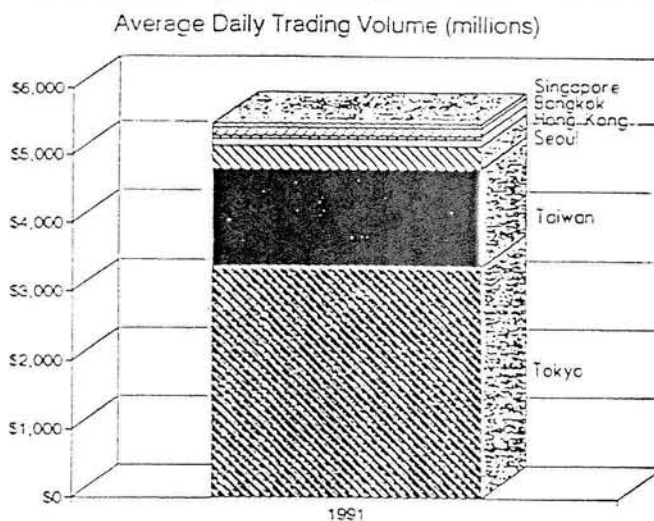


Figure 10: Trading Volumes in Major Asian Stock Markets

Source: Financial Times (U.K.)

Not included in figure are the consolidated Australian Stock Exchanges, which had daily trading volume of \$187 million in 1991, or slightly greater activity than the Hong Kong market.

Japan. The Tokyo Stock Exchange (TSE) was the world's largest equities market in 1988, but in 1992 placed third behind the NYSE and NASDAQ. The TSE's average daily trading value was about \$3.5 billion in 1992. After rising at a 20 percent annual rate between 1980 and 1990, prices in the Japanese stock market entered a prolonged slump in January 1990. The market index has fallen by half, and trading volumes are 60 percent below their peak level from 1988.

The TSE's trading mechanism is an agency auction overseen by a "Saitori", a special class of TSE member, that matches submitted orders, and smooths price swings by calling trading halts when an imbalance of buy and sell orders exists. TSE stocks have "price collars" that specify the maximum allowable price movement in a day. When these limits are reached trading stops and can continue only at prices within the limits. In contrast, NYSE specialists are expected to facilitate a continuous, "fair and orderly" market by trading as a principal for their own account. The TSE introduced the Computer Assisted Order Routing and Execution System (CORES) in 1982. CORES is modeled on Toronto's CATS. Floor trading has remained for the 150 most active issues, and CORES accounted for 44 percent of the TSE's volume in 1989.

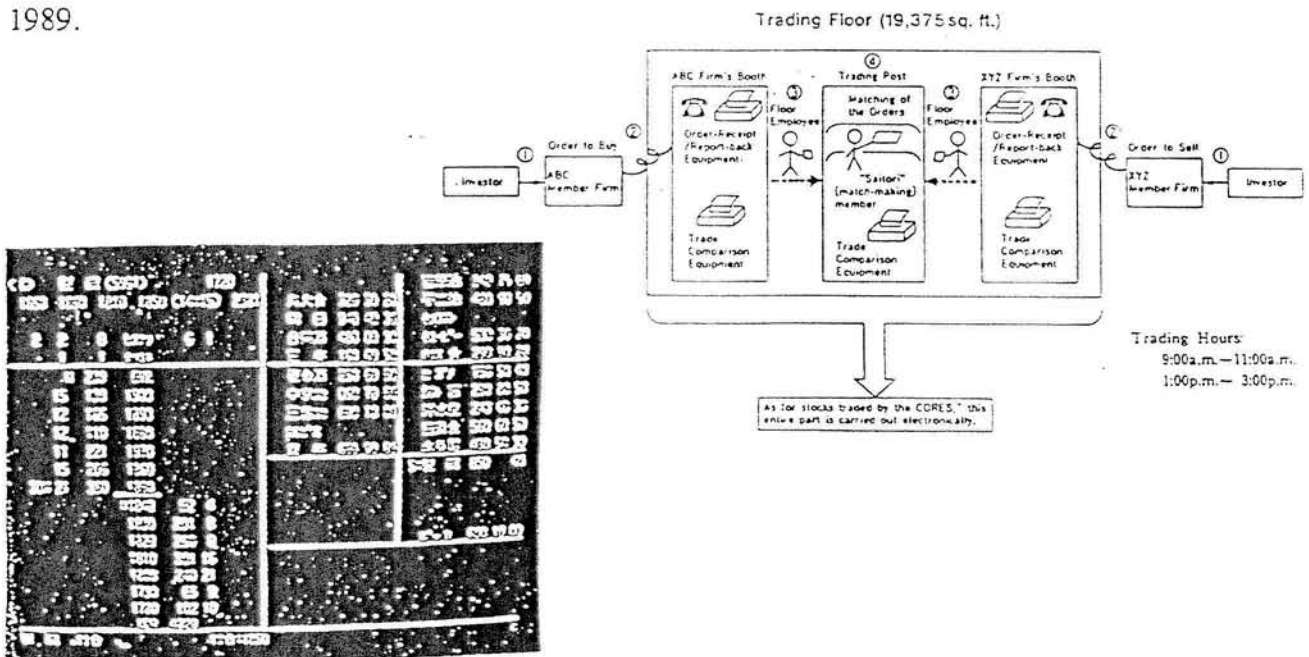


Figure 11: Trading on the Tokyo Stock Exchange — Floor Trading Process and CORES Screen Display

Source: Tokyo Stock Exchange

The CORES screen is broken into three sections. On the right hand side is a display of prices for a number of stocks and the index. On the left hand side is detailed information on a single stock. The top left section displays the name of the stock, its maximum allowable trading range for the day, and market orders and market-on-close orders. The lower left section is limit order book, which in this case displays a bid of ¥1,840 for 9,200 shares and an offer price of ¥1,850 for 36,000 shares with another 20,600 shares available at ¥1,860.

Dragon Countries. Singapore, Hong Kong, Taiwan, and Seoul (Korea) are the financial capitals of the four Dragon countries. These countries experienced rapid economic growth and development in the 1980s. While the financial markets in these countries are not large by New York-London-Tokyo standards, they are growing rapidly. The use of trading technology varies from market to market. In Taiwan's market, for instance, share prices are posted on a chalkboard, and traders use binoculars to monitor changes.

China. The financial markets in China have tremendous potential, but also carry enormous risks. China's financial industry is developing rapidly, but with little leadership or regulation. In 1992, fifty companies were listed on the Shanghai and Shenzhen exchanges — up from 15 in 1991 — and daily trading volumes were \$68 million in 1992 compared to \$7 million daily in 1991. The current speculative frenzy may hinder capital formation in the long term unless government regulations are introduced. As commercial and property laws are written, accounting standards are established, and technology improves, the Chinese markets will grow and attract greater global interest.

6. International Market and Technology Issues

Advances in data processing and communications technology, and the opening up of markets, have increased the flow of financial information around the world. This has attracted

investors into overseas markets that previously lacked visibility, and restricted market entry and competition. Developments in trading networks and international cross-listings of securities have heightened competition for trading volumes, are forcing antiquated exchanges to respond. Many observers foresee a unified global financial market based on screen trading. Despite optimistic forecasts for integrated, 24-hour securities markets, this vision is many years off. A number of barriers exist to the technology that could support an integrated global financial market. These hurdles include inertia and the critical mass required to establish liquidity in a new trading mechanism, vested interests, regulatory discord, and IT development costs in an industry contending with declining margins.

Critical Mass. In markets, a "network externality" exists because liquidity is a self-reinforcing characteristic of trading; the greater the level of trader participation, the more liquid and attractive the market. For a new trading system to develop liquidity requires a critical mass of adopters, whose participation is based on the system's liquidity. This paradox is reflected by a partner in a major Wall Street firm commenting on the 1991 introduction of NASDAQ International for trading U.S. stocks between 3:30 a.m. and 9:00 a.m. New York time: "*People may not use it because it's not very active, but if it becomes more active, then they'll use it.*"¹¹ Most evidence about intermarket competition indicates that order flow is retained by the market that already has the greatest liquidity and depth. The director of financial markets at a French bank pointed out "people don't care what medium they trade through, as long as it has the business."¹² Experience has shown that when an off-hours market is introduced, its liquidity is limited, and investors prefer to wait for the domestic market to open.

¹¹ Newman, A. and Torres, C. "SEC Will Vote on Plan to Allow Early-Hours U.S. Stock Trading", *Wall Street Journal Europe*, 9 October 1991, p. 15.

¹² "Frankfurt Fights to Regain Bunds", *Financial Times*, November 26, 1990, p. 21.

Some observers believe that "in the long run, automated trading systems offer a richer mixture of the market information and the anonymity necessary for trading than either the crowd or the telephone."¹³ Although automated markets are technically feasible, trading systems do not create markets; public buying and selling, and in some cases dealers or specialists, are required to create liquidity and a viable market.

In rare instances traders have demonstrated an ability to move their activities to an alternative market when it appeared advantageous. The primary and secondary markets for Eurobonds quickly moved from New York to London after 1963, when the Kennedy administration imposed the Interest Equalization Tax (IET), lowering investors' returns on such bonds by about one percent. London did not offer a different trading mechanism; the market remained an over-the-counter market. Yet because trades are physically settled — certificates need to be delivered to a clearinghouse or to the contra-party — the market derives operational benefits from a single locale, and the relocation of the Eurobond market represented a tacit collective decision to move trading to an alternative center. The IET was repealed in 1974, but the market has remained in London. Trading volume in Eurobonds in 1992 was about \$10 billion a day, up from \$6 billion in 1990.¹⁴

In other cases, trading mechanisms that appeared to offer technological advantages were ignored by traders and remained illiquid. Many attempts to create alternative markets for securities have failed; the Cincinnati Stock Exchange (1983), Ariel (1974) in the U.K., Boss in Germany (1989), and Intex (1984), a Bermuda-based automated futures exchange, are examples of electronically-supported trading mechanisms that failed to attract liquidity and never seriously challenged the dominance of established, floor-based markets.

¹³ [CMSW86], p. 66.

¹⁴ "Complaints about Poor Liquidity", *Financial Times*, 21 December 1992, p. 19.

Vested Interests. Computer-based market systems enable traders in diverse geographic locations to interact, discover prices, and execute trades through a trading screen. The result is a new market structure without the time and geographic constraints of participating in floor-based stock exchanges. In many screen-based markets, investors are capable of trading directly with each other, bypassing the traditional role played by dealer intermediaries. Since the existing, dominant structure for securities trading in most countries involves a profitable intermediary role similar to the NYSE specialist, established participants may resist change. Furthermore, firms that are earning inadequate returns on capital are not willing to cooperate and support trading technology project that could further reduce margins.

New markets often operate as open limit order books, which are visible to market participants, who can enter limit orders, or trade immediately by matching an existing order. It is often argued that without the necessity of paying the intermediaries' costs, investors will reap larger gains from trade and higher market quality will result. However, this neglects the potential value of intermediation. Market makers with a continuous market presence, such as specialists on the New York Stock Exchange, may improve the quality of the market at a cost less than the value of the service [WEBE91]. Intermediaries stabilize prices by buying or selling as principals when the net order flow is imbalanced, and also contribute by maintaining a "fair and orderly" market.

The Eurobond market has resisted attempts to introduce real-time screen prices. A proposed system, Eurex, was rejected by the self-regulatory body and trade association for Eurobond dealers in 1983. Since then, several refined proposals have been spurned by dealers in the market. The banks that trade in the market feel their ability to trade profitably would be compromised by too much transparency. Vested interests strive to maintain the current market mechanism, which is telephone search of dealers, who can quote comfortably wide bid-ask spreads.

Discordant Regulations. To achieve an integrated global market requires unified regulatory policies. In fact, regulations vary considerable from country to country, and are often self-serving responses to national rivalries. Despite the efforts of international coordination committees, an inconsistent pattern of regulations exists. Many countries have established of *mutual recognition*, or *reciprocity agreements*, whereby one country's firms can sell financial products to another's domestic investors, and vice versa. Such bilateral access agreements are useful, but illustrate the protective stance taken toward financial markets in most countries. Until regulatory authorities begin to converge on a global standard, markets will remain multi-domestic rather than global.

The changes in global markets have prompted the reexamination of regulations to ensure the international competitiveness of a country's or a region's financial sector. The U.S. financial markets are undergoing thorough study. Recent studies of policy issues include "Securities Trading: SEC Action Needed to Address National Market System Issues" by the General Accounting Office (1990), "Electronic Bulls and Bears" by the Office of Technology Assessment (1990), and the Securities and Exchange Commission's Market 2000 study, due in early 1993.

The twelve member nations of the European Community (EC) are seeking to harmonize regulations and financial services access. The idea of a single market for securities trading has not taken hold because of contention about its market structure and regulation. A system to electronically link EC stock markets was approved in 1989. The system was termed PIPE for Price Information Project Europe, and a company named Euroquote was established to develop the network. The objective was to publish the prices of 200 or more securities on a new list of European blue-chip stocks. In 1991, the project stalled when EC exchanges admitted their conflicting objectives for PIPE, and declined to inject \$15 million in capital into the project.

Cost and inexperience with technology. Some observers argue that markets are highly sophisticated processors of information and signals. Given such complexity, it is not evident that screen-based trading currently offers a more attractive market design than a market based on face-to-face interaction. Mark Harding, the head financial markets group at Clifford Chance, a law firm, said "I do not think anyone has found a computerized system, which is user friendly or simple enough to take the place of open outcry trading." Skeptics point out that a market may appear to be an easily-automated transaction process, but it is also a complex price discovery mechanism.

Furthermore, initiatives to develop more sophisticated market systems are expensive. Globex cost \$80 million. The DTB cost \$85 million to develop. The London Stock Exchange abandoned its TAURUS settlement system in March 1993, after spending £75 million and encouraging the industry to incur costs of £325 million in developing interfaces and connections to the planned systems.

7. Conclusions

Information technology enhances a market's ability to perform valuable economic functions: providing liquidity and channelling investment funds into productive uses. Across the globe, trading processes are being restructured, and automation continues to lower the costs of transacting and monitoring financial markets. Technology, along with sweeping changes in regulations, and investor interest in cross-border diversification, are driving up international trading volumes. Competing for trading volumes, network providers such as Reuters, and the major international exchanges are increasing their use of information technology. In a number of markets, screen-based trading has taken the place of physical marketplaces and trading floors. Experience shows that information technology threatens some sources of profits in the securities industry, but it also creates opportunities and a means of reacting to market challenges.

International market integration is occurring, but in a haphazard way. Today's "global financial market" is actually multiple trading structures, and firms with a patchwork of local expertise in many markets. Progress toward uniformity of regulations and market practices is spotty, and the design of an integrated global financial market remains clouded with many technological and regulatory issues unsolved. Fragmented markets that impose inefficiencies and require expertise in local practices may be a consequence of lack of agreement on the structure of an integrated financial market. The consolidated, worldwide exchange is illusory. "The End of Geography" remains an elusive goal.

The trading systems of the near future will likely be global routing systems that connect and maintain consistent prices across multiple markets internationally. Regulators will continue to seek coordination among markets to reduce risks and inefficiency. Indexation and passive investing will grow. More risk management activities and derivatives trading are likely. All of these strategies require extensive IT investments and systems capabilities on the part of firms, and advanced market technologies to be provided by exchanges and trading network providers. Clearly, responding effectively to the changes and pressures will be the hallmark of successful firms and expanding market centers in the coming years.

8. References

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