ELECTRONIC MARKETS AND FLOOR MARKETS: COMPETITION FOR TRADING VOLUMES IN FUTURES AND OPTIONS EXCHANGES

by

Hugues Levecq

Bruce W. Weber

STERN #IS-95-20

Center for Digital Economy Research
Stern School of Business
Working Paper IS-95-20

Electronic Markets and Floor Markets: Competition for Trading Volumes in Futures and Options Exchanges

Hugues Levecq

Department of Information Systems
Stern School of Business
New York University

Bruce W. Weber

Operations and Information Management Department
Wharton School
University of Pennsylvania

June 15, 1995

Working Paper Series
STERN IS-95-20

Center for Digital Economy Research
Stern School of Business
Working Paper IS-95-20

Electronic Markets and Floor Markets: Competition for Trading Volumes in Futures and Options Exchanges

Hugues Levecq
Department of Information Systems
Stern School of Business, New York University

Bruce W. Weber
Operations and Information Management Department
Wharton School - University of Pennsylvania

Abstract

The internationalization of financial markets and the increasing demand for risk management products have fueled the growth of derivatives markets. While most exchanges have experienced increasing volumes over recent years, the pace of growth varies widely across exchanges, and the established marketplaces face increasing competitive pressures. In this paper, we investigate whether the trading mechanism offered to derivatives investors influences growth in market volumes. In particular, we distinguish between manual open outcry and electronic trading. In a floor market, traders gather in a pit and announce their orders. They complete trades using a combination of hand signals and eye contact. In an electronic market, orders are submitted to a central order book, and trades are created according to a matching algorithm. Using volume data from 1990-1994 for futures and options exchanges worldwide, we compute growth rates for the largest contracts and find that contracts traded in screen-based exchanges have experienced faster growth than those traded in manual markets. We discuss several interpretations of the data, but conclude that electronic exchanges are developing a competitive advantage.

1. Introduction

Fueled by the internationalization of the financial community and the increasing demand for risk management products, markets for derivative instruments have experienced rapid growth in recent years. Derivatives are financial instruments whose value depends on an external parameter, usually called the "underlying", such as the price of a commodity (such as wheat or gold), the value of an index (such as the S&P 500), or the level of interest rates (such as the Treasury bond). The complexity of a derivative contract ranges from simple standardized instruments such as futures and options which are traded on formal exchanges,

Center for Digital Economy Research
Stern School of Business
Working Paper IS-95-20

to exotic products such as "knock-out options", "look-back options", and "inverse floaters" which are offered by specialized over-the-counter (OTC) dealers.

Compared to the markets for the underlying asset (i.e., the cash or spot market), derivative instruments traded on exchanges allow investors to establish a position at low cost, and with a credit guarantee from the clearinghouse to eliminate the risk of a counterparty default. Investors use derivative market worldwide to adjust their exposure to asset price and rate fluctuations, and to maintain a desired level of risk.

Figure 1: Using Derivatives to Hedge Exchange Rate Risks

A U.S. organization entering a one year contract *to buy* from a Japanese supplier may want to protect itself against adverse changes in currency rates by buying Japanese Yen futures contracts. By doing so, the U.S. firm "locks-in" an exchange rate for Yen that will be delivered in exchange for U.S. dollars at set dates in the future. The futures position eliminates the risk of a slide in the Yen/$ exchange rate, but also takes away potential gains from the dollar's appreciation.	Alternatively, the U.S. firm could purchase Yen-Dollar options that would provide the ***right, but not the obligation,*** to exchange dollars for yen at a fixed rate up to a set date in the future. Using an option, the U.S. firm hedges against a slide in the dollar, by establishing a "floor" on the yen/$ rate. If the dollar appreciates, the investor shares in the upside by not exercising the option and instead buying the needed yen more cheaply in the cash market.

Investors today have unprecedented choice and access to derivatives markets. There are 63 futures and options worldwide, many trading identical or closely-related instruments. New exchange openings hace led to growing competitive pressures between the various market providers. In addition, securities firms and banks compete to offer and price exotic products tailored to specific classes of risk in the OTC market. Exchanges, which provide markets for the more standardized futures and options contracts, compete aggressively with the OTC market and each other for trading activity and investor interest. Information technology, already a crucial element in streamlining paper flows and operations to handle today's processing volumes, is now a strategic resource used in trading to improve market liquidity, and attract trading volumes.

The oldest formal futures exchange is the Chicago Board of Trade, which opened in 1844. Beginning with the telegraph, floor-based exchanges have introduced technology to distribute price information and enhance their markets. In 1988, the first fully electronic futures market, SOFFEX, was opened in Switzerland. Today, new market venues challenge the

Center for Digital Economy Research
Stern School of Business
Working Paper IS-95-20

established markets, and many rely on screen-based trading. In recent years, although most exchanges have witnessed remarkable increases in volumes, the pace of growth varies across exchanges. In this paper, we describe how the trading mechanism and the level of market automation can influence a market's attractiveness to different classes of investors, and lead to above average growth. In particular, we distinguish between manual open outcry, the environment offered by the more traditional exchanges with a long tradition of derivatives trading such as the Chicago Mercantile Exchange or the Chicago Board of Trade, and screen-based trading, which appears to be preferred by new exchanges, such as SOFFEX in Switzerland, or DTB in Germany.

The paper is organized as follows: in section two, we introduce the major trading mechanisms offered by futures and options exchanges, and discuss their potential impact on investors demand for trading services. In section three, we review the academic literature and previous research on futures market micro-structure. In section four, we present our study and introduce our hypotheses. In section five, we discuss our findings. We conclude with directions for further research on market structures and trading mechanisms.

2. Organization of Derivatives Markets

Futures and options exchanges are organized as ***auction*** markets; any investor or dealer can submit an order or a quote to the market. Order quantity and price are publicized or 'exposed' to all other market participants, and the order is executed if there is an opposite side order similarly priced. The organizing principle in the operation of an auction market is price priority. That is no trades will occur at an inferior price until all orders at "better" prices are filled. For instance, no trades can occur at $17.49 until all orders to buy at $17.50 have executed. Similarly, no trades can occur at 17.52 until all orders to sell at $17.51 have been filled. Note that there is no guarantee that an order will cause a trade to occur: if there is no counterparty to take the other side of the trade at the specified price, the order must wait for a matching order. Auction markets are often contrasted with ***dealer markets***, which are more common in securities and fixed income markets. In a dealer market, investors' orders are executed immediately by a market maker's against his or her own inventory at either the price a dealer is willing to buy (bid price) or sell (ask price) a security.

Center for Digital Economy Research
Stern School of Business
Working Paper IS-95-20

Open outcry market structure. The traditional trading environment for futures and options is the open-outcry auction market: traders gather at a central location, usually a tiered pit[1], and disclose their bids and offers to the other market participants. For example, a trader bidding $17.50 for 10 NYMEX September oil futures contracts would shout '50 for 10'; to sell 10 contracts at $17.52, the trader would shout '10 at 52' (the 17 is implicit). If a trader is satisfied by the bid or offer announced by another trader, he/she uses eye contact and sign language to signify to the other trader that he/she wants to hit the bid, or lift the offer. The trade is recorded by both traders involved in the transaction for subsequent reconciliation and settlement, and the price and quantity are reported to an exchange clerk for immediate dissemination to the rest of the trading community. Distinguishing characteristics of screen-based markets compared to open-outcry markets are:

- ***Time is used as a secondary trading priority.*** Only the best bid and ask quotes are announced in the pit at a given time. However, chances are that more that one trader is offering the best price, and ties occur between the orders that compete to be matched with an incoming market order. In the case of open outcry, no formal tie-breaking rule is implemented, and traders select their counterparty essentially on the basis of qualitative criteria[2]. There is an incentive therefore for traders with orders to fill to adjust their behavior, by shouting louder and repeating their quotes, in order to get attention and get the trade. For example, in a 49 bid-51 offered market, traders who want to join the 49 bid do so simply by announcing their bid, and get the same a priori chances to get executed as any other bidding trader. Note that an aggressive trader could choose to bid 50, in which case some of the buyers at 49 might drop out.

- ***Locals and trade immediacy.*** Another characteristic of open outcry markets is the participation of a special class of traders, commonly known as locals. Locals are members of the exchange trading for their own account. They take small positions, either long or short, and generally unwind this position soon after for a small per-trade profit. Locals trade frequently, but only keep a position open for very short periods of time (seconds to minutes) to reduce the risk from adverse market moves. They play an essential role in open outcry market, as they act as market makers (Silber 1984). Locals are usually willing to trade against customer market orders, thereby providing immediacy to markets in which the uneven flow of customer orders creates temporary imbalances.

---

1 A trading pit is a concentrically organized set of descending steps.

2 For example, some traders have a reputation of making fewer errors, and will be preferred for the quality of their trades. Other selection criteria include returning a favor, or simply, the proximity of a trader who just announced a quote.

Center for Digital Economy Research
Stern School of Business
Working Paper IS-95-20

Agency auction market structure. The agency auction is an alternative way to organize floor-based futures and options markets. In this market design, an exchange member, called a specialist in U.S. exchanges, is assigned an exclusive role in handling orders and executing trades. Investors submit their orders to the specialist who centralizes them in a limit order book. Order are matched manually by the specialist, assisted in some cases through an electronic limit order book. Matching is based on price and time priorities: the order with the best price will execute against a market order. If more than one order compete for execution, the one which was submitted first will be given priority. The objective of the specialist is to maximize the number of contracts traded while minimizing price fluctuations. Specialist smooth out temporary imbalances between buy and sell orders either by trading against their own inventory, or by postponing trade execution until the balance is restored. The main difference between this market structure and open outcry is that strict time priority is maintained by the specialist's limit order book.

Electronic market structures. Because they require a physical floor and human intervention for a trade to occur, both the open outcry and the agency auction are considered manual markets. Technology and the relatively well understood auction mechanism have created opportunities to automate the trading process. Established exchanges are looking at electronic trading as a way to expand their trading services, both in time by offering 24 hour trading services, and geographically by allowing access to the market to remotely located traders[3]. New markets have embraced technology to offer a fully automated trading environment, instead of creating a trading floor.[4] In an electronic trading system, as in the agency auction, investor orders are consolidated in a central limit order book. When a new order is submitted to the market, it is routed for processing to the limit order book. If there is in the book an order that matches the price of the incoming order, a trade is automatically created, and the price reported to the financial community. Otherwise, the order is entered in

---

[3] Examples of such after hours trading systems include GLOBEX, developed by Reuters in collaboration with the Chicago Mercantile Exchange and the French MATIF, ACCESS of the New York Mercantile Exchange, and APT of the London International Financial Futures Exchange.

[4] Example of market that have been created fully automated include the German Deutsche Terminbörse (DTB), the Spanish MEFF Renta Fija and MEFF Renta Variable, the Swiss SOFFEX, the Irish Futures and Options Exchange (IFOX), the New Zealand Futures and Options Exchanges, and the Australian SYCOM.

Center for Digital Economy Research
Stern School of Business
Working Paper IS-95-20

the book, and waits for a counterparty order. In most electronic markets, the full book of orders is visible to participants. Most floor agency auctions provide information only on the best bid and the best offer quote. Unlike the open outcry auction, the most common tie-breaking rule for screen-based systems is based on time: at equal price, the order entered first gets priority.

2.2. Market Structure Comparison

As researchers have observed, market structure directly impacts the type of trading services offered on the exchange, and determines the overall quality of the market, as measured by various indicators such as liquidity, volatility, and depth.[5] Market observers have found that the price-time priority rule in electronic trading systems tends to suppress the participation of locals. Because locals' trading strategy relies on the rapid turnover of their position, their ability to liquidate a position quickly is essential to their profitability (Silber 1984). In an open outcry environment, locals can hope to turn around their inventory quickly using various behavioral tactics. In an electronic trading system, locals who just took a position must wait for all the other similarly priced orders that have been entered prior to theirs to be matched before they can get an execution. For example, consider a market which is 49 bid and 50 offer. A local who is short after his/her offer was lifted at 50, generally wants to buy the contracts at 49 before adverse market moves wipes out potential profits. In the open outcry, the local can aggressively shout and muscle forward with a 49 bid to trade quickly. In an electronic system, he/she must enter the order to buy at 49, and wait for the competing 49 bids in the queue to be filled before to get a trade. In terms of expected time to execution, everything else being equal, the local will have to wait twice as long in the electronic system compared to the open outcry. Therefore, locals have less incentive to participate in a electronic trading system. The absence of locals to act as market makers may reduce the degree of immediacy and liquidity of trade execution in electronic trading systems.

During normal market conditions, the open outcry tends to supply good liquidity, as locals provide counterparty services for investors orders, thereby absorbing temporary order

---

[5] The depth of a market is measured by the quantity of a financial instrument that can be traded at or near the current market price.

Center for Digital Economy Research
Stern School of Business
Working Paper IS-95-20

imbalances. However, at times of unusual activity, the level of noise and the limited capitalization of locals contribute to a degradation of the market which may become less liquid and more chaotic. As the level of pit activity increases, it becomes very difficult for all the participants to communicate and hear trading intentions, and the market tends to become fragmented. Submarkets develop, consisting of physically close traders. There may be discrepancies between prices in the various submarkets. This situation undermines the price discovery process by reducing competition and isolating orders, which forces locals to further protect themselves against adverse price movements by widening their quotes. In addition, locals, who are typically individuals with small capital, cannot take large positions, which limits their market making potential. The combination of these factors results in lower liquidity and increased volatility.

The agency auction and screen-based systems have a built in protection against fragmentation, as they centralize orders in a limit order book. The consolidation of orders also helps price discovery by providing an indication of the trading intentions of market participants. The disclosure of away-from-the-market orders in screen-based systems gives traders a sense of where the market is likely to go, a sense of its depth, as well as information how fast and at what price they can hope to get out of a position in case of adverse price changes. This information encourages the participation of dealers and investors in the market. The time priority rule is an incentive for traders and investors to reveal their trading intentions early in order to maximize their chances of execution. This early submission increases the number of orders contributing to the price discovery, thereby improving liquidity and reducing volatility.

Screen-based systems alter the way traders and investors access and interact with the market. To disclose their trading intentions, traders in the pit announce their quotes to other market participants. These quotes are short lived, and understood to be good "as long as the breath is warm". Therefore, traders who want to withdraw their quotes simply do not repeat them. This is a very efficient way to adjust to fast moving markets. In an automated environment, traders interact with the market through computer terminals. Orders must be entered into the system, and any modification or cancellation of these orders involve another transaction by the trader. The time required to execute the transaction, e.g. the time for

Center for Digital Economy Research
Stern School of Business
Working Paper IS-95-20

physical entry plus the system's response time, create a delay between the traders' formulation of trading intentions and the time these intentions are actually exposed to the market. During this delay, traders face the risk of either getting an unwanted execution or missing a trade. This negative factor for electronic systems might be offset by the better accessibility of automated markets. Terminals can be remotely located, allowing traders from different regions of the world to participate in the market. The flexible access structure of an automated market encourages traders who are active on related markets to take part in the electronic market, thereby increasing the overall liquidity.

The impact of trading errors is factored into commissions and fees paid by investors, ultimately affects trading costs. One recurrent type of error is an out-trade. An out-trade results from a mismatch between the information reported by the two parties involved in a trade. The source of the error can be a miscommunication between buyer and seller, resulting in different quantities or prices recorded by the traders, an error in writing the trading ticket, or an error in reporting the trade. This type of problem is quite frequent in manual markets, and involves costly error resolution, and possibly losses from inaccurate order execution. Out-trades are virtually impossible in electronic systems, as trade are created by automatically matching buy and sell orders. The superior risk management capabilities of a screen-based system reduce the overall cost of trading, and should increase the willingness of traders and investors to participate in automated markets.

To summarize, the open outcry market mechanism, whose lack of time priority encourages the participation of locals, is conducive to high immediacy, provided at the cost of the locals spread, and a tendency to deteriorate into submarkets under stress. The market structure of the agency auction and screen-based systems, which enforces the centralization of orders in a limit order book and a price-time priority rule, has the potential for lower trading costs, but also has lower immediacy, as imbalances may delay trade execution. In addition, screen-based trading provides improved market access, and the information processing capabilities of a computerized environment.

Center for Digital Economy Research
Stern School of Business
Working Paper IS-95-20

2.3. Market Users

There are two general classes of derivatives participants: hedgers, who use derivatives to reduce market risk, and speculators, who hold derivatives to get exposure to price variations of the underlying at a fraction of its cost. For both classes of investors, the ability to trade quickly is essential: for hedgers who want to protect themselves against adverse market moves, delay in execution may ruin the benefit of the hedge if the market moves before they can take on a position. For speculators, inability to execute an order quickly might mean the loss of profit opportunities. Therefore, a critical attribute of a derivative market must be immediacy. Trading cost is less important for hedgers, as their main objective is risk protection. Cost is important, however, to speculators who are motivated by profit. Lower trading costs allow them to trade more often, and to maximize their margin on round-trip trades. The position of the traditional exchanges based on open outcry is that their market structure, with higher costs but higher immediacy than electronic systems, provides a superior trading environment. Floor market justify their lack of automation by screen-based systems' inherent price-time priority rule, which results in a lack of attractiveness to market makers, and hence, lower immediacy.

The debate on the competitive merits of the various trading mechanisms highlights the controversy over which market structure provides the best trading environment, and hence, which is the most attractive to investors. As illustrated in this discussion, the inability of electronic trading systems to mimic open outcry does not necessarily mean that they cannot attract the dealers or locals to provide the immediacy required by participants in derivatives markets. In the next section, we review previous research on market structure for derivatives markets, and discuss their contribution to this debate.

3. Literature Review

The relationship between market making and immediacy was investigated by Grossman and Miller (1988). They used a model of market maker behavior to show that immediacy is a positive function of the number of market makers, and that the number of market markers will adjust to equate the supply and demand for immediacy. The implication

Center for Digital Economy Research
Stern School of Business
Working Paper IS-95-20

of their research is that market makers need to be present in electronic systems to provide immediacy, and will require and adequate return to maintain their presence.

Using simulation, Domowitz (1992) studied the efficiency of the price discovery process in open outcry and automated environments. He concluded that the superior information content of the electronic limit order book leads to lower volatility, more liquidity and more depth in the market. These findings are consistent with Glosten's (1994) results on the impact of an electronic order book on the organization of markets. His closed-form model showed that "the electronic exchange provides as much liquidity as possible" and does not encourage competition, and that all trading activity should eventually be consolidated in a unique electronic system. Glosten attributes the sustained coexistence of manual and electronic markets to the fact that manual markets must offer services that were not included in his analysis.

Empirical research on the relative efficiency of open outcry and screen-based systems has been inconclusive. Pirrong (1994) studied the German Government Bund futures contract which is simultaneously being traded on the German electronic trading system Deutsche Terminbörse (DTB) and the open outcry of the London International Financial Futures Exchange (LIFFE). He found that the electronic system, DTB, offered at least similar liquidity, and more depth than the London market. Kofman and Moser (1995) also investigated trading of the German Bund futures contract on LIFFE and DTB, and found no evidence of differences in volatility and liquidity. Fremault Vila and Sandmann (1995) compare liquidity and informational efficiency for the Nikkei Stock Average futures contract which traded on two manual markets with different trading mechanisms, the Singapore Monetary Exchange (SIMEX), based on open outcry, and the Osaka Securities Exchange (OSE), based on agency auction. They conclude that the open outcry market is more liquid and less volatile, and that trading occurs less frequently but in larger size in the agency auction market, which seems to indicate that the OSE is preferred for its market depth, while SIMEX is favored for its liquidity. They also evidence a strong bi-directional relationship between the two markets, which is consistent with each market occupying a market structure niche. Lohse and Parikh (1995) identify several shortcomings in the user interfaces provide by the major electronic trading mechanisms. They note that "by automating the trade process, the human element is forgone

Center for Digital Economy Research
Stern School of Business
Working Paper IS-95-20

... [the problem is] how to improve the human interaction in these automated trade systems." They argue for a electronic market design based on a closer replication of the defining characteristics of a floor-based market.

These studies show no consensus over which market structure provides the best trading environment. Perhaps there is not one best market, but many good market structures that satisfy a diverse demand for trading services. Indeed, exchanges seems to strive on a competitive advantage derived from their market structure. Investors with large orders concerned by their ability to trade with minimum market impact may prefer a deep agency auction based market, such a the OSE, while investors seeking low trading costs will favor a more liquid but thinner open outcry environment, such as the SIMEX. This assumption is also consistent with the evolution of order flow distribution between LIFFE and DTB for the German Bund futures contract: the trading volume share of DTB grew from zero at its creation in 1990 to a peak of 40% in 1992, to stabilize at 35% thereafter. Some market characteristics of DTB, such as its better market depth, initially attracted investors away from LIFFE. After a period of time, this situation stabilized, and providing that investors needs do not change, market shares should remain constant.

4. Market Trading Volumes

Previous research has focused on the market characteristics implied by various trading mechanisms, and measured empirically by market quality proxies. In this study, we take a different approach and concentrate on the demand for derivatives products and trading volumes (a proxy for liquidity and quality). Our underlying assumption is that market quality and the benefits of a particular market structure are assessed rationally by market participants, and their decision to trade in a particular environment is a function of the quality of the trading services provided by the exchange. While there are a number of factors that may affect the demand for a particular futures contract or a particular option, we believe that changes in expectations and value of the underlying asset of financial futures and options is more likely to translate into fluctuations in overall trading volumes than into a reallocation of order flow across exchanges. Furthermore, competition between exchanges is not limited to cross-listings, but extends to entire classes of derivatives. World financial markets are highly interconnected,

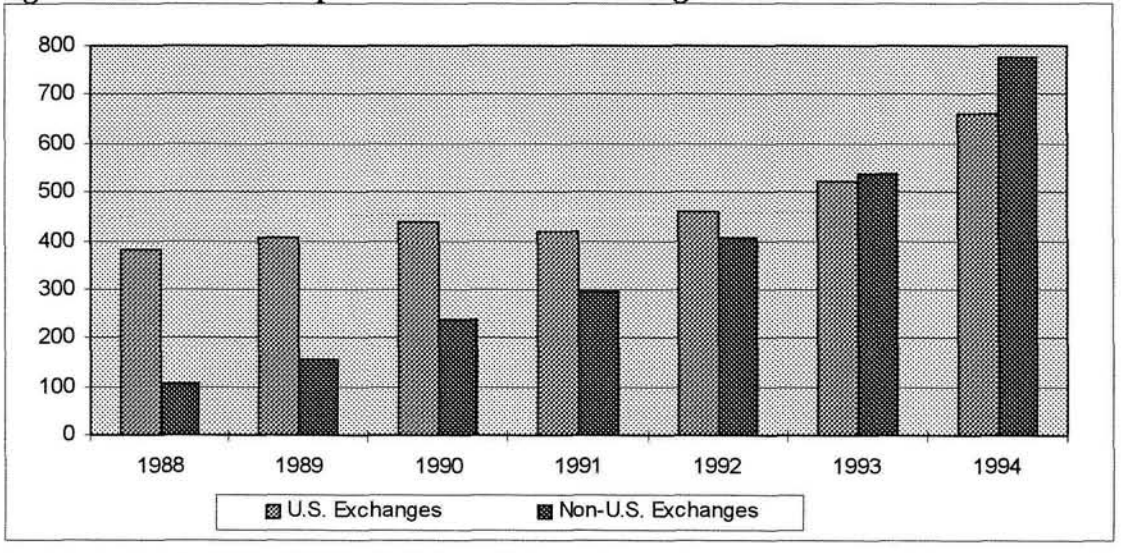
Center for Digital Economy Research
Stern School of Business
Working Paper IS-95-20

and many of the derivatives underlying assets are strongly correlated, which creates stronger competition between less differentiated contracts. Therefore, investors seeking exposure to a specific asset usually have a choice between equivalent or related instruments. In summary, the market structure and the degree of automation should be important variables explaining the variance in volume growth, e.g. changes in market shares.

The derivative industry has grown rapidly over the past few years. While the pace of growth varied across financial places, almost every futures and options exchange has experienced higher volume in 1994. This growth was realized through increased demand for existing products, and innovation. New contracts have been introduced and new exchanges were created to better respond to investors needs. After-hour screen-based systems have also contributed to better service investors by allowing 24 hour trading.

Financial derivatives outgrew non-financial derivatives by 5 to 1 in 1994, and account today for 80% of the worldwide trading volume in futures and options. U.S. growth has been slower than in the rest of the world, which can be explained by the fact that most of the new trading venues and the new contracts were introduced outside the U.S.. Figure 1 summarizes the evolution of futures and options markets in the U.S. and in the rest of the world.

Figure 1 - Futures and options worldwide - Trading volume in millions of contracts



Source: Futures Industry Association

Center for Digital Economy Research
Stern School of Business
Working Paper IS-95-20

5. Results

Most new exchanges have selected a screen-based, price and time priority market structure. These exchanges offer a range of new trading services, such as improved risk management procedures, not available in manual markets. In addition to the growth generated by the increased demand in derivatives products, the electronic markets should benefit from the migration of classes of investors who are better served in a screen-based environment. Therefore, we should expect trading volume in these markets to grow faster than in manual markets.

If screen-based markets grow at the expense of manual markets, it is likely that agency auction markets will suffer the most from this competition: both are based on the same trading mechanism, but electronic markets offer better information access and lower trading costs. Therefore, in the group of manual markets, open outcry should grow faster than agency auction markets. Consequently, electronic markets should also experience faster growth rates than manual agency auction markets.

The data. There were 63 futures and options exchanges in the world at the end of 1994. This relatively small number allowed us to consider the entire population of exchanges, which alleviates the statistical problems that usually arise from using sampling techniques. The data was provided by the Futures Industry Association. The distribution of futures and options contracts between market structure and location for the period 1993-94 is presented in table 1. These numbers vary for the 3 other periods (1990-91, 1991-92, 1992-93) due to the introduction of new contracts and new exchanges.

Table 1 - Number of contracts by region and by market structure in 1994

	Open outcry	Agency auction	Electronic
North America	51	6	3
Europe	31	1	23
Latin America	5	0	0
Asia	11	14	5

Center for Digital Economy Research
Stern School of Business
Working Paper IS-95-20

For each of the 63 exchanges, we selected futures and options contracts that had a traded volume equal to or greater than 1 million contracts in 1994. If an exchange had only one or no contracts that traded that high, we selected the two largest contracts for that exchange, providing that the volume was equal to or greater than 500,000 contracts for 1994. If an exchange had no contract with 1994 trading volume of at least 500,000 contracts, it was not included in the analysis. This excluded 23 exchanges. The rationale for the elimination of contracts with low volumes is that they tend to exhibit very large growth rates due to the small number of trades used as the basis to compute the rates. An analysis of variance in growth rates between the contracts included and excluded from our analysis showed a variance which was on average 10 times larger for the contracts *not* included in the study. Data for the year a contract was introduced on an exchange is not included, as other non measurable incentives such as aggressive promotion, or reduction of trading fees are the norm the inaugural year of a contract.

For the 150 contracts selected, we took the yearly trading volume for 1990 to 1994, and computed the annual growth rates.

Manual and electronic markets. Results for volume growth of screen based and manual markets are presented in table 2.[6] They show that electronic markets have consistently grown more rapidly than manual markets. The large standard deviations reflect widespread distribution of growth rates.

The increase in the number of contracts traded on screen-based systems, from 9 in 1990-91 to 31 in 1993-94, results from the creation of new exchanges. It may also indicate an emerging competitive advantage for electronic systems, as new automated exchanges place growing competitive pressure on existing manual markets. When a new electronic exchange is introduced, a reallocation of order flow occurs as investors are initially being attracted by the positive features of the new market. After a few years, the winning away of volume from establish exchanges declines, as investors, more aware of their trading options, select the market that best satisfies their trading needs. The repeated introduction of new electronic

---

[6] Statistical significance tests have no clear interpretation here, since these values are not sample estimates, but the true values of the population parameters.

Center for Digital Economy Research
Stern School of Business
Working Paper IS-95-20

exchanges, however, appears the prevent a stable distribution of volume from being established.

Table 2 - Average growth rates for electronic and manual/floor markets

		1990-91			1991-92			1992-93			1993-94	
	Growth	Std Dev	#obs	Growth	Std Dev	#obs	Growth	Std Dev	#obs	Growth	Std Dev	#obs
Manual	18.60%	0.4920	105	22.66%	0.4889	102	29.87%	0.4344	112	29.71%	0.4376	119
Screen	42.45%	0.5125	9	52.16%	0.5879	13	48.62%	0.6959	23	51.80%	0.5992	31

F-tests of the difference of means for all four periods are statistically significant at the .01 level. The majority of new electronic exchanges have been introduced in Europe. In table 3, we present the respective growth rate of electronic and manual markets for Europe only. By focusing on a single region, we remove the potential distortion from geographical growth patterns, and hence, a better picture of respective growth patterns.

Table 3 - Average growth rate for European electronic and manual markets

		1990-91			1991-92			1992-93			1993-94	
	Growth	Std Dev	#obs	Growth	Std Dev	#obs	Growth	Std Dev	#obs	Growth	Std Dev	#obs
Manual	32.49%	0.3208	25	53.21%	0.4031	24	36.63%	0.2972	28	41.16%	0.3797	32
Electronic	51.30%	0.5732	4	67.30%	0.6158	8	58.26%	0.8153	15	57.52%	0.5888	23

The numbers in this table are consistent with the general results of table 2, and provide stronger support that electronic markets experience faster growth rates than manual markets. Similar regional analysis would be meaningless for the other regions of the world, as the number of contracts traded on electronic exchanges is very small.

Open outcry, agency auction and electronic markets. Results on the comparative growth rates between the three market mechanisms analyzed here are presented in table 4. They show no relationship between volume growth in open outcry and in agency auction markets. The growth patterns in the two structures may be due to the fact that about half of the contracts traded in agency auction markets are commodities futures and options. These contracts are less fungible, and are not exposed to the same level of competition as financial derivatives, and are not affected by the same economic conditions.

Center for Digital Economy Research
Stern School of Business
Working Paper IS-95-20

Contracts traded in a screen-based environment exhibit greater growth rates than those traded in agency auction structure. However, the same qualifications must be made due to the large proportion of commodities contracts in the agency auction group.

Table 4 - Average growth rate for open outcry, agency auction and electronic markets

	Growth	1990-91 Std Dev	#obs	Growth	1991-92 Std Dev	#obs	Growth	1992-93 Std Dev	#obs	Growth	1993-94 Std Dev	#obs
Open-outcry	14.43%	0.3793	85	28.57%	0.4802	82	29.34%	0.36	91	32.95%	0.3843	97
Agency auct.	36.31%	0.805	20	-1.58%	0.4588	20	32.13%	0.6807	21	15.44%	0.6123	22
Electronic	42.45%	0.5125	9	52.16%	0.5879	13	48.62%	0.6959	23	51.80%	0.5992	31

Overall, these results show strong support for the claim that an electronic trading mechanism provides exchanges with a competitive advantage.

6. Conclusion

In this paper, we investigated the relationship between the trading mechanisms provided by futures and options exchanges and growth patterns. While market structure is only one of many variables that affect the demand for trading services, we believe that, due to the global competition and access to derivatives, market design has a significant impact on trading decisions and volume in different markets.

Electronic markets are characterized by a strictly maintained price-time priority rule. Many consider it to be a deterrent to the participation of locals. However, our results show that electronic markets are experiencing rapid growth. They must therefore be compensating for reduced locals' participation with other market enhancements to provide an attractive trading environment. Traditional exchanges, based on manual trading mechanisms, are now under competitive pressure from electronic markets, and face the obligation to diversify their trading services if they want to retain order flow.

The results also show that automation currently provides an advantage in the competition for order flow. It is not clear whether this competitive advantage is sustainable

Center for Digital Economy Research
Stern School of Business
Working Paper IS-95-20

over long periods of time, and research must focus on individual exchanges to investigate this issue. It is probable that electronic markets initially satisfy a demand for specific trading services that has been unmet by manual environments. Subsequently, electronic markets expand based on the type of trading needs they fulfill, and their share of order flow in instruments also available from other floors. While diversity seems to better serve the investor, the fragmentation resulting from multiple trading environments could eventually degrade overall market quality.

7. References

"Emerging Futures and Options Markets", International Finance Corporation, Capital Markets Department, March 1994.

Clemons, Eric K., and Weber, Bruce W., "Demand for Off-Exchange Trading Systems: Trading Preferences of Investors on the London Stock Exchange", Center for Research on Information Systems, Stern School of Business, Working Paper STERN IS-92-20.

Domowitz, Ian, "Equally Open and Competitive: Regulatory Approval of Automated Trade Execution in the Futures Markets", Working paper, Northwestern University, February 1992.

Domowitz, Ian, and Wang, Jianxin, "Auctions as Algorithms", ***Journal of Economic Dynamics and Control***, Vol. 18, 1994.

Fremault Vila, Anne, and Sandmann, Gleb, "Floor Trading versus Electronic Screen Trading: An Empirical Analysis of Market Liquidity and Information Transmission in the NIKKEI Stock Index Futures Markets", Working paper, London School of Economics, February 1995.

Glosten, Lawrence R., "Is the Electronic Limit Order Book Inevitable?", ***Journal of Finance***, Vol. XLIV, No 4, September 1994.

Grossman, Sanford J., and Miller, Merton H., "Liquidity and Market Structure", ***Journal of Finance***, Vol. XLIII, No 3, July 1988.

Kofman, Paul, and Moser, James T., "Spreads, Information Flows and Transparency across Trading Systems", Federal Reserve Bank of Chicago, Working Paper WP-95-1, February 1995.

Lohse, Gerald and Parikh, Satu "Electronic Futures Markets Versus Floor Trading: Implications for Interface Design", ***Proceedings***, Human Factors in Computer Systems CHI '95, Denver, CO, May 1995.

Massimb, Marcel N. and Bruce D. Phelps, "Electronic Trading, Market Structure and Liquidity", ***Financial Analyst Journal***, January-February 1994.

Pirrong, Craig S., "Derivatives Exchanges, Liquidity and Locals: A Look to the Future", Catalyst Institute, August 1994.

Silber, William L., "Market "Maker Behavior in an Auction Market: An Analysis of Scalpers in Futures Markets", ***Journal of Finance***, Vol. XXXIX, No 4, September 1984.

Center for Digital Economy Research
Stern School of Business
Working Paper IS-95-20

Wunsch, Steven R., "The Auction Market, the Dealer Market and the National Market System", ***Auction Countdown***, Arizona Stock Exchange, May 23, 1995.

Center for Digital Economy Research
Stern School of Business
Working Paper IS-95-20