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by

Albert S. Kyle
Duke University

and

Terry A. Marsh
Walter A. Haas School of Business
The University of Tokyo

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**ON THE ECONOMICS OF SECURITIES CLEARING
AND SETTLEMENT¹**

**Albert S. Kyle
Fuqua School of Business
Duke University
Durham, NC 27708-0120
(919) 660-7797**

**Terry A. Marsh
U.C. Berkeley
Walter A. Haas School of Business
350 Barrows Hall
Berkeley, CA 94720
(510) 642-1651**

**University of Tokyo
Department of Economics
7-3-1 Hongo Bunkyo-ku T113
(03) 3812-2111, Ext. 5656**

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1. INTRODUCTION

Prior to the Brady Report's (1988) recommendation that the structure of clearing organizations for options, futures, and stocks be unified, the topic of clearing of equity instruments had received little attention from academics interested in the structure of U.S. equity markets. Since that Report, various proposals have been put forward for linking securities markets both domestically and internationally. At the same time, the lack of a unified clearing facility in the fast-growing OTC market has drawn the attention of regulators (e.g. Corrigan (1988)). However, there still remains little in the way of academic framework to guide the discussion.

In retrospect, the lack of academic attention is perplexing. Options exchanges, futures exchanges, and stock exchanges, as well as the OTC market, are all part of one large market for interrelated securities, yet they have distinctly different structures for clearing and settling trades. For example, exchange traded equity options have been issued, cleared, and settled, by one central clearing corporation -- the Options Clearing Corporation ("OCC"). The futures industry, in contrast, generally has distinct clearing organizations for distinct exchanges, and no single clearing organization dominates the industry, as it does for options. Furthermore, no interface mandated by federal regulation or industry custom requires the multiple clearing organizations to be connected together. For equities, there are several clearing organizations, but one alone clears the vast majority of transactions, and the SEC mandates that an interface connect them all together. For OTC contracts, there is currently no centralized clearing facility at all---each dealer's book is essentially a "clearing" mechanism. There is no obvious reason why these

clearing arrangements need to differ as much as they do, particularly for options and futures contracts. The contracts are similar book-entry instruments, and contract performance for both is facilitated by a system of daily margins based on the riskiness of positions.

In this paper, we explore the economic rationale for these different clearing mechanisms. In our analysis, each securities trade is regarded as a bundle of services which include both trade execution and clearing and settlement of the trade. The former, the quality of which is usually gauged in terms of bid-ask spreads, price impact, and the like, is taken as given here. The latter---the clearing and settlement services, can be conveniently divided into two categories. The first is the "bookkeeping" function; the second is the minimization of the risk of default in the clearing and settlement process. We then analyze the efficiency of the clearing and settlement bookkeeping function in a framework in which exchanges and clearing and settlement facilities can be viewed as components of a giant network. By submitting an order to an exchange, a trader gains access to a network of floor traders, arbitrageurs, and other customers. The value of the network to a customer clearly depends upon the number of other users, thus creating positive externalities. We argue that, all else equal, the network externalities favor unified clearing and settlement of "related" securities. Further, when we examine the returns to scale in clearing costs, we find that for the technologies which have been adopted in the past, unit costs are either decreasing or, at the very least, constant with respect to scale. These increasing returns to scale, along with the improved coordination and savings in interface costs which are borne by users (and which are not directly measured in the clearing firm's own figures), re-inforce the demand-side network externalities which favor unified clearing.

With respect to the default-risk of clearing and settlement, we assume that it is costly for

each trader to measure and price this risk, so that *ceteris paribus* the most efficient clearing and settlement process manages the risk so as to keep it at minimal levels for a given user cost of services.² Unified clearing also seems to best control the risk through pooling ("securitizing") both the actual risks of customer default and the moral hazard and adverse selection problems in assessing it.

That network externalities and minimization of default risk seem to make unified clearing most efficient leaves us with a two-fold challenge: first, to identify the factors that have resulted in the fragmentation of clearing systems in the past; and second, to analyze whether and why one organization might be a "natural" unified clearing and settlement organization.

The most important cause of fragmentation is, we think, the incentives of exchanges, or suppliers of customized securities in the OTC case, to monopolize the market. As with, say, airline reservation systems, personal computer software, and consumer electronic media formats, there are gains from standardization and open access, but the owner of the network may have incentives to sacrifice these gains for the sake of preserving monopoly profits in the network itself. The potential inefficiency of a relatively unregulated network structure is illustrated by the evolution of clearing in the futures industry. Historically, futures exchanges have controlled their

² For example, a manufacturer's (or dealer's) warranty is typically bundled with electronic appliances, computers, automobiles etc. Yet the financial state of the manufacturer is typically opaque to the customer. It will generally be inefficient for each consumer-investor, *qua* consumer (or their agents---the brokers and securities firms who bundle the trades and clearing and settlement services), to investigate the financial state, both because of duplicate search costs and because, if the risk tolerances of consumers are different, they will want to "trade" the risk which otherwise would be in proportion to their commodity purchases. Thus if the seller's risk is in doubt, it may be, for example, more efficient for it to buy a wholesale guarantee (e.g., Ross (1987), Merton(1990)). Along the same lines, much of the discussion of the rationale for futures exchanges centers on the guarantees of contract performance that they offer to users.

own clearing houses, and government has not aggressively regulated futures clearing arrangements. Although some clearing houses have gradually achieved a measure of independence, we still have a system where distinct clearing houses are associated with distinct exchanges. These exchanges compete with each other through contract innovation, but the ease with which successful contracts can be imitated gives exchanges incentives to use clearing to preserve monopoly power over contracts, and thus internalize gains from innovation. This deters economically efficient unification, i.e. standardization, of clearing services. Cross margining and common clearing are at odds with exchanges' incentives to place their own interests above those of their customers (securities firms acting on behalf of the general public). In the OTC market, "[c]entralized clearing would broaden competition between swaps dealers---hardly a popular concept with current dealers making huge profits" (Business Week (1993, p. 103). And certainly an element of "protectionism" seems to be one impediment to international co-ordination of long-established local exchange and clearing and settlement systems which enjoy some measure of monopoly profit.

Why is the options market, where unified clearing has prevailed, different? In fact, the exchanges which applied to the SEC in 1974 to trade options actually did propose the use of separate clearinghouses. We discuss whether the SEC, as a "tough regulator" in a period of substantial review and restructuring of the securities industry, distributed the gains from the new option contracts across the exchanges in part through common clearing. A second explanation for the unified options clearing system is that the SEC's role was more passive, and that exchanges agreed to common clearing for efficiency reasons at a time when none had a substantial monopoly position in the new option contracts.

Multiple clearing is sometimes advocated for essentially normative reasons. It is claimed that the monopoly profits from fragmented clearing both fund and stimulate the development of *new* exchange products and clearing and settlement technology.. That is, it is argued, competition to sell a new and better technology might lead to fragmentation in clearing and settlement, just as it does in the short-run battle to establish "the" standard for say HDTV or cellular telephone technology, but that fragmentation is the inevitable price of providing market incentives to produce the "best" technology. Whilst the power of the market in providing incentives is indisputable, we argue that the stimulus is much more complicated in the presence of network externalities present in clearing and settlement.

This paper is organized as follows. In Section 2, we discuss how exchanges and clearinghouses can best be viewed as giant networks in which there are demand-side economies of scale. In Section 3, we focus on default-risk in the clearing network, arguing that there is also an economy of scale in bundling clearing transactions so as to enable the clearing corporation to diversify both risks of customer default and the risks of incomplete information about customer risk. In Section 4, we empirically analyze supply-side costs in clearing, and conclude that unit costs are decreasing with respect to scale of operation. Given that the analysis in Sections 2-4 points toward unification in clearing and settlement, we turn in Section 5 to the factors which might explain why we often observe fragmented clearing in practice. Primary amongst these is exchanges' incentive to use clearing to establish an upstream monopoly in exchange products. We compare the clearing structures in the futures and options industries to provide an example. In Section 6, we briefly look at the incentives for innovation in industries where standardization and co-ordination diminish market incentives, as it might appear would happen if there were common

(single firm) clearing. We present a briefy summary and discussion in Section 7.

2. NETWORK EXTERNALITIES IN CLEARING AND SETTLEMENT

In our analysis, the demand for clearing and settlement services is derived from the demand for securities trading. In this section, we discuss the nature of this derived demand without worrying about the possibility of default in the clearing and settlement system. Default risk will then be addressed in Section 3. For brevity, we will say that securities are traded on "exchanges," though we really mean any organized facility---e.g. an OTC market where customers approach a dealer and "clearing" in essence takes place on the books of the dealers and customers.

An organized exchange is first and foremost a giant network. The existence of organized exchanges that trade futures, options, or other financial instruments is due largely to a positive network externality which an organized exchange is designed to create. By connecting himself to a trading floor (through, say, one telephone call to a broker), a trader connects himself to a network that gives him access to trading opportunities resulting from bids and offers placed by many thousands of floor traders, arbitragers, and customers. This makes an organized exchange an efficient way to structure trading in any instruments with standardized terms and conditions of trading.³

Network externalities are also present in the clearing of futures and options transactions. When there are separate clearing organizations for different futures or options contracts, it is necessary to have some interface which allows cash or value generated on positions at one

³"[t]he wide selection of similarly structured contracts on Liffe is considered a source of strength: during the turmoil in autumn, for example, there was substantial arbitrage trading between different Liffe products" (Financial Times, Friday, January 13, 1993, p. 13).

clearing organization to be transferred to, and monitored by, other clearing organizations. In the absence of unified clearing, the "interfaces" may be crude and inefficient, relying on settlement banks to transfer excess margins and clearinghouse staff phone calls to determine risk positions when setting margins. With common clearing, a network externality is created which makes one account settlement automatic and which facilitates cross margining of positions in different instruments.

Airline reservations systems and computer software are two network analogues to clearing which also display varying degrees of integration and compatibility, and which help illustrate the incentives of network operators. Airline reservation systems have obvious network features---the more interconnecting flights listed on a system, the greater the benefit to the traveller planning a trip. The reservation systems also allow travel agents to book travel-related services such as car rentals and hotel rooms (clearing firms are in a similar position with respect to the provision of additional services related to the clearing of standardized securities).

An airline clearly has an incentive to participate in the biggest reservation system because that system will provide for more convenient routes for more customers, its own included. However, each airline also has an incentive to run its own reservation system, because on those routes where it doesn't have a local monopoly, it can give its own flights priority⁴. Indeed, an

⁴A federal regulation now prevents the airline owning a reservation system from giving its flights more prominent listing in the system. However, other airlines claim that the systems still give an advantage to the owner's flights because the owner's computers are 100% interfaced with the reservation system, while those of competitors are not. Just as an airline running a reservation system has an incentive to imperfectly interface its competitors' flight information, an exchange with a successful product has an incentive to imperfectly interface that product with competitors. Moreover, although clearing members can be members of two or more exchanges, while travel agents only access one reservation system, the multiple memberships don't allow brokers to correct the imperfect clearing interfaces.

airline might find that others could break a monopoly that it has on some routes by offering alternative connections in a common reservation system. We argue below that similar monopoly incentives exist in exchange-clearing networks.

In principle, an intermediate position exists between uncoordinated and common clearing which could produce many of the network externalities of the latter. To achieve this, an interface could be built between clearinghouses which remain separate but thereby coordinated. In fact, it seems that this interface could even result from vertical competition. For example, given competing clearing organizations A and B, C could enter to integrate both A and B and choose a fee schedule for A and B clearing services that in effect prices these services plus any additional retail services it offers. Such an arrangement would resemble that where an operator of an ATM machine (analogous to an exchange) offers access to multiple ATM networks (like STAR, PULSE, etc.) and is free to differentially price the network access to users.⁵ In banking, there is only one clearing system, but banks which are part of the check (and bankcard) clearing system compete by selling differentiated products, including products which bundle the clearing services.⁶

⁵Salop (1988) explains that in practice, ATM networks collectively determine their interchange fees, which are the per transaction fees paid by the ATM card issuers to the owners of ATMs used in a transaction. [Are they different for different networks??] This collective determination restrains at least some of the ATM owners in pricing the services of various networks, as well as their own services of convenience and the like; as Salop discusses, the grounds for collective determination seem to lie in the networks' origins----groups of banks.

⁶In fact, specialized check cashing services are "value added" resellers of check clearing services; when deposited in the reseller's bank account, the bank then routes the check through the check clearing system. Similarly in the case of securities, there are various final retailers of the clearing and settlement services. As in the case of check cashing, these retailers could charge a competitively determined price for their services.

There are at least two ways to interface multiple clearing operations. One would be to allow the separate entities to compete for business, beginning at the point of trade registration, with data on matched trades sent simultaneously to the separate clearing organizations. Here there is a perfectly level playing field, though the potential for customer confusion (which could possibly be reduced if a firm like C "retailed" the services). A second model would allow competition only in the financial component of clearing. Here, all trades would be sent to a primary clearing organization at the point of registration. Sometime later (perhaps immediately), positions would be transferred to a separate clearing organization which would then handle subsequent financial arrangements.

The potential interface problems in either model include the following: (i) There are presumably increased risks of errors as trade records are transferred between clearinghouses, since there are now more balances and controls to deal with; (ii) Also, effective financial and information systems for monitoring clearing member risk might require use of data from trade capture and trade matching. If one clearing organization does capture and matching, arrangements must be made to insure sharing of this data in real time; otherwise, there is not a level playing field and the effectiveness of competition is undermined; (iii) the price of the contract would be influenced by which clearing organization was going to clear it. Traders would be allowed to choose the clearing organization of their choice, so the price of the contract would reflect the exercise of this option of choice, but it is easy to see how confusing this would have become on the week of October 19, 1987. Exercises would also need to be carefully assigned; (iv) Since one clearing organization might have a preponderance of longs and another clearing organization might have a preponderance of shorts, clearing organizations would need to post

bonds with each other and make variation payments to each other. Perhaps this could be done by a neutral bank which would in effect become a super-clearing organization, facilitating settlements between clearing organizations. Alternatively, each clearing organization could be made responsible for guaranteeing the performance of its own contracts. Obligations to the other clearing organizations would take precedence over obligations to its own customers, i.e., competing clearing organizations would be required to make payments to other clearing organizations before making payments to other customers.

It might be thought that cross-margining would accomplish partial compatibility in exchange clearing systems, and thus confer many of the benefits of "fully unified" clearing while at the same time avoiding most of the above problems. By cross-margining, we mean that gains on the winning side of an intermarket spread or arbitrage position (each leg of which might exist only as a book entry maintained by a clearing organization) can be used as collateral against which credit can be obtained to provide margin for other the losing side of a spread⁷. Under futures style margining⁸, the gains on the winning side of the spread would be automatically recognized in cash, but in its absence customers could in principle obtain securities (e.g. short term governments or a repo) from the clearing organization equal in value to the value of open positions minus required margins.

⁷This concept is variation cross-margining. A slightly different concept---initial cross margining---refers to the idea that the sum of two negatively correlated positions is less risky than either of the two positions taken separately and therefore should have a margin requirement lower than that for either of the two positions taken separately (e.g. a long in-the-money index call option plus a short stock index futures position is less risky than either contract alone). While our discussion in the text refers to variation cross-margining, nothing would be changed if initial cross-margining were added.

⁸Futures style margining means that margins are marked-to-market in cash.

The problem is that the laws concerning liens on winning positions are subject to just as many uncertainties about enforcement as the posting of bonds between clearinghouses in a more fully interfaced system: "[t]he failure of many States to adopt a revised version of Article 8 which recognizes 'uncertified' securities, significant disparities among the States' existing versions of that 'uniform' law, the introduction of new financial instruments which are not accorded consistent treatment among the States, and the absence of a coordinated response to these developments by State authorities, over time may tend to undermine confidence in the legal relations underlying financial transactions" (SEC,1988)⁹.

⁹Memorandum dated October 24, 1988 from Richard G. Ketchum to SEC Chairman Ruder, page 1.

3. CLEARING-HOUSE DEFAULT-RISK

Traders demand "low" default risk in the clearing system for securities, i.e. that the clearing corporation be solvent in "most" bad states of the world.¹⁰ While industrial corporations may default on securities which they've issued, the clearing system's product is the claim it issued. From a bank regulatory perspective, Corrigan (1988) has identified "finality" of clearing and settlement transactions as the key to reducing risk in the financial system. It is easy to understand that it is just not efficient for individuals to diversify default risk in clearing on their own accounts.

In the presence of discontinuities in security prices and/or lack of continuous margining, collateral is required on transactions. The clearing corporation has to manage that collateral in light of the risk in the customer's wealth position. At the same time that users want counter-party performance to be assured, they also want the clearing and settlement process to minimize their own cost of posting collateral. Here, we can assume that there is a trade-off. All else equal, the clearing corporation would prefer to have low volatility, high grade, liquid assets posted as collateral. These assets minimize the clearinghouse's (or their agents, the futures commission merchants and brokers) actual risk of default, as well as its monitoring costs and asymmetric information/moral hazard-type risks in determining the value of the collateral. On the other hand, we can assume that to post low volatility, high grade, liquid assets, users have to forego higher returns on more illiquid, "opaque" assets, or they have to have a specialist like a bank "certify"

¹⁰It is presumably impossible to insure the clearing house obligations against literally all risks. So, more precisely, the insurance is against all states for which the marginal utility of a default loss is substantial (assuming the states have the same probability).

or securitize such assets at a relatively high marginal cost.

If banks securitize illiquid assets so that the securities can be pledged as collateral, they are in a position to pool some of the asymmetric information risk in assessing illiquid asset values. However, it seems reasonable to assume that the clearing corporation can efficiently "pool" the risks of monitoring the "mark-to-market" default risk of traders. A real question is why a bank cannot also be in the clearing business---in fact, why it is not a "natural" clearer. The economics here behind clearing and settlement differ only in detail from those behind banking. Banking and clearing and settlement both involve networks which process transactions and move funds between accounts and institutions. Both involve credit judgments, a function of clearing and settlement which will become even more important if cross-margining allows investors to make withdrawals or otherwise borrow against winning positions. Both are subject to liquidity crunches and "runs" when mismatches occur between cash payments and receipts, as occurred on the week of October 19, 1987. Investors who want their bank account balances available for immediate withdrawal probably also find futures style margining attractive. On the other hand, a small investor who does not want to leverage the unrealized profits from winning positions into other positions, would prefer banking procedures like the current option system which automatically and conveniently reinvests the cash flow which the investor would otherwise have to worry about (by building them into the price of the option).

One quick answer as to why banks don't typically operate securities clearinghouses is the potentially increased moral hazard of Federal banking guarantees if a bank *cum* clearinghouse could change its default risk quickly relative to Federal audits and/or the clearing operations couldn't be completely segmented. A second point of view is that, in fact, banks sometimes do

run securities clearing systems: "A stock market based on such a short settlement cycle can only function when control of shares and cash is centralised. Germany has achieved this partly because the securities business has always been the domain of the banks" (*Financial Times*, March 12, 1993, p. 13). The implication is that it is regulation keeping banks out of the securities business which separates clearing and banking. An alternative potential explanation might follow along the "transaction costs approach" to organizational economics. Williamson (1985) points out that, scale economies aside, factors which favor integration of productive activities include the specificity of the activities, the extent of uncertainty surrounding them, and the frequency with which separate entities would have to transact on the market if they weren't integrated. Banks' securitization of illiquid assets is useful for many transactions beside posting collateral on trades, and there is little uncertainty in the clearinghouses' assessment of the worth of high-grade securitized assets. Also, we observe that, for example, packaging of Federally guaranteed mortgages is typically carried on by a different entity from the originator.

Returning to the feasibility of an interfaced multiple clearing operation, the evidence is that in the past, multiple clearing systems have not worked as an integrated whole in times of stress. Disarray in the securities markets in October 1987 was reported by all the major studies of the event. For example, the GAO stated that "[t]here was much confusion among banks, major clearing houses, market makers, and investors on their financial commitments to one another," and that such "...misunderstandings in the clearance and settlement process pose the greatest threat to financial stability should the circumstances of October 19 and 20 be repeated."¹¹ Voluntary "information sharing" agreements between clearinghouses will be imperfect. The

¹¹GAO, Financial Services Industry Issues Report, November 1988.

informal "regulator crisis-coordination" network among clearinghouses, exchanges, and regulators did play some role in the week of October 19, 1987, probably in part because the regulator is able to act as an arbitrator, much like courts do in cases of disputes involving incomplete contracts. However, information sharing cannot solve the problems encountered when market participants myopically direct their energy toward maximizing their own advantages in circumstances not contemplated in their contractual relations.

It is also instructive to look at the organizational structure of options clearing, where only one provider of services, OCC, has been authorized by the SEC. This provider is not controlled by individual exchanges, but is owned jointly by the five exchanges whose contracts it clears. Clearing members constitute a board majority. The options industry is thus structured to realize the gains from unification of services and interfacing. In particular, its common clearing system can be expected to be more resilient and provide better coordination under unexpected conditions of stress such as those experienced in October 1987. Just as the role of a central bank is important in preventing liquidity runs, it is better to have clearing and settlement mechanisms which protect asset values against default during a panic under one roof. This helps prevent myopic behavior which leads to a collapse of the system.

4. CLEARING COSTS

In the previous two sections, we have argued that network externalities in the demand for clearing and settlement services, along with a demand that the clearing firm contracts be default-free. We begin by examining the steady-state costs borne by the clearing firm.

Empirical evidence as to the long run costs of clearing can be sought in the pattern of clearing costs over time as cleared volume has increased, and/or the pattern of clearing costs across different organizations. Figure 1 is a plot of OCC's unit costs and unit revenues as volume (per contract side) has grown from approximately 92,000 contracts in 1973 to more than 308 million in 1987. Revenue data is given in addition to costs because the accounting allocation of costs to periods is necessarily somewhat arbitrary, and because the revenue figures are indicative of unit costs if OCC's revenues are competitively determined. As can be seen from Figure 1, or the underlying data given in Table 1, constant dollar unit costs have fallen from the nine to ten cent range in 1974-75 (the 16 to 25 cent range for revenues) to the ?? to ?? cent range (?? to ?? for revenues) in 1987. Overall, the impression is one of quite rapid decreases in unit costs with volume increases at low volumes, and reasonably constant or perhaps slightly decreasing costs at high volumes.

Of course, not all else beside volume is likely to have remained equal. For example, technology improvements almost certainly decreased the average costs of all sized plants, (though the adoption of the technology in clearing may itself be endogenous to the higher volume). On the other hand, the quality of the clearing services has undoubtedly increased over time, and thus

quality-adjusted costs would have decreased relative to those shown.

Data for a cross-sectional comparison of clearing firm costs is not routinely disclosed by exchanges/clearinghouses. Fee structures are publicly available, however, and we use them here as a proxy for marginal long-run costs. In doing this, it is important to recognize that the split between clearing fees and exchange fees is, at least in part, a matter of choice on the part of exchanges with affiliated clearinghouses. For example, on July 1, 1988, the CME had a member clearing fee of 7 cents for options and no exchange fee, while the CBOT had a clearing fee of 5 cents on all trades and a 2 cent exchange fee for members. Further, fees charged members and nonmembers differ. One way of dealing with the problems of measuring clearing costs per se is to aggregate exchange fees and clearing fees across exchanges, and to treat member and non-member fees separately. The sum of clearing, trade match, and exchange processing fees, as of July 1, 1989, are plotted against exchange volume and superimposed on the Figure 1 unit cost curve in Figure 2.

The proxy cost curve to the right of the NYMEX volume ordinate in Figure 2 seems roughly consistent with the pattern in Figure 1, i.e. significant decreases in costs at low volumes, with reasonably constant costs at high volumes. The apparent exceptions to the left of the ordinate are the CEC group of exchanges (the Cotton Exchange, the Coffee, Sugar, and Cocoa Exchange, the Comex, and the NYMEX Exchange), and the Kansas City Board of Trade. However, the Comex carries out some exchange processing for the other CEC group members, and carries out the data processing for the Cotton Exchange. This limited specialization in processing among the CEC exchanges suggests that their volumes should be partially aggregated in Figure 2. However, we've not attempted to do this because even if cost data were publicly

available, it would be difficult to allocate many of the costs of the shared facilities. KCBOT fees are higher than those stated because traders "pay" a loss of interest on excess margins not immediately credited to their accounts [any quantification possible?]. As with the time series evidence, all else beside scale of operation is hardly constant across these exchanges/clearinghouses. Also, some additional fees which we've not been able to include, such as member dues, booth rentals, and clearing corporation interest income, may not be invariant across exchanges.

Measurement problems aside, the costs just discussed are those for the historically chosen plant sizes. However, the level at which clearinghouses operate, i.e. the points on the cost curve at which they find themselves over time, might not correspond to the minimum cost operation of the chosen facility. For example, if volume was unexpectedly high for the 1973 plant, it may have been operated at higher unit cost to meet volume, while volume may have been unexpectedly low in 1988, so the current plant may have been operated at less than expected capacity with higher unit costs. Since the time series and the cross section of observations in Figures 1 and 2 are neither large nor, presumably, independent, such failures of expectations to be met could either steepen or flatten the curves in Figures 1 and 2.

The cost figures discussed above are for the clearing firm, i.e. they are unit costs for OCC or for each of a cross-section of firms. As such, they take into account the difficulty of coordinating clearing activities within firms which are themselves essentially "network organizations" (e.g. Kilmann (1989)). However, they don't take account of the economies or diseconomies of scale in costs imposed on users. We believe, however, that these costs would rise if clearing were carried out by two or more firms, because of the coordination costs for users.

The Amex pointed to examples of such costs in its S.E.C. submission in 1974 supporting the establishment of a common clearing firm for options. It argued that: (1) a single clearing system would be much less expensive to operate than interfaced separate systems; (2) there would be a single system for assuring that controls, records, margins, etc. are in balance on a daily basis, with less chance of error arising from the exchange of data in interfaced systems; (3) the single system would eliminate problems in creating a fair system for the allocation of exercise notices; (4) member firms had expressed great preference for a single system as one which would reduce back office costs and confusion to them.¹²

¹²These points were made in a letter dated July 23, 1974, from Paul Kolton, Chairman of Amex, to Lee A. Pickard, the Director of the Division of Market Regulation at the SEC. We have quoted a summary of them as stated in the Phlx's January 23, 1989 draft of an SEC comment.

5. WHAT FACTORS AMELIORATE THE FORCES FOR COMMON CLEARING?

The economics of the supply of goods and services by network operators like the exchanges with their clearing and settlement systems, airlines with their reservation systems, and computers with their software systems, involve two sets of issues. First, on what basis do suppliers decide on the degree of compatibility of their products? Second, for a given level of compatibility among firms' products, how many firms will exist as suppliers? In the clearing industry context, these questions translate into: (a) what factors might explain the observed fragmentation or incompatibility among exchanges and their associated clearing systems in the futures industry, and why are options different?; and (b) if clearing systems are unified, will, or should, services be provided by one common clearinghouse or by several houses?

Turning to the first question, we noted in the introduction that futures clearing is performed by multiple clearinghouses, each aligned with a futures exchange. The clearing organizations which service futures exchanges have not attempted to integrate and consolidate their services. Indeed, they've resisted several attempts to do so. This failure of futures clearing organizations to make their services compatible suggests that each futures exchange derives a benefit from having its own separate clearing organization, that this benefit is something other than low-cost trade processing and risk assessment by a clearing organization, and that it is sufficiently large to offset the higher fees which the smaller clearing organizations charge, as well as the increase in prices which could be charged to customers who would derive additional benefits from the larger network.

Exchanges will presumably only voluntarily agree to make their clearing systems

compatible if it is in each of their respective interests. Such would be the case, for example, if all gained equally from a joint compatibility decision. An exchange with a successful contract, however, may stand to lose more than it gains from making its contract compatible with those of other exchanges. The successful exchange might expect to earn higher revenues because, with compatibility, its network would be bigger, but it may justifiably fear loss of much of its substantial market share. All else equal, the more inequality in the market shares of suppliers, the lower the incentive of the successful firm to agree to making its product compatible with those of the less successful firms unless they make side-payments to compensate for the loss of market¹³. This conclusion holds a fortiori if the successful firm bears compatibility costs on top of the loss of market share.

We believe that there is predictable asymmetry in the gains and losses to futures exchanges if they were to unify their clearing systems for various contracts. These exchanges compete fiercely with one another by introducing futures contracts which are often close substitutes for contracts traded on other exchanges. The terms and conditions of these contracts can be cloned relatively easily (assuming the CFTC freely approves new contracts). In spite of this apparent low-cost entry, however, the experience of the futures industry has suggested that it is very difficult for one futures exchange to compete successfully with a successful, established contract traded at another exchange by introducing a competing contract with similar provisions.

Evidently, once a futures contract becomes successful, the futures exchange with the successful contract obtains a substantial amount of monopoly power over that contract. The value

¹³Less successful firms would presumably be willing to make such side-payments, ignoring the compatibility costs, since greater network externalities in the industry's products would mean higher aggregate demand for the product.

of seats on the successful exchange strongly reflects the exchange's monopoly position in its successful contracts, and maintaining that monopoly position becomes an important goal for the exchange. In a like fashion, securities firms compete fiercely to preserve monopoly profits from new OTC products that they have engineered, and the customized nature of these products often seems to help in that effort.

The monopoly power which exchanges and dealers have over their contracts arises from the network externality which pools liquidity in one trading location. Quite simply, if all traders know that the best place to obtain a liquid marketplace for an asset is on the floor of a particular exchange, then traders have an incentive to direct orders toward that exchange, and that exchange will continue to have the most liquid market. To forestall competition from another exchange, an exchange with a successful contract has an incentive to prevent its liquidity from being shared with other exchanges offering a contract with identical or similar provisions.¹⁴ The exchange will want to charge a higher price for sharing its trading network with other exchanges than it costs the exchange to provide the network services to traders on competing exchange floors.

One way to deter competition by making it difficult for competing exchanges to clone contracts is to make it difficult to maintain arbitrage positions in which a trader is long a contract at one exchange and short a contract at another exchange. If an exchange has a captive clearinghouse, this can be accomplished by simply not developing an efficient system for settling and cross-margining such arbitrage positions. If cross-margining is difficult, it becomes difficult for one exchange with a new product similar to that offered by another exchange to compete with

¹⁴Internationally, "...competitive considerations between different market centers complicate the implementation of a worldwide linkage system [between exchanges and clearing systems]" Melamed (1993, p. 202)).

the established contracts offered by the other exchange. Similarly, the exchange with a successful contract can extend its monopoly position through in-house development of complementary products.

Clearinghouse control also provides an exchange with a number of levers which could help it better extract rents. Margin rules can be slanted toward those with the most control over the exchange. In general, clearinghouse operation provides an exchange with an option as to when and how to change rules should unforeseen circumstances affect exchange members. An exchange might also be better able to price discriminate by bundling clearing services with execution services, in much the same way that IBM was alleged to have done in the 1960s by requiring buyers of its computers to also purchase its punch cards.

To summarize, competitive forces in the futures industry have resulted in a system in which futures exchanges compete by erecting barriers which prevent efficiencies associated with network externalities from being shared by customers of other exchanges. The barriers include an absence of common clearing, an absence of one account settlement, and an absence of effective cross margining agreements across different futures contracts. Interestingly, Government proposals for the ownership of airline reservation systems have shied away from single-carrier ownership, or at least management, of the systems, citing some of these problems. Indeed, the Justice Department has frowned upon a merger ("unification") of the American and Delta systems. The Apollo system has much wider ownership and control.¹⁵

It would nevertheless be a mistake to predict from the above that futures exchanges will

¹⁵ It is now managed by the Covia partnership, which is half owned by British Airways, Alitalia, KLM/Royal Dutch Airlines, Swissair and US Air. Covia and United have also agreed to develop a new system, Galileo, in Europe with these European airlines.

never cooperate to share network externalities under any circumstances. For example, cooperation is to be expected in situations where competition from other sources is so intense that it overcomes efforts by exchanges to exploit trading and clearing network externalities inefficiently.¹⁶ If, however, an exchange's position is well entrenched, such as is the CBOT in its grain contracts, it will have little incentive to offer cooperative sharing of its market.

Currently, futures exchanges face a substantial competitive challenge from foreign exchanges, competitive OTC products such as swaps, and automated trading systems. To meet this competition, it may be in the interest of U.S. futures exchanges to pursue more cooperative policies than in the past. Of course, given past history, such cooperation may be as likely to be between a U.S. and a foreign exchange in a new or changing product market (such as derivative foreign exchange and equity index products, or government debt instruments) as it is to ally U.S. futures exchanges which now compete with one another in established markets.

In contrast to the futures industry, the clearing systems of the exchanges which trade options are fully compatible---they are operated by a single entity, OCC. Yet options and futures are similar products. They are both book-entry products---essentially "blips on a computer screen"

¹⁶"Faced with increasing competition from over-the-counter products developed by banks, [European] futures exchanges have become increasingly keen to co-operate with each other. Technological advances have enabled traders around the world to come together on screen-based systems, while the breakdown of barriers between markets has spurred investor demand for a broader range of products" (*Financial Times*, Thursday, January 14, 1993, p. 1). "Out of the fray of fierce competition between the Chicago exchanges came the realization that the greater danger was external, not internal. The present contracts at the CBOT and CME do not compete directly with one another, and the exchanges had no problem allowing the marketplace to make its determination about future competitive products. On the other hand, both exchanges saw the clear and present competitive danger posed by other world exchanges trading the traditional CBOT and CME products in their own time zones. The same anxiety was voiced by every exchange around the globe" (Melamed (1993, p. 196)).

or computer disk file. Because they exist as contracts issued by the clearinghouse for the exchange on which they are traded, they are not fungible instruments, unlike (say) stocks which are issued by corporations and can be traded on any exchange. What is it, then, that accounts for the different structure of the clearing systems in futures and options?

The options industry actually started out in the futures mold. When CBOE had began trading options in 1973, it cleared them through OCC, then a captive clearing subsidiary. Shortly after CBOE began trading the contracts, the American and Philadelphia exchanges (Amex and Phlx respectively) put forward proposals for their own options contracts, stating their intention to clear the contracts through their own captive clearinghouses. In mid-1974, the SEC notified the three exchanges that "the achievement of a common clearing system" and "standardization of option terms and conditions" would be important factors in the approval of their proposals.

While Amex and Phlx would, as potential entrants, have an incentive to agree to common clearing, CBOE's incentive to voluntarily go along with common clearing is less obvious if its initial option contracts were established and expected to be successful. CBOE would, of course, have had good grounds for believing that the bigger clearing and hence trading network would be more attractive to users and lend credibility to the relatively new option instruments. Also, the CBOE wanted to increase the number of options it could trade. Perhaps the SEC's reference to "standardization of option terms and conditions" might have suggested to the CBOE that it could not look forward to telescoping any success to an exclusive on new option contracts¹⁷.

¹⁷One method of empirically analyzing CBOE's motives might be to look at the price of CBOE (and Amex and Phlx) seats around the time when the SEC's policies first became known, but it would be very difficult to abstract from other influences on seat prices).

Would competition bring about unified clearing? Miller et. al (1989, p.215) suggest that: "...if the economic advantages of unified clearing are as large and as unambiguous as the Brady Report suggests, the various exchanges will find ways in their mutual interest to bring about such a consolidation without specific legislation" (p. 15). However, the workings of the market are likely to be quite complicated in the presence of the network externality in trading and clearing. First, as we've explained, exchanges with successful contracts generally have disincentives to voluntarily make their clearing systems compatible. We understand that the clearing organizations of the various futures exchanges have negotiated with one another in the past about joint clearing and cross margining of intermarket spread positions. The fact that these negotiations resulted in neither unified clearing nor comprehensive cross margining agreements in the futures industry is evidence of the exchanges' and clearing organizations' pursuit of their own self interest¹⁸. Second, the complicated marketplace strategies to be employed by participants in the non-zero sum game to establish their preferred standard may mean that some form of non-market communication may speed up the market as it gropes toward a uniform standard.

At the same time, while generally sharing Miller et. al.'s general skepticism as to the effectiveness of traditional regulatory approaches, we looked at the role of the SEC as a "visible

¹⁸ It is interesting that in the telecommunications industry, there are clear benefits to having everyone hooked up to the same network, just as there would be benefits to having common clearing in the futures industry. If there were competing telecommunications networks, however, it might be in the private interest of the operator of a large network to deny access to local companies who also receive and transmit calls over competing networks. This would benefit the operator of the large network either by putting its competitors out of business or by forcing the competitors' customers to subscribe to the large network's services if they want to connect with other subscribers of the large network. When ATT was split up, the telecommunications industry changed from a regulated monopoly to a system of competing providers of service with a regulated interface allowing universal connections to a large network.

hand" in achieving standardization of the clearing procedures in the new market.¹⁹ The time at which the options exchange proposals were submitted to the SEC was a time of intense debate as to whether competitive or common clearing best fosters competition in the securities marketplace.²⁰ In the midst of the debate, the SEC's role could have been consistent with that of a "tough regulator" which, along the lines of Peltzman's (1976) model, acted to allocate some of the new market's gains to the Amex and Phlx. This interpretation of SEC policy is, for example, often cited as the major reason that the smaller clearinghouses for stocks were "grandfathered" into the linked clearinghouse structure for the national market system, while single firm (e.g. NSCC) clearing would have been more efficient. Also, the Commodity Exchange Act does not give the CFTC "tough regulator" authority over non-Exchange-affiliated futures clearance and settlement, which might explain the absence of unified clearing and associated redistribution of Exchange rents in the futures industry. Some evidence of the relative strengths of Amex and Phlx as political interest groups would help bolster the tough regulator explanation.

¹⁹A visible hand also seems likely to be involved in clearing and settlement in London after abandonment of the Taurus project: "The decision to ask the Bank of England what to do makes some sense. Settlement is not unlike a public good: the incentive for the potential beneficiaries is not sufficient for them to set up a system on their own initiative" (*Financial Times* Editorial, March 12, 1993, p. 13).

²⁰The amendments to the Securities Exchange Act of 1934 were passed in 1975. They had their genesis in the "paperwork crisis" in clearing in the late 1960s, and in Justice Department and institutional investor pressure on the securities firms and exchanges to make commission rates competitive. The amendments directed the SEC to have "...due regard for...the maintenance of fair competition among brokers and dealers, clearing agencies, and transfer agents" [Section 17Aa(2)], while specifying as an objective the "...linking of all clearance and settlement facilities and the development of uniform standards and procedures for clearance and settlement..." [Section 17Aa(1)(D)].

An alternative hypothesis is that the common options clearing arrangement was arrived at in a committee-like procedure, with the SEC playing a more benign role as "moderator." The premise is that communications had developed by 1974 to the point where common clearing was most efficient, whereas trading was more regionalized when the older stock and futures exchanges developed with their own clearinghouses. In 1974, at the outset of options trading, the exchanges could be presumed to be on an equal footing with respect to gains and losses to be had by coordinating clearing---by then, the efficient solution. However, the exchanges still needed to reach agreement concerning which standards would be adopted for the interface. At least under certain conditions, committees offer an efficient method for establishing such a standard in the many-period game in which each of the parties with vested interests play out their strategies to have their preferred standard adopted (e.g. Farrell and Saloner)²¹.

Of course, monopoly considerations don't disappear in the common clearing environment.²² If only one network operator survives, he becomes a monopolist and--if his

²¹ Along the same lines, it is interesting to watch the evolution of automated after-hours trading systems by the exchanges and the processes by which they move toward compatibility, (which is perhaps a likely result given the overseas customer base and competition). For example, both the CME and CBOT pursued their own independent after-hours systems at the outset. Then, as we predicted in an earlier version of this paper, they jointly moved to a common venture, which became the Globex project with Reuters. However, there still seem to be lots of political problems and bargaining plays as each tries to protect its turf (as do other foreign exchanges who would have their product monopolies eroded by Globex).

²²

The market demand curve of course limits the monopoly power of unified clearers or Exchange-affiliated clearers alike. In particular, the demand for bundles of clearing and exchange services is limited by the abilities of customers, particularly the larger institutions, to develop their own third and fourth markets. Also, all else equal, the larger is the fraction of trading costs attributable to clearing, the more elastic its demand curve (and thus the more limited is any monopoly power in clearing). In 1987, clearing accounted for roughly ?? percent of trading costs.

customers cannot control his actions--he has an incentive to raise prices, even if this means that some customers choose not to join the network though it is economically efficient for them to do so (in the sense that consumers who would join at a lower-than-monopoly price would be better off, as would the existing network members). Given that users understand this "gouging" incentive, the profits for the monopoly network operator may be lower than if the network was operated by two or more active firms if the monopolist cannot credibly precommit not to charge monopoly prices and thus operate a smaller network which is less valuable to members (Katz and Shapiro (1985, p. 431)).

It is interesting that OCC in fact appears to be structured to maximize precommitment credibility. OCC is owned equally by the five exchanges whose contracts it clears. It is managed by a board of directors that includes nine directors representing clearing members who constitute a board majority. The fees which it charges clearing members are fixed by its board of directors and are equal for all exchanges (including new entrants). Excess revenues are rebated to clearing members in proportion to the amount of revenue that each generates for OCC, and unless OCC's by-laws are altered to permit the payment of now-prohibited dividends, there is no obvious "back-door" way in which monopoly profits could be distributed.²³ Perhaps also user involvement as

²³ Since there are differences among clearing members and the prices that are charged to them, "monopoly pricing" refers to the array of prices. So a related question is whether cross-subsidization could occur in the exchange-owned/clearing member-controlled clearinghouse. Indeed, fees will typically be uniform on some dimension across different clearing members and contracts. Weinberg's (1988, pp. 16-17) observation that "today, many smaller brokers and banks already cannot participate directly in the larger clearing agencies because of their higher financial qualification standards..." might appear to be testimony to the unequal effects of apparently equal treatment of customers. Yet if economies of scale are being exploited by the common clearing firm, marginal costs for handling the additional volume of smaller brokers and banks should, *ceteris paribus*, be lower than otherwise. Perhaps the added fixed costs of hooking the small users into the network makes their firm size uneconomic from a social viewpoint.

a means of credibly pre-committing the network operator not to later charge monopoly prices is most effective in a clearing and settlement operation than in the "standard" case. The customers of the clearing and settlement firm are clearing firm members who are specialists supplying the other part of the bundle of trade services. If clearing and settlement services become monopolistically priced or technologically outdated, sales of the bundle will suffer.

There is additional evidence on what happens when exchanges are prohibited from capturing the clearinghouses. For example, we have been able to observe consolidation taking place over time in the clearance of stocks---a fungible security for which one-account settlement was mandated in 1975. Various regional stock exchanges have abandoned the clearing business, while the National Securities Clearing Corporation (NSCC) clears some 90% -95% of stocks traded. As a second example, Salop (1988, p. 33) reports that "actual inter-[ATM] network competition has declined in recent years as a result of consolidation among regional networks.

One instance of alleged subsidization across users of different contracts, rather than across different users of a single contract, is cited by Rutz: "OCC is pursuing a centralized system for netting, clearance, and settlement of cash-market foreign currency transactions...in effect, floor traders (which account for the majority of options trading) and the investing public that presumably has no interest in cash foreign currency transactions, were providing the funds (subsidizing the OCC) through OCC clearing fees for this potential new venture." (p. 34) Obviously new product development must be financed from some source. In the case of Exchange-aligned clearinghouses, the source is the exchange membership. Does this mean that members "subsidize" new developments? Unlikely. The decision to invest funds in a new product must be made by someone with title to the funds. In the case of common clearing, clearing members make up the majority of the board which makes such decisions. The fact that the source of the funds is fee inflow is irrelevant, for the fees could have been rebated to members and returned. It may be that the OCC decision framework means that "...exchange members themselves were funding activities...that could effectively compete with them at a later date" (Rutz, p. 34), but this is anything but bad. It illustrates that new product development in common clearing is not distorted by the influence of exchange members seeking to protect current products which are successful.

In addition to technological scale economies, there are sizable benefits to universal access, that is, having a bankcard that can be used in every ATM in a region."

6. UNIFIED CLEARING AND INCENTIVES FOR INNOVATION

It is generally recognized that unifying or centralizing any set of operations "under one roof" or in conformity with one standard rather than through the market involves some sacrifice of intense incentives provided by the market. (e.g. Williamson (1985)). Indeed, discussion of the Brady Commission's recommendations for unifying clearing and settlement has already implicitly recognized this point. For example, Miller et. al (1988) argue that "[w]hether ... strengthening [of the liquidity support system] should aim for a unified clearing system covering stocks, options and futures as recommended in the Brady Report is far from clear. Competition in providing clearing services, like competition generally, can be a spur to innovation and improved efficiency" (p. 15).

At a slightly different level, economists have often suggested that some guarantee of monopoly rents, not competition, is a necessary inducement to innovation. Rutz(1989) applies essentially this argument in the exchange and clearing context: "Futures exchanges spend millions of dollars annually for research and development to attempt to design truly innovative futures contracts. The success of a product, as measured by trading volume and widespread market participation, rewards the exchange for costly research and development" (p. 36). The argument is that competition in the provision of exchange services detracts from innovation, though of course there is no generally valid argument that monopoly rents for the life of a new product provide the optimal level of incentive for R&D. Rutz's argument has two immediate corollaries. First, multiple clearing is desirable if it does help shore up an exchange monopoly, not necessarily because it fosters competition in clearing per se. Second, if a common clearinghouse

were a monopoly, there would be more, not less, costly research and development in clearing techniques.

Unfortunately, even if the prospect of monopoly rents does spur contract innovation, the monopoly itself is typically undesirable. Further, to the extent that innovation relates to improvements in current products, it ipso facto enhances an Exchange's monopoly position.

In a system of common clearing which is not exchange-aligned, exchanges can be given equal competitive access in the provision of new products. This fosters innovation by providing a level playing field for the development of new ideas. It may be the case that "...multiple listings [of new products] may disperse trading activity and cause a reduction in liquidity that could result in the ultimate failure of that [instrument] to trade successfully on any or all exchanges" (Rutz, 1989, p. 35). However, because trading is a highly centralized activity, it might not be undesirable that a new instrument will fail to trade on all exchanges. Also, if the eventual survival of one successful contract is the equilibrium, the dynamics of determining Exchange allocations within the common clearing framework are likely to be at least as efficient as the competitive "shake-out" that determines which exchange's new product prospers in the aligned-clearinghouse structure.

Even if we agreed that common clearing reduced competition, there is no hard and fast rule that tells us how much attenuation there is likely to be in competitive market incentives, nor how much gain in better coordination and economies of scale it is likely to offer²⁴. In practice, of course, the tradeoffs are assessed and the boundaries of firms determined. The better the

²⁴Of course, the mere existence of several firms supplying a good or service won't, per se, ensure its provision at competitive, rather than monopoly, prices.

monitoring opportunities within the hierarchical structure, the less the loss in competitive incentives, and the more likely we are to find activities to be integrated. Thus, both for this reason and because of low volume and relatively few network externalities, there would seem little purpose in integrating clearing facilities for uncorrelated contracts, such as corn futures and equity index options. Further analysis along these lines would establish the appropriate boundaries for a "common" clearing firm for equity-related securities.

The multiplicity of settlement banks used by some clearinghouses, which seems on the surface as if it would increase the likelihood of cash flow mismatches in settlement under stress, might also have a deeper explanation. The multiplicity could serve the role of taking advantage of Federal bank guarantees to the extent that the Fed injects liquidity to offset mismatched settlement flows, to the extent that the banks guarantee clearinghouse payments at a time (6:40am Chicago time) prior to the completion of fund transfers, and to the extent that the large cash flows may more easily bankrupt a smaller settlement bank than a large one. Presumably the banks themselves can cover the costs of the implicit put options which they extend when they bridge the cash flow mismatches from letter-of-credit income and the like.

7. SUMMARY AND DISCUSSION

Our analysis of the network externalities that are present in securities trading and clearing, along with the diversification benefits of bundling the credit risks of clearing and the apparent economies of scale on the cost side, lead us to believe that integrated clearing will typically be the most efficient form of clearing organization. We argue that incentives to monopolize successful contracts are the main reason that we don't see unified clearing in the futures industry, the OTC markets, and across international markets.

REFERENCES

- Coase, R.H., 1937, "The Nature of the Firm," Reprinted in Readings in Price Theory, Ed. by K.E. Boulding and G.J. Stigler, Published for the American Economic Association by Richard D. Irwin, 1952.
- Coase, R.H., 1960, "The Problem of Social Cost," Journal of Law and Economics, 3 (October, 1960), 1-44.
- Corrigan, E.G., 1988, "Remarks Before the Federal Reserve Bank of Richmond Payment System Symposium," Williamsburg, VA, May 25.
- Demsetz, H., 1968, "Why Regulate Utilities?" Journal of Law and Economics, ???.
- Farrell, J., and G. Saloner, 1988, "Coordination through Committees and Markets," Rand Journal of Economics, 19(2), Summer, 235-252.
- Gilbert, R. A., 1989, "Payment System Risk: What is it, and what will happen if we try to reduce it?" Federal Reserve Bank of St. Louis Economic Review, January/February.
- Group of Thirty, 1989, "Clearance and Settlement Systems in the World's Securities Markets, March.
- Hinkes, T.F., 1988, "Cross Margining and Futures Style Margining: The Facts," Commodities Law Letter, VIII(9,10), pp. 2,3,7-11.
- Holmstrom, B., 1988, "Agency Costs and Innovation," Unpublished Paper, Yale University, June.
- Katz, M.L., and C. Shapiro, 1985, "Network Externalities, Competition, and Compatibility," American Economic Review, 75(3), June, 424-440.
- Killman, R. H., 1989, "Tomorrow's Company won't have Walls," New York Times, Sunday, June 18.
- Knight, F.H., 1951, The Economic Organization, Harper Torchbooks, New York.
- Melamed, L., 1993, Leo Melamed on the Markets, John Wiley & Sons, New York.
- Merton, R.C., 1990, Continuous Time Finance, Cambridge, Basil Blackwell Inc.

- Miller, M.H., and M. Scholes, B. Malkiel, and J. Hawke Jr., "Final Report of the Committee of Inquiry Appointed by the Chicago Mercantile Exchange to Examine the Events Surrounding October 19, 1987," in Black Monday and the Future of Financial Markets, Ed. by R. W. Kamphuis Jr., R. C. Kormendi, and J.W.H. Watson, Irwin, Homewood IL.
- Presidential Task Force on Market Mechanisms (Brady Commission), 1988, Report submitted to the President of the United States, the Secretary of the Treasury, and the Chairman of the Federal Reserve Board, USGPO, Washington D.C., January.
- Ross, S.A., 1989, "Institutional Markets, Financial Marketing, and Financial Innovation," The Journal of Finance, 54(3) July, 541-556.
- Rutz, R.D., 1988, "Intermarket Cross-Margining: The Myth and the Reality," Commodities Law Letter, VIII(9,10), pp. 4-7.
- Rutz, R.D., 1989, "Clearance, Payment, and Settlement Systems in the Futures, Options, and Stock Markets," Unpublished Manuscript, Chicago Board of Trade, February 24.
- Salop, Steven C., 1988, "Deregulated Self-Regulated Shared ATM Networks," Unpublished paper, Georgetown University Law School, November 20.
- Stigler, G.J., and C. Friedland, 1962, "What Can Regulators Regulate? The Case of Electricity," Journal of Law and Economics, V (October), 1-14.
- U.S. Commodity Futures Trading Commission, 1988, Final Report on Stock Index Futures and Cash Market Activity during October 1987, Division of Economic Analysis, Division of Trading and Markets, USGPO, Washington D.C., January.
- U.S. Securities and Exchange Commission, 1988, The October 1987 Market Break: A Report by the Division of Market Regulation, USGPO, Washington D.C., February.
- Weinberg, M.L., 1988, "Unsettled Question: 'Unified' Clearing Draws Challenge," Barrons, February 15, pp. 16,17, 98.
- Williamson, O., 1985, The Economic Institutions of Capitalism, Free Press, New York.

Figure 1
Real Unit Costs and Revenues
For The Options Clearing Corporation
Over the Period 1974 through 1987

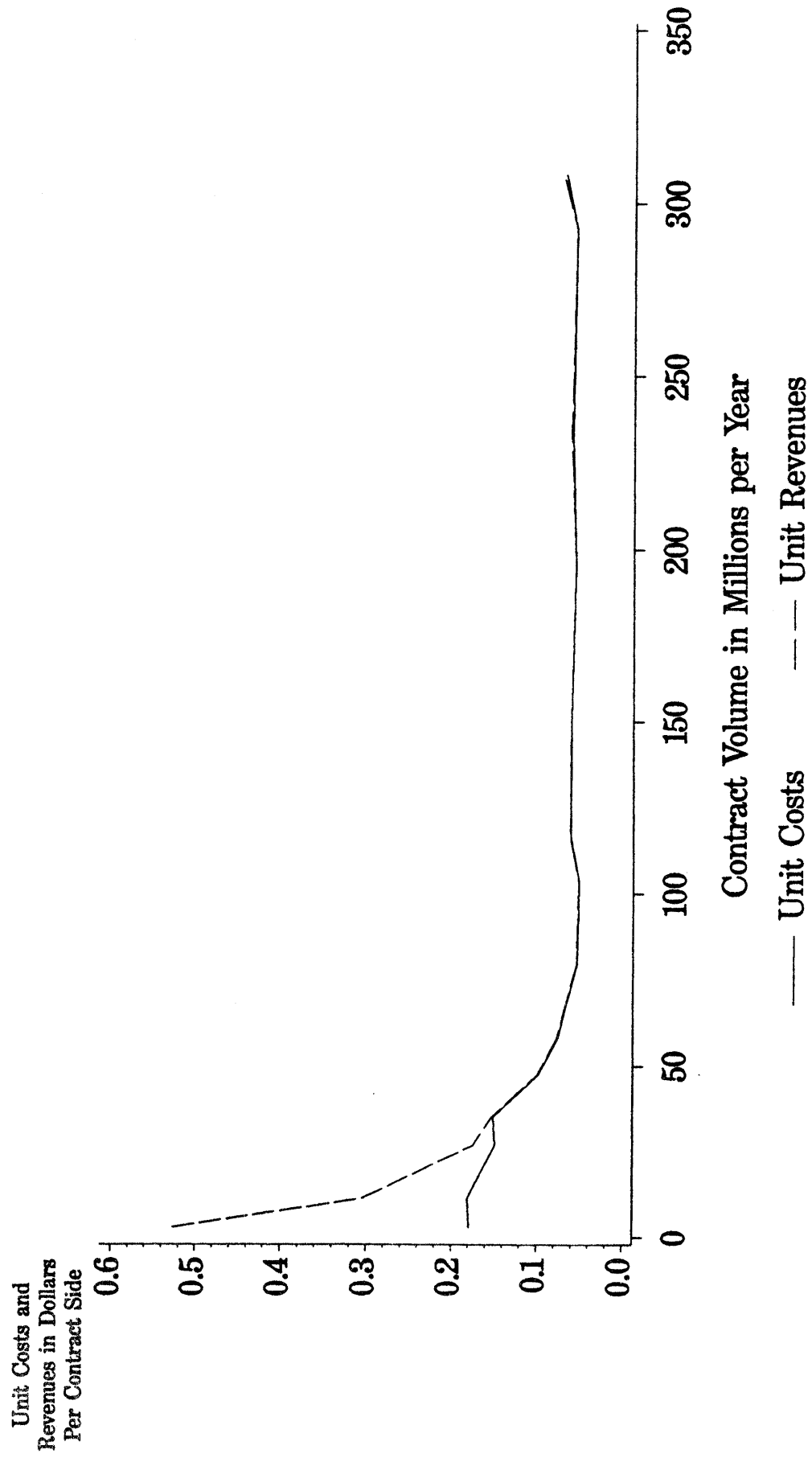


Figure 2
Member and Non-Member Fees Charged by US Options
And Futures Exchanges and Clearing Houses in 1987

