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THE STOCK-EXCHANGE INDUSTRY:  
NETWORK EFFECTS, IMPLICIT MERGERS,  
AND CORPORATE GOVERNANCE

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THE STOCK-EXCHANGE INDUSTRY:  
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AND CORPORATE GOVERNANCE<sup>(\*)</sup>

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ABSTRACT

The evolution and integration of financial markets in recent decades have created increasing competition among stock exchanges, which are behaving more and more like “standard” firms. Stock exchanges are peculiar firms that produce listing, trading, and clearing services and “sell” price information. They have different types of customers: firms that want to be listed, financial intermediaries who want to trade securities, and institutional and private investors. Some of them, in particular financial intermediaries, are often the “owners” of the stock exchanges, which traditionally have been organized as cooperatives or public entities.

This paper focuses on the stock-exchange industry, analyzing the competition among exchanges and, more theoretically, the corporate-governance problem of customer-controlled firms, of which stock exchanges are a clear example. Policy implications are provided in both cases.

After the introductory chapter, the second chapter, “Competition and Integration among Stock Exchanges in Europe: Network Effects, Implicit Mergers, and Remote Access”, analyzes the role of network externalities in the stock-exchange industry through a model in which two exchanges compete. It is shown, using the European regulatory background, that competition may end up in inefficient equilibria while an “implicit merger” may be Pareto optimal and give greater profits to both exchanges. In the end, exchanges may specialize in listing and trading services, or unilaterally start to trade stocks listed on other markets (as did Seaq-International some years ago or many automated trading systems in recent years).

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(\*\*) *Divisione Mercati, Consob.*

The third chapter, “Customer-Controlled Firms: the Case of Stock Exchanges”, shows that monopolist customer-controlled firms, like cooperative banks, or life insurance companies, and stock exchanges, never price their goods at the monopoly price, so that minority shareholders always receive less profits. When the firm is completely customer-owned, the monopolist achieves the first best, and pricing policies are irrelevant if they face a unit demand, while price equals marginal cost if the firm faces a downward demand.

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## I. INTRODUCTION

Competition among stock exchanges, both national and international, is a recent phenomenon, especially in Europe. Until some decades ago, it was difficult to think of exchanges as firms that produce and sell goods to customers and compete among themselves. Traditionally, exchanges were seen either as public entities (like the continental European exchanges), or as formally private bodies, regulated, more or less, by public rules (the Anglo-Saxon exchanges). In both cases, they were often legal monopolist, given the special nature of their activity that very much resembled that of a public good.

The increase in competition, due mainly to the technological innovation and transformation of the securities markets in Europe, has produced new trading systems, technological agreements among existing exchanges, price wars, mergers, takeovers, and the creation of new exchanges, even within the same country, as well as the failure of previous agreements and alliances.

Furthermore, many quasi-exchanges (automated trading systems) have developed. From an economic point of view, an automated trading system can be seen as a special kind of exchange, which specializes in producing trading services without producing listing services, given that it generally trades securities already listed in regulated exchanges.

Many exchanges, formerly cooperatives of intermediaries who were both members and owners, have changed their ownership structure to become standard corporations while others, formerly public, have been privatized. Some of them are, in a sense, customer owned or controlled. Only a few of them, until now, have belonged to shareholders other than financial intermediaries. Since many exchanges are self-regulated, conflicts of interest may arise. For example, a manager of the exchange may not enforce a rule against one of its owners. Thus the governance structure may matter in the process of competition.

The process of monetary union and the full implementation of the Investment Service Directive (ISD) will further integrate financial markets in Europe. The single currency will eliminate one of the reasons for fragmentation of firm listing among different national exchanges (and a reason behind their natural monopoly). The ISD, in fact, allows each recognized exchange to offer "remote access" to intermediaries in other countries. There will be mutual recognition and home-country control for all securities firms and banks performing investment services. Finally, banks are already, or will be, allowed to trade directly on exchanges without the need of subsidiaries.

Of great uncertainty still is the evolution of the exchange industry in Europe. Will the exchanges merge? Is there enough space for some of them to survive? What about integration with off-European exchanges? Is it better for the exchanges to have an agreement among themselves or to decide unilaterally to trade shares listed in other exchanges and/or to offer remote access? Will the price-war game in listing and trading fees come to an end?

In Chapter 2, the economic theory of network externalities and a simple-game theoretical framework are used to explore the issue of competition among stock exchanges and the

possibility of consolidation in the European stock-exchange industry, among the different exchanges. The main features of the second chapter are the following: the treatment of exchanges as firms; the application of network externalities to study competition among exchanges; the extension of network externalities, through implementing “cross-network” effects; and the existence of equilibria where exchanges may decide, even unilaterally, to achieve full compatibility through implicit mergers and remote access, specializing only in trading or listing services. One implication is that consolidation of European exchanges into one may occur with a welfare-efficient outcome or with a lock-in to a Pareto-inferior equilibrium. This is due to the network externalities and the different starting points of the various exchanges. “Implicit mergers” among exchanges together with remote access are always weakly (in half of the cases, strictly) more efficient than the actual competition. This finding also sheds light on the existence and efficacy, especially in the U.S., of automated trading systems, which are exchanges specializing in trading services.

Chapter 3 deals with customer-controlled firms. In many industries, there are firms whose owners (or some of them) are also customers. They have contrasting interests: they get more utility as the firm’s profits increase, and the price of the good decreases as their private consumer surplus increases. An interesting example is the stock-exchange industry, as well as many clearing houses or central custodians. Chapter 3 shows that a customer-*owned* monopolist always achieves first-best social outcome, but in customer-*controlled* firms, profits are not necessarily maximized and minority shareholders are damaged. When customers have equal unit demand, less profits arise if they hold a share of the firm’s capital lower than their percentage over the total number of customers. When customers have equal downward demand, the firm never maximizes profits; furthermore, if the share of capital of customer-owners is less than half the weight of customer-owners over total customers, the firm will always price at 0. It follows that customer-*owned* stock exchanges are welfare efficient if all the customers (listed firms, intermediaries, price vendors, etc.) hold all the capital; more important, monopolists price, efficiently, at marginal cost if the share of capital owned by customer-owners is equal to their weight over the total number of customers. Customer-controlled exchanges do not maximize profits. This finding casts some doubt on the policy of listing a stock-exchange company itself on exchanges.

## II. COMPETITION AND INTEGRATION AMONG STOCK EXCHANGES IN EUROPE: NETWORK EFFECTS, IMPLICIT MERGERS, AND REMOTE ACCESS

### II.1 INTRODUCTION

This chapter describes the competition among exchanges, applying some of the network externality literature. A problem is that, in general, exchanges have not been considered as firms. That is why, first, there is a brief analysis of what an exchange is, what its products are, what its revenues and costs are and who its customers are. Exchanges are special kinds of firms that produce a combination of two goods: listing and trading services. Exchanges have two main direct customers: firms that want to be listed and intermediaries that want to trade on the exchange. There are many reasons that they should want to be on an exchange and there are many costs they have to bear.

Second, the concept of network externalities is introduced. This concept has been analyzed in depth in the industrial organization literature. As Economides (1993) notes, “one can view the various financial exchanges (NYSE, NASDAQ, AMEX, Pacific, London, Tokyo, etc.) as well as the various companies that provide matching services (Instinet, Posit, AZ, etc.) as (at least partially) incompatible networks. The existence of such a variety of organizations begs the question of the potential for new, innovative ways of organization of transactions, matching of orders, and price discovery”. This chapter concentrates (not on the market microstructure but) on the competition among exchanges and on the possibility of a strategic interaction among them. Exchanges can be considered as networks in which the greater the number of customers, the higher the utility for everyone (Economides, 1993 and 1995). All else being equal, firms want to be listed where other firms are listed (the direct-network effect) and especially where many intermediaries trade (the cross-network effect), as more liquidity is on the market. Intermediaries want to be present at the exchanges where more firms and intermediaries are present as they are more attractive to their final customers (investors) and for themselves (their own portfolios and all the risk-management services).

The model presented here draws upon the network externality literature (especially Katz and Shapiro, 1986a and 1986b), applying it to the study of the competition among exchanges. We also adapt their model with a different utility function and introduce explicitly cross-network externalities, in order to capture cross-utility effects that have been developed in the empirical finance literature. We compare a model of “incompatibility” (exchanges competing



against one another) to one of “complete compatibility” (where exchanges agree on implicit merger and reciprocal remote access)<sup>(1)</sup>.

The model yields a variety of interesting implications with regard to the competing strategies of exchanges, especially in Europe, and adapts to exchange competition in both the competition and the implicit-merger case; the network effect allows the existence of different equilibrium outcomes. It is plausible that, *ceteris paribus*, when firms decide to be listed on an exchange, they choose the one with more intermediaries and firms due to greater liquidity on the market. The same strategy is followed by the intermediaries that want to become members of that exchange (unless regulations prohibit this choice).

When exchanges are not interconnected (the incompatible case), only pure-corner solutions in equilibrium may arise, with only one exchange surviving. This may lead to the end of the fierce competition among exchanges in Europe, where some exchanges are disappearing after mergers. The presence of many exchanges in reality is not incompatible with this view, as exchanges were not competing with one another, at least in Europe, until a decade ago, due to different regulations and currencies that let them be monopolist in their relevant markets. In fact, in each country, either only one exchange existed or only one was dominant and absorbed the small regional ones (as in France, Italy, Spain, and Germany).

The first finding of this chapter is that implicit merger is a clear strategic option for exchanges. In the presence of cross advantages in marginal costs<sup>(2)</sup>, this strategy can give both exchanges higher profits, with some side payments. In the absence of any coordination or policy guide, an implicit merger will not arise. In any case, the exchange with higher marginal costs (that should be defeated in “normal” competition) has an incentive to achieve a unilateral implicit merger, listing or trading securities of the other exchange.

The second finding is that implicit mergers always strictly improve welfare when there are cross advantages in marginal cost of the exchanges. Regulators should favor implicit mergers, eliminating all obstacles to listing and delisting in exchanges and to trading, implementing full remote access.

The third finding is that there is neither a private nor a social reason to achieve an implicit merger when an exchange is an efficient monopolist with all costs lower than others. If competition leads to an efficient monopoly, welfare is already maximized. There is no need in each country for either a national exchange or a national airline. Protectionist regulations that, for example, give tax exemptions to national firms that list only in the national exchange and not in foreign exchanges are inefficient and more costly for taxpayers.

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(1) We define an implicit merger between exchanges as an agreement between two exchanges such that the securities, originally listed in one exchange, are listed by the other one, and remote access is offered to the traders of each exchange, with reciprocity and without further requirements.

(2) It means that one exchange has lower marginal cost in trading and the other exchange in listing.

The fourth finding is that total consumer surplus is strictly higher with implicit merger, in all cases but one. Even when an exchange remains monopolist, implicit merger keeps alive some price competition; that is the difference from having an explicit juridical merger among the exchanges.

The fifth finding is that we may have in some cases a specialization of exchanges where they decide for complete compatibility (implicit merger and remote access). If there are differences in marginal costs, one exchange could just list the firms and the other could accept intermediaries as members for trading. In an extreme case, the listing service may be done by rating agencies and the trading by exchanges.

The model shows that network externalities may lock-in exchanges into inefficient outcomes, due to a lack of coordination, even in perfect competition. This is a standard finding in the literature. In these cases, implicit mergers improve welfare, consumer surplus, and total profits. There is, even in this case, a strong incentive for exchanges to achieve compatibility. They only must agree on some side payments from one to the other.

These findings also help to explain the success of automatic trading systems. In fact, these systems can be seen either as exchanges that specialize in trading or as exchanges that *unilaterally* achieve “compatibility” with other exchanges, trading stocks already listed in other exchanges, and, thus, free-riding on the fixed cost of listing, borne entirely by the “regulated exchanges”. This last explanation would also be consistent with the aggressive policy of the London Stock Exchange in the late 1980s, when the LSE decided to trade the major stocks listed in the other European exchanges, or with the U.S. case, which has a system of regional exchanges that only have to apply to the SEC in order to trade in stocks listed on other exchanges.

The chapter is organized as follows: Section II.2 gives some background on the reasons for competition among exchanges in Europe and on the nature of exchanges as firms. In Section II.3, the notion of network effects and their application to financial exchanges are presented. The model, the welfare analysis, and their implications are in Section II.4. Section II.5 offers some concluding remarks.

## II.2 INTEGRATION AND COMPETITION AMONG EXCHANGES

There was “an era when exchanges were natural monopolies” (Steil, 1996b), but the structure of securities markets all over the world has changed dramatically during the last decades.

The evolution of new financial instruments, the falling monopoly of banks as a source of direct funding to borrowers and of direct investment for investors, the tremendous improvement in information technology, and a greater financial culture among common people as well as the fluctuations in interest, price, and exchange rate due to the oil crises have caused the increasing importance of securities markets in the financial system, both as regulated exchanges and over

the counter<sup>(3)</sup> (OECD, 1996). New theories of financial intermediation (Allen and Santomero, 1996; Allen and Gale, 1997) underline the importance of the markets in such a way that all intermediaries (banks, mutual funds, etc.) perform a risk-management activity in between borrowers and lenders on one side and markets on the other, providing a kind of risk insurance. In spite of that, banks and markets can still coexist (Boot and Thakor, 1997).

The evolution and transformation of securities markets and of information technology is becoming an important issue in Europe and in the U.S. for another reason: it makes exchanges comparable and more integrated. The borders of the “relevant” market that investors face are blurring. In this way there is an increasing competition among the stock exchanges (Pagano and Steil, 1996) and among exchanges and automated trading systems (Domowitz and Lee, 1996).

## II.2.1 THE EXISTING COMPETITION

Examples of competition among exchanges are not new at all, especially in the U.S.. They can be found, for example, from the initial years of the NYSE. In 1885 the Consolidated Stock Exchange<sup>(4)</sup> decided to trade NYSE-listed stocks, charging lower commissions due to its lower costs because it used the NYSE quotes and did not incur the costs of establishing the price-discovery mechanism (Mulherin *et alii*, 1991)<sup>(5)</sup>. Blume and Goldstein (1997) analyze empirically the integration of the U.S. equity markets in recent years.

In more recent times, the London Stock Exchange, deeply reformed in 1986<sup>(6)</sup>, decided unilaterally to trade on its international segment (SEAQ International) the most important European stocks. It gained such a significant market share in other European securities listed on national exchanges that they had to quickly update their markets<sup>(7)</sup>. Nowadays, the LSE must face the national competition of Tradepoint. After its entry into the market in 1995 and the shift to it of the trades of three out of four interdealer markets, the LSE slashed its fees by more than

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(3) *OECD (1996) distinguishes over-the-counter exchanges in proprietary-trading systems and internal-crossing system.*

(4) *The Consolidated Stock Exchange was created in 1875; then it absorbed the American Mining & Stock Exchange, the National Petroleum Exchange, the Miscellaneous Security Board, and the New York Petroleum Exchange & Stock Board (Mulherin et alii, 1991).*

(5) *Later in the paper we will discuss this strategy, which is really a unilateral compatibility decision.*

(6) *The Exchange was originally constituted in 1802 and reformed in 1875. It was incorporated under the Companies Act of 1985 as a private limited company in 1986 under the name of “The International Stock Exchange of the United Kingdom and the Republic of Ireland Limited” (“The Exchange”). The Exchange changed its name to London Stock Exchange Limited in 1995 following the separation of the Irish Stock Exchange as a result of EC legislation (LSE, Annual Report, 1997).*

(7) *Pagano and Steil (1996) give an excellent review of the empirical literature. Some authors find that SEAQ-I did not really “steal” trades but on the contrary stimulated more trades on the national exchange; others find that in any case SEAQ-I was a price taker with respect to national exchanges.*

60% to undercut Tradepoint<sup>(8)</sup>, which recently introduced remote access for U.S.-based institutions and, through Bloomberg, for Hong Kong-based institutions. Meanwhile, the LSE decided to move from a quote-driven system to an order-driven system for the FT100 Index<sup>(9)</sup> leading shares, to better compete with the order-driven European exchanges. The major move of LSE was the strategic alliance with the Deutsche Borse (July 1998) in order to harmonise the markets for their leading securities and, ultimately, to develop a joint electronic trading platform.

Exchanges are facing even stronger competition from quasi-exchanges, like automated trading systems (ATS), where it is possible to *trade* securities generally *listed* on exchanges. ATS compete with exchanges even if their nature is not clear from a regulatory point of view. While, in fact, the existence and nature of exchanges once were not controversial as they were easily identified and characterized, computer technology has led to the birth of these new MONSTERS (Market-Oriented New Systems for Terrifying Exchange Regulators) (Lee, 1992). This matter may give rise to regulatory competition among automated trading systems and regulated exchanges (Instinet versus NYSE, for example). The tendency in Europe seems to be to try to classify as regulated exchanges even markets like Tradepoint, which seem more similar to automated trading systems than to exchanges. In general, automated trading systems free-ride on the process of listing, given that they generally trade only securities listed on other exchanges; furthermore, they sometimes free-ride on the price-discovery process given that members of exchanges may direct trade on ATS to make some arbitrage or to operate in off-regular hours. But the main customers of ATS seem to be institutional investors that generally are not allowed to trade directly on exchanges. In the U.S. this topic is important for two reasons (SEC, 1997): the exponential growth of trading systems that present comparable alternatives to traditional exchange trading and the development of automated mechanisms that facilitate access to foreign markets from the U.S.. Therefore, the SEC is reconsidering its approach to the regulation of exchanges and other markets and has provided a concept release on this topic, soliciting comments (Macey and O'Hara, 1997). In fact, automated trading systems also compete with exchanges on a regulatory basis as they are often regulated in a different way; the regulatory arbitrage may even lead some of them to ask to be regulated as broker-dealers (Domowitz and Lee, 1996).

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(8) *The new price structure, effective from October 20, 1997, includes*

- *for trading outside the order book, the maximum charge is cut from £10 to 2.50, bringing the charge for an average £50,000 trade down from £7.50 to £2.35. A minimum charge of 25p is currently going to be maintained for smaller trades, and*
- *for trading on the new order book, charges are cut to 6p per £1,000 compared with 15p under the previous pricing system, with a maximum charge of £10 per order. For example, a £50,000 trade will now cost £3 (less than half the previous charge of £7.50) (FIBV, Press Release, August 1997)*

(9) *The new system started October 20, 1997.*

There is also non-price competition (process and product innovation, advertisement), which may be summarized in reputation and quality and led many regulators and/or exchanges to reform their governance structure, trading systems, and surveillance rules<sup>(10)</sup>. Competition, in fact, takes place on many grounds, as Ferrarini (1996) notes, “such as the provision of immediacy, price discovery, low price volatility, liquidity, transparency and transaction costs. Moreover, competition is a substitute for regulation. Indeed, the more competition there is, the more likely it is that exchanges themselves will adopt rules that benefit and protect customers”.

There is, finally, derived competition, partially real and partially potential, by intermediaries acting as brokers (but looking like markets) that try to exploit the Internet to offer customers the chance of trading directly on exchanges for very low fees<sup>(11)</sup>.

This evolutionary process has recently accelerated in Europe due to the implementation in many countries of the Investment Service Directive (ISD, no. 93/22/CEE). With respect to exchanges<sup>(12)</sup>, ISD stipulates that no more restrictions can be effective and all authorized investment firms (including banks) must be allowed to become members of, or be given access to, all “regulated markets” in any state, home or host<sup>(13)</sup>. Finally, being a “regulated market” does indeed represent a competitive advantage with respect to non-regulated markets such as automated trading systems. In fact, regulated markets are entitled (art. 15.4) to provide trading screens to investment firms based in other member states without having to seek approval from the relevant foreign authority: “This provision of the Directive is popularly viewed as the European single passport for screen-based trading systems” (Steil, 1996b). Some exchanges have already permitted remote membership<sup>(14)</sup>; others, like Paris and Brussels, are about to.

Competition led some exchanges to sign strategic alliances<sup>(15)</sup>, to merge<sup>(16)</sup>, to launch takeovers<sup>(17)</sup>, to compete in market architecture<sup>(18)</sup>, to allow remote membership, to modify

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(10) *The example of the deep reforms on NASDAQ in 1996 is the most obvious.*

(11) *A price war characterized the last months of 1997 among Fidelity (which cut its commissions twice in two months, now down to \$14.95 per trade), Charles Schwab, E-Trade, Quick & Reilly, Ameritrade, and other intermediaries (Italia Oggi, October 10, 1997).*

(12) *A detailed and critical description of the ISD and its impact on market structure is in Steil (1996b).*

(13) *In some states, there were restrictions to access for national entities either because membership was necessary for access or because certain kinds of entities were not allowed (for example, in Italy until 1996, banks and all foreign entities were obliged to buy or create an Italian stockbroking firm to have access).*

(14) *By June 1997, there were remote members in Helsinki (four from three foreign countries), Frankfurt (10, three), Milan (three, three) and Stockholm (13, five).*

(15) *The most important agreement is the strategic alliance of the London Stock Exchange with the Deutsche Borse (July 1998) in order to harmonise the markets for their leading securities and, ultimately, to develop a joint electronic trading platform. The Swiss Exchange (Swx) and Paris Bourse (Sbf) signed on January 29<sup>th</sup> 1999, an alliance which should lead to an implicit merger (cross membership and cross listing) by the end of 1999. In the US the AMEX merged with NASDAQ and the Philadelphia Stock Exchange joined the alliance, too.*

prices and trading hours<sup>(19)</sup>, and to sign cooperation and technological agreements<sup>(20)</sup>. In many cases the exchanges changed their juridical forms and ownership structures<sup>(21)</sup>. Some of them<sup>(22)</sup> listed their shares. Many of the agreements have failed after some time<sup>(23)</sup>, due to problems in the governance structure and to technical reasons on the clearing and settlement part.

In this framework, foreign-listing and voluntary or “compulsory” dual-listing are increasing the integration among markets. Firms often choose to be listed on exchanges different from their national one or on both the national and foreign ones (Werner and Tesar, 1997). Sometimes they *are* listed unilaterally without their consent; this happens when an

(16) *For example, the Helsinki Stock Exchange and the Finnish Options market (SOM) signed a merger agreement (July 1, 1997) to form a new company, HEX Ltd. (Helsinki Stock and Derivatives Exchange Clearing House). Under the existing cooperation agreement between SOM and the Swedish exchange, OM Stockholm, SOM products will be traded in Stockholm and at the market operated by OM’s London-based exchange, OMLX. On the other hand, the products of OM will be traded in Finland (FIBV, Press Release, July 1997).*

(17) *The Paris Bourse, which was controlling 23% of the Matif futures Exchange, launched a takeover of it on September 17, 1997 (Financial Times, September 17, 1997). OM, which, after the privatization of the Stockholm Stock Exchange, held a share of it, increased later its shareholding.*

(18) *The example is LSE, once again, which passed to a quote-driven system in October 1997 even though, according to Steil (1996b), the London dealer market injected vital “private liquidity” into continental markets dominated by illiquid public auction markets.*

(19) *In August 1997, LIFFE decided that it would begin trading its German government bond futures 45 minutes earlier each morning in order to gain trades from Germany’s DTB (The Economist, September 20, 1997).*

(20) *A clear example is the cooperation between the Chicago Board of Trade (CBOT) and the London International Financial Futures and Option Exchange (LIFFE) that started May 9, 1997. The two exchanges decided to trade on their markets some contracts traded on the other in order to give customers wider time opportunities to trade these contracts (respectively the T-bond and the Bund) (Il Sole 24Ore, May 10, 1997).*

*The cooperation between the competing exchanges led, in early September 1997, Deutsche Borse, based in Frankfurt, and the Swiss Exchange in Zurich, to merge their derivatives exchanges into a single market, EUREX, launched in summer 1998. The French Matif will join EUREX, too, after the introduction of an electronic trading system (The Economist, September 20, 1997). The venture will operate as a single market with a common product range, a single settlement system, and a unified screen-based trading facility. This new initiative follows the decision made in July 1997 by the three markets to cooperate on European equity indexes. This planned cooperation opens the way to a full-fledged alliance also integrating the cash markets in the future (FIBV, Press Release, September 1997).*

(21) *The Australian Stock Exchange, Helsinki, Amsterdam, and Milan, became, partially, companies with shares freely tradeable.*

(22) *The Australian Stock Exchange is the first exchange listed on itself: its shares traded from October 14<sup>th</sup> 1998 outperformed the index by 100% in three months. Tradepoint is also listed but on the Vancouver Stock Exchange, from March 1993 even if its value downperformed dramatically the index from 1996 on. The shares of Amsterdam Exchanges will be listed from 2002, and are now traded on Reuters pages.*

(23) *For example, the CBOT-LIFFE open outcry linkage (see above) was suspended on December 17<sup>th</sup>, 1997; the CBOT members voted also against the alliance with Eurex, in January 1999, due to a change in the management of the US market.*

exchange or an automated trading system decides to regularly trade some shares. Amihud and Mendelson (1996) strongly object to this practice as the trading regime of a security affects its liquidity, and consequently its value; thus, non-requested multimarket trading may produce negative externalities that harm security holders collectively.

In short, exchanges are behaving much more as “standard” firms than as exchanges, or, more precisely, are now firms that create markets. Policy makers must adapt their traditional regulations to deal with these transformations.

## II.2.2 THE EFFECTS OF THE INCREASING COMPETITION AMONG EUROPEAN EXCHANGES

The effects of the increasing competition among exchanges are difficult to evaluate in terms of the future market structures in Europe.

On the one hand, in the long run, as in any other industry, only the most efficient exchanges should survive, trading stocks from all the other European countries and offering the most innovative and competitive financial instruments (especially derivatives). As Steil (1996b) notes, “the existence of three dozen European stock exchanges - almost all of which are operating with the same basic trading mechanism (the continuous electronic auction) - is, at the very least, duplicative and wasteful of resources. The expansion of remote membership access after 1996 will undoubtedly go a considerable way towards facilitating cost-effective cross-border trading, and thereby eliminate significant barriers to creating a common and expanded pool of equity market liquidity. A single European currency would serve to integrate the market even further”. The first model in this paper is consistent with this explanation; only one exchange (but not necessarily the most efficient) should survive.

On the other hand, it is possible that a unique exchange will emerge only for highly standardized and/or traded products, especially after the introduction of the Euro<sup>(24)</sup> (like government bonds, derivatives, and stocks of the biggest firms). In fact, remote access makes useless any competition among the different exchanges at least if they are at the same technological level; furthermore, the informative advantages on national firms (especially small and medium-size firms) by their national exchanges and intermediaries will remain important. Finally, all the past projects or attempts to create a unique European stock exchange (PIPE, Euroquote, etc.) were unsuccessful (Cybo-Ottone, Di Noia and Murgia 1999). In any case, the rationale for a coexistence of many markets, in different nations, trading the same stocks, could easily be given by different trading systems (as continuous auction favors transparency and market making favors liquidity). The launch of the Euro could conversely strengthen smaller

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(24) *Obviously, with the adoption of a unique currency in Europe, all stocks, government and private bonds, and derivatives will not be affected by exchange-rate risk.*

bourses as “today, portfolios [...] tend to concentrate on large markets and large currencies”,<sup>(25)</sup> mainly because of the ease of dealing in heavily traded currencies and the perception that less familiar currencies are riskier. Many different exchanges, eventually connected, could form a sort of web<sup>(26)</sup>. The coexistence of more than one exchange is consistent with the second model in this paper.

### II.2.3 WHAT IS AN EXCHANGE?

The starting point in order to understand competition among exchanges is to define what they are.

There are at least three views of stock exchanges: the exchange as a market; the exchange as a firm; and the exchange as a broker-dealer.

Normally an exchange is thought to be an organized market of securities. This “market view” of the exchange is shared, for example, by the American Securities Exchange Act (section 3.a.1) which defines an exchange as “any organization, association, or group of persons, whether incorporated or unincorporated, which constitutes, maintains, or provides a market place or facilities for bringing together purchasers and sellers of securities or for otherwise performing with respect to securities the functions commonly performed by a stock exchange as that term is generally understood, and includes the market place and the market facilities maintained by such exchange”. But the generally understood meaning of exchange led Domowitz (1996) to give a more precise definition: An exchange is a trading system that must:

- provide trade execution facilities;
- provide price information in the form of buy and sell quotations on a regular or continuous basis;
- engage in price discovery through its trading procedures, rules, or mechanism;
- have either a formal market-maker structure or a consolidated limit order book, or be a single price auction;
- centralize trading for the purpose of trade execution;
- have members;
- exhibit the likelihood, through system rules and/or design, of creating liquidity in the sense that there be entry of buy and sell quotations on a regular basis, such that both buyers and sellers have a reasonable expectation that they can regularly execute their orders at those quotes.

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(25) *O. Lefebvre, chairman of the Brussels Bourse (The Wall Street Journal Europe, October 8, 1997).*

(26) *Hagel (1996) analyzes webs as clusters of companies that collaborate around a particular technology.*



The market view is shared also by the ISD, which defines a “regulated market” (art 1, par. 13) as a market for financial instruments (defined in the annex of ISD) which:

- appears on the list of regulated markets<sup>(27)</sup>;
- functions regularly;
- is characterized by the fact that regulations issued or approved by the competent authorities define the conditions for the operation of the market, the condition for access to the market and, where [...] applicable, the conditions governing admission to listing;
- requires compliance with all the reporting and transparency requirements laid down pursuant to two articles of the Directive.

The “firm” view of exchanges concentrates on the production side. Mulherin *et alii* (1991) stress the definition of a financial exchange not as a market, as usually is done, but as a firm that creates a market in financial instruments and thus has the property of the price information produced. Furthermore, a security market can then be seen as a firm that produces a composite good, the exchanging of securities, which may be formed of different elements (Padoa-Schioppa, 1997): price formation, counterpart research, insurance for a good clearing, and the standardization of the good exchanged. In short, the production cycle (Cybo-Ottone, 1997) is divided into three parts: listing, trading, and settlement. These three different stages of the production cycle lead to the formation of different goods that the exchange can sell: listing services, trading services, settlement services, and price-information services.

In this paper, we omit the settlement service as many of the exchanges do not have it<sup>(28)</sup> or are dismissing it<sup>(29)</sup>. We consider the exchange as a producer of a combined good formed by listing and trading services, given that we want to concentrate on the network externalities’ effects among listed firms and intermediaries.

Even accepting the firm view, it is important to note that the exchange produces a special “good” as a sort of public utility, even if the firm has a private nature. In fact, inefficiencies in each part of the cycle fall upon the whole community (negative externality), not only on the entities that actually trade. Low quality information tends to form “wrong” prices that contribute to a bad allocation of resources; inadequate clearing and settlement procedures can threaten the stability of the whole financial system. This is why the efficient functioning of an exchange can be viewed partly as a public good (Padoa-Schioppa, 1997), even when it is privately managed. The exchange owners, in other words, should satisfy all the interested entities: intermediaries, issuers, institutional investors, and private investors. The efficiency of the market is necessary to

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(27) *This is quite a peculiar and circular (Steil, 1996b) definition.*

(28) *In Italy, for example, clearing and settlement is done by three entities: a clearing house (Cassa di Compensazione e Garanzia), a natural legal monopolist (Montetitoli S.p.A.), and, in part, by the Bank of Italy.*

(29) *The LSE has recently moved from the proprietary settlement system Talisman into the new electronic share-settlement service provided by CRESTCo (in which the exchange is a three percent shareholder).*

increase savings, to protect them and, finally, to expand production and employment. Thus, “social” market utility cannot be measured only by the profits of the stock exchange company because there is not necessarily a direct correspondence between cost and (social) revenues, given the “social” service of the market. Private management and ownership may give greater efficiency to the exchange given the strong competition among them; the welfare problems are generally tackled by public supervision on the market and by organizational structure such to reduce conflicts of interest. It is obvious that, in the long run, an inefficient exchange would lose its market share in favor of others (Fishel and Grossman, 1984), but in the short run it can cause losses to investors.

Another view is the exchange as a broker-dealer, recognizing that the exchange is a kind of intermediary among intermediaries. In fact, a problem underlined by Domowitz (1996) and by Domowitz and Lee (1996) is the blurring distinction among broker-dealers, registered exchanges, exempt exchanges, and securities association. Entities that perform very similar activities are sometimes regulated in fully different ways. In this sense, the exchange can be seen as, simply, a broker-dealer that, like many banks or security houses, gathers trading orders and supplies the way of executing them. An example of an exchange regulated as an intermediary is EuroMTS, the wholesale Euro-denominated government bond market, which has recently asked the authorization in UK as an interdealer broker and not as a regulated market.

#### II.2.4 EXCHANGES AS FIRMS

It is difficult to define competition among exchanges because it is difficult to understand clearly what is the industry and what is the relevant market. On the other hand, an exchange can be seen as a large corporation that competes with other firms and is forced to produce the best price-quantity-quality combination feasible (Fishel and Grossman, 1984).

From an industrial organization point of view, the first thing that makes exchanges different from normal firms is that, due to ownership structures, some of the customers may be the owners of the firms as well. The management of these exchanges may not necessarily want to maximize profits<sup>(30)</sup>; in fact, the exchange’s price for, at least, one of its products (trading fees, for example) can influence the shareholders’ value<sup>(31)</sup> not only through the firm’s profit but

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(30) *Chapter 3 studies the problem of customer-controlled firms, with particular attention to stock exchanges.*

(31) *In all cases where intermediaries are, even minority, shareholders.*

also through their consumption of the exchange's "good" as long as the firm is not perfectly competitive<sup>(32)</sup>. These problems are addressed in Chapter 3.

If exchanges compete against one another to gain clients, it means that they are operating, at least in part, in the same industry, "the market of exchanges". In this sense the borders of the relevant market (in an antitrust sense) are blurring due to technological development. The geographic concept has less and less meaning due to the progressive integration of financial markets, instruments, and intermediaries even if a certain amount of market power of exchanges is still present with respect to small and medium firms that want to be listed, as they are reluctant to go public on foreign exchanges. There are different sides of the competition among stock exchanges. With respect to firms, exchanges may compete in trying to list them exclusively or, at least, to dual list them. The original listing fees are gained in any case by the exchange even if the annual listing fees, if based on the trading volumes, could be lower in case of dual listing, given that the trading is spread over more than one exchange<sup>(33)</sup>. With respect to intermediaries, competition is similar even if the structure of the fees is reversed (the original fees are lower than the average amount of trading fees for each intermediary). The exchange is thus interested in maximizing the amount of trading volumes; the exclusivity of the connection of each intermediary may influence the number of trades conveyed to the exchange.

However, what is the demand that exchanges are facing and what are they supplying?

First of all, in order to understand the demand that a firm is facing, the easiest thing to do is to look to its balance sheet and check where the revenues come from. In this way the "good" that is produced should be clear.

From one of the few analyses of the balance sheet of the European exchanges<sup>(34)</sup>, it emerges that the revenues come from three major sources plus two eventual or minor sources:

- trading fees (both membership and trading fees)<sup>(35)</sup>;
- listing fees (both initial and yearly listing fees)<sup>(36)</sup>;

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(32) *Actually, the intermediaries-shareholders may not even agree on the firm's best decision in such cases. This is a standard textbook definition of one of the exceptions to the profit-maximization rule (Tirole, 1988).*

(33) *In case of dual listing, it is normal that the greatest part of the trading volumes is formed on the national exchanges.*

(34) *Based on 1993-94 balance sheet of 11 European stock exchanges (Baggiolini, 1996).*

(35) *For example, the structure of the trading fees for intermediaries trading shares on the Italian stock exchange was the following, in 1996: there were fixed annual fees of 60 million ITL (\$35,000) and a nominal fee per transaction of 2,200 ITL (\$1.3) (Consiglio di Borsa, 1997). In general, it may be true to state that exchanges want to introduce contracts (listed stocks, bonds or derivatives) which maximize the total volume of trade (Fishel and Grossman, 1984, referring only to commodity derivatives).*

(36) *Listing fees are generally of two kinds: original and continuing annual. "On the NYSE a foreign company listing 15,000,000 shares at a price of \$41 per share would pay an initial listing fee of \$130,100 and an annual listing fee of \$24,260" (Werner and Tesar, 1997). For the Italian case, before the privatization of the exchange, the original fee was 0.01-0.02% of the value of the company (segue ...)*

- information and price-dissemination fees<sup>(37)</sup>;
- settlement fees, even if little by little exchanges are transferring this activity to specialized entities where exchanges are, in general, among the shareholders;
- other revenues may come from the developing and selling of proprietary software and information technology.

One problem, not solvable with available public data, is to understand correctly how the costs are allocated. In fact, not all the costs contribute directly to the production of the three main “goods” sold. There are the costs for the regulation and supervision of the market that make it more efficient, and thus more attractive, for issuers and intermediaries to enter. There are R&D costs and marketing costs, and there could be an implicit cost in charging low or zero fees to traders and issuers<sup>(38)</sup>.

These revenues do not really define either the “good” or a “good” sold by the exchange, but they show that an exchange sells trading services that are structured in three different parts: the object traded (issued by some entities that generally pay a fee to have it listed)<sup>(39)</sup>, the means of trading (trading facilities, computers, a computerized floor, settlement); and price dissemination.

The customers of exchanges can be divided into direct and indirect customers:

- Direct customers are the direct purchasers of exchanges’ services. The most important are issuers who usually<sup>(40)</sup> pay fees in order to be listed on an exchange; intermediaries<sup>(41)</sup> who usually pay fees in order to be admitted to trading<sup>(42)</sup>; and information vendors who pay fees to have the right to disseminate price information of the market.
- Indirect customers are all the entities that send orders to intermediaries to be executed on an exchange: institutional investors and all other financial intermediaries (if not allowed to trade directly), single customers, both physical or juridical persons. These customers have two

*(“certificato peritale”); the continuing annual fee was calculated in two parts based on the nominal value of the firm (10 million ITL up to 20 billion and 100,000 ITL for every billion ITL over 20 billion) and on the yearly trading value of the previous year (for every million ITL of trading, the firm owes the exchange 130 ITL up to 200 billion and proportional lower fees for higher trading value) (Consiglio di Borsa, 1995).*

*(37) Mulherin et alii (1991) provide an excellent description of the property rights on prices formed on the exchange, which can be sold or given out to non-member firms.*

*(38) Or, in any case, charging less than the cost of evaluating the firms to list.*

*(39) In the case of derivatives, the issuer is the exchange itself.*

*(40) They usually pay a fee, but in some exchanges, like Seaq International or in many automated trading systems, it is the exchange itself that decides unilaterally to list a firm or its bond. In some circumstances it could be the regulator itself that decides to list financial instruments, when there are, for example, many trades (or an organized trading) effected outside regulated markets.*

*(41) Leaving aside market microstructure differences, intermediaries operate on markets to satisfy orders coming from outside customers and on their own accounts.*

*(42) Trading revenues and risk-management fees play a very important role in the balance sheet of intermediaries.*

choices: one is the intermediary through which to trade, unless they trade directly; the other may be the exchange where to trade, either asking the intermediary to trade there (if the regulation makes it possible) or asking for a financial instrument traded only on the preferred exchange. In the second case, the investor will be affected by the overall “quality” of the exchange; price factors could be important as it is possible that part or all the cost of transaction paid by the intermediary is passed along to the customer<sup>(43)</sup>. Besides, market microstructure, either as liquidity, price discovery, or quick execution of the orders, is different in order or quote-driven markets. Finally, market reputation and (fiscal) regulation can influence the choice, too.

Some of the indirect customers are becoming and will become direct customers. Many institutional investors trade on exchanges through their subsidiaries and trade directly on automated trading systems and some regulated exchanges. Many customers, through the Internet and intermediaries<sup>(44)</sup>, can or will trade directly on the markets so that competition among exchanges will influence their choice.

In short, depending on what the strategic variables and who the customers are, the competition among exchanges can be shaped with the basic “games” that are often used to analyze many industries, even if, regarding trading services competition, Steil (1996b) argues that “it is simply not meaningful to compare prices across markets unless the investor is demanding the same service” because “different types of orders and trades are characteristic of different types of markets and trading strategies: e.g., market orders, limit orders, program trades, protected trades (U.K.), stopped trades (U.S.), and not-held orders (U.S.)”.

Fishel and Grossman (1984) underline that an exchange profits by increasing the volume of transactions that depend on the “quality” and the “good reputation” of the exchange and, thus, “the exchange faces the same incentives to produce quality products (i.e., transaction services) as any other business”. Pirrong (1995), argues that the exchange, in some cases, may not maximize the total wealth of exchange members due to the governance structure; for example, “it is likely that the exchange membership will choose a level of enforcement that is smaller than the level that would maximize the wealth of exchange members. This is especially true if the exchange membership is large”.

In the end, as Fishel and Grossman (1984) note, “competition among exchanges will lead to prices which induce the socially optimal purchases by customers; this is just another application of the Fundamental Theorem of Welfare Economics. The only difficulty with this application arises when there are externalities among exchanges”. An example is the innovation or the price discovery process that other exchanges may free-ride, or the network effect.

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(43) *The amount depends on the elasticity of demand and supply.*

(44) *Simply think of E-trade, C. Schwab, etc..*

### II.3 NETWORK EFFECTS AND STOCK EXCHANGES

Some of the issues arising in the previous section can be captured using models taken from industrial organization literature. The application of economic principles (especially taken from industrial organization) to policy issues in the securities industry is a relatively young discipline<sup>(45)</sup>. In particular, we model the competition among exchanges using network externalities literature.

Many industries are economic networks, like railroads and telecommunications, and networks arise also in non-network industries like banks (for ATMs<sup>(46)</sup>), too. Positive network externalities (the benefit to an individual increases in the number of others on the system<sup>(47)</sup>) arise when a good is more valuable to a user the more users adopt the same good or a compatible one<sup>(48)</sup>. Thus, the essential relationship between the components of a network are complementarity, compatibility, and coordination.

It is possible to think of an application of the network-externalities literature<sup>(49)</sup> to financial intermediation and exchanges. The application of network externalities to finance is a relatively new topic but has developed substantially in the last years. Regarding stock exchanges, they can be seen as networks where the more traders (drawn from the same distribution of uncertain endowments) enter the market, the more market uncertainty (measured by the variance of market prices) is diminished (Economides, 1993).

A paper that explicitly applies network externalities to exchange competition is Domowitz (1995). Though not analytically described, he uses network externalities to set up a game among exchanges where two technologies (floor and automated trading) are available for traders and network externalities are, in trading terms, the liquidity effect, as the more traders

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(45) *Lo (1996) attributes the birth of this new interdisciplinary subject at the NBER Conference on the industrial organization and regulation of the securities industry in 1994.*

(46) *See Saloner and Shepard (1992) and, especially, McAndrews and Rob (1996).*

(47) *Network externalities have two main effects on the industry evolution (Katz and Shapiro, 1986a): “demand-side economies of scale”, as a given product is more attractive the larger is the in-place base of consumers using that product; and care for future success of competing products in today’s choice. Network externalities share the first type of increasing return to scale with learning by doing, while the second one is peculiar.*

(48) *A positive-consumption externality is not normal since in general demand is downward sloping. Economides points out (in his excellent review of 1995) that with network externalities the demand still slopes downward but shifts upward with increases in the number of units expected to be sold. Cowan et alii (1997) study a model of demand with social interactions among consumers.*

(49) *The literature on network externalities is huge; see, for example, Katz and Shapiro (1985, 1986a and 1986b), Farrell and Saloner (1985, 1986a and 1986b), Arthur (1989), Besen and Johnson (1986), Dybvig and Spatt (1983), and Economides (1993 and 1995). A quite complete literature on network externalities and network externalities in finance is contained in a Web page managed by Economides himself (<http://raven.stern.nyu.edu/networks/>).*

are in a market, the more liquid it is. In the paper “it is argued that increased network externalities offered by electronic exchange structures will [...] encourage and provide the vehicle for implicit mergers<sup>(50)</sup>”, which is something that is already happening in reality with various agreements, especially among derivatives exchanges.

Pirrong (1995), referring to manipulation, argues that “if traders must choose which market to trade on simultaneously (or if there is no specified order in which traders choose), it is well known that network externalities can lead to inefficient equilibria. Liquidity effects make this simultaneous choice of market a game of coordination, and inefficient equilibria usually exist in these games [...]. But if traders choose which market to trade in sequentially with a specified order of moves, in the absence of informational asymmetries, traders choose the lower-cost market”.

### II.3.1 NETWORK EFFECTS FOR FIRMS AND INTERMEDIARIES

Among the possible sources of network externalities in the stock-exchange industry, we concentrate on the network and cross-network externalities arising among firms that want to be listed and financial intermediaries that want to trade on exchanges.

#### *Firms: the decision to go public and the choice of the exchange*

The reasons that firms go public have been deeply explored by the literature<sup>(51)</sup>; other literature explain the decision to dual list (i.e., to list on more than one exchange),

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(50) *An implicit merger is defined in this paper as an agreement between two exchanges such that all securities listed in one exchange are listed in the other, and all intermediaries trading in one exchange are offered remote access in the other (this is a slightly broader definition than Domowitz, 1995), with reciprocity and without further requirements.*

(51) *The literature, both theoretical and empirical, of why companies go public is huge; see, for example, Pagano and Roell (1996) and Pagano, Panetta, and Zingales (1995), who summarize costs and benefits. The benefits are the following: overcoming borrowing constraints, greater bargaining power with banks, portfolio diversification for the initial owners, stock market discipline for management, liquidity investor recognition, ways to change control, and windows of opportunities in case of market overvaluation. The costs are the following: underpricing, administrative expenses (including underwriting fees, registration fees, auditing, certification, dissemination of accounting information, and stock exchange fees), and loss of confidentiality. On average the total costs for going public are 3-5% of the value of the IPO (Consiglio di Borsa, 1995). Naturally there are contingent factors that may explain the decision to go public such as fiscal advantages for being listed (this was done in Italy for small-sized companies listed in the period 1994-1997).*

internationally and intranationally<sup>(52)</sup>. In this paper we use the network externalities as a possible explanation of the *choice* of the exchange where to be listed.

Firms may derive more utility in being listed on exchanges where there are more intermediaries as they give more liquidity to the market (Economides, 1993); they can gather more trading orders from consumers and their increasing competition could lower commissions to buy stocks. This is an example of what we call in this paper “cross-network externality”. Utility derives from an increase in the consumption of a *different* good belonging, in a sense, to the same network. Many empirical studies show that liquidity has a sizable impact on securities value. Listing on a major exchange can attract many investors, as Pagano *et alii* (1995) note, “by acting as an advertisement for the company. Merton (1987) has captured this point in a capital-asset-pricing model with incomplete information, showing that stock prices are higher the greater the number of investors aware of the company’s securities”.

At the same time, firms may prefer to be listed on an exchange where many firms are listed (direct network-effect), as it may be a sign of quality of the market, or because they anticipate that more intermediaries will be there and the variance of such a market may be lower than of an exchange with a very small number of firms highly correlated<sup>(53)</sup>.

The value of being listed for a firm is higher the more listed firms and the more intermediaries trading on the same exchange. A firm will prefer, with other conditions equal<sup>(54)</sup>, to be listed on high-quality exchanges where many other firms are listed (the market is more liquid with 100 listed firms than ten) and many intermediaries can send trading orders.

#### *A game with exchanges and listed companies*

The general situation for listed companies in Europe until the end of the 1980s was a national listing on the home exchange. Some important European firms were dual listed on their national exchange and, for example, NYSE, but mainly due to marketing reasons, given that all the trading was effected on the national exchange. In that case competition among exchanges could not exist among homogeneous products as the listed companies were different; yet, even in this case, competition may exist as the degree of substitution can be high especially among bonds. In order to compete with other markets, exchanges could in principle lower their listing fees and listing requirements in order to attract new firms.

A more aggressive strategy was followed by the Seaq International. In fact, the exchange decided to list some important European companies, already listed in national exchanges,

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(52) See McConnell *et alii* (1996) for a review of this literature.

(53) There may be opposite reasons to dislike the presence of other firms, such as competition in raising capital, etc.

(54) Or even worse, with higher listing fees.



without their request<sup>(55)</sup>. In this way it could compete directly with other national exchanges for trading services. This strategy was very effective at the beginning because many trades began to be effected in London. The reaction of the European exchanges took some time. They understood that London was free-riding on price discovery but could guarantee a fast market execution of the orders given the quote-driven structure, while the other exchanges had, in general, a call-auction system. They could have chosen to react or not to react. The second strategy could have been used as some research showed that Seaq had not “stolen” trades but had stimulated more trades on national markets<sup>(56)</sup>; the first one was very risky given that the changing of trading rules meant a high fixed cost to bear without knowing the possible result. This reaction was chosen; it led European exchanges to modernize their order-driven systems and, thus, many trades went back to the original exchanges.

Just recently London changed its trading system from quote to order-driven (October 20, 1997).

Meanwhile, other exchanges in continental Europe (like the Paris Bourse) are trying to convince foreign firms, whether already listed on a national exchange or not, to be listed there.

#### *Financial intermediaries and exchanges*

Financial intermediaries of various kinds perform more and more risk management activities (Allen and Santomero, 1996), which are profitable and can substitute other forms of revenues that are drastically falling (like the net interest income), due to the transformation of financial markets. Changing regulations and new technologies allow them to trade (directly or through subsidiaries) on stock exchanges as broker-dealers.

Intermediaries can choose nowadays where to trade. They may find more interesting an exchange with more financial products listed because it is more attractive for diversifying their own portfolios and their customers’.

At the same time, despite competition in commissions and spread, intermediaries may find more attractive an exchange with many more intermediaries as they should give liquidity to the market, as we discussed earlier. Actually, Lee (1996) notes that “an exchange is often thought to be a natural monopoly due to the tendency for order flow to attract order flow; the fact that some orders are sent to a particular trading system makes it more likely that other

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(55) *Every company had to have a market maker in order to guarantee liquidity.*

(56) *Pagano and Steil (1996) provide an excellent review of the empirical literature. Some authors find that SEAQ-I did not really “steal” trades but on the contrary stimulated more trades on the national exchange; others find that in any case SEAQ-I was a price taker with respect to national exchanges.*

orders sent to the same trading system will be executed: bluntly, liquidity attracts liquidity”<sup>(57)</sup>. Exchanges compete for intermediaries to attract them on their floor or in their computerized system: the more intermediaries, the more connection fees (one shot) and, hopefully, if intermediaries have a customer base, more trading fees.

Furthermore, exchanges try to attract the greatest possible number of traders for efficiency and quality reasons, due to increasing returns to scale in the production of transaction services. Fishel and Grossman (1984) argue that exchanges produce transaction services that are more effective in a liquid market, and the liquidity of a market will be larger the larger the number of traders monitoring the activities of the market.

#### *Other network effects*

There may exist other network externalities that we briefly summarize here.

- 1) There may be indirect effects as a bigger market (more listed firms and intermediaries) may have better side services like clearing and settlement.
- 2) The bigger the market, the more product-information<sup>(58)</sup> may be easily available.
- 3) The bigger the market share, the more this is a sign of market quality.
- 4) Psychological effects.

### **II.3.2 COMPATIBILITY DECISIONS AND IMPLICIT MERGER**

Some of the effects described increase exchanges’ incentive to make their product compatible (Farrell and Saloner, 1985)<sup>(59)</sup>, given that the more compatible they are the greater is the willingness to pay for the services of their customers.

Compatibility among exchanges, on the other hand, may have important social costs as it may reduce variety in trading mechanisms, which seem to be an important factor of success of some exchanges<sup>(60)</sup> and especially, as Farrell and Saloner (1985) note, “it is plausible that the

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(57) *On the other hand, an excessive amount of liquidity may cause some diseconomies of scale if the trading system is not able to manage it.*

(58) *More information available refers to the quality of both the price sensitive information on issuers and the price discovery process.*

(59) *A disincentive is the fact that bigger networks may enhance price competition among sellers.*

(60) *For example, the LSE has just moved, like all the major European exchanges, to an order-driven system, but many institutional investors preferred the possibility of trading the same stocks on order and quote-driven markets, as they have different features (in terms of transparency, liquidity, etc.) (Steil, 1996a).*

industry, once firmly bound together by the benefits of compatibility and standardization, will be inclined to move extremely reluctantly to a new and better standard because of the coordination problems involved”<sup>(61)</sup>.

Exchanges in many cases act to be incompatible or to lock-in their customers with different strategies. With respect to firms, an exchange can limit their willingness to list on other exchanges; for example, NYSE rules stipulate that at least two-thirds of shareholders of a listed firm must vote in favor of the decision to list on another market and no more than 10% of shareholders must oppose this decision<sup>(62)</sup>. With respect to intermediaries, there are often rules that limit the possibility of members to trade out of the market in order to concentrate trading on the exchange.

### *Implicit mergers and remote access*

Competition among exchanges may end up in different ways as indicated in Section 2.2. In this chapter we concentrate on achieving “complete compatibility” through implicit merger and remote access.

An implicit merger between exchanges is defined by Domowitz (1995) “to consist of a set of derivative products, offered by at least two existing exchanges, and sharing a common membership for the purpose of trading via direct access to the market”. We use a broader definition in order to include stock exchanges, and not only derivatives. In our framework, an implicit merger between two exchanges consists of an agreement such that the set of securities, originally listed in one exchange, is listed by the other exchange and remote access is offered to the traders of each exchange, with reciprocity and without further requirements. An example is the recent letter of intent between the Stockholm Stock Exchange and the Copenhagen Stock Exchange<sup>(63)</sup> and the various agreements among derivatives exchanges<sup>(64)</sup>. A “unilateral”

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(61) *There could be other effects of network externalities. If the benefit of others’ participation in the market is gained only after these entries, then there could be an incentive for firms and intermediaries to not enter and wait until the exchange grows to the point that their utility reach a certain level. In this case, the exchanges or a social planner could decide promotional fees for the first entrants.*

(62) *Recently, there has been a proposal to revise this rule in such a way that the listing in the other exchange must be approved only by the majority of the board of directors or by the independent members of the board, and then proposed to shareholders who could veto it (MF, November 12, 1997).*

(63) *The two exchanges signed on June 12, 1997, a letter of intent regarding cooperation aimed at creating a common Nordic securities market. The intention is to start trading the Danish shares in the Stockholm Stock Exchange’s trading system, SAX, during 1998.*

(64) *A clear example, as we have illustrated before, is the cooperation between the Chicago Board of Trade and the London International Financial Futures and Option Exchange that started May 9, 1997. The two exchanges decided to trade on their markets some contracts traded on the other in order to give customers wider time opportunities to trade these contracts (respectively the T-bond and the Bund) (Il Sole 24Ore, May 10, 1997).*

implicit merger is the trading in one exchange of securities listed in another, as in the SEAQ International case.

Implicit mergers may display network externalities because the more exchanges trade the same shares, the more trading arises (compatible technology). Only recently have exchanges understood the importance of implicit mergers, because various reasons were an obstacle to them. One reason could be that listing is, in general, on request of the issuer, which in the case of derivatives is the exchange itself. The other could be that network externalities are higher for derivatives than for shares. Finally, it simply could be that it is difficult to find an agreement.

The new European framework allows exchanges to offer intermediaries of all the E.U. countries remote access to the market, as we described in section 2.2. The advantages that an exchange with remote access can offer to intermediaries are different: direct access to information, lower transaction costs, higher correlation with other exchanges, increased liquidity, and better price discovery.

The eventual cost of implicit mergers and remote access can result by creating what in the industrial organization literature is called “a standardized interface” or adapter. In our framework, for example, the adapter for remote access is simply the cost of the computer connection from the foreign intermediary to the hosting exchange, given that the hardware is the same among all intermediaries; the adapter for the listing service could be the adoption of common accounting regulations and listing requirements.

## II.4 A GAME WITH NETWORK EXTERNALITIES

The model presented here consists of a two-stage game where two exchanges compete to get more traders and more firms listed. The starting point to develop our game is Katz and Shapiro’s (1986a and 1986b) model with “sponsored” technology. We use a model with two different goods (listing and trading services produced by two different exchanges), with two types of consumers (firms that want to be listed and intermediaries that want to become members), and network combined with cross-network externalities. The utility functions of the consumers capture the particular nature of the cross-network externality and the combined good produced by the exchanges.

### II.4.1 DESCRIPTION OF THE GAME

We consider an oligopoly game, in two stages where two exchanges compete to get more traders and more firms listed.

The stages of the game are

- 1) two exchanges (London ( $L$ ) and Milan ( $M$ )) set listing and trading fees;

2) firms ( $F$ ) choose in which exchange to be listed; at the same time, intermediaries ( $I$ ) choose in which exchange to enter.

The two exchanges charge different fees for the different services; they charge, respectively, trading prices ( $p_t$ ) of  $M_{p_t}$ , and  $L_{p_t}$ ; and listing prices ( $p_l$ ) of  $M_{p_l}$ , and  $L_{p_l}$ .

The listing and trading technology are assumed to be proprietary and hence patented (sponsored technology) in order to ensure the possibility of different marginal costs and of pricing above marginal costs.

They may have different production costs for the listing services ( $c_l$ ) and the trading services ( $c_t$ ). We define

$$\begin{aligned}\alpha_l &= M_{c_l} - L_{c_l} \\ \alpha_t &= M_{c_t} - L_{c_t}\end{aligned}$$

as the (eventual) difference between the per-unit production cost of the two exchanges for the two goods.

The exchanges may also have different prices for the listing services and the trading services. We define

$$\begin{aligned}\delta_l &= M_{p_l} - L_{p_l} \\ \delta_t &= M_{p_t} - L_{p_t}\end{aligned}$$

as the difference between the per-unit price of the two exchanges for the two goods.

The exchanges' profits are just the difference between prices and marginal costs<sup>(65)</sup>.

Apart from the firms' costs, the problem is symmetric across the two firms. Two games will be presented: in the first, called the "incompatible" game or the pure-competition game, the two exchanges compete without coordination; in the second game, called the "implicit-merger" game or the compatibility game, the two exchanges make their networks compatible.

#### II.4.2 COMPETITION AMONG "INCOMPATIBLE" EXCHANGES

Let  $f_M$  and  $i_M$  be the customers of Milan and  $f_L$  and  $i_L$  be the customers of London (with  $f_M + f_L = F$  and  $i_M + i_L = I$ ).  $F$  firms and  $I$  intermediaries are given exogenously.

All the customers of each of the two types (firms and intermediaries) have the same completely inelastic demand function for one unit of the good (listing or trading services)<sup>(66)</sup>. All payoffs are monetary.

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(65) *Exchanges are costly to set up. Fixed costs may be relevant but as long as they are smaller than the equilibrium revenues minus variable costs, the fixed costs have no effect on the equilibrium. In any case, they are assumed to be zero.*

(66) *In this framework, firms and intermediaries live only one period but listing and trading services can be seen as durable goods. A firm is listed once in one exchange, not every year (even if, in general, there exist rules that allow for suspension or exclusion from being traded).*

Intermediaries get net utility from trading in Milan and in London, respectively:

$$H + v(f_M) * w(i_M) - M_{p_t} - X$$

$$H + v(f_L) * w(i_L) - L_{p_t} - X$$

Firms gets net utility from being listed in Milan and in London, respectively<sup>(67)</sup>:

$$K + v(f_M) * w(i_M) - M_{p_t} - Q$$

$$K + v(f_L) * w(i_L) - L_{p_t} - Q$$

$H$  and  $K$  represent the utility of entering the exchange, independent of the other customers, which we described in the previous section.  $X$  and  $Q$  represent all the fixed costs, implicit and explicit, to be ready to enter the exchange. Without loss of generality, we can normalize  $H$  and  $K$ , and  $X$  and  $Q$  to 0, in order to concentrate on the network effect. We assume that  $v(\cdot)$  and  $w(\cdot)$  are strictly increasing and  $v(0)=0$  and  $w(0)=0$ .

The benefits that firms and intermediaries derive from the consumption of one unit of the good (being listed or becoming a member of the exchange) depend on how many other customers of the same type (network effect) or of the other type (cross-network effect) purchase compatible units of the good (i.e., how many customers are in the same exchange). This is reasonable, as we have seen, given the finding of the literature on the incentives for firms to be listed and of intermediaries to trade<sup>(68)</sup>; they get more utility in any case if the other type of consumer enters the exchange.

The multiplicative utility function captures the fact that firms do not get any utility in being listed in exchanges where there are no intermediaries, and intermediaries do not get any utility in paying fees to be members of exchanges where no firms are listed. The good produced by exchanges is really a combined good of listing and trading services. Regulated exchanges cannot produce only one service. On the other hand, as we have already illustrated, we may see an exchange or an automated trading system where there are securities traded that are listed in other exchanges (i.e., the system is not providing a listing service). Even in this case, however, we need an initial exchange where the security must be listed<sup>(69)</sup>.

(67) *It is obvious that by assuming that firms' and intermediaries' utility depends only on the number entering the same exchange, we are assuming, for now, that the two exchanges sell incompatible goods. In the next game (the compatibility case), we will assume that independent of the exchange choice, both types of players get utility from all the other consumers who entered the exchange.*

(68) *Different effects for the direct-network externalities could be imagined in special cases. (Marginal) utility may decrease as more (or too many) firms producing the same good enter the exchange; this is particularly true if we take the amount of savings that people are willing to invest in stocks as given. Competition in raising capital may lower the utility as other firms are listed. At the same time, too many intermediaries trading in the exchange could create a price war in commissions. This paper concentrates on the network externalities, which are believed to be positive.*

(69) *If we use an additive utility function or a generic strictly increasing utility function for the customers, we get the same results; the main difference is that we will have in the incompatible game a cross-corner solution with a specialization of exchanges in listing and trading from the beginning. This is*  
(segue ...)

We look for Nash equilibria of the game and start from the demand side.

*The demand side*

Each consumer (both intermediaries and firms) makes his choice of exchanges taking all prices as known and exogenously given, as the exchanges fixed them in the previous stage.

For an interior solution to exist (i.e., having some intermediaries and some firms in one exchange and the others in the other exchange), it must be the case, for intermediaries, that given the homogeneous tastes of the consumers of each type, no intermediary entering one exchange wants to switch to the other one.

For Milan, this condition is

$$v(f_M) * w(i_M) - M_{p_t} \geq v(f_L) * w(i_L + 1) - L_{p_t}$$

$$\text{or } v(f_M) * w(i_M) - v(f_L) * w(i_L + 1) \geq M_{p_t} - L_{p_t} \equiv \delta_t$$

For London, this condition is

$$v(f_M) * w(i_M + 1) - M_{p_t} \leq v(f_L) * w(i_L) - L_{p_t}$$

$$\text{or } v(f_M) * w(i_M + 1) - v(f_L) * w(i_L) \leq \delta_t$$

To be satisfied at the same time it must be that

$$v(f_M) * w(i_M + 1) - v(f_L) * w(i_L) \leq \delta_t \leq v(f_M) * w(i_M) - v(f_L) * w(i_L + 1)$$

But, given that  $w(\cdot)$  is a strictly increasing function, this inequality cannot be satisfied as  $v(f_M) * w(i_M + 1) - v(f_L) * w(i_L)$  cannot be less than or equal to  $v(f_M) * w(i_M) - v(f_L) * w(i_L + 1)$  as, in the last difference, a greater number is subtracted from a smaller number.

This fact ensures that only corner equilibria (i.e., equilibria in which all intermediaries will go on Milan or London) will exist.

The corner equilibria argument is symmetric for firms as they play at the same time. There cannot exist equilibria where both Milan and London list firms as they will have an incentive to deviate. All firms, in equilibrium, will be listed either in Milan or in London.

A big caveat (Katz and Shapiro, 1986b) to the corner solutions is that this is true only if each intermediary and firm has an influence on the network size, and thus on utility. If they

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*not possible in reality as, in a world with only two incompatible exchanges, specialization has no meaning. Automated trading systems need always to trade securities listed somewhere else. This is not true, as it will become clear later, in the implicit-merger case.*

ignored it (i.e., if there were a continuum of intermediaries and firms), then an unstable interior equilibrium might exist<sup>(70)</sup>.

At this point, in order to find the equilibria of the demand game, we simply check what are the corner and cross-corner equilibria and seen where they are feasible.

The situation can be summarized in the following game (where  $Network = v(F) * w(I)$  is the value of the network effect):

FIRM	INTERMEDIARIES	
	LONDON	MILAN
LONDON	$Network - L_{p_t}, Network - L_{p_t}$	$0 - L_{p_t}, 0 - M_{p_t}$
MILAN	$0 - M_{p_t}, 0 - L_{p_t}$	$Network - M_{p_t}, Network - M_{p_t}$

It is easy to see that for prices lower than the value of the network effect, there are two Nash equilibria, even if both prices of one exchange are higher than the other. A unique Nash equilibrium will arise only if at least one price of one exchange is higher than the network value. It is also obvious that cross-corner solutions (firms in London and intermediaries in Milan, and vice versa) can never arise.

In the following (and in the next figures), the different equilibria are shown as a function of the differences in prices; in this way the strategic interaction of exchanges is easier to get.

Suppose that all firms are listed in London. Then, all intermediaries compare the utility they can get from Milan  $w(I) * 0 - M_{p_t}$  (which is always negative for positive prices) with the one they can get from London  $v(F) * w(I) - L_{p_t}$ . Milan naturally would never prevail as with negative utility intermediaries stay out of the market. London would be chosen when  $-M_{p_t} < v(F) * w(I) - L_{p_t}$  (i.e.,  $\delta_t > -v(F) * w(I)$ ). This is naturally true only if intermediaries are getting positive utility, too (i.e.  $v(F) * w(I) - L_{p_t} > 0$ ). For  $\delta_t > -v(F) * w(I)$ , all intermediaries go to London if firms went to London. In the listing game, given that London wins the trading game, the best choice for firms is, symmetrically, to be listed in London: (L,L) is a Nash equilibrium of the game.

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(70) *An unstable interior equilibrium may exist also if we take into account the possibility that firms are listed on both exchanges and intermediaries may trade on both. The equilibrium will have half firms and intermediaries in each exchange. If we simply assume an odd number of customers, then dual listing and trading do not change the corner equilibria result.*



In short, in the area with  $\delta_t > -v(F)*w(I)$  and  $\delta_l > -v(F)*w(I)$ , London winning the trading and listing game can be an equilibrium of the game, or put another way for these conditions (and positive utility), the demand for listing and trading services can be directed to London.

Suppose now that all intermediaries chose Milan. Then all firms compare the utility they can get from London  $w(I)*0 - L_{pl}$  (which is always negative for positive prices) with the one they can get from Milan  $v(F)*w(I) - M_{pl}$ . London naturally would never prevail as with negative utility, firms stay out of the market. Milan would be chosen when  $-L_{pl} < v(F)*w(I) - M_{pl}$  (i.e.  $\delta_t < v(F)*w(I)$ ). This is naturally true only if firms are getting positive utility (i.e.,  $v(F)*w(I) - M_{pl} > 0$ ). For  $\delta_l < v(F)*w(I)$ , all firms go to Milan if intermediaries went to Milan. In the trading game, given that Milan wins the listing game, the best choice for intermediaries is, symmetrically, to trade in Milan: (M, M) is a Nash equilibrium of the game.

In short, in the area with  $\delta_t < v(F)*w(I)$  and  $\delta_l < v(F)*w(I)$ , Milan winning the trading and listing games can be an equilibrium of the exchange game.

The equilibria of the demand game are summarized in figure II.1 as functions of the difference in the prices charged by the two exchanges for the two different services.

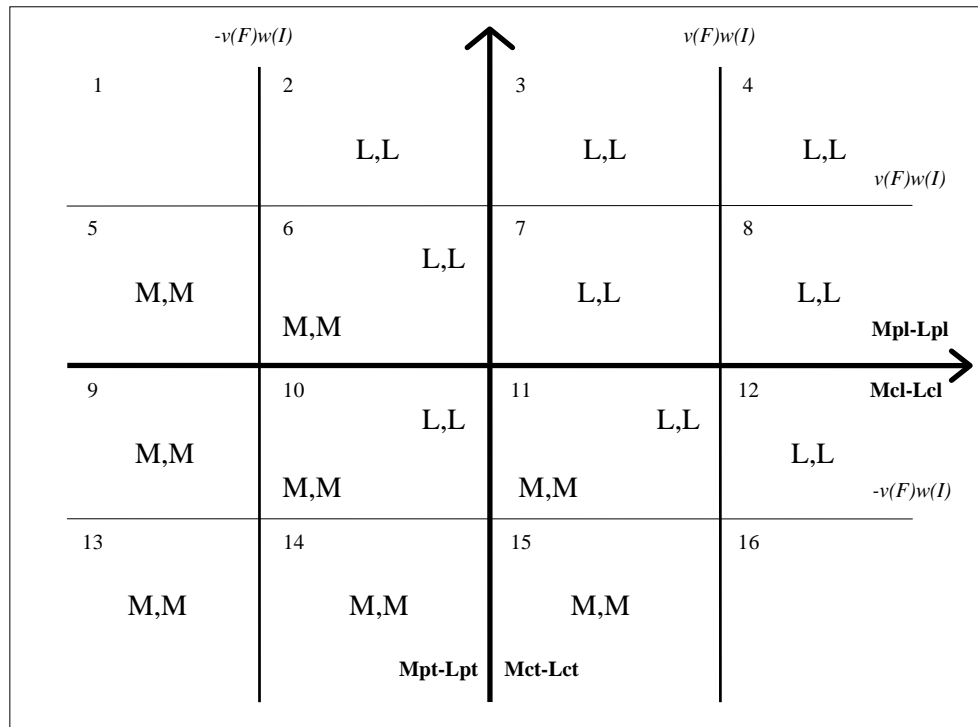


Figure II.1: Structure of the demand of listing and trading services as functions of the difference in prices of listing (Mpl-Lpl) and of trading services (Mpt-Lpt) between Milan and London.

Notice that the conditions for equilibria in terms of price (and later, cost) differences are only necessary but not sufficient for the customers to choose an exchange.

First of all, a trivial equilibrium for every kind of price is the trivial equilibrium where both types of customers are out of the exchange. More important, drawing the equilibria as function of the difference in prices cannot show that in some cases the prices (and later the marginal costs) can both be greater than the network effect: in this case, the trivial equilibrium with both types of customers out of the market will be the unique equilibrium of the game. Where in the figure a unique equilibrium exists, it means that at least one price of the losing exchange was higher than the gross network effect (which is represented by the horizontal and vertical lines).

The two areas of equilibria overlap partially (in areas 6, 7, 10, and 11). In those areas, there are two Nash equilibria (L,L and M,M).

There are some regions with unique equilibria (2, 3, 4, 8, and 12 for London; 5, 9, 13, 14, and 15 for Milan): in these regions, the losing exchange has at least one price higher than the gross network effect and so is never chosen.

Figure II.1 shows that in two small areas (1 and 16) all firms and intermediaries stay out of both exchanges as the great price advantage in one service of each exchange is useless given that in the other service its price is higher than the network and cross-network effect.

It is important to notice that the network externalities play a key role in the demand. Without the network effect, there would not be two Nash equilibria. The exchange with the lower price would win and in case of equal prices the unique Nash equilibrium would be split. The network effect makes it possible that, even in case of higher prices in both services, the exchange with the higher price can be chosen. There is the possibility of lock-in at a Pareto-inferior equilibrium: “this is a consequence of the self-reinforcing nature of networks: history matters” (Economides, 1993). The lock-in effect is called “excess inertia” by Farrell and Saloner (1985) and “null Nash equilibrium” by Dybvig and Spatt (1983)<sup>(71)</sup>.

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(71) *Katz and Shapiro (1986a and 1986b) assume that the Pareto-preferred equilibrium serves as a focal point when there are multiple equilibria. In particular they assume that firms and intermediaries in the market at a given date select the exchange yielding the greater surplus to each of them. This “coordination” does not require any side payments, since the consumers purchasing at a given date have coincident interests; actually, it makes sense in their game as they have two purchasing periods while in our game, as it is shown in the next paragraph, consumers in any case do not get any surplus so they have no interest in coordinating. In our paper, on the contrary, Pareto-preferred coordination is not assumed; in fact, “although some games have focal points that are natural predictions, game theory lacks a general and convincing argument that a Nash outcome will occur” (Fudenberg and Tirole, 1991).*

*Examples of exchange choices by customers (demand side)*

Take the utility function  $v(F)*w(I)$  as simply  $(F*I)$  with five firms and seven intermediaries (i.e.  $v(F)*w(I)=35$ ).

AREA 3	FIRM	INTERMEDIARIES	
		LONDON	MILAN
	LONDON	33, 33	-2, -38
	MILAN	-3, -2	32, -3

$$L_{p_t} = 2, M_{p_t} = 38, L_{p_l} = 2, M_{p_l} = 3$$

(L,L) is the unique Nash equilibrium.

AREA 6	FIRM	INTERMEDIARIES	
		LONDON	MILAN
	LONDON	32, 32	-3, -4
	MILAN	-2, -3	33, 31

$$L_{p_l} = 3, M_{p_l} = 2, L_{p_t} = 3, M_{p_t} = 4$$

(M,M) and (L,L) are both Nash equilibria but intermediaries prefer London while firms prefer Milan.

AREA 7	FIRM	INTERMEDIARIES	
		LONDON	MILAN
	LONDON	33, 32	-2, -4
	MILAN	-3, -3	32, 31

$$L_{p_l} = 2, M_{p_l} = 3, L_{p_t} = 3, M_{p_t} = 4$$

(M,M) and (L,L) are both Nash equilibria. (L,L) is Pareto preferred as London has both marginal costs lower than Milan.

AREA 11	FIRM	INTERMEDIARIES	
		LONDON	MILAN
	LONDON	33, 31	-2, -3
	MILAN	-3, -4	32, 32

$$L_{p_l} = 2, M_{p_l} = 3, L_{p_t} = 4, M_{p_t} = 3$$

(M,M) and (L,L) are both Nash equilibria but intermediaries prefer Milan while firms prefer London.

AREA 15	FIRM	INTERMEDIARIES	
		LONDON	MILAN
	LONDON	33, -11	-2, -10
	MILAN	-3, -46	32, 25

$$L_{p_l} = 2, M_{p_l} = 3, L_{p_t} = 46, M_{p_t} = 10:$$

(M,M) is the unique Nash equilibrium.

*The game among exchanges*

The exchanges must decide their prices before the choices of the customers. Given that then the game ends, the exchanges can forecast (backward induction) the equilibrium choices of the customers. The market outcome is represented in Figure II.2 which is identical to Figure II.1, but the choices are now functions of the differences in marginal costs.

The firms play a Nash game in trading and listing prices. They know that if they win they are going to be monopolist and, thus, price at the maximum possible to get all the consumer surplus: the gross network utility.

Competition, in fact, hinges on the two differences between the exchanges: the possible cost differences and the network and cross-network effect.

- The first case is the pricing policy of London in the areas where it can win. All intermediaries compare the maximum utility they can get from Milan, which can at the most price at marginal cost,  $w(I)*0 - M_{c_t}$  (which is always negative for positive marginal cost) with the one they can get from London  $v(F)*w(I) - L_{c_t}$ . Milan naturally would never prevail as with negative utility, intermediaries stay out of the market. London is chosen for  $-M_{c_t} < v(F)*w(I) - L_{c_t}$  (i.e.  $\alpha_t > -v(F)*w(I)$ ). This is naturally true only if also intermediaries are getting positive utility (i.e.  $v(F)*w(I) - L_{c_t} \geq 0$ ). London can charge maximal trading fees which satisfy  $0 \leq v(F)*w(I) - L_{p_t}$  or  $L_{p_t} = v(F)*w(I)$ . In this way, London can earn profits of  $I(v(F)*w(I) - L_{c_t})$ . In the listing game, London can charge maximal listing fees<sup>(72)</sup> which satisfy  $0 \leq v(F)*w(I) - L_{p_l}$  or  $L_{p_l} = v(F)*w(I)$ . In short in the areas (2, 3, 4, 6, 7, 8, 10, 11, 12) of Figure II.2, where  $\alpha_t > -v(F)*w(I)$  and  $\alpha_l > -v(F)*w(I)$ , London winning the trading and listing games, pricing at  $L_{p_t} = v(F)*w(I)$  and  $L_{p_l} = v(F)*w(I)$ , is a Nash equilibrium of the exchange game and London gets total overall profits of  $I(v(F)*w(I) - L_{c_t}) + F(v(F)*w(I) - L_{c_t})$ . Total welfare in this area is the same as profits, given that London exploits all the consumer surplus.
- The second case is the pricing policy of Milan where it can win. All firms compare the maximum utility they can get from London, which can at the most price at marginal cost,  $w(I)*0 - L_{c_l}$  (which is always negative for positive marginal cost) with the one they can get from Milan  $v(F)*w(I) - M_{c_l}$ . London naturally would never prevail as with negative utility, firms stay out of the market. Milan is chosen when  $-L_{c_l} < v(F)*w(I) - M_{c_l}$  (i.e.,  $\alpha_t < v(F)*w(I)$ ). This is naturally true only if firms are getting positive utility (i.e.,  $v(F)*w(I) - M_{p_l} \geq 0$ ). For  $\alpha_l < v(F)*w(I)$  all firms go to Milan if intermediaries went to Milan. But then, in the trading game, given that Milan wins the listing game, the best choice for intermediaries is, symmetrically, to trade in Milan, for  $\alpha_t < v(F)*w(I)$ . (Milan, Milan) is a Nash equilibrium of the game. In the listing game, Milan can charge maximal listing fees, which satisfy  $0 \leq v(F)*w(I) - M_{p_l}$  or  $M_{p_l} = v(F)*w(I)$ . Milan can earn profits of  $F(v(F)*w(I) - M_{c_l})$ . In the trading game, Milan can charge maximal trading fees, which satisfy  $0 \leq v(F)*w(I) - M_{p_t}$  or  $M_{p_t} = v(F)*w(I)$ . In this way, Milan can earn profits of  $I(v(F)*w(I) - M_{c_t})$ . In short, in the areas 5, 6, 7, 9, 10, 11, 13, 14, 15 of Figure II.2, Milan winning the trading and listing games, pricing at  $M_{p_t} = v(F)*w(I)$  and  $M_{p_l} = v(F)*w(I)$ , can be an equilibria of the exchange game and Milan gets total overall profits of  $I(v(F)*w(I) - M_{c_t}) + F(v(F)*w(I) - M_{c_l})$ . Total welfare in this area is equal to the total amount of profits, given that Milan exploits all the consumer surplus.

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(72) Throughout the game it is assumed that pricing just under a certain level means matching it perfectly. More formally, it means to price at that level minus an  $\varepsilon$ .

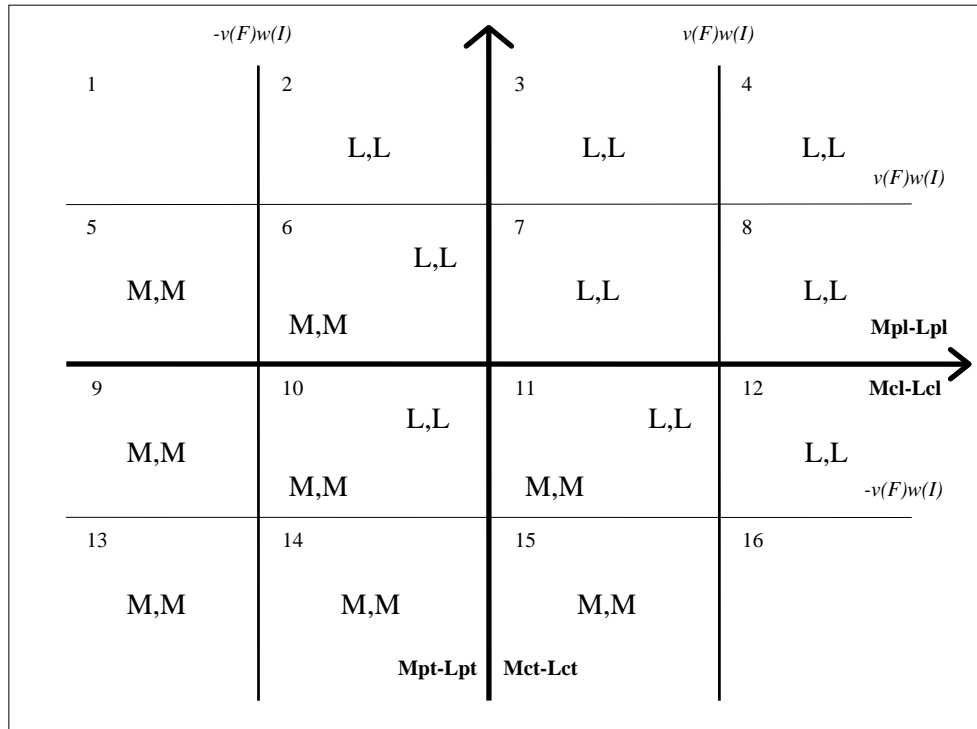


Figure II.2: Market outcomes of the exchanges' game as functions of the difference in marginal costs of listing (Mcl-Lcl) and trading services (Mct-Lct) between Milan and London.

Notice that in the overlapping areas welfare is different.

In area 7, welfare is clearly higher if (L,L) is the equilibrium, as both its marginal costs are lower than Milan; in area 10, it is the opposite. This is obvious as the equilibria are Pareto ranked.

In areas 6 and 11, the situation is more difficult to evaluate. It is possible to compare the welfare and see where it is higher:

In (M,M) case, welfare is equal to

$$W_{MM} = F(v(F) * w(I) - M_{c_l}) + I(v(F) * w(I) - M_{c_t})$$

In (L,L) case, welfare is equal to

$$W_{LL} = F(v(F) * w(I) - L_{c_l}) + I(v(F) * w(I) - L_{c_t})$$

Then  $W_{MM} > W_{LL}$  if  $I\alpha_t < -F\alpha_l$ . In Figure II.3, this means that the line with equation  $\alpha_t = -\frac{F}{I}\alpha_l$  passing from the origin and from areas 6 and 11 divides them in two parts. Welfare is higher in Milan in the lower part of areas 6 and 11 where the marginal cost advantage of Milan is higher relative to London. Vice versa for London in the upper part of the triangles.

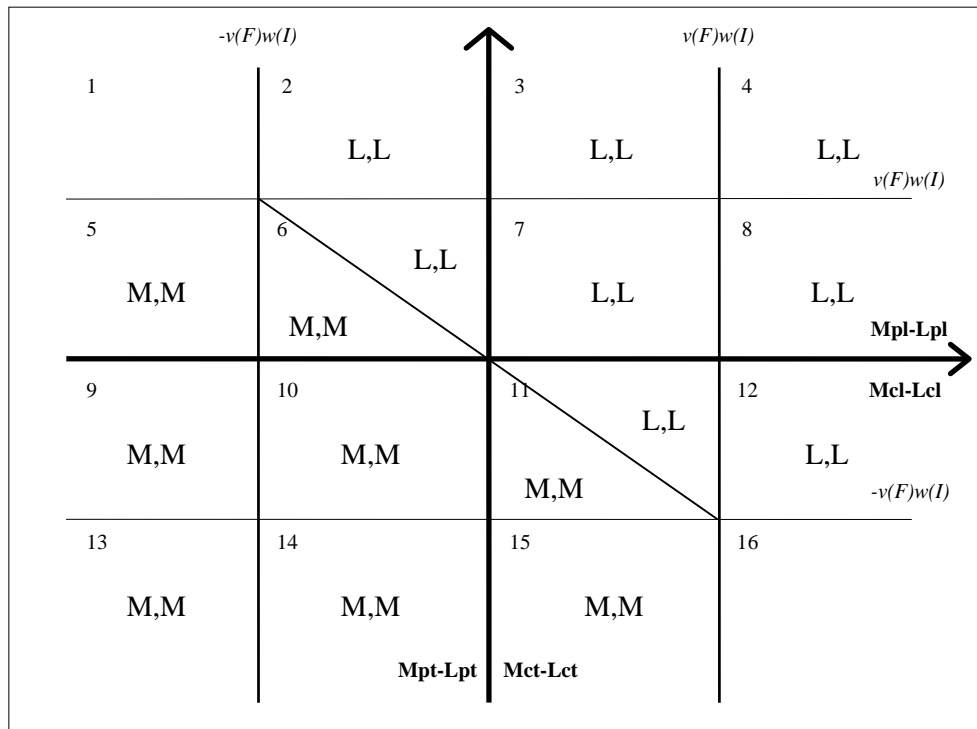


Figura II.3: Market outcomes with higher welfare equilibria.

II.4.3 COMPLETE COMPATIBILITY AMONG EXCHANGES: IMPLICIT MERGER AND REMOTE ACCESS

What happens if exchanges decide on implicit merger for listed firms with a remote access for intermediaries? This looks very much like the case of product compatibility in the network externality literature (Katz and Shapiro, 1986a and 1986b).

A “complete compatibility” among exchanges has been already defined as an agreement such that each exchange decides to list the firms already listed in the other exchange without additional cost for the firm and offers remote access to the other exchange’s members (remote access in the European ISD regulation), with reciprocity and without further requirements.

The outcome of the game changes as well as its welfare implications.

All the firms and intermediaries get utility from all the other existing customers wherever they purchase listing and trading services. Both types of customers buy the cheapest service from exchanges, which can never price over the other’s marginal costs, relying on the customer base for the network effect.

The utility functions are now **independent of the exchange choices**. They become

- for firms:  $v(F) * w(I) - \min(L_{p_t}, M_{p_t})$  ;
- for intermediaries:  $v(F) * w(I) - \min(L_{p_t}, M_{p_t})$  .

The location of intermediaries has no relevance to firms wherever they trade and vice versa.

It is straightforward to understand that now that customers go where the lower price is, having no regards if the other customers enter the same exchange. In fact, the implicit merger creates a unique listing and trading computerized floor, and it is immaterial in terms of gross utility to be listed in Milan or London because  $v(F) * w(I)$  will be always the same on both exchanges.

Figure II.4 shows the equilibria of the demand game.

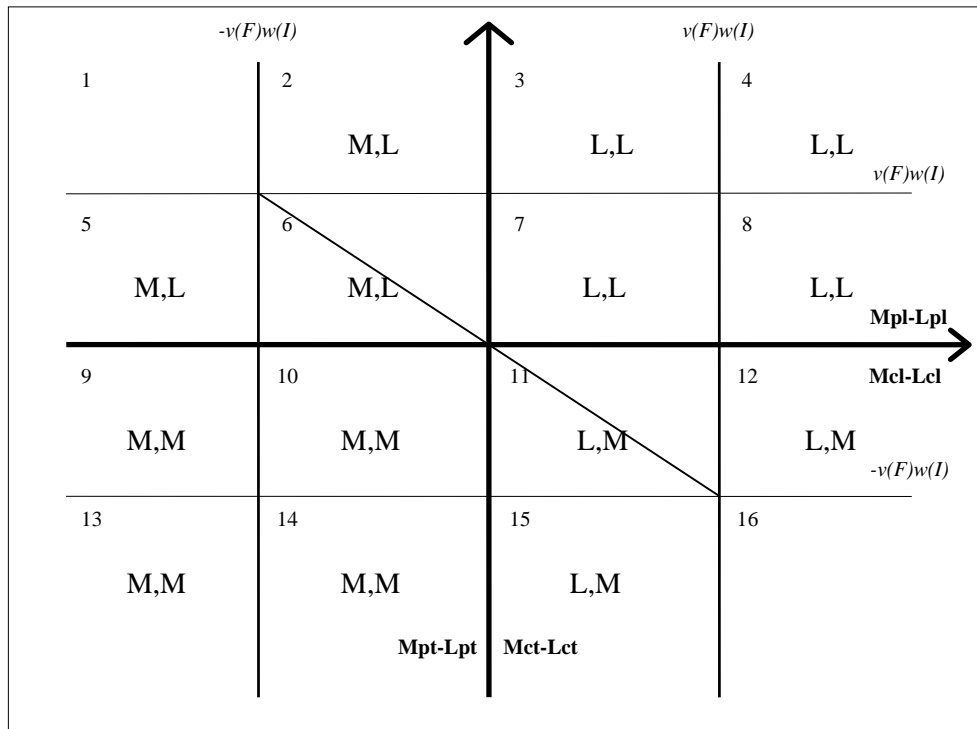


Figure II.4: Complete compatibility case: implicit merger and remote access. Equilibria of the game as functions of the difference in listing and trading prices between Milan and London.

The main differences are the following: uniqueness of equilibria in the overlapping areas of the pure competition case (6, 7, 10, 11); and specialization of exchange when there are advantages in only one good produced (listing or trading).



Obviously, exchanges play a standard Nash pricing game where the winner is the exchange that has lower marginal costs, pricing just under the other's marginal cost if it was lower than the network effect; otherwise, it just prices at the network effect.

There are four main possible cases<sup>(73)</sup>.

- $\alpha_l > 0, \alpha_t > 0$ . In the first case, London has both marginal cost lower than Milan and gets all the consumers of both types at a price just below Milan's marginal costs or, if too high, at the network effect. Total welfare in this case  $W = I(v(F)*w(I) - L_{c_t}) + F(v(F)*w(I) - L_{c_l})$ . There are different profit and consumer surpluses in the sub-areas 3-4-7-8:
  - In area 3, London's profits  $I(v(F)*w(I) - L_{c_t}) + F(M_{c_l} - L_{c_l})$ . Intermediaries get no consumer surplus while firms get  $F(v(F)*w(I) - M_{c_l})$
  - In area 4, London's profits are  $I(v(F)*w(I) - L_{c_t}) + F(v(F)*w(I) - L_{c_l})$ . There is no consumer surplus.
  - In area 7, London's profits are  $I(M_{c_t} - L_{c_t}) + F(M_{c_l} - L_{c_l})$  namely  $\Pi^{LL} = I\alpha_t + F\alpha_l$ . Intermediaries get consumer surplus of  $I(v(F)*w(I) - M_{c_t})$  while firms get  $F(v(F)*w(I) - M_{c_l})$
  - In area 8, London's profits are  $I(M_{c_t} - L_{c_t}) + F(v(F)*w(I) - L_{c_l})$ . Intermediaries get consumer surplus of  $I(v(F)*w(I) - M_{c_t})$  while firms get no surplus.
- $\alpha_l < 0, \alpha_t < 0$ . In the second case, Milan has both marginal costs lower than London's and gets all the consumers of both types at a price just below London's marginal costs, or, if too high, at the network effect. Total welfare in this case is  $W = I(v(F)*w(I) - M_{c_t}) + F(v(F)*w(I) - M_{c_l})$ . There are different profit and consumer surpluses in the sub-areas 9-10-13-14:
  - In area 9, Milan's profits are  $I(L_{c_t} - M_{c_t}) + F(v(F)*w(I) - M_{c_l})$ . Intermediaries get consumer surplus of  $I(v(F)*w(I) - L_{c_t})$  and firms get no surplus.
  - In area 10, Milan's profits are  $I(L_{c_t} - M_{c_t}) + F(L_{c_l} - M_{c_l})$ , namely  $\Pi^{LL} = -I\alpha_t - F\alpha_l$  (the profits are positive as both  $\alpha$ 's are negative). Intermediaries

(73) To be precise, we have five other cases:

- 1)  $\alpha_l = \alpha_t = 0$ . In this case we have four equilibria MM, LL, ML, and LM with every exchange pricing at marginal cost and the maximum consumer surplus possible.
- 2)  $\alpha_l = 0$  and  $\alpha_t > 0$ . Again we may have only corner solutions given the strictly increasing utility function: LL and ML.
- 3)  $\alpha_l = 0$  and  $\alpha_t < 0$ . Equilibria are MM and LM.
- 4)  $\alpha_t = 0$  and  $\alpha_l > 0$  with LL and LM.
- 5)  $\alpha_t = 0$  and  $\alpha_l < 0$  with ML and MM.

- get consumer surplus  $I(v(F)*w(I)-L_{c_l})$  and firms get surplus of  $F(v(F)*w(I)-L_{c_l})$ .
- In area 13, Milan's profits are  $I(v(F)*w(I)-M_{c_l})+F(v(F)*w(I)-M_{c_l})$ . Intermediaries and firms get no surplus.
  - In area 14, Milan's profits are  $I(v(F)*w(I)-M_{c_l})+F(L_{c_l}-M_{c_l})$ . Intermediaries get no consumer surplus and firms get  $F(v(F)*w(I)-L_{c_l})$ .
- $\alpha_l > 0, \alpha_t < 0$ . In the third case, London has lower marginal cost in listing and Milan in trading. In the implicit-merger case, there is a unique Nash equilibrium in which the two exchanges specialize: one in listing and the other in trading services as the relevant trading circuit is in any case combined. The equilibrium outcome is the one where London gets all the firms that want to be traded at a price just under Milan's marginal cost (or, if too high, at the network value) and Milan gets all the intermediaries at London's marginal cost (or, if too high, at the network value) and all the customers have no incentive to deviate. Total welfare becomes  $W = I(v(F)*w(I)-M_{c_l}) + F(v(F)*w(I)-L_{c_l})$ . Profits and surplus are different in the three sub-areas 11-12-15:
    - In area 11, London's profits are  $F(M_{c_l}-L_{c_l})$ , namely  $F\alpha_l$  and Milan's are  $I(L_{c_l}-M_{c_l})$ , namely  $-I\alpha_t$ . The surplus for firms will be  $F(v(F)*w(I)-M_{c_l})$  and for intermediaries  $I(v(F)*w(I)-L_{c_l})$ .
    - In area 12, London's profits are  $F(v(F)*w(I)-L_{c_l})$ , and Milan's are  $I(L_{c_l}-M_{c_l})$ , namely  $-I\alpha_t$ . There is no surplus for firms, while intermediaries still get  $I(v(F)*w(I)-L_{c_l})$ .
    - In area 15, London's profits are  $F(M_{c_l}-L_{c_l})$ , namely  $F\alpha_l$  and Milan's are now  $I(v(F)*w(I)-M_{c_l})$ . The surplus for firms is  $F(v(F)*w(I)-M_{c_l})$  but there is nothing for intermediaries.
  - $\alpha_l < 0, \alpha_t > 0$ . In the fourth case, London has lower marginal cost in trading and Milan in listing. The equilibrium outcome is the one where London gets all the intermediaries that want to trade at a price just under Milan's marginal cost (or, if too high, at the network value) and Milan gets all the firms at London's marginal cost (or, if too high, at the network value); none of the customers has any incentive to deviate. Total welfare becomes  $W = I(v(F)*w(I)-L_{c_l}) + F(v(F)*w(I)-M_{c_l})$ . Profits and consumer surplus are different in the three sub-areas 2-5-6, symmetrically to the previous case:
    - In area 2, London's profits are  $I(v(F)*w(I)-L_{c_l})$  and Milan's are  $F(L_{c_l}-M_{c_l})$ , namely  $-F\alpha_l$ . The surplus for firms is  $F(v(F)*w(I)-L_{c_l})$  but there is nothing for intermediaries.
    - In area 5, London's profits are  $I(M_{c_l}-L_{c_l})$ , namely  $I\alpha_t$ , and Milan's are  $F(v(F)*w(I)-M_{c_l})$ . The surplus for firms will be nothing while intermediaries get  $I(v(F)*w(I)-M_{c_l})$ .

- In area 6, London's profit are  $I(M_{c_t} - L_{c_t})$ , namely  $I\alpha_t$ , and Milan's are  $F(L_{c_t} - M_{c_t})$ , namely  $-F\alpha_t$ . The surplus for firms will be  $F(v(F)*w(I) - L_{c_t})$  and for intermediaries  $I(v(F)*w(I) - M_{c_t})$ .

It is interesting to notice that in this game there is specialization in about half the cases. In a normal exchange, the final good offered to the final customers (the indirect customers, as we defined them before) logically must be composed of trading and listing services (no one would send an order if there are not intermediaries and, on the other hand, there is no point in having an exchange without listed firms<sup>(74)</sup>). In case of an implicit merger and remote access, on the contrary, one exchange, with technological advantages in trading costs, may have all the intermediaries and the other exchange, with listing cost advantages, could examine and list all the firms.

As in the previous case, there are two areas (1 and 16) where, even in the presence of cost advantage, the lower marginal cost of the prevailing exchange is higher than the utility the customers can get and so they stay out of the market.

Total industry profits are  $F|\alpha_l| + I|\alpha_t|$ , and consumer surplus is, respectively, for all listed firms  $F(v(F)*w(I) - \max(L_{c_t}, M_{c_t}))$ , and for intermediaries  $I(v(F)*w(I) - \max(L_{c_t}, M_{c_t}))$ .

Aggregate welfare<sup>(75)</sup> is

$$W = F|\alpha_l| + I|\alpha_t| + F(v(F)*w(I) - \max(L_{c_t}, M_{c_t})) + I(v(F)*w(I) - \max(L_{c_t}, M_{c_t}))$$

which is equal to

$$W = (F + I)(v(F)*w(I)) - I \min(L_{c_t}, M_{c_t}) - F \min(L_{c_t}, M_{c_t})$$

Comparing the welfare results in the two cases, some implications can be drawn.

#### II.4.4 COMPATIBILITY DECISIONS

The previous paragraphs presented the different equilibria in the pure competition (incompatible) case in which only one exchange survives and the implicit merger (compatible) case in which both exchanges may survive and specialize.

In the structure of our general game, it can be assumed that the decision to agree with the other exchange for an implicit merger and remote access (or, in any case, the decision to build by oneself an adapter to link one's network to the other) is taken prior to the actual production of the listing and trading services.

(74) This is true in general, even for derivatives; they have to be listed.

(75) Aggregate welfare is considered here as the sum of consumer and producer surplus.

Different problems must be checked: when exchanges prefer compatibility and if they actually want to achieve it; and when the two types of consumers prefer it; when, from a total welfare point of view, compatibility is better.

Call  $\Delta\Pi^L$  and  $\Delta\Pi^M$  the change in profits from the pure competition to the implicit merger case and  $\Delta\Pi = X\Pi^L + \Delta\Pi^M$ . Then call  $\Delta F_S$  and  $\Delta I_S$  the change in firms' and intermediaries' surplus and, finally,  $\Delta W$  the change in welfare.

As the problem is symmetric, we describe only the case that  $\alpha_t < 0$ , that is Milan has an advantage in trading costs. All the conclusions will be valid in the opposite case by just reversing them.

In all the cases, not taken explicitly into account is the fixed costs that can arise: the costs of compatibility. In fact, in general there will be some costs  $F^{M,L} \geq 0$  to achieve compatibility:  $F$  denotes total standardization costs for the industry and  $F^M + F^L = F$ . In general, if the two exchanges are willing to achieve implicit merger, each of them should bear its part of the cost; but it is possible, as will be seen later, that one exchange may have a strong unilateral incentive for implicit merger, in which case it can bear all the total cost  $F$ . All the conclusions drawn are valid, from a private and a social point of view, if the gains are higher than the costs. A comment on that is in the following paragraph.

**Proposition 1.** *Implicit merger strictly improves welfare in all the areas with cross advantages in marginal costs and where a Pareto-inferior equilibrium was selected.*

**Proposition 2.** *Implicit merger always strictly increases total consumer surplus, except when one exchange has both marginal cost higher than the network externality.*

The implicit merger case obliges, generally, the winning exchange, which has lower marginal costs, to price at no more than the other's marginal cost, if competing, and not at the value of the network externalities, as before. That is why welfare is always higher in the areas with cross advantages in marginal costs and where a Pareto-inferior equilibrium was selected; furthermore, prices are never higher than the competition case. In the areas where monopoly was already efficient in the competition game, implicit merger has no social welfare effect, of course. In the areas with a unique Nash equilibria, the losing exchange had already marginal cost higher than the network externality and so compatibility has no effect.

**Proposition 3.** *If an exchange is the only winner in the pure-competition game because the other has both marginal costs higher than the network effect, then there will be neither private nor social strict incentive to achieve implicit merger.*

- This is the case in area 13, where (M,M) in the pure-competition case must be compared to (M,M) in the implicit-merger case:  $\Delta\Pi^L = 0$ ,  $\Delta\Pi^M = 0$ ,  $\Delta\Pi = 0$ ,  $\Delta F_S = 0$ ,  $\Delta I_S = 0$ ,  $\Delta W = 0$ . Milan has no strict incentive to achieve implicit merger as it gets the same profit in

the pure-competition case. The reason is simply that it remains a monopolist that perfectly discriminates and thus this is efficient from a welfare point of view. In fact, London is in any case out of the market as both its marginal costs are higher than the network externality and so Milan's pricing policy is the same in both cases.

**Proposition 4.** *If an exchange is the only winner in the pure-competition game, and the other has both marginal costs higher than the winner's and one higher than the network effect, then there will be neither exchanges' nor social strict incentive to achieve implicit merger. All the customers of one type will get some surplus.*

- This is the case in areas 9 and 14. In area 9, (M,M) in the pure-competition case must be compared to (M,M) in the implicit-merger case:  $\Delta\Pi^L=0$ ,  $\Delta\Pi^M < 0$ ,  $\Delta\Pi < 0$ ,  $\Delta F_S=0$ ,  $\Delta I_S > 0$ ,  $\Delta W=0$ . This happens because Milan cannot price the trading fees at the value of the network any more but at London's marginal cost. So Milan has no incentive in achieving implicit merger.
- In area 14, (M,M) in the pure-competition case must be compared to (M,M) in the implicit-merger case:  $\Delta\Pi^L=0$ ,  $\Delta\Pi^M < 0$ ,  $\Delta\Pi < 0$ ,  $\Delta F_S > 0$ ,  $\Delta I_S=0$ ,  $\Delta W=0$ . This happens because Milan cannot price the listing fees at the value of the network any more but at London's marginal cost. So Milan has no incentive in achieving implicit merger.

In area 10, there are two Nash equilibria in the pure-competition case.

**Proposition 5.** *If in the pure-competition case with both advantages in marginal cost, the Pareto-superior equilibrium is selected, then there will be neither social nor exchanges' incentives in achieving implicit merger but both types of customers will increase their surplus.*

- In area 10, (M,M) in the implicit-merger case must be compared to the (M,M) equilibrium of the pure-competition case (the "good" one):  $\Delta\Pi^L=0$ ,  $\Delta\Pi^M < 0$ ,  $\Delta\Pi < 0$ ,  $\Delta F_S > 0$ ,  $\Delta I_S > 0$ ,  $\Delta W=0$ . Milan remains monopolist but cannot price at the monopoly level (all the network effect) but at the maximum at London's marginal cost; so Milan has no incentive in achieving compatibility, while customers both gain but welfare does not change.

These first propositions are also coherent with Katz and Shapiro's 1985 paper where they show that a firm that is expected to have a large network prefers incompatibility.

**Proposition 6.** *If, in the pure competition case with both advantages in marginal cost, a Pareto-inferior equilibrium is selected, then implicit merger will increase welfare, both consumer surplus and the entering exchange's profit; furthermore, there will exist couples of marginal cost such that implicit merger will also increase total profits and can be socially and privately optimal with side payments.*

- In fact, in area 10, in the pure-competition case there may be a different outcome (L,L), which was the socially worst and it is socially worse compared to the implicit-merger case (M,M):  $\Delta\Pi^L < 0$ ,  $\Delta\Pi^M > 0$ ,  $\Delta\Pi \geq 0$ ,  $\Delta F_S > 0$ ,  $\Delta I_S > 0$ ,  $\Delta W > 0$ . In fact, welfare in the pure-competition case when London gets all the firms is

$$I(v(F)*w(I) - L_{c_l}) + F(v(F)*w(I) - L_{c_l}),$$

which is strictly lower than the implicit-merger case

$$I(v(F)*w(I) - M_{c_l}) + F(v(F)*w(I) - M_{c_l})$$

as the marginal costs of Milan are both lower than London's. Implicit mergers are welfare improving. The effect on total profits of the firms can be positive or negative. In fact, in the implicit-merger case, Milan gets

$$I(L_{c_l} - M_{c_l}) + F(L_{c_l} - M_{c_l}),$$

while in the pure-competition case, London gets

$$I(v(F)*w(I) - L_{c_l}) + F(v(F)*w(I) - L_{c_l}).$$

It is easy to see that if the difference between the network effect and London's marginal costs is lower than the difference between London's and Milan's marginal costs, then total profits are always higher in the implicit-merger case (there could be cases in between, of course). Milan may make some side payments to London, even greater than London's profits, and everyone would be better. From the consumers' point of view compatibility is better as they get more consumer surplus in both cases.

In area 11 the situation is slightly more complicated; there are two Nash in the pure-competition case, welfare ranked.

**Proposition 7.** *If in the pure-competition case there are two Nash equilibria with cross advantages in marginal costs, then implicit merger will increase welfare, both consumer surplus and the entering exchange's profit; furthermore, there will exist some couples of marginal cost such that implicit merger will also increase total profits and can be socially and privately optimal with side payments.*

- First, we must compare, in area 11, the equilibrium of the implicit-merger case (L,M) to (M,M), which was the equilibrium with higher welfare in the pure-competition case, under the diagonal line.  $\Delta\Pi^L > 0$ ,  $\Delta\Pi^M < 0$ ,  $\Delta\Pi \geq 0$ ,  $\Delta F_S > 0$ ,  $\Delta I_S > 0$ ,  $\Delta W > 0$ . Milan never wants to achieve compatibility as far as its profits are higher in the pure-competition case

$$I(v(F)*w(I) - M_{c_l}) + F(v(F)*w(I) - M_{c_l}) > I(L_{c_l} - M_{c_l}).$$

London wants compatibility in any case. From a welfare point of view, there is an improvement because

$$I(v(F)*w(I) - M_{c_l}) + F(v(F)*w(I) - M_{c_l}) < I(v(F)*w(I) - M_{c_l}) + F(v(F)*w(I) - L_{c_l})$$

as  $L_{c_l} < M_{c_l}$ .

The effects on total profits are uncertain: if  $\Delta\Pi^L > -\Delta\Pi^M$  then total profits increase.

$$\Delta\Pi^M = I(L_{c_t} - M_{c_t}) - I(v(F)*w(I) - M_{c_t}) - F(v(F)*w(I) - M_{c_t}) \equiv IL_{c_t} + FM_{c_t} - (F + I)(v(F)*w(I));$$

$$\Delta\Pi^L = F(M_{c_l} - L_{c_l})^{(76)}.$$

- Now, the equilibrium, in area 11, of the implicit-merger case (L,M) is compared to (L,L), which is the equilibrium with higher welfare in the pure-competition case over the diagonal.  $\Delta\Pi^L < 0$ ,  $\Delta\Pi^M > 0$ ,  $\Delta\Pi \geq 0$ ,  $\Delta F_S > 0$ ,  $\Delta I_S > 0$ ,  $\Delta W > 0$ . London never wants to achieve compatibility as far as its profits are higher in the pure competition case:

$$I(v(F)*w(I) - L_{c_t}) + F(v(F)*w(I) - L_{c_l}) > I(M_{c_l} - L_{c_l}).$$

Milan wants compatibility in any case. Consumers' surplus is

$$I(v(F)*w(I) - L_{c_t}) + F(v(F)*w(I) - M_{c_l}).$$

From a welfare point of view we have an improvement because

$$I(v(F)*w(I) - L_{c_t}) + F(v(F)*w(I) - L_{c_l}) < I(v(F)*w(I) - M_{c_t}) + F(v(F)*w(I) - L_{c_l})$$

as  $L_{c_t} > M_{c_t}$ .

The effects on total profits are uncertain and symmetric as above:  $\Delta\Pi^M > -\Delta\Pi^L$ , then total profits increase.

$$\Delta\Pi^M = I(M_{c_t} - L_{c_t});$$

$$\Delta\Pi^L = F(M_{c_l} - L_{c_l}) - I(v(F)*w(I) - L_{c_t}) - F(v(F)*w(I) - L_{c_l}) \equiv FM_{c_l} + IL_{c_t} - (F + I)(v(F)*w(I)).$$

**Proposition 8.** *If in the pure-competition case there is a unique equilibrium outcome with cross advantages in marginal costs, then implicit merger will increase welfare, total consumer surplus and the entering exchange's profit; furthermore, there will exist some couples of marginal cost such that implicit merger will also increase total profits and will be socially and privately optimal with side payments.*

- In area 12 (L,L) is the equilibrium in the pure-competition case and (L,M) in the implicit merger.  $\Delta\Pi^L < 0$ ,  $\Delta\Pi^M > 0$ ,  $\Delta\Pi \geq 0$ ,  $\Delta F_S = 0$ ,  $\Delta I_S > 0$ ,  $\Delta W > 0$ . Milan has all the incentive to achieve compatibility as in the pure-competition case it is out of the market even

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(76) As a numerical example using as value of the network the previous 35 (5 firms and 7 intermediaries), then if  $M_{c_t} = 20$ ,  $M_{c_l} = 30$ ,  $L_{c_l} = 4$  and  $L_{c_t} = 25$ , then total profits will go from 130 to 165. There is space enough for London to compensate Milan and still get positive profits.

if it has an advantage in trading cost. London will not favor compatibility in any case, unless it gets side payments. Compatibility is welfare improving as

$$I(v(F) * w(I) - L_{c_t}) + F(v(F) * w(I) - L_{c_l}) < I(v(F) * w(I) - M_{c_t}) + F(v(F) * w(I) - L_{c_l})$$

as  $L_{c_t} > M_{c_t}$ .

Only intermediaries get some surplus because firms still pay the same price. The effects on total profits are uncertain: if  $\Delta\Pi^M > -\Delta\Pi^L$ , then total profits increase.

$$\Delta\Pi^L = F(v(F) * w(I) - L_{c_l}) - I(v(F) * w(I) - L_{c_l}) - F(v(F) * w(I) - L_{c_l}) = -I(v(F) * w(I) - L_{c_l});$$

$$\Delta\Pi^M = I(L_{c_t} - M_{c_t}) \text{ but then } \Delta\Pi^L + \Delta\Pi^M > 0 \text{ when } -I(v(F) * w(I) - L_{c_l}) + I(L_{c_t} - M_{c_t}) > 0,$$

i.e., when  $2L_{c_t} > v(F) * w(I) + M_{c_t}$ .

- In area 15, (M,M) is the equilibrium in the competition case and (L,M) in the implicit-merger case:  $\Delta\Pi^L > 0$ ,  $\Delta\Pi^M < 0$ ,  $\Delta\Pi \geq 0$ ,  $\Delta F_S > 0$ ,  $\Delta I_S = 0$ ,  $\Delta W > 0$ . Milan never wants to achieve compatibility as far as its profits are higher in the pure-competition case:

$$I(v(F) * w(I) - M_{c_t}) + F(v(F) * w(I) - M_{c_l}) > I(L_{c_t} - M_{c_t}).$$

London wants compatibility in any case. Only firms get some surplus and so gain with compatibility. From a welfare point of view, there is an improvement as

$$I(v(F) * w(I) - M_{c_t}) + F(v(F) * w(I) - M_{c_l}) < (F + I)(v(F) * w(I)) - I(M_{c_t}) - F(L_{c_l})$$

as  $L_{c_l} < M_{c_l}$ .

The effects on total profits are symmetric to those in area 12: if  $\Delta\Pi^L > -\Delta\Pi^M$ , then total profits increase.

$$\Delta\Pi^M = I(v(F) * w(I) - M_{c_t}) - I(v(F) * w(I) - M_{c_l}) - F(v(F) * w(I) - M_{c_l}) = -F(v(F) * w(I) - M_{c_l});$$

$$\Delta\Pi^L = F(M_{c_l} - L_{c_l}) \text{ but then } \Delta\Pi^L + \Delta\Pi^M > 0 \text{ when } -F(v(F) * w(I) - M_{c_l}) + F(M_{c_l} - L_{c_l}) > 0,$$

i.e., when  $2M_{c_l} > v(F) * w(I) + L_{c_l}$ .

#### II.4.5 IMPLICATIONS OF THE MODEL

The results seem compatible with what reality shows.

Of course, the compatibility decisions depend on the cost of compatibility with respect to the gains. In our case, both firms never gain in achieving compatibility (i.e., implicit merger), but there is the possibility for both firms to increase their profits with implicit merger with some side payments, which could be decided in the implicit-merger agreement. In many cases, an exchange could decide to achieve a “unilateral implicit merger” even if it incurs in the total cost



F of compatibility. The exchange would do it only if the expected gain is higher; we could have a unilateral compatibility decision<sup>(77)</sup>.

Competition among different firms can arise only when they operate in the same “relevant” market. Exchanges were not competing across countries until some time ago. They were natural monopolies, and, in fact, in general only one stock exchange was existing in each country.

When competition begins, the incompatible model predicts that only one exchange can survive. For example, in the U.S. we do not have one stock exchange in each of the fifty states and the presence of only three main different stock exchanges (NYSE, NASDAQ, and AMEX) may be historically reconducted to the fact that NASDAQ was born as an exchange for start-up enterprises. Consistently with this hypothesis, Blume and Goldstein (1997) quote Doede (1967) who notes that there were over 100 regional stock exchanges in the US at the beginning of the twentieth century, 35 by 1935, and 15 by 1965. Today there are only five regional stock exchanges (Boston, Chicago, Cincinnati, Pacific, and Philadelphia). The model with implicit mergers seems to fit the past European framework where at least from the listing side, in some countries (Italy and France, but not Germany and Spain) there were regional exchanges which were listing the same firms but in the end with computerized trading they were merged into a national exchange (Milan and Paris) as the cost advantage of the leading exchange was enormous. Competing exchanges could have been in areas 9-10-13-14.

The model has several implications.

- It indicates that competition among stock exchanges may end up with a monopolist exchange, if no agreements are found. This not necessarily implies that only one exchange will exist but that whenever exchanges compete, for example in case of highly standardized securities, then a unique exchange should prevail.
- Implicit merger is a clear strategic option for exchanges. In the presence of cross-advantages in marginal costs, this strategy can give both exchanges higher profits, with some side payments. In the absence of any coordination or policy guide, implicit merger will not arise. In any case the exchange that remains out of the market will, in the “normal” competition, achieve a unilateral implicit merger, listing or trading securities of the other exchange. Thus, even for the incumbent monopolist exchange, implicit merger is a choice to evaluate carefully.
- Implicit merger always strictly improves welfare when there are cross advantages in marginal cost of the exchanges. Regulation should guide or favor implicit merger, eliminating all obstacles to listing and delisting in exchanges and to trading, implementing,

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(77) *A partial example of this is, again, the unilateral decision of the London Stock Exchange, often cited in this paper, to trade on the Seaq International the stocks traded on other European exchanges.*

in full, remote access; public and exchange regulators should avoid discrimination among national firms and intermediaries and foreign ones.

- When an exchange is an efficient monopolist with all costs lower than those of other exchanges, then there is neither an exchanges' nor a social incentive to achieve an implicit merger. If competition leads to an efficient monopoly, welfare is maximized. There is no need in each country either for a national exchange or for a national airline. Protectionist regulations that, for example, give tax exemptions to national firms that list only in the national exchange and not in foreign exchanges are inefficient and more costly for the taxpayer.
- Total consumer surplus is strictly higher with implicit merger, in all cases but one (when it is unchanged). Even when an exchange remains monopolist, implicit merger keeps alive some price competition. That is the difference from having an explicit juridical merger among the exchanges.
- Specialization of exchanges is possible where they decide for complete compatibility (implicit merger and remote access). If there are differences in marginal costs, one exchange could just list the firms and the other could accept intermediaries as members for trading. In an extreme case, it could happen that the listing service may be done by rating agencies and the trading by exchanges.
- An exchange with a very strong market power will never look for agreements with others. This is compatible with the network externality literature that predicts that a firm, expected to have a large network, prefers incompatibility. Only exchanges that are dominant and have decisive cost advantages in listing and trading services may avoid implicit mergers as they will be in any case the only one to survive. Their profits in the pure-competition case are in any case higher as they perfectly discriminate.
- The model shows that network externalities may lock-in exchanges into inefficient outcomes, due to a lack of coordination, even in perfect competition. This is a standard finding of the literature. In these cases, implicit mergers improve welfare, consumer surplus, and total profits. There is, even in this case, a strong incentive for exchanges to achieve compatibility. They just have to agree on some side payments from one to the other.

The specialization issue is very important also to interpret some existing behaviors.

- On the one hand, some exchanges may achieve unilateral compatibility if the fixed cost to do it is less than the new profits gained. This explanation is consistent with the aggressive policy of the London Stock Exchange in the late 1980s, when the LSE decided to trade the major stocks listed in the other European exchanges, or with the U.S. case, which has a system of regional exchanges that only have to apply to the SEC in order to trade in stocks listed on other exchanges.
- On the other hand, the use of this simple model helps to understand the dramatic evolution and success of automated trading systems (like Globex, Instinet, or even Tradepoint). In fact, they can be seen either as exchanges that have already specialized in trading or as exchanges

that *unilaterally* achieve “compatibility” with other exchanges listing stocks already listed there. In a sense, they free-ride on the listing process for many of the securities they trade, and enter the market using the fact that their trading costs may be lower than those of regulated exchanges, given the regulatory bias in their favor.

## II.5 CONCLUSIONS

Competition among stock exchanges is a new phenomenon since only recently have they become more like firms than legal, public or private, monopolies. This chapter focuses on the possibility that network externalities have a role in this competition as suggested by Domowitz (1995). We use and adapt Katz and Shapiro’s (1986a and 1986b) models, introduce the possibility of cross-network externalities, and study the compatibility decision of exchanges. The competition and the new regulations in Europe can push towards implicit mergers and remote access. Such a strategy may be followed by exchanges and, in cases of cross advantages in marginal cost, exchanges and consumers may increase their profits and surpluses.

The implicit-merger model shows that specialization among exchanges is possible; they could specialize in listing or trading services. In this sense the great success of automated trading systems (ATS) could be interpreted as an already existing specialization. ATS are exchanges that achieve unilateral compatibility by trading stocks listed on other exchanges, given their strong cost advantage. As Domowitz (1995) notes, “electronic exchanges are increasingly cost effective. The days of \$100 million developments are over, and it is now possible to build a very nice facility, hardware and software, for under \$10 million”. From the point of view of the firms, the unilateral decision of trading their stocks on many markets (and, in the case of ATS, for free) should increase their utility. On the other hand, Amihud and Mendelson (1996) argue that a security issuer should have the exclusive right to determine the markets in which its security will be traded.

Implicit mergers and remote access can be helpful in exiting lock-in Pareto-inferior equilibria, and should be guided by policy makers. However, if an exchange is becoming a monopolist due to strong advantages in costs, then policy makers should abstain from imposing, directly or indirectly through regulation, implicit mergers, even if the national exchange is losing. Integrated financial markets mean that the welfare of national firms and intermediaries does not depend on their national exchange.

Finally, the model can be extended straightly to the  $n$ -exchanges case; the implications are identical. We can have up to  $n$ -Nash cross-corner equilibria but implicit mergers are welfare improving and leave space for a maximum of two exchanges: the most efficient.

The future could be one where regulated exchanges are only order driven, as quote-driven systems could be replaced by each dealer trading directly on its own account with some information disseminators putting them together (maybe with software or the Internet). Economides (1993) argues that “the present electronic communication technology allows an

individual or a firm not in financial intermediation to participate in the exchange on almost equal footing as a broker. One expects that [...] regulations will be liberalized in the face of technological change”. Rating agencies may produce listing services in the sense that they may rate firms independent of their listing and exchanges or ATS could then decide what could be traded in them.

### III. CUSTOMER-CONTROLLED FIRMS: THE CASE OF STOCK EXCHANGES

#### III.1 INTRODUCTION

In many industries there are customer-owned enterprises; agricultural cooperatives are the most common example but they can be found also in utilities, social affiliation, housing, and banking. In many cases, all the customers have a share of the property of the firm and there are no outside shareholders (i.e., shareholders who are not at the same time customers of the firm), but this is not necessarily true. In general not all the owners are customers of the firm and not all the customers are also owners; there may exist other customers who buy the products of the firm and shareholders who do not buy the products of the firm. An example is in the stock-exchange industry. Many stock exchanges are owned or controlled by financial intermediaries who are the major buyers of the exchanges’ services; on average, one third of the European exchanges’ revenues come from trading services paid by financial intermediaries (Baggiolini, 1996), which are often, at the same time, among the major owners of the exchange itself. In stock exchanges, there may exist shareholders who are not customers (for example, when exchanges go public) and there may exist customers who are not owners (intermediaries, listed firms, price vendors, trading system providers).

In these kinds of firms, pricing policies and, in general, profit-maximization policies are decided by some of the customers (who are shareholders, indeed) who consume the good, whose price they are fixing themselves. This chapter investigates whether there are any “perverse” effects on having these “dual-capacity” individuals who have a relationship with the firm. On one hand, they get utility as a share of the firm’s profits; on the other hand, they get more utility paying the lowest price possible for the good they purchase from the firm. The different maximizing problems of diverse shareholders can also create conflicts of interest not only in pricing policies but also in investment policies, in self-regulation, and in enforcement of regulation among members. In the appendix of this chapter, this argument is presented with respect to stock exchanges.

The topic of customer-controlled firms is relevant for many reasons:

- 1) Customer-controlled firms are increasingly important all over the world. Many of them are listed on stock exchanges and pricing policies, which eventually do not lead to maximize

profits, may represent a problem for dispersed and minority shareholders who may gain less profits. Customer-controlled firms, in reality, may not be directly owned by a direct customer but be hidden in complex group structures. For example, it could be that a firm is controlled by a holding and this holding controls another firm that is a customer of the first one (such as a car maker and a tire maker). The transfer pricing between the firms can affect the profitability of both firms' shareholders.

- 2) Normal customers, not owners, may be affected, too, in the case of different pricing policies due to customer-owners. If we start from a monopoly situation, they are going to face lower prices and increase their utility.
- 3) Finally, welfare may be affected, as the quantity and prices may vary depending on the customer and ownership structures of the firm.

In order to give general implications to the paper in terms of different percentages of customer-owners, some strong simplifying assumptions must be made:

- This chapter concentrates on the case where all customers have the same demand; otherwise, it should be checked, case by case, who are shareholders and who are not. In this way, all the "voting" side of the problem, which arises if shareholders have different preferences, is lost.
- If some customers are also shareholders, each of them has the same stake of capital and the same voting capacity.
- Firms acting in a competitive environment always price at marginal cost and customer-owned firms could not behave differently. That is why we concentrate on a non-competitive environment where the firm is a monopolist<sup>(1)</sup>.
- The standard principal-agent problems of the separation between ownership and control are not taken into account, either. It is assumed that the controlling shareholders decide the pricing policies of firms through the management they appoint.

The problem of customer-controlled firms is treated in a general way, but some emphasis is added on its implication over stock-exchange companies, which represent a peculiar example of customer-controlled firm. That is why their ownership structure is described and, in the appendix, their corporate governance problems and some conflict of interest, which may arise, are briefly analyzed.

The main findings of this chapter are the following:

When a monopolist firm, with constant marginal costs, faces customers who have the same completely inelastic unit demand, then welfare is never affected if the firm is customer-owned or controlled. Actually, in this case, the monopoly always achieves the first best outcome. This firm will always price at the monopoly price as far as the customer-owners have a stake in the firm higher than their proportion among consumers. But if the customer-owners

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(1) *Utilities are a common example of customer-owned firms and are generally monopolist (Hansmann, 1996).*

are “a lot” compared to the capital they own in the company, then the firm will price at zero (even lower than the marginal cost), “ripping off” all the common investors in the firm, as it gets zero or negative profits. On the other hand, if the firm is a cooperative where all the customers are also shareholders with the same voting and claim rights, then pricing policy is irrelevant.

When the firm, with constant marginal costs, faces a downward linear demand, then total welfare tends to the pure-competition welfare the closer is the percentage of capital owned by customers to the proportion of customer-owners on total customers. In this case, a monopoly is a first best solution. The firm never prices at the monopoly price. Minority shareholders always receive less profits or even a loss whenever there are many customers who own a stake of the firm a bit lower than their ratio on total customers. In this case the firm will price at zero.

The chapter is organized as follows: Section 3.2 gives some background on the problem from a theoretical point of view and with regard to the stock-exchange industry. Section 3.3 analyzes the unit-demand case. Section 3.4 presents the linear downward-demand case. Section 3.5 concludes, giving some implications. The appendix deals with the corporate governance of exchanges and conflict of interest.

## III.2 CUSTOMER-CONTROLLED FIRMS AND STOCK EXCHANGES

The relation of a customer-owner with the firm is very special; she gets utility from the consumer surplus from buying the good, and from a part of the profits of the firm itself.

As Hansmann (1996) notes, “firms that are collectively owned by their customers are surprisingly common and play an important role in a variety of markedly different industries”. In general they are not common in the retail goods market but more in the wholesale market. Classical examples of customer-owned enterprises, carefully described by Hansmann (1996), are: consumer cooperatives whose primary business is farm supplies; bookstores; utility companies; clubs and other associative organizations; housing cooperatives and condominiums; cooperative and savings banks owned or controlled by depositors or borrowers; and insurance companies.

Another example of an industry with customer-controlled firms is the stock-exchange industry.

### III.2.1 THE OWNERSHIP STRUCTURES OF STOCK EXCHANGES

Stock exchanges have different ownership structures, from the continental European traditional view of the exchange as a public entity to the new Scandinavian and Australian view of the exchange as an investor-owned firm (even a public company listed on a stock exchange itself).

In reality, there are many categories in which exchanges can be classified according to their ownership structure<sup>(2)</sup>:

- public entities;
- cooperatives of intermediaries;
- corporations controlled by intermediaries;
- corporations controlled by intermediaries, institutional investors, and issuers;
- corporations controlled by outside owners.

There are also some exchanges where the board may be composed of representatives not elected by shareholders<sup>(3)</sup>.

If shares are freely tradeable, it is plausible to think that some of the customers of the exchange, like intermediaries, listed firms, or information vendors, may buy shares of an exchange to extract private rents in terms of pricing of the different goods or even in terms of loose self-regulation by the exchange.

On the other hand, it “is apparent that the LSE is increasingly being run as a business than a cooperative. We can see no reason why the stock exchange should not now develop a corporate structure”<sup>(4)</sup>.

Currently, many stock exchanges are cooperatives of intermediaries or corporations controlled by them. In the Stockholm Stock Exchange issuers have 50% of the shares, while the Australian Stock Exchange, Amsterdam, and Tradepoint are listed companies and so private investors may own their capital.

*An application of Hansmann’s (1996) theory of the ownership of enterprise to financial exchanges*

Two questions arise (Ferrarini, 1996): why “members’ ownership” has prevailed as the main ownership structure of exchanges, and what is driving the ownership structure towards outside ownership.

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(2) See Cybo Ottone (1997).

(3) *The structure of the Board of the London Stock Exchange (21 people) is somewhat peculiar because, although membership is open only to intermediaries, there are members representative of institutional investors (2), listed companies (3), private client firms (3), and securities houses (5); there is also the government broker (appointed by the Bank of England), five executive directors, the chairman, and a deputy chairman (London Stock Exchange, 1996, appendix A).*

(4) *See the proposals of the Treasury Committee of the House of Commons of the British Parliament (March 1997) demanding that the LSE no longer be owned by member companies and move to a public offering (Financial Times, 1997b); a member of the British Parliament was quoted as saying that “the stock exchange has been run for the short-term interests of market makers rather than the maximum benefit of the London market as a whole” (Financial Times, 1997a).*

Both questions can find an answer in Hansmann's (1996) theory of the ownership of enterprise. In his book, Hansmann treats every firm and its ownership structure looking at the relations between the firm and its "patrons" (i.e. "all persons, individuals, or other firms, who transact with the firm either as purchasers of the firm's products or as sellers to the firm of supplies, labor, or other factors of production").

All firms can be classified according to three ownership structures:

- Producer-owned enterprises like employee-owned firms, agricultural cooperatives, or investor-owned enterprise which are the normal business corporations owned by patrons who supply one of the factors of production: capital.
- Customer-owned enterprises.
- Nonprofit and mutual enterprises, like many nonprofit firms, banks and insurance companies, which have no owner<sup>(5)</sup>.

The cost of market contracting and the cost of ownership lead to the different structures. As the cost of transacting is high<sup>(6)</sup>, it is efficient, other things being equal, for firms and patrons to internalize these costs so that one category owns the other. Then it is more efficient that this integration happens with the patrons with whom transacting is more costly<sup>(7)</sup>. Different structures of ownership imply different costs of governance and monitoring managers. These costs vary with respect to different classes of patrons as some of them may better govern the firm.

Hansmann's ideas can explain why member-owned exchanges arose and why they are changing.

First of all, exchanges were firms with a great degree of monopoly power in dealing with their customers and "this is a common reason for organizing the firm as a consumer cooperative". In this way, member firms could avoid two types of costs: the first is paying a monopoly price for the trading services they purchased from the exchange; the second is the underconsumption of trading services due to high prices<sup>(8)</sup>. The cost of ownership in an exchange led naturally to a members' ownership, as exchange members were quite homogeneous. Thus, this minimized the cost of collective decision making and gained

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(5) *A firm's "owners" are those persons who share two formal rights: the right to control the firm and the right to appropriate the firm's profits or residual earnings. In nonprofit firms, in particular, the persons who have control are barred from residual earnings and so they cannot be considered owners.*

(6) *There are several market imperfections whose costs can potentially be reduced by assigning ownership to the affected patrons (ex-ante and ex-post market power, risk of long-term contract, asymmetric information, strategic bargaining communication of patron preferences, etc.).*

(7) *For example, if a firm is a monopolist with respect to consumers but purchases its factors of production in a competitive market, then total costs are minimized if it is owned by its customers.*

(8) *It must be admitted that this is true only if members could not pass along all the higher costs to final consumers, which is likely, at least for trading on their own account.*



managerial control with low costs as generally the intermediaries themselves had all the relevant information needed to organize and manage their exchange.

Nowadays, exchanges are moving from being customer-owned to being investor-owned and Hansmann's general explanation can be exploited, too.

Integration of the markets and evolution of technology change the monopoly position of exchanges, reducing the main advantage of members' ownership. Exchanges must raise capital to compete efficiently and investor ownership is the obvious solution to solve, at least partially, asymmetric information problems in the capital market<sup>(9)</sup>. The cost of ownership in the new environment is reduced by investor-owned exchanges mainly because the cost of collective decision making is increasing due to the massive heterogeneity of exchange members. There are no more simple brokers of the same size and profitability but they are more and more diverse. Banks are much different from brokers. Market makers, which may be different from banks, have different interests from brokers. In short, there are many conflicts among members that increase the cost of governance. Furthermore, risk bearing is reduced in an investor-owned exchange by definition, as investors are in a position to eliminate firm-specific risk through diversification of their investment<sup>(10)</sup>.

### III.2.2 THE LITERATURE ON CUSTOMER-CONTROLLED FIRMS

From an industrial organization point of view, the first thing that makes customer-controlled firms different from normal firms is that, due to ownership structures, the management may not necessarily want to maximize profits. In fact, the price for, at least, one of its products can influence the shareholders' value not only through the firm's profit but also through their consumption of the good as long as the firm is not perfectly competitive. In general industrial organization textbooks view this exception as of minor importance because, as Tirole (1988) states, "the shareholders' (at least the influential ones') consumption of their firms' products is usually very small, so that price effects are small relative to the income effect generated by the firm's profit level". However, this may not be true for all the firms. Scherer (1980) says that deviations from profit-maximization behavior, "both intended and inadvertent, undoubtedly exist in abundance, but they are kept within more or less narrow bounds by competitive forces, the self-interest of stock-owning management, and the threat of managerial displacement by important outside stockholders and takeover traders". These three conditions

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(9) *Hart and Moore (1995) and Cybo Ottone (1997) raise this important point.*

(10) *In general, patrons face much higher costs in spreading their transactions across a number of different firms in different industries. Actually, member firms in exchanges may have the chance to be customers and shareholders of more exchanges as shares become tradeable (see, for example, Amsterdam, Stockholm, Milan, etc.).*

are becoming slowly existing for exchanges, too. Competition is increasing. Stock-owning management already exists in some exchanges (the LSE, for example). Takeovers begin to happen (OM over Stockholm Stock Exchange), as well as outside ownership so that new owners replace old management.

Beyond Hansmann's (1996) book, the literature on customer-controlled firms is not abundant, while the theoretical and empirical literature on cooperatives is considerable<sup>(11)</sup>.

A deep analysis is in King (1977), which uses a simple model of a stock-market economy<sup>(12)</sup>. There is a "two-period, three states, one commodity" world in which there are a given number of securities consisting of shares in a fixed number of firms. Shareholders' consumption is affected by the firms' policies and "there is no presumption that the policy which maximizes the share price is in the shareholders' interest [...] because the firm can alter the effective prices of the goods which the shareholders are implicitly purchasing". This is true in particular when the firm is a monopolist and in general "in any circumstances in which the firm can affect the prices of commodities which its shareholders buy or sell, directly or indirectly [...] This is often overlooked because the firm is regarded as a black box and the composition of its owners ignored" (King, 1977).

McAndrews and Rob (1996) analyze the ATM networks, which are often customer-controlled because cooperatives of banks own the ATM companies. The demand of banks for ATM services is a derived demand because the final demand is the one by bank customers. This framework looks very much like the case of stock exchanges, which can be seen as networks owned by intermediaries who are customers for the trading services that are really necessary to satisfy the demand for trading services of final investors. McAndrews and Rob (1996) show that the reason that joint ownership of a network switch occurs is twofold: "first, the joint ownership of the wholesale switch eliminates a double margin as in a standard vertical integration story [...]; second, [...] joint ownership results in more concentrated markets, in which the network externality is more fully exploited [...]. Indeed, the monopoly equilibrium of the jointly owned network produces the same output as the solely owned network".

Barone and Masera (1997) propose, among other things, the listing of stock exchanges on exchanges themselves, claiming that in this way minority shareholders would be more protected and the market could verify their efficiency.

One paper related to the ownership structures and stock exchanges is the one by Hart and Moore (1995).

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(11) See Bonin et alii (1993) for a recent survey, even though they concentrate on producer cooperatives.

(12) King's model is also analyzed by Macchiati, 1992.

*Hart and Moore's (1995) paper*

This paper underlines at the beginning the new challenges of exchanges: the increasing competition, due to reduced cost of communication; the changing product mix of exchanges, which no longer need to be vertically integrated as many functions (providing a trading mechanism, disseminating information, providing a clearing house, settling trades, etc.) can be offered by specialist service providers; the need to finance substantial investment programs; more open and diverse membership so that many members may have other activities outside the exchange (such as over-the-counter businesses) which make themselves competitors of the exchange.

Then, the paper considers that exchanges differ from most commercial organizations because the major exchanges are run as cooperatives, on behalf of their members, the people who use the exchange, while, on the other hand, the most common form of governance structure is outside ownership.

The purpose of their paper is to show that both outside ownership and the cooperative structure are inefficient, for different reasons and in different ways. The analysis of Hart and Moore suggests that the relative merits of the two structures depend on the level of competition between exchanges and the diversity of interest of the exchange members: the greater the competition and the greater the diversity, the more likely that outside ownership will be more efficient. The policy implication is that it is no more sensible to operate exchanges as cooperatives and “the balance of the argument is shifting towards outside ownership and this seems to be supported by the actions of the Stockholm Exchange, the CME and Nymex”.

Hart and Moore (1995) study the problem in an extreme way; they compare a profit maximizing firm (outside ownership) with a customer owned firm (cooperative). They compare an exchange facing a linear demand, which is the sum of 100 unit-demand functions with reservation prices distributed from 100 to 1, and each customer is a shareholder with one vote. They clearly show that, given the marginal cost at 20, the profit-maximizing choice for the outside owner is pricing at 60 selling the good to 40 people while the cooperative-maximizing choice is to price at 10, because of the voting rule that penalizes all the members of the cooperative who cannot trade but have a loss given that the firm prices under the marginal cost. In the paper, all the customers are also owners and all the owners are also customers.

Hart and Moore's analysis shows that a members' cooperative is relatively more efficient than outside ownership. Introducing competition, outside ownership becomes relatively more efficient than a cooperative, even if this is true only for a very small range of prices. In fact, they admit that “in a pure pricing model, where the median is smaller than the mean, a members' cooperative will be (at least weakly) more efficient than outside ownership--no matter how skewed the distribution towards the smaller traders, and no matter how strong the competition”. In any case, “free entry encourages the membership to adopt a policy of pricing at cost-which is more efficient”.

Hart and Moore's results<sup>(13)</sup> are difficult to generalize to the case of customer-controlled (and not fully owned) firms given that they have a very particular demand function, unless assumptions are made on who the customer-shareholders are and on each single demand function.

### III.3 THE UNIT-DEMAND MODEL

In this section, it is assumed that the firm is a monopolist in its market and is controlled by some of its customers who naturally want to maximize their total utility, which is composed of their consumer surplus and part of the profits. If these customer-owners have the right to appoint the management, this becomes also the maximizing policy of the firm. Agency problems between management and shareholders are not taken into account.

By assumption, all customers have the same utility function. In this way when the problem is extended to customers who only control the exchange, there is nothing to worry about their identity.

There are  $i$  customers ( $i=1,2,..,I$ ) who all have a completely inelastic demand for one unit of the good, which gives them gross utility of  $U$  (i.e., the consumer always buys the good if its price is lower than  $U$ ) and net utility  $U-P$ . All payoffs are monetary.

Some customers may be shareholders, too: call  $OCU$  the total *owner-customer utility*, which will vary in the following cases.

The monopolist has marginal cost of  $c < U$  and prices cannot be strictly negative.

#### III.3.1 THE PURE MONOPOLIST

The pure monopolist prices, obviously, at  $U$  and its total profit will be  $I(U - c)$ , which is also equal to the social welfare as consumer surplus is zero.

#### III.3.2 THE CUSTOMER-OWNED FIRM

**Proposition 9.** *The pricing policy of a monopolist owned by all its customers with equal unit demand is irrelevant.*

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(13) *Hart and Moore also use a model with quality choice and a pricing model where traders vary in size, to strengthen their results.*

If all the customers own the monopolist and are the only customers, then pricing policy is totally irrelevant as the total profits for the customers-owners will be  $I(U-p)+I(p-c)=I(U-c)$ , equal to the total welfare, whatever price is fixed. Each customer will receive  $OCU = \frac{I(U-c)}{I} = U-c$ .

**Proposition 10.** *A monopolist owned by some of its customers with equal unit demand will always price at the monopoly price.*

If only a part of customers ( $B$  with  $B/I = \alpha$ ) own 100% of the firm ( $0 < \alpha < 1$ ), then the problem of the manager of the firm becomes that of maximizing the utility of each customer-owner:  $\max \frac{I(p-c)}{B} + (U-p)$ . The first term in brackets is the part of profits that goes to each customer-owner while the second part is her consumer surplus. It can be rewritten as  $\max p \frac{1-\alpha}{\alpha} + U - \frac{c}{\alpha}$ , which is an increasing function in  $p$  as  $\alpha$  is less than one and then the firm will price at the maximum possible price  $p=U$ . Total profits are  $\Pi = I(U-c)$  and total welfare is obviously the same given that there is a monopolist that perfectly price discriminates.  $OCU = \frac{U-c}{\alpha}$ , the customer's share of profits.

### III.3.3 THE CUSTOMER-CONTROLLED FIRM

**Proposition 11.** *A monopolist controlled by some of its customers with equal unit demand will price at the monopoly price (their reservation price) if they control a share of capital higher than their proportion among the other consumers; if it is lower it will price at zero even with positive marginal costs. Pricing policy is irrelevant if the share of capital owned by customer-owners is equal to their proportion among the other consumers.*

Suppose now that the customer-owners only control the firm (so that the pricing policy is still decided by them) but do not own it completely (i.e., there are some minority shareholders). Assume that  $\alpha$  customers control a total fraction  $\delta$  ( $0 < \delta < 1$ ) of the firm; this fraction could be even less than 51% but must be such that the pricing policies are decided by them (i.e., the customers elect the management<sup>(14)</sup>). Then, assume that the controlling customers get in total  $\delta$  profits (i.e., there is just one type of stock).

In this case the managers want to maximize:

$$\max OCU \equiv \max \delta \frac{I(p-c)}{B} + (U-p) \equiv \max \frac{p(\delta-\alpha) - \delta c}{\alpha} + U.$$

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(14) *With disperse shareholding, like that in public companies, firms can be controlled even with less than 5% of the capital.*

As far as  $\delta > \alpha$ , the function is increasing and the firm will find it profitable to price at the monopoly price  $U$ . This means that if the customer-owners act more as owners than customers in the market (i.e., the share of capital held by customer-owners is higher than their proportion over the total number of customers), then they will act as outside owners, pricing at the customer's reservation price  $U$ :  $OCU = \delta \frac{(U-c)}{\alpha}$ .

If  $\delta = \alpha$ , pricing policy is irrelevant as in the first case. Price will disappear from the profit function, meaning that each price will maximize it:  $W^i = U - c$ .

If, on the contrary, the customer-owners act more as customers than owners, (i.e.,  $\delta < \alpha$ ), the function is decreasing and the pricing policy of the firm will be to price at zero. It is convenient to price under marginal costs because then the customer-owner must bear part of the loss as profits will be negative, but his consumer surplus increases more than the loss, as some minority shareholders will share the loss:  $OCU = \frac{\delta}{\alpha}(-c) + U$ . Welfare is, obviously, always the same, given that now consumers exploit all the surplus:

$$W = I(0 - c) + I(U - 0) = I(U - c)$$

The problem is clear. A customer-controlled firm may not maximize profits. In this way, the minority shareholders receive less dividends than normal.

Another implication is that the customer-owners may not necessarily be direct customers of the firm but they may control other customers of the firm (i.e., other companies). An example may be represented by interbank deposits among banks belonging to the same group.

In any case there is no social loss given this demand function.

### III.3.4 A NUMERICAL EXAMPLE

Assume we have three customers ( $I=3$ ) with the same completely inelastic unit demand with reservation price  $U=6$ . The monopolist has marginal costs of  $c=2$ .

A profit-maximizing monopolist will naturally price at 6, getting profits of  $\Pi = I(p - c) = 3(6-2) = 12$ . Consumer surplus is zero.

A fully customer-owned firm may price whatever it wants given that each customer-owner will get  $U - c = 6$ , independent of the price.

A firm fully owned by *some* of its customers (for example 2) will price at the monopoly price (6) and each of them will get

$$OCU = \frac{U-c}{\alpha} = \frac{6-2}{\frac{2}{3}} = 6.$$

A firm *partially* owned by *some* customers may price at the monopoly price or at 0 depending on the relative weight of the customer-owners.

If there are two customers (66.7% of customers) who own 80% of the firm, the price will be the monopoly price and each customer will get

$$OCU = p \frac{\delta - \alpha}{\alpha} + U - \delta \frac{c}{\alpha} = 6 \frac{80 - \frac{2}{3}}{\frac{2}{3}} + 6 - \frac{80}{100} \frac{2}{\frac{2}{3}} = \frac{24}{5} = 4.8.$$

If the two customers own 10% of the firm (still deciding the pricing policy), then the firm will price at zero, and

$$OCU = p \frac{\delta - \alpha}{\alpha} + U - \delta \frac{c}{\alpha} = 6 - \frac{1}{10} \frac{2}{\frac{2}{3}} = 5.7.$$

#### III.4 THE LINEAR DOWNWARD-DEMAND CASE

In this section we analyze the same problem with a linear downward-demand function in order to check the effect on the maximizing behavior of customer-controlled firms.

Again, in order to generalize the argument, there is a set of customers with the same demand function.

We have  $I$  individuals with demand  $q_i = a - P$  with  $i = 1, 2, \dots, I$ .

$0 \leq P \leq a$  is the usual condition for positive finite sales and profits.

Aggregate demand is the sum of individual demands:  $Q = Iq_i = I(a - P)$ . The aggregate inverse demand (which is the horizontal sum of the single demands) is  $P = a - \frac{Q}{I}$ .

Marginal cost ( $c$ ) is constant and there are no fixed costs.

$\alpha = \frac{B}{I}$  is the percentage of customers who are also owners.

$\delta$  is the aggregate capital that the  $\alpha$  customers possess.

Each customer-owner wants to maximize its private profits, which come in part from the profit of the firm and in part from its consumer surplus<sup>(15)</sup>.

With linear downward-demand function<sup>(16)</sup> and constant marginal cost, the maximizing  $OCU$  is

$$\max \frac{\delta}{B} \Pi + \frac{(a - P)Q}{2} \frac{1}{I} = \max \frac{\delta}{B} I(a - P)(P - c) + \frac{(a - P)^2}{2}.$$

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(15) The generic formula of the “owner-customer utility” ( $OCU$ ) with an increasing supply curve  $c(Q)$  is

$$OCU = \frac{\delta}{B} \left( PQ^* - \int_0^{Q^*} c(Q) \right) + \frac{1}{I} \left( \int_0^{Q^*} f(Q) - PQ^* \right)$$

where the first term is the share of the firm’s profit for the customer-owner and the second term represents its consumer surplus.

(16) We assume that all payoffs are monetary; thus, the consumer surplus, which we take simply as the area under the demand, is expressed in monetary terms.

### III.4.1 THE PURE MONOPOLIST

A pure monopolist, obviously, maximizes profits:

$$\max \Pi = \max I(a - P)(P - c)$$

$$P = \frac{a+c}{2}; Q = I \frac{a-c}{2}; \Pi = I \left( \frac{a-c}{2} \right)^2.$$

Total consumer surplus is  $C_S = \frac{(a-P)Q}{2} = I \frac{(a-c)^2}{8}$ ; individual consumer surplus is  $\frac{(a-c)^2}{8}$ .

$$\text{Welfare is } W = \Pi + C_S = I \left( \frac{a-c}{2} \right)^2 + I \frac{(a-c)^2}{8} = I \frac{3(a-c)^2}{8}.$$

### III.4.2 THE CUSTOMER-OWNED FIRM

It is straightforward to see that if the firm is customer-owned (i.e.,  $B = I$  and  $\delta = 1$ ), then the maximizing price is  $P = c$ . The firm makes zero profit but the customer-owner gets more consumer surplus.

In fact the maximization problem of the customer-owner becomes

$$\max OCU = \max(a - P)(P - c) + \frac{(a-P)^2}{2} = \max aP - ac - P^2 + Pc + \frac{a^2 + P^2 - 2aP}{2}.$$

The first-order condition is

$$a - 2P + c + P - a = 0 \Rightarrow P = c.$$

Given that the second-order condition equals -2, the function is strictly concave.

$P=c$  is the unique maximum,  $Q = I(a - c)$ ,  $\Pi = 0$ .

Total consumer surplus is  $C_S = I \frac{(a-c)^2}{2}$ ;

individual consumer surplus is equal to  $OCU$  and is  $\frac{(a-c)^2}{2}$ .

Welfare is  $W = \Pi + C_S = I \frac{(a-c)^2}{2}$ .

Notice that if the firm had priced at zero,  $OCU$  would have been, of course, lower<sup>(17)</sup>.

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(17) In particular, with a zero price  $OCU = \frac{a^2 - 2ac}{2} < \frac{(a-c)^2}{2}$  as  $c > 0$ .



### III.4.3 THE CUSTOMER-CONTROLLED FIRM

Here the situation is more complicated.

$$\begin{aligned} OCU &= \frac{\delta}{B} I(a-P)(P-c) + \frac{(a-P)^2}{2} \equiv \frac{\delta}{\alpha} (aP - ac - P^2 + Pc) + \frac{a^2 + P^2 - 2aP}{2} = \\ &\equiv \frac{2\delta aP - 2\delta ac - 2\delta P^2 + 2\delta Pc + \alpha a^2 + \alpha P^2 - 2\alpha aP}{2\alpha} = \\ OCU &= \frac{1}{2\alpha} \left[ P^2(\alpha - 2\delta) + P(2\delta a + 2\delta c - 2\alpha a) - 2\delta ac + \alpha a^2 \right] \end{aligned}$$

Remember that  $0 \leq P \leq a$ . For  $P = a$  nobody buys any good and  $OCU=0$ , while for  $P=0$  the function has value<sup>(18)</sup> of  $\frac{-2\delta ac + \alpha a^2}{2\alpha}$ .

The first-order condition of the  $OCU$  is

$$FOC: \frac{1}{\alpha} [P(\alpha - 2\delta) + a(\delta - \alpha) + \delta c] = 0 \Rightarrow P^* = \frac{a(\delta - \alpha) + \delta c}{2\delta - \alpha}.$$

Notice that for the relevant values of  $P$  the first derivative has value of  $\frac{1}{\alpha} [a(\delta - \alpha) + \delta c]$  when price is 0 (and this value is less than zero, indicating a decreasing function, for  $a(\alpha - \delta) > \delta c$ ) but is always smaller than zero for  $P=a$  (the first derivative becomes  $\varepsilon(c - a)$ , which is always negative) indicating the  $OCU$  for the relevant values of  $P$  is always decreasing if it is convex or is in any case decreasing when  $P=0$  (eventually after a maximum) if it is concave.

The second-order condition is

$$SOC = \frac{(\alpha - 2\delta)}{\alpha}.$$

There are two main cases, related to the concavity or convexity of the function.

- The function is strictly convex when  $\delta < \frac{\alpha}{2}$ .

**Proposition 12.** *If some customers of a firm own a share of the firm lower than half of their proportion on the total number of customers, then they will always price at zero. Minority shareholders get only losses and welfare can be better than the monopoly case.*

In this case, the first-order condition gives us only the minimizing price. The price that maximizes profits will be the one that gives the highest corner solution. Given that the function

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(18) Notice already that  $\frac{-2\delta ac + \alpha a^2}{2\alpha} < 0$  when  $\delta > \frac{\alpha a}{2c}$ , i.e. when the customer-owners have a share of capital higher than half their proportion on total customer multiplied by a factor  $\frac{a}{c}$  that is always greater than one. This means that when the customer-owners are “much more owners than customers”, they will never price at zero because they would get negative utility.

is strictly decreasing in the relevant range,  $OCU$  is maximized when the price equals zero. Notice, that welfare can be better than the monopoly case. In fact,  $I \frac{3(a-c)^2}{8} < -caI + \frac{Ia^2}{2}$  if  $a^2 - 3c^2 - 2ac > 0$  which is plausible for sufficiently low marginal costs.

- If the function is strictly concave ( $\delta > \frac{\alpha}{2}$ , which means that a percentage  $\alpha$  of customers own a share  $\delta$  of the capital of the firm that is at least more than double of their percentage of the firm), then the first derivative is decreasing in  $P$  (its coefficient in the first derivative is negative, and so the slope of the function is decreasing). In order to have an interior solution we need that the profit-maximizing price  $P^*$  is in its relevant range (positive but not higher than  $a$ ):

$$0 \leq \frac{a(\delta - \alpha) + \delta c}{2\delta - \alpha} \leq a.$$

The second part of the inequality is always satisfied for  $c \leq a$  which is always true to have positive supply.

**Proposition 13.** *A monopolist controlled by some of its customers never prices at the monopoly price.*

The maximizing price will be always lower than the monopoly price, if the function is strictly concave (and if it is convex, it will always price at zero): in fact  $\frac{a(\delta - \alpha) + \delta c}{2\delta - \alpha} < \frac{a+c}{2}$  as  $c < a$ .

**Proposition 14.** *If some customers of a monopolist own a share of the firm higher than their proportion on the total number of customers, then the firm will always price higher than its marginal cost. Welfare improves with respect to the pure monopoly, but minority shareholders get less profits.*

The first part of the inequality is always satisfied for  $\delta > \alpha$  given that the marginal costs must be positive. More formally, it is satisfied whenever  $\delta c \geq a(\alpha - \delta)$  (remember that we are in the case of a strictly concave function and so in any case  $\delta > \frac{\alpha}{2}$ ).

Actually, if  $\delta > \alpha$ , then the firm will always price higher than its marginal cost: in fact  $\frac{a(\delta - \alpha) + \delta c}{2\delta - \alpha} > 0$  if  $\delta > \alpha$ .

**Proposition 15.** *If some customers of a monopolist own a share of the firm equal to their proportion on the total number of customers, then the firm will always price at its marginal cost. Welfare is maximized but minority shareholders get zero profits.*

With customer-controlled firms, the competitive outcome with  $P^* = c$  is achieved in two cases: if  $\alpha = \delta$  and  $a = c$ . The first case is very important because it means that the “social”

problem of customer-controlled firms is solved if the proportion of customer-owners with respect to all customers equals their share of the capital of the firm. Naturally the closer are the two proportions, the worse it is for minority shareholders, as the firm will price closer to the marginal cost. In this case there is no incentive for a customer to become a shareholder as she gets the same surplus. When  $a=c$  the firm can only price under marginal cost, thus getting only losses. There could be an improvement in welfare from the monopoly case as far as pricing is closer to the perfect competition level.

**Proposition 16.** *If some customers of a firm own a share  $\delta$  of the firm lower than their proportion on the total number of customers and such that  $\delta < \frac{a\alpha}{a+c} (< \alpha)$ , then the firm will always price at zero. Minority shareholders get only losses but welfare can improve with respect to the monopoly case.*

If  $a(\alpha - \delta) > \delta c \Rightarrow \delta < \frac{a\alpha}{a+c} < \alpha$  (remember that  $\frac{\alpha}{2} < \delta$ ), then the maximizing price is negative and for positive prices the *OCU* is decreasing. This means that the maximizing relevant price is 0 (for example  $\alpha = \frac{2}{3}$ ,  $\delta = \frac{2}{5}$ ). In this case the effect on welfare depends on the relative dimension of  $a$  and  $c$ . In fact (the monopoly welfare)  $I \frac{3(a-c)^2}{8} < -caI + \frac{Ia^2}{2}$  (the welfare for  $P=0$ ) if  $a^2 - 3c^2 - 2ac > 0$ , which is plausible for sufficiently low marginal costs.

#### III.4.4 A NUMERICAL EXAMPLE

Take  $I=3$ ,  $a=6$ ,  $c=2$ ,  $Q=3(6-P)$

- The profit-maximizing choice of the pure monopolist is  $P=4$ ,  $Q=6$ , total consumer surplus is  $C_S = 6$ , and individual surplus is 2.  $\Pi^M = 12$  and  $W = 12 + 6 = 18$ .
- The profit-maximizing choice for a fully customer-owned firm is to price at  $P=c=2$ . Then  $Q = 12$ ,  $\Pi^M = 0$ ,  $W = 24$  and each customer-owner will get a private profit equal to the maximum consumer surplus 8. Welfare is maximized; even with a monopolist we have a first best solution.
- For  $\alpha = \frac{2}{3}$  and  $\delta = \frac{2}{3}$ , again  $P = c = 2$ . Then  $Q = 12$ ,  $\Pi^M = 0$ ,  $W = 24$  and welfare is maximized at its first best.
- For  $\alpha = \frac{1}{3}$  and  $\delta = \frac{1}{2}$  the private-profit function is strictly concave. The profit-maximizing price is  $P=3$  and  $Q=9$ . The customer-owner will get

$$OCU = \frac{3(6-3)(3-2)}{2} + \frac{(6-3)^2}{2} = 9,$$

which is naturally higher than the fully owned enterprise where the customer-owner is getting 8.  $\Pi^M = 9(3-2) = 9$ ,  $C_S = 13.5$ ,  $W = 22.5$ .

- For  $\alpha = \frac{2}{3}$  and  $\delta = \frac{3}{5}$  the private-profit function is strictly concave and the profit-maximizing price is  $P=1.5$  and  $Q=13.5$ . The customer-owner will get  $OCU=8.1$ ,  $P=c=2$ . Then  $\Pi^M = -6.75$ ,  $C_S = 30.375$ ,  $W = 23.625$ .

- For  $\alpha = \frac{2}{3}$  and  $\delta = \frac{1}{2}$  the private-profit function is again strictly concave and the profit-maximizing price is  $P=0$  and  $Q=18$ . The customer-owner will get

$$OCU = \frac{3(6-0)(0-2)}{2*2} + \frac{(6-0)^2}{2} = 9.$$

The intuition is clear: the customer-owners push prices to 0 because part of the loss falls over the other shareholders. Notice that  $OCU$  is less than consumer-not-owners' surplus as customer-owners also receive the loss of the firm. They may have an incentive to sell the shares but then the firm will behave like a monopolist, pricing at 4 and they would get only 2 of consumer surplus, thus they keep the shares.  $\Pi^M = -36$ ,  $C_S = 54$ ,  $W = 18$ .

- For  $\alpha = \frac{2}{3}$  and  $\delta = \frac{2}{5}$  the private-profit function is again strictly concave and the profit-maximizing price is  $P=-6$ . This means that the relevant profit-maximizing price is 0, given that the function is decreasing in the relevant range. The customer-owner will get

$$OCU = \frac{2*3(6-0)(0-2)}{5*2} + \frac{(6-0)^2}{2} = 10.8;$$

$\Pi^M = -36$ ,  $C_S = 54$ ,  $W = 18$  as above.

- For  $\alpha = \frac{2}{3}$  and  $\delta = \frac{1}{5}$  the private-profit function is now strictly convex. The first derivative is

$$\frac{1}{\alpha}[P(\alpha - 2\delta) + \delta a + \delta c - \alpha a] = \frac{3}{2}\left(P\frac{4}{15} - \frac{12}{5}\right) \Rightarrow P^* = 9$$

is the minimum of the function and is beyond  $a=6$ , which is the right border of relevant values. There is a convex function that is decreasing in the relevant range. The maximum will be at  $P=0$ .

$$OCU = \frac{3(6-0)(0-2)}{2*5} + \frac{(6-0)^2}{2} = 14.4.$$

The intuition is the same as above: the customer-owners push prices to 0 because part of the loss falls over the other shareholders. Notice the increase in  $OCU$  given that customers possess fewer shares than in the previous example.  $\Pi^M = -36$ ,  $C_S = 54$ ,  $W = 18$  as above.

- For  $\alpha = \frac{1}{2}$  and  $\delta = \frac{1}{3}$  the private-profit function is again strictly concave. The profit-maximizing price is  $P=-2$ . The problem is that the first derivative, for positive values of price, is always negative. The private-profit function is strictly concave and strictly decreasing, so the profit-maximizing value is again at 0.

$$OCU = \frac{2(6-0)(0-2)}{3} + \frac{(6-0)^2}{2} = 10.$$

$\Pi^M = -36$ ,  $C_S = 54$ , as above.

- For  $\alpha = \frac{1}{3}$  and  $\delta = \frac{3}{3}$  the private-profit function is strictly concave with an interior solution. The profit-maximizing price is  $P = \frac{10}{3}$  and  $OCU \cong 10.57$ ,  $Q = 8$ ,  $\Pi^M = \frac{32}{2} \cong 10.67$ ,  $C_S = \frac{2}{3} \cong 10.67$ ,  $W \cong 21.3$ .

### III.5 IMPLICATIONS AND CONCLUSIONS

Customer-controlled enterprises have particular pricing policies that depend on the demand function they are facing. It is thus difficult to generalize a statement about their efficiency. In this paper it is assumed that all customers have the same demand function in order to give general results about the proportion of customer-owners in the firms and their influence on pricing policies.

The results are different from those in Hart and Moore (1995), who note that both outside-owned firms and cooperatives price inefficiently, when facing a downward-sloping aggregate demand formed by all different individual unit demands with reservation prices distributed over a range.

This chapter, due to the different assumptions, finds that customer-owned monopolists achieve the first-best outcome when facing a downward-sloping linear demand and a unit demand (in this last case, pricing policy is irrelevant), formed by identical individual demands.

In the unit-demand case, increasing competition to the monopolist is also irrelevant unless the entrant price is lower than the incumbent marginal cost. Only in this case will the customer-owner shift to it.

In the unit-demand case, welfare is never affected and the firm will price at the monopoly price only if the share of capital of customer-owners is higher than their proportion over the total number of customers. Otherwise, it will price not at the marginal cost but at zero. The implication is clear: if the firm is facing all equal unit-demands<sup>(19)</sup>, investors different from customers should be very careful in buying stocks of this firm because they could get losses. Maximizing-profit firms are the only ones with customer-owners who behave more as owners.

In the linear downward demand case, there are different results. Minority shareholders *always* lose profits if pricing policies are decided by customers, independently of the relative share of capital and the proportion over all customers. The firm will never price at the monopoly price. Minority shareholders are going to lose a lot of money. The minority shareholders may opt to quit the firm but at that point the stock value may already be lower, incorporating the losing pricing policy. In reality, the management will not really price at zero or at the marginal cost, getting negative or zero profits, but will price at a level that can assure a certain amount of profit, surely lower than

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(19) *Such as the demand for trading and listing services that stock exchanges face.*

if the firm was really profit-maximizing. The shareholders who are not customers may not realize that and keep their investment. Given that the firm may be listed on exchanges, there is a clear problem for common investors.

When the share of capital is higher than the share of all the customers, then the firm is pricing closer to the perfect competition level and so welfare always strictly improves. But if the share of capital is less than  $\frac{a\alpha}{a+c}$  (somewhat lower than the proportion of customer-owners over all customers), then the firm will always price at zero. Minority shareholders get a big loss even if welfare may improve, for sufficiently low marginal cost.

An interesting finding is that a customer-controlled monopolist is efficient (pricing at marginal cost) whenever the share of capital owned by (some of) its customer-owners is equal to their proportion on the total number of customers.

Given that public regulation is always worried about minority shareholders, especially if the firm is listed, particular attention should be given to these firms. In particular, it is important to identify not only the transaction between firms and its customer-owners but especially those among the firm and other firms, customers of the first one, and controlled by the same owner.

The implications for stock exchanges depend strongly on the different demands they are facing and the different customers.

Exchanges organized as cooperatives or fully owned companies with homogeneous members always achieve the first-best outcome. The more outside owners enter in an exchange where all the customers are also owners ( $\alpha = 1, \frac{1}{2} < \delta < 1$ ), the lower is the price, and the lower is welfare. But if there are many customers who are not owners, then the optimal policy is to achieve  $\delta$ , the closest possible to  $\alpha$  to get the competitive outcome.

Naturally, an efficient policy could be simply to set regulations such that pricing policies are not necessarily decided by shareholders. Fees could be approved by a public or external regulator, for example, but this seems incompatible with having outside owners, interested only in profits, given eventual rent-seeking behaviors of the customer-owners. Another alternative could be regulation (or self-regulation) of exchanges such that pricing policies are decided by representatives of customers who are not owners<sup>(20)</sup>.

It seems difficult to believe that common investors can be interested in buying shares of exchanges just for profit reasons, to diversify their portfolio, given the “interested” pricing policies of some of its owners. In this sense, the listing of a stock exchange may not seem reasonable as far as intermediaries and other customers of exchanges retain effective control of it. Listing of stock-exchange companies is plausible only with IPO of 100% of capital, limiting

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(20) *An example is the board of the LSE, composed also of representatives of issuers (different from member firms), even though the effectiveness of fair pricing policies is doubtful. In fact, in the year ended in March 1997, the LSE charged high listing and trading fees but then decided to give a rebate of £10 million, only on trading fees, giving back the money just to customer-owners (the intermediaries) and not to the other customers (the listed firms).*

the purchase to investors different from customers. From a welfare point of view, the most efficient policy would be to set the placement of the stock-exchange shares such that customer-owners keep a share of the capital of the exchange exactly equal to their proportion on other customers. In this sense, regulations (or self-regulations) that allow intermediaries to buy shares of the exchange proportionally to their trading volumes (and fees) seem correct.

### III.6 APPENDIX: GOVERNANCE OF EXCHANGES, CONFLICT OF INTEREST, AND SELF-REGULATION

Some countries (Italy, for example) where the stock exchange was a government-owned utility are taking the opportunity of the implementation of the Investment Services Directive (1993/22) to privatize the exchanges, transforming them into companies that eventually could be even listed on an exchange<sup>(21)</sup>. In other cases, even when not government owned, like the LSE, the exchanges transformed into limited companies. In some countries the problems of the governance of the exchange led to reforms, in the U.S.<sup>(22)</sup>, or just to debate (the London Stock Exchange) (LSE, 1996). The access to stock exchanges is not tied any more to the membership and to ownership claims on it<sup>(23)</sup>.

At the same time, the new exchanges have important self-regulatory powers in terms of regulation and supervision of the market that may give rise to conflicts of interest, given some ownership structures. It is easy to understand that the issue of who must be the shareholder of the exchange is relevant in different ways according to the effective powers the exchange may have. Even if it is a private company, in fact, it would be possible that all the decisions are made by an external authority given the importance of the matter. In this latter case, however, someone could be interested in buying shares of the exchange if the return is interesting.

The ownership structure may create, in principle, many conflicts of interest.

- 1) Conflicts between intermediaries that control the exchange and the other intermediaries (either in a minority position or not having shares of the exchange). In particular, they could discriminate through sanctions, not admitting them to particular activities, and discriminating on fees.

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(21) *The Australian Stock Exchange and Tradepoint have already done it. The Paris Bourse is planning its listing (Financial Times, 1998).*

(22) *The reforms of NASDAQ in 1996 are an example.*

(23) *Domowitz and Lee, 1996, describe the growing perplexity about the term "members" of an exchange. "Traditionally the members of an exchange have been the owners of, and the participants on, the exchange's trading systems, and have also either undertaken themselves, or appointed, the management of the system. As such, they were said to have a proprietary interest in the exchange. It is, however, frequently no longer true that the owners and managers of, and participants on, a trading system are all the same institutions".*

- 2) Conflicts between intermediaries who are dealers/market makers (and/or operates on their own account) and brokers. The former prefer to organize the market in an inexpensive and less transparent way to satisfy the need of institutional investors while the latter prefer transparency to meet retail customer need. In any case the conflicts may delay efficiency and development of the markets.
- 3) Conflicts between intermediaries that control the exchange and the intermediaries out of it (especially foreign intermediaries). They would not be interested in facilitating the access and/or remote access to the exchange, imposing artificially heavy rules because of fear of losing business passing from them to the new ones.
- 4) Conflicts between intermediaries that control the exchange and the issuers. They could impose high listing fees and manipulate the market<sup>(24)</sup>.
- 5) Conflicts between intermediaries that control the exchange and the investors.
- 6) Conflicts may also arise when there is not a clear separation between the ownership of the exchange and its customers (the same intermediaries). For example, when the NYSE tried to computerize some operations (in order to maintain market share to benefit shareholders) some shareholders who, as customers, used paper procedures fiercely opposed the project up until the point to damage the new machines<sup>(25)</sup>. Cybo Ottone (1997) discusses the possible interest of some intermediaries to block some labor intensive innovations, citing the examples of the locals of CBOT and of the specialist of the NYSE facing automatic trading.
- 7) Strategic conflicts in the same intermediary, who is a shareholder and has access to the exchange but could be also be interested in developing his own automated trading system or in avoiding to convey trades in the exchange as he could make more money trading on his own account.
- 8) Strategic conflict and conflict of interest for entities who are intermediaries, issuers, and owner of exchanges.
- 9) The most important are the conflicts derived by the relation between ownership structure and the two functions of the exchange (especially after ISD): managing and surveillance of the market. Self-regulation of the exchange<sup>(26)</sup> can have potential problems often analyzed in the literature. In general, self-regulating entities find it difficult to enforce rules against their members (Miller, 1991) and, even if they are sufficiently independent at the beginning, capture is going to arrive, sooner or later: “with self-regulation, regulatory capture is there

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(24) *The experience of the Stockholm Stock Exchange is clear. It became a private company in 1993; a new governance structure was established with member firms, listed companies and investors allowed to 3 directors each; the exchange first act as a private company was to allow remote membership. Today, 27 of the 48 members are foreign owned and 15 of the 27 are entirely remote (Toronto Stock Exchange, 1998).*

(25) *Hathaway (1996), quoted in Barone and Masera (1997).*

(26) *See the arguments in Pirrong (1995).*



from the outset” (Kay, 1988). Obvious examples can be the drafting of market regulation that affects shareholders. On the other side, the reputation and efficient regulation of exchanges affect, in the long run, its success. Fishel and Grossman (1984) point out that there is a close relationship between the extent to which a future exchange provides regulations to achieve customer protection and the volume of trade. Lee (1996) suggests that ownership should not matter if exchanges face stiff competition: “if, say, the LSE’s share-dealing owners created rules and trading systems which favored themselves over their customers, investors would go elsewhere”<sup>(27)</sup>. In this sense, the basic conflict of interest where one member engages in an activity (fraud) that benefits himself but hurts other members and the overall reputation of the exchange (Fishel and Grossman, 1984) is offset by competition among exchanges that should drive out of business the ones with the lowest quality/price ratio. An opposite view is in Pirrong (1995)<sup>(28)</sup>, who refers to market manipulation in commodity exchanges: “one cannot expect competition to ensure efficiency any more than one would expect competition between steel producers to induce them to control the costs of the pollution from their stacks that others bear”.

That is why, in all regulatory regimes, self-regulation in the exchanges is deeply limited by public regulation or supervision, given the importance of the exchange in the financial and economic system. But external regulation may have a perverse effect on the competition among exchanges (Fishel and Grossman, 1994), for example, regulations that increase the fixed cost of operation (antifraud or disclosure regulation or customer-suitability requirements) will have a detrimental effect on the extent to which competition works to assure the optimal quality of transaction services provided by exchanges.

What is crucial is in any case the organizational structure of the exchange itself, in terms of who does what and the checks and balances between ownership and management<sup>(29)</sup>.

Some key points must be considered.

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(27) See *The Economist* (1997).

(28) According to Pirrong (1995), the view that exchanges that adopt inefficient rules concerning conduct of member firms and public customers would suffer losses in trading volume, pushing members to adopt efficient rules as profits increase in volume, has some fallacies: “The assertion that exchange members internalize nearly all of the costs and benefits of deterring manipulation is too sanguine”; the effects of competition on the incentives of exchanges to adopt anti-manipulation rules are exaggerated; and the arguments favoring self-regulation overestimate the intensity of exchange policing efforts because they ignore the effect of rent seeking and influence activities on the costs that exchanges incur to deter manipulation. Furthermore, Pirrong shows many examples where in the absence of outside regulation, exchanges showed no incentives to implement anti-manipulation rules.

(29) *Stimson* (1995) indicates the possible entities that truly govern an exchange: the governing body, the committees of the governing body, the members, individuals connected to members, the customers of the members, the executives, the regulatory supervisor, the national and international regulators, other exchanges, and lobby groups.

- Exchanges are competing markets; the main factors of competition are the quality of the services offered, product innovation, the grade of transparency, and the operative efficiency.
- The corporate governance of an exchange, especially if stocks are traded, has two main functions: the first one, common to every corporation, is to control that the management, and thus the firm, acts in the interest of the shareholders, even the minority. The second one, typical of a regulated exchange, is to give a signal to issuers.
- The same entities could become shareholder of many exchanges in Europe. This could lead to higher prices (listing or trading, depending on who they are) and a monopoly position or simply a cartel.

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