Equity Trading Systems in Europe

A survey of recent changes

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T. Foucault, HEC, Dpt of Finance, 1 rue de la Libération, 78351, Jouy en Josas, France. Tel: 33 1 39 67 94 11. Fax: 33 1 39 67 70 85. E.mail: foucault**Erreur! Signet non défini.**

Abstract

This paper provides a survey of recent changes in the market microstructure of the 5 largest European Stock Exchanges. We first provide a brief statistical overview of European equity markets. Then we discuss how the introduction of the Investment Services Directive and the development of institutional trading have prompted European Stock Exchanges to modify their trading systems since 1994. We show that these exchanges have converged to a similar market organization. In this organization, trading takes place in an order-driven market but trading rules can vary according to the type of securities. We also describe the remaining differences between the trading systems, in particular with respect to the consolidation of the order flow and transparency.

1. Introduction

Since 1994, four new equity trading systems have been introduced by major European exchanges: TSA by the Amsterdam Stock Exchange in 1994, SWX by the Swiss Exchange in 1995, SETS by the London Stock Exchange and XETRA by Deutsche Börse AG, both in 1997. Furthermore, the Paris Bourse upgraded its trading system and reviewed its trading rules in 1994, introducing NSC, a new release of its former trading system CAC. Table 1 in the Appendix provides an overview of these new trading systems. The purpose of this article is to describe their main features and to survey these recent changes in the market microstructure of European Stock Exchanges.

We show that these trading systems share two common features. First they are all electronic order matching systems, which essentially operate as order-driven markets. Second the trading rules in these systems can vary according to the type of security (namely its capitalization and/or its liquidity) or the type of orders (namely large, medium or small orders). This segmentation of the market by securities' types or by orders' types allows exchanges to respond better to the variety of needs of both investors and firms.

We also stress that important differences remain among the trading systems surveyed in this paper. In particular, they significantly differ with respect to the degree of consolidation of the order flow. In the Paris Bourse and the Swiss Exchange, a very large proportion of all trades takes place within the trading system (NSC or SWX). On the contrary, the order flow remains fragmented in the London Stock Exchange and in Germany for stocks that trade in SETS and XETRA, respectively. Actually, in these two cases, the trading systems operate in tandem with other trading venues (a telephone market in London and floor trading in Germany). Furthermore the level of transparency is not the same in all the trading systems. First they do not provide the same level of pre-trade transparency. For instance, public investors can observe all the orders placed in the limit order book in SETS, the five best bids and offers in NSC and TSA and only the best bid and offer in SWX and XETRA. Second the level of post trade transparency also differs for large trades. Finally we point out differences in the obligations and privileges of the dealers operating in these trading systems and the clearing and settlement procedures of the exchanges.

It is worth stressing that we do not provide a detailed account of the evolution of European

trading systems since the London "Big Bang" of 1986. This account and the causes of the evolution of European trading systems at the end of the 80s' and at the beginning of the 90s' are already well-known (see Pagano and Röell (1990) or Pagano and Steil (1996)). Rather we focus on the main causes of the creation of the new trading systems that are surveyed in this paper. We identify two main causes: (i) the Investment Services Directive that creates a more competitive environment for European Stock Exchanges and (ii) the concomitant growth of institutional investors' trading and cross-border trading (for diversification purpose) by these investors.

Our analysis is limited to equity markets. It is important to note, however that the trading systems used for derivatives have also evolved in the recent years (see Benos and Crouhy (1996)). Several articles (e.g. Pagano and Röell (1990), Röell (1992), Huang and Stoll (1990), Pagano and Steil (1996), Benos and Crouhy (1996), Benos (1998)) have provided descriptions of European equity trading systems until 1995 or have focused on a single Stock Exchange (e.g. Hamon (1995), Le Fol (1998). Our paper complements these articles since it describes features of trading systems that were not in place when these studies were written.

The paper is organized as follows. In the next section, we provide a statistical overview of the different exchanges. In Section 3, we present the new environment in which European Stock Exchanges operate. Section 4 reviews the recent changes that occurred in the five Stock Exchanges that are the focus of the present article. Section 5 describes the main features of the new trading systems introduced in these exchanges. Section 6 concludes.

2. European Equity Markets: A statistical Overview.

In this section, we provide several measures (namely market capitalization, number of listings and market turnover) of the relative sizes of the exchanges whose trading systems are described in this paper. The figures for 1998 are given as of September 1998.

Figure 1 in the Appendix compares, in 1990 and 1998, the market capitalization of domestic companies of countries in the European Union (without Ireland[1]) and Switzerland.

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[1] Before December 1995, figures for the Irish Stock Exchange were aggregated with those of the London Stock Exchange.

The five largest exchanges with regard to market capitalization are located in the United Kingdom, Germany, France, Switzerland and the Netherlands. It is worth noting that the Netherlands and Switzerland experienced the two largest increases in the value of their shares (respectively 336% and 261%) in the 90s'. The ranking of the exchanges in term of number of listings (Figure 2) closely reflects the ranking in term of market capitalization. Spain appears to have a relatively large number of listings, due to cross-listings of Spanish firms on the three regional exchanges (Barcelona, Bilbao and Madrid).

Here Insert Figure 2

Another way to judge of the size of the different equity markets is to compare the market capitalization with a measure of the economic activity, e.g. the Gross Domestic Product (Figure 3). Market capitalization is relatively large in the U.K, the Netherlands and Switzerland. The importance of equity markets traditionally has been smaller in France and Germany. But, in these two countries, the ratio of market capitalization to GDP has significantly increased in 1998, up to 59% in France and to 46% in Germany. Indeed, in all European countries, equity markets play a more and more important part in the economy. In particular, Switzerland, Spain, Finland and the Netherlands have all experienced a dramatic increase in market capitalization relative to the size of their economy.

Here Insert Figure 3

This growing place of stock markets in continental Europe has been accompanied by an increase in turnover (See Figure 4)[2]. This increase has certainly been a spur for changes in equity trading systems at the end of the 80s' and during the 90s'. The Netherlands and Switzerland have experienced the largest increases in market turnover, followed by the U.K. and France. The increase in Germany has been relatively more modest.

Here Insert Figure 4

Figure 5 provides the market turnover of these exchanges in 1997. As usual comparisons based

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[2] Market turnover, in a given year, is the total value of share trading in that year.

on market turnover must be treated with caution. Actually European exchanges do not measure and report trading volumes in the same way (See Pagano and Steil (1996), Gresse and Jacquillat (1998) and FIBV). We have decided to report market turnover figures using the REV approach[3]. Market turnover is obviously related to market capitalization. For this reason, the ranking of the major European exchanges in term of turnover closely follows the ranking in term of market capitalization.

The following picture emerges at the end of this brief review. In Europe, France, Germany, the Netherlands, Switzerland and the U.K dominate in term of trading volume, market capitalization and number of listings. This is one of the reasons of our interest in the trading systems that have been implemented in these countries. The other reason is that these trading systems have all experienced major changes recently.

3. Equity Trading Systems in Europe: A New Environment.

In this section, we describe the main recent changes in the environment in which financial markets operate in Europe, namely:

(a) A change in the regulatory environment for financial markets in the European Union, with the introduction of the Investment Services Directive (ISD).
(b) The development of institutional trading in Europe.

These changes have provided the stimulus to the recent wave of innovations in trading systems, that we describe in the next sections.

3.1 The Investment Services Directive.

The ISD was adopted by the European Union in 1993 and defines a unified regulatory framework for the securities industry in the European Union. There are 3 main aspects of the ISD that impact Stock Exchanges:

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[3] There are two approaches to collecting turnover statistics: Trading System View (TSV) and Regulated Environment View (REV). In the first approach, only the transactions taking place on the exchange are considered as part of this exchange turnover. In the second approach, all the transactions that are subject to the exchange supervision are taken into account.

- First, the ISD allow financial intermediaries of the European Union to operate in all the countries of the Union. As a result these intermediaries can trade directly on other European Union's exchanges and can by-pass the member firms of these exchanges.

- Second the ISD gives Stock Exchanges the possibility of establishing remote members without obtaining first the approval of the remote member's State (so called «single passport» provision). Under the ISD, it is sufficient for an exchange to be designated as a *regulated market*[4] in its home country, to be able to operate in all the other Member States. It follows that an exchange can offer foreign financial intermediaries the possibility of trading on its system, using screens that are based in the home country of the intermediary. Such a strategy of remote membership has already been implemented by some Stock Exchanges in Europe. For instance, the Amsterdam Stock Exchange provides trading screens to 58 remote members.

- Third, the ISD authorizes the creation of new exchanges[5] and OTC trading. In this way, 3 new European Stock Exchanges have been created since 1995: Tradepoint, an electronic order-driven market based in London, Easdaq and EuroNM[6], which are markets for small capitalization firms with high growth potential. By allowing OTC trading, the ISD enables trading between members either directly or through proprietary electronic trading systems (so-called PTS) for stocks listed on European exchanges. Thus investors could by-pass traditional exchanges by operating through these systems. This is already the case in the United States, where PTS such as Instinet or Posit capture 20% of trading volume in US shares.

The ISD prompted exchanges to review their trading systems, for 2 reasons. First the ISD removes some barriers to entry that were protecting the Stock Exchange of each Member State. In this way it has opened the road to new competitors (e.g. Tradepoint). It also eases trading by financial intermediaries outside their home market, which also reinforces competition. This prospect of an accrued competition has accelerated the overhaul of their trading systems by

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[4] A regulated market must comply with a minimum set of rules regarding market access, listing requirements, trading and transparency. These requirements are defined by the ISD. See Steil (1996).
[5] Under the ISD, a trading venue can be considered as an exchange if it satisfies the requirements to be considered as a regulated market.
[6] The years of creation of these exchanges are respectively 1995, 1996 and 1997. EuroNM links the segments for small capitalization stocks of the Brussels Stock Exchange, the Amsterdam Stock Exchange, the Paris Bourse and Deutsche Börse. These segments are respectively: EuroNM Belgium, NMAX, Nouveau Marché, and Neuer Markt.

European Stock Exchanges. In particular, the automation of the trading process has been a way for exchanges to reduce both development and operating costs (Domowitz and Steil (1998))[7] and thus to reduce their fees. Electronic trading also facilitates entry in markets dominated by competing exchanges. Stock Exchanges are also merging equity and derivatives markets in order to create new synergies (as, for instance, in France, the Netherlands, Germany, and Switzerland) and they are building alliances and cooperation schemes with other exchanges. Second, exchanges have altered their trading rules to make sure that they are eligible as regulated markets. For instance, the London Stock Exchange increased the level of post trade transparency, which was lower in SEAQ than in continental exchanges (see Section 5.2.3).

3.2. The development of institutional trading.

The importance of domestic and foreign institutional investors (banks, pension funds, insurance companies, mutual funds) keeps growing in Europe. For instance, institutional investors today hold 60% of French market capitalization, (of which 35% is held by foreign investors), 50% of German market capitalization (of which 12% is held by foreign investors) and 74% of British market capitalization (of which 16% is held by foreign investors)[8]. American investors are increasingly diversifying their portfolios by investing in foreign securities, especially in Europe. Between 1980 and 1995, the total investment of US investors in foreign securities grew from USD 53 billion to USD 2600 billion[9].

The introduction of a single currency (the Euro) in the European Union will accelerate this trend. Furthermore some institutional investors, such as insurance companies and pension funds, are still restricted in their foreign investments. These restrictions will disappear with the single currency. For these reasons, cross-border trading by European institutional investors can be expected to grow. As a result institutional investors will increasingly be in search of a single trading system that would allow them to trade in all European securities, including derivatives.

In face of this growing importance of institutional trading, the trading systems used by Stock Exchanges have partly been devised in order to respond to the needs of institutional investors. Recent surveys in the United States (Economides and Schwartz (1995)), in Europe (Schwartz

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[7] Domowitz and Steil (1998) estimate that development costs are at least 3 to 4 times higher for floor trading based systems than for electronic order matching systems.
[8] Source: Stock Exchanges.
[9] Source: Securities Industry Association, 1996 Securities Industry Fact Book.

and Steil (1996)) and in France (Demarchi and Thomas (1996)) have shown that institutional investors are concerned by execution costs. Ultimately these costs impair their portfolios' performance. In particular, these surveys show that institutional investors are willing to sacrifice immediate execution if this sacrifice results in lower trading costs. For this reason, exchanges are designing their trading mechanisms with a view at offering a choice between immediate execution or delayed execution. The London Stock Exchange, for instance, has emphasized that one purpose of SETS (a new order-driven market, see below) is to reduce trading costs by offering the opportunity of trading patiently, with limit orders, to investors. Institutional investors also often trade in large sizes. For this reason, exchanges have designed special trading procedures for large trades (see Section 5.1.2). Finally exchanges have merged equity and derivative markets and they have started developing similar trading systems for the securities traded in these markets (e.g. in France and in Switzerland).

4. Equity Trading Systems in Europe: The Recent Changes.

In this section, we outline the main changes that occurred in the recent years in the Stock Exchanges that we survey. The features of the new trading systems offered by these exchanges will be presented with much more details in the next section. In the rest of the paper, we often categorize the trading systems as continuous order-driven markets, call auctions or quote-driven markets. The basic features of these trading mechanisms are defined in Appendix A.

4.1 The Amsterdam Stock Exchange.

The Amsterdam Stock Exchange introduced major changes in the organization of its trading procedures in 1994. Following these changes, the Amsterdam Stock Exchange reviewed the organization of its electronic trading system TSA in 1997 and took new measures implemented in 1998.

The Amsterdam Stock Exchange distinguishes two different segments: *the retail segment* and *the wholesale segment*. Orders for a size below a threshold chosen by the exchange for each stock belong to the retail segment and must be placed in a central limit order book (or traded between members at the best bid and offer). Orders above the threshold can trade outside the central limit

order book by members acting as principal[10].

The retail segment is organized as an electronic order-driven market (TSA). The limit order book of each stock is managed by a single broker-dealer[11], the «*Hoekman*», whose role is similar to that of the «specialist» in the NYSE. The «*Hoekman*» has the obligation to post quotes for a minimum number of shares that varies according to the type of stock. He is required to participate in trading only where necessary as a result of inadequate order flow and he can only trade with members (restricted capacity). In 1997, the Amsterdam Stock Exchange altered the Hoekman's privileges for the most liquid stocks (those that are included in AEX and AMX indexes). For instance the following privileges were suppressed: (i) exclusive knowledge of traders' identities (ii) possibility of price improvement of an incoming order within 15 sec and (iii) possibility of freezing the limit order book in other cases than when his quote has been lifted. Measures of Hoekman's performance have been devised as well and, in the future, stocks will be allocated on the basis of a periodic review of this performance.

Until 1997, the wholesale segment was organized around two electronic trading systems: AIDA and ASSET[12]. ASSET was an electronic quotation and advertisement system in which brokers could post indicative quotes for large orders. It was abolished in 1997. AIDA was an inter-member trading system, organized as an electronic order-driven market. AIDA was particularly attractive because trading was completely anonymous and fees were lower than in the retail segment. But for this reason, part of the order flow was diverted from the central limit order book. In order to consolidate the order flow, the exchange decided to suppress AIDA as well. Orders above the wholesale limit can now be executed either directly with a counterparty, outside the central limit order book or against the limit order book. For the time being, no price links are enforced between the prices in the wholesale segment and the retail segment.

4.2 Deutsche Börse AG[13].

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[10] The wholesale thresholds are currently under review. The Amsterdam Stock Exchange considers the possibility of a distinction based on the type of investor (retail/institutional) rather than on the order size.

[11] As of 1996 there were 7 Hoeklleden on the Amsterdam Stock Exchange against 50 in 1983 (Source: Anslow (1996)).

[12] ASSET stands for Amsterdam Stock Exchange System. AIDA means Automatic/Interprofessional Dealing System Amsterdam.

[13] Deutsche Börse AG is the holding company for the Frankfurt Stock Exchange and the Deutsche Terminbörse (DTB) derivatives exchange.

A main feature of Germany is that trading still takes place in eight different Stock Exchanges: Berlin, Bremen, Düsseldorf, Frankfurt, Hamburg, Hanover, Munich and Stuttgart. Companies can be listed on one or several of these exchanges, which in case of cross-listings result in order flow fragmentation[14]. For each exchange, trades take place on a floor. Each stock features a limit order book that is managed by one broker-dealer: the «*Kursmakler*». Orders are routed to the «Kursmakler» either directly by brokers on the floors or through an electronic order routing system (BOSS). Frankfurt is the major German exchange, with 520 domestic listed companies and accounts for 90% of turnover in value for DAX securities and 83% for MDAX stocks[15].

In April 1996, the Exchange Council of the Frankfurt Stock Exchange decided to introduce an electronic order matching system, XETRA in replacement of IBIS, an electronic trading system introduced in 1991 to trade the most liquid stocks. IBIS was an inter-dealer-broker system, which operated in tandem with the floors of the German exchanges. It was designed for wholesale trading since only orders above 100 or 500 shares (depending on stock price) could be placed (versus a minimum of 50 shares on the floor). IBIS had features of both an order-driven and a quote-driven system. In contrast XETRA is a pure electronic order-driven market. Specific members (the «*Betreuers*») can provide additional liquidity for medium and less liquid stocks. The main features of XETRA are described in more details in the next section.

The implementation of XETRA aimed at reducing market fragmentation, improving market quality by concentrating liquidity in one central order book, and strengthening the Deutsche Börse's position in German equity trading. However, XETRA still operates in parallel with floor trading on the eight German Stock Exchanges.

XETRA was developed and implemented on a step-by-step basis, in several releases. In June 1997, Release 1 provided XETRA Front End. On November 1997, XETRA Back End was introduced with Release 2. On this occasion, XETRA replaced IBIS for wholesale trading in approximately 100 stocks (including the DAX component stocks). On October 1998, it was supplemented by retail trading for all stocks, bonds and exchange traded warrants. Release 4 will be introduced in 1999 and will include a block trading facility.

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[14] A market is fragmented if orders for a given stock can be routed to different trading venues. Differences in order handling procedures are one source of fragmentation. Cross-listings or in-house trading are other sources of fragmentation.

[15] The DAX index includes the 30 largest German stocks by capitalization and MDAX include 70 mid-size German stocks.

4.3 The London Stock Exchange.

The London Stock Exchange has traditionally been organized as a dealer market. In 1986, it introduced a screen-based system, SEAQ, on which dealers can post two-sided quotes for a minimum order size, mandated by the exchange[16]. But this innovation did not modify the quote-driven structure of the London Stock Exchange. In these conditions, the introduction by the LSE of an electronic order-matching system, SETS, in October 1997 appears as a major change.

This new order-driven market replaces SEAQ for all the FTSE 100 stocks (plus approximately 30 other stocks). It will gradually be implemented for FTSE 250 stocks that are still traded on SEAQ. Until June 1998, only medium-sized orders were executed through SETS, retail orders being executed by member firms or Retail Service Providers (RSPs') at SETS best bid and ask prices and orders larger than 10 NMS (*Normal Market Size*)[17] could not be executed in the limit order book. For now, there is no minimum order size so that small orders can be executed either directly against the limit order book or through RSPs' at best market prices. Furthermore the maximum order size allowed in SETS has been increased from 10 to 20 NMS and a new closing price calculation has been introduced (a weighted average of transaction prices in the last 10 minutes of the trading day). Finally the LSE has recently modified the organization of the call auction that opens the trading day. The duration of the pre-trading phase is shorter and trading starts later in the day. It is worth stressing that, for all stocks of the FTSE 100 index, members can still act as counterparty for all order sizes and conduct trades by phone, outside the central limit order book.

4.4 The Paris Bourse.

The Paris Bourse is the first European exchange to have introduced a fully computerized order-driven market in 1986, the CAC system. Furthermore, order routing, data dissemination, clearing and settlement have been fully automated and integrated with the CAC system. In the recent years, the trading system of the Paris Bourse has been modified along two dimensions.

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[16] A similar system, SEAQ-I, exists for foreign stocks.
[17] The Normal Market Size varies according to the liquidity of a stock and represents at least 2% of its average trading volume.

First, the CAC system has been technologically improved. For instance, investors can now directly route their orders to the central computer. This means that their orders are placed automatically on the order book without any reentry by brokers (so-called open-architecture). Moreover the capacity of order flow treatment has been increased from 30 orders to 60 orders per second. Finally, it offers now a greater flexibility for trading. For instance, the system gives the possibility to place new types of orders (At Any Price, Stop Orders, All or None) and trading lots have been suppressed in September 1995. Following these technological improvements, the name of the system changed and became NSC (Nouveau Système de Cotation). All stocks listed on the Paris Bourse trade on NSC. Furthermore NSC is also used to trade derivatives (NSC-VF and NSC-VO are the NSC versions developed for futures and options trading[18]).

Second, some trading rules have been significantly altered. Thus dealership services were gradually introduced to provide additional liquidity to the limit order book. Member firms can act as market makers for medium liquidity stocks through Registered Dealers Agreements introduced in 1992. They can also act as market-makers for small capitalization stocks listed on the Nouveau Marché. Since 1994 and only for the most liquid stocks, member firms acting as principal can execute trades that are larger than a given threshold (the Normal Block Size)[19], at a price outside the best bid and ask prices. Until 1994, the member firm acting as principal had the obligation to execute all the limit orders placed at better prices (in the limit order book) than the block price. This obligation has been suppressed in September 1994. Now the Paris Bourse requires block prices to be inside the Weighted Average Spread (WAS), which is the difference between a weighted average of the best ask prices and a weighted average of the best bid prices[20, 21].

4.5 SWX Swiss Exchanges.

As in Germany, trading in Switzerland was taking place on three different Stock Exchanges: Basel, Geneva and Zurich. These 3 exchanges merged into SWX Swiss Exchange in 1995 and

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[18] MONEP and MATIF which manage the French options and derivatives markets moved exclusively to electronic trading in 1998.

[19] The NBS is the minimum order size for an order to be eligible as a block trade. For each stock, it is roughly at least equal to 2.5% of the average daily trading volume in the last quarter and equal to 7.5 times the average depth at the best bid and ask prices in the last quarter.

[20] The computation of the WAS is based on all displayed orders in the book up to the Normal Block Size (NBS). For very large trades (>5NBS), the weighted average spread can be enlarged (computation of SuperWAS on request by the Paris Bourse).

[21] Other changes in trading rules for the Paris Bourse include the enforcement of time priority in the opening call auction and the implementation of a closing call auction in June 1998.

their floors were replaced by an electronic order matching system, under the name of SWX (previously EBS). SWX is an electronic order-driven market which matches all orders in one limit order book (a special procedure exists for odd lots). More information is provided below on the main features of this trading system. Two other major changes took place in 1995. First, SWX Swiss Exchange developed a fully computerized settlement system, operated by SEGA. The specificity of this settlement system is to link in real time trading and settlement in stocks, bonds, funds and warrants. Second a new federal exchange regulation came into force, in replacement of the various regional laws covering the listing and trading of securities.

5. Main Features of European Trading Systems.

In this section, we describe the basic design features of the trading systems used by the European Stock Exchanges that are the focus of this paper. In Section 5.1, we first focus on their common features. Then, in Section 5.2, we review some of the differences that still remain between these trading systems. For each subsection, the discussion is supplemented by tables that are provided in the Appendix.

5.1. A common feature: Market Segmentation.

The architectures of the exchanges considered in this paper share a common feature. Instead of using a unique trading mechanism for all the stocks and for all the orders, exchanges use a variety of trading mechanisms. In fact exchanges have defined different trading segments according to various criteria. A specific trading mechanism is associated to each segment. We describe below the criteria that are used by exchanges in order to segment their stock market.

5.1.1 Trading mechanisms by type of stocks

Stocks are classified by exchanges according to their liquidity and/or their capitalization. Thus different groups of stocks are defined and different trading mechanisms are used for each group. Tables 2.1 and 2.2 present the trading mechanisms that are used in each segment.

As an illustration, we consider in detail the case of the Paris Bourse. In the Paris Bourse, stocks can be traded, on NSC, in 3 different markets: (i) «Le Premier Marché», (ii) «Le Second

Marché» and (iii) «Le Nouveau Marché»[22]. Stocks are allocated to these different market segments according to their capitalization. «Le Premier Marché» includes large French and foreign companies, «Le Second Marché» caters to medium-sized companies whereas «Le Nouveau Marché» is designed for high-growth companies. Roughly, these markets are organized as order-driven markets. However, they are significant differences in the trading mechanisms used in each market. In particular, market-makers, can operate in «Le Second Marché» and «Le Nouveau Marché»[23]. Stocks listed on «Le Nouveau Marché» are traded using a dual trading mechanism: they are called twice a day (at the open and at the close) and are continuously traded by market makers posting bid and ask quotes between these two calls. The obligations and the privileges of the market makers in these 2 markets are described in Section 5.2.2.

The Paris Bourse also classifies stocks according to their liquidity[24]. Thus stocks can belong to three different groups: «Continu A», «Continu B», «Fixing A «. Stocks with high or medium liquidity belong respectively to the first two groups. The last group includes stocks with low liquidity. Each trading group has its own trading mechanisms. Stocks in the first two groups are traded in a continuous order-driven market. Less liquid stocks are traded through call auctions, twice a day. Furthermore, for each group, different maximum authorized daily price variations are applied (see Section 5.3).

As it can be seen in Tables 2.1 and 2.2, the same type of segmentation is used in the other trading systems. In XETRA, stocks with high or medium liquidity are traded in a continuous order-driven market. Less liquid stocks, those with a monthly turnover lower than DM 20 million, are traded in one or several call auctions per day. Dealers (Designated Sponsors called «Betreuers») can intervene for medium and less liquid stocks. In the London Stock Exchange, trading for the stocks of the FTSE 100 index (most liquid stocks) takes place in an order-driven market (SETS) whereas other stocks are still traded in a dealership market (SEAQ). In the Amsterdam Stock exchange, the most liquid stocks, those belonging to the AEX and AMX indexes, are traded in a continuous order driven market with automatic matching. For medium and less liquid stocks, execution is not automatic but controlled by the Hoekman who enters quotes manually.

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[22] There is another market segment on the Paris Bourse: OTC-free market which is an unregulated market with no listing requirement. Stocks in this segment trade in a call market, once a day.

[23] Market-makers are respectively called «*Animateurs*» (in Second Marché) and «*Introducteurs Teneur de Marché*» (ITM) in the Nouveau Marché.

[24] The Paris Bourse measures liquidity by the trading volume (number of shares and amounts traded) and by the number of orders entered into the system.

SWX is the only exchange that does not provide specific trading mechanisms by type of stock. All stocks are traded in a continuous order driven market. The stocks included into SMI index have a smaller authorized maximum price fluctuation (0,75% from last traded price versus 2% for all other stocks), however.

5.1.2 Trading mechanisms by order size

In this case, the trading mechanism varies with the size of the order. This size can be defined in term of number of shares or in term of monetary value. Three different types of orders are defined, small orders, medium-sized orders and large orders, to which specific trading procedures may be applied by exchanges. These procedures are described in the third column of Table 3, for each trading system.

Small Orders.

All the exchanges but the Paris Bourse use distinct procedures to handle orders below a minimum order size (odd lots). In the Amsterdam Stock Exchange, small orders are executed against the «*Hoekman*» inventory at best bid and ask prices[25]. In SETS, brokers can direct small trades to the central limit order book or to Retail Services Providers (5 or 6 largest brokers). In the latter case, execution prices offered by RSPs' must be as good as the best bid and offer standing in the book. In XETRA, odd lots are aggregated and executed in the next call auction. In SWX, odd lots can be placed only as market orders. They can be executed against each other at the last transaction price or they accumulate and they are executed in round lots against the orders standing in the book.

In the Paris Bourse, odd lots were suppressed in September 1995. The purpose of the Bourse was to increase individual investors' access to the market and to consolidate liquidity in one central order book[26]. For now, all orders can be placed and executed on NSC.

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[25] The Amsterdam stock exchange is considering a new rule for small orders under which they would be executed against the Hoekman's inventory at the mid-quote (and not at the best bid and ask prices).

[26] Interestingly, the elimination of odd lots has indeed improved market liquidity, especially for medium size stocks and for high-price stocks. A study from the Paris Bourse, *« From Round Lot Trading to Units Trading: An Empirical Investigation of the Paris Bourse »*, Department of Research and Development, SBF-Paris Bourse, May 1998, reveals that, following the elimination of odd lots, spreads declined significantly, with no decrease in market depth. Furthermore for these stocks, the suppression of odd lots was accompanied by a sharp increase in the number of buy and sell orders.

Medium-Sized Orders

In all the trading systems considered in this paper, medium-sized orders are traded in continuous order-driven markets or in call auctions. For these orders, member firms (other than designated sponsors such as for example «Betreuers») can also act as principal. In the Paris Bourse or in TSA, member firms acting as principal must trade within the framework of the order book, at best bid and ask prices. On the contrary, in SETS and XETRA, principal trading for medium-sized orders can be conducted outside the central limit order book.

Large Orders (Block Trades)

A block trade is defined with respect to a threshold, which can be specified in term of number of shares or effective value. In all exchanges, orders above this threshold can be traded away from the central order book by members acting as principal (or as brokers crossing clients' orders). The thresholds for each of the trading systems considered in this paper are described in the second column of Table 3,

For orders that are eligible as block trades, the trading mechanism can switch from an order-driven mode to a quote-driven mode. The organization of the Amsterdam Stock Exchange based on the distinction between the wholesale segment and the retail segment (see Section 4.1) provides a good illustration. The prices of block trades must comply with specific rules that aim at linking the central limit order market and the block market. Specific rules also apply to the delay for the publication of block trades. These rules are described in Sections 5.2.1 and 5.2.3, respectively. For the time being, there are no defined rules for block trading in Germany. A block trading facility[27] will be introduced in XETRA with the introduction of Release 4 in 1999. For the time being, block trades can be conducted off-XETRA as OTC trading.

In SWX, large trades (larger than CHF 200,000 for individual orders) may be executed off-system. For these trades, SWX offers a trading facility that provides for a form of electronic negotiation. Using this facility, a member can make Statement of Interests that indicate to the other members, in a non-binding manner, that he or she would like to trade in a certain stock. Members can also direct an Addressed Offer to a specific member (or to several specific

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[27] So called «Vermittlungs und Surchmarkt».

members), which can then be accepted, ignored or rejected. The situation for SETS is special since member firms can act as principal for all order sizes. However, the London Stock Exchange has introduced a special procedure (Worked Principal Agreement (WPA)) for large trades (> 8 NMS) in SETS. Under a WPA, a member firm acting as principal and its client agree to execute, at some point in time in the future, a large trade. The price and size of the trade are determined at the time of the agreement but the member must offer price and/or size improvement.

5.1.3 Trading Mechanism and Time of the day

In most of the exchanges considered in this article, a call market is used to open the trading day for the stocks traded in continuous time (see Table 4). In the Amsterdam Stock Exchange, the opening price is determined by the Hoekman. A call auction is also used to close the trading day in NSC, SWX and XETRA.

XETRA has a unique feature: the use of *intra-day* call auctions integrated with a continuous order-driven market. The call auctions[28] take place at pre-specified points in time. At the time of the call auction, the continuous trading process stops. During a *pre-trading phase*, traders can submit limit and market orders, which are added to the orders initially standing in the book. The time at which the pre-trading phase stops is determined randomly. At this point in time, a clearing price is determined. The orders that could be executed at this price but are not, form the *surplus*. Just after the call, *an order book balancing phase* (that lasts 30 seconds) takes place. During this phase, the *Betreuers* first and then all market participants can execute the surplus at the clearing price. Then trading restarts in the continuous order-driven mode.

5.1.4 Summary

The previous overview shows that European exchanges converge toward a similar organization of trading. The main features of this organization are as follows:

(i)   Continuous order-driven markets are used for large capitalization stocks and for liquid stocks.

(ii)   Dealers can provide liquidity in small capitalization stocks, illiquid stocks and immediacy to very large orders.

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[28] The frequency of call auctions varies across stocks.

(iii)   Call markets are used to open and to close the trading day. They can also be used to trade less liquid stocks.

Important differences remain between exchanges, however. They will be described in the next section. We close this subsection by providing some possible explanations for the emergence of common features in European trading systems.

Trading Costs

There is substantial empirical evidence that trading costs are smaller in order-driven markets than in quote-driven markets, at least for small and medium-sized orders. Many of the empirical findings have been obtained by comparing the trading costs in Nasdaq (a quote-driven market) and the NYSE (an order-driven market)[29].

Similar findings have been obtained in Europe by comparing trading costs for stocks that trade both in continental exchanges and in SEAQ-I. For instance, DeJong, Nijman and Röell (1995) perform such a comparison for French stocks[30]. First they compare the *quoted spreads*[31] (at the time of a transaction) in the Paris Bourse and SEAQ-I for different order sizes. They find that for all order sizes, the quoted spreads in Paris are lower than in SEAQ-I. Many transactions take place inside[32] the quoted spreads («the market touch») in SEAQ-I. For this reason, quoted spreads tend to overestimate effective trading costs in SEAQ-I. In order to avoid this bias, DeJong *et al.* (1995) compare also *effective spreads*[33] for different order sizes. They also find that effective spreads are lower in Paris, for all order sizes in their sample. However, these results must be interpreted with caution. First (at the time of this empirical study) the distribution of order sizes is markedly different between the Paris Bourse and SEAQ-I. The orders in the Paris Bourse are of smaller sizes than the orders in SEAQ-I. The low frequency of transactions in large sizes in the Paris Bourse makes trading costs comparisons more difficult for large sizes. Second, spreads in London are posted including commissions and taxes, which is not the case in Paris.

The recent creation of SETS also offers the opportunity to compare the impact of an order-

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[29] See, for instance, Huang and Stoll (1996a), (1996b).

[30] Other empirical studies include Schmidt and Iversen (1992) and Davis (1993) for German stocks and DeGryse (1997) for Belgian stocks.

[31] The quoted spread is the difference between the best ask and bid price.

[32] See Reiss and Werner (1995).

[33] For a given transaction, the effective spread is the difference, (in absolute value) between the transaction price and the mid-price.

driven market on trading costs. Empirical studies on SETS are still scarce but the existing studies suggest that trading costs have been reduced for stocks that trade on SETS. For instance, Gemmill (1998) finds that the average market touch[34] have been reduced after the introduction of SETS and the modal (most frequently posted) touch at the close has fallen significantly. A study of the Plexus Group (1998) compares execution costs for a sample of U.K and US institutional investors. The study finds that for these institutional investors, execution costs have significantly decreased after the introduction of SETS.

The advantage of continuous order-driven markets with respect to trading costs for orders of small or medium sizes can explain why they are now predominant in Europe for these order sizes. In fact, as shown by Pagano and Steil (1996), the order flow on SEAQ-I started declining after the introduction of electronic order-driven markets on continental exchanges. Large trading costs on medium size orders, in SEAQ, also attracted competition from Tradepoint, an electronic order-driven market based in the U.K. In this context, the creation of SETS can be seen as an attempt by the LSE to restore its competitiveness on the segment of small and medium-size orders.

Immediacy

It is well-known (see Pagano and Steil (1996) and Pagano and Röell (1990)) that this is under the competitive pressure of SEAQ-I that continental exchanges introduced specific trading mechanisms for block trading, at the end of the 80s'. Actually SEAQ-I was diverting the order flow from traders seeking to execute large trades. In order-driven markets, these trades take time to execute. Actually, the depth of the limit order book can be insufficient to accommodate, quickly, very large orders without a substantial price impact. In order to minimize this price impact, the block trade must be split into smaller pieces, which are executed over time against the prices in the limit order book. Consequently traders in search of a quick execution can find more attractive to trade with a dealer, who is willing to provide immediacy. The competitive response of continental exchanges was to design their trading systems in such a way that they allow dealers to step in for very large trades, as discussed in Section 5.1.2.

Note that the coexistence of a limit order book and market making mechanisms for large trades gives investors the possibility of choosing between trading patiently by working an order in the

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[34] For a stock, the market touch is the difference between the best bid and ask price.

limit order book or trading immediately off the limit order book, at principals' prices. As investors pay more and more attention to execution costs, they are likely to base their choice on the relative costs of the two trading procedures.

Liquidity

The use of electronic call markets and/or dealers in small-capitalization stocks can be seen as a way to enhance the liquidity of these securities.

Electronic call markets have several advantages. First their operating costs are low. Second, in thin markets, by aggregating a large number of orders, a sequence of call auctions results in lower price variability than in a continuous auction (see Garbade and Silber (1979), Pagano and Röell (1990)). This reduces the deviations between the fundamental value of the asset and transaction prices. In this way, call auctions result in lower execution costs.

There are at least three benefits to the presence of dealers in small-capitalization stock markets. First, they can provide immediacy in between call auctions and additional liquidity in continuous market. Second, they can, and are indeed often required to, complement the supply of liquidity at the time of the call auctions. Finally, they also play a role as sponsors of small stocks, either because they have an obligation or incentives[35] to produce information on the stocks in which they make the market.

Price Discovery

Call markets are frequently used to open the market. One possible reason is that they better aggregate information and thus facilitate price discovery in subsequent continuous trading. Price discovery is particularly important and difficult when the market opens because of uncertainty concerning the asset valuation following the overnight trading interruption. Biais, Hillion and Spatt (1995) provide an empirical analysis of the pre-trading phase before the market opening in the Paris Bourse. They find empirical evidence that price discovery occurs during the pre-trading phase, especially toward the end of this phase. This result supports the view that a pre-trading phase and the call auction contribute to informational efficiency[36].

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[35] In the «Nouveau Marché», the dealers («Introducteurs Teneur de Marché) must provide information on stocks in which they make the market. Angel (1997) argues that large spreads on Nasdaq provide dealers with incentives to promote stocks in which they make the market.

[36] Madhavan and Penchapagesan (1998) also study theoretically and empirically price discovery at the opening of the NYSE. They show that the specialist in the NYSE contributes to price discovery at the opening.

5.2. Remaining differences between European exchanges.

There are four main important differences that remain between European exchanges:

(i)   Trading systems do not reach the same level of consolidation of the order flow.

(ii)   The obligations and the privileges of dealers differ in each system.

(iii)   Pre-trade transparency and Post-trade transparency differ between exchanges.

(iv)   Clearing and settlement procedures are not standardized.

5.2.1 Consolidation of the order flow

Exchanges have not reached the same degree of consolidation of the order flow (see Table 5) yet. With this respect, we can distinguish three groups of exchanges. In the first group, which includes the Paris Bourse and the Swiss exchange, the order flow is highly centralized and price links between on and off-system trades are enforced. In the Amsterdam Stock Exchange, the order flow is centralized but there are no formal price links between on and off-system trades. Finally the third group, which includes the London Stock Exchange and Deutsche Börse, is characterized by a fragmentation of the order flow.

NSC concentrates more than 90% of the turnover value (source: Paris Bourse). The order flow is also highly centralized in Switzerland since SWX concentrates 80% of the turnover value[37]. Moreover, in these exchanges, links between transaction prices and order book prices are enforced. In NSC, block trades for the most liquid stocks (approximately 90 stocks) can be conducted away from NSC. However, block trade prices must be at or within the Weighted Average Spread[38] computed for each stock. The Swiss Exchange enforces the Best Execution Principle, under which off-system trades have to be executed at prices at least as favorable as SWX prices.

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[37] Source: Presentation of Antoinette Hunziker-Ebneter, CEO of SWX Swiss Exchanges at a conference organized in Frankfurt, October 22 and 23, 1998, « The Stock exchange of the Future ». In addition, we calculated the turnover in value captured by SWX for SMI stocks based on real time data from October 19 to November 13, 1998. We found that on average 86% of all transactions in value were taking place in SWX.

[38] The Weighted Average Spread has been defined in Section 4.4. For very large trades (so called "structural" blocks) prices must be at or within +/-10% of the best bid and ask prices. The definition of a structural block is given in Table 9.

To some extent, concentration of the order flow is even greater in NSC than in SWX. Actually, there are no odd lots in NSC. Thus, even very small orders are executed within the limit order book and participate to price formation. In contrast, the Swiss exchange imposes a minimum size for orders that are placed in the central limit order book. This minimum order size varies from 5 to 100 shares depending on stock prices and can be placed only as market orders (See Section 5.1.2).

The Amsterdam exchange is also characterized by a relatively high centralization of the order flow. Actually, TSA concentrates approximately 70% to 80% of turnover in value[39]. However, there is no formal price link between on and off-TSA trades, leading to partial fragmentation. It follows that trades can be conducted at quite different prices in the wholesale and the retail segments. The Amsterdam stock exchange is considering imposing a new rule that would reinforce centralization of the order flow. Under this new rule, wholesale prices for trades between members would have to be at best bid and ask prices. However, such a requirement would not be enforced for trades between a member and an institution.

For FTSE 100 stocks, orders can be executed either on SETS or through members dealing outside of SETS, as principal or as broker. This coexistence of two trading venues leads to market fragmentation and in fact SETS captures only 30% to 35% of the total trading volume in eligible shares (60% of all eligible trades)[40]. This figure goes up to 50% if one adjusts for double-counting. There are at least two reasons for this diversion of order flow from SETS. First, it takes time to change trading practices in a market place, which traditionally was operating as a quote-driven market. It follows that institutional traders keep trading with market-makers for large size orders[41]. Second, by design, a large part of the order flow used to be excluded from SETS. Orders greater than ten times Normal Market Size (NMS) were not accepted into the order book. Furthermore retail orders were exclusively executed by member firms (Retail Service Providers). These trading rules were undermining the liquidity of SETS by reinforcing the

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[39] Source: Exchange officials. In addition, we calculated the turnover in value captured by TSA for AEX stocks based on real time data from October 19 to November 13, 1998. We found that on average 85% of all transactions in value was taking place in TSA.

[40] Source: London Stock Exchange. In addition, we calculated the turnover in value captured by SETS for FTSE100 stocks based on real time data from October 10 to November 10, 1998. We found that on average 33% of all transactions in value was taking place in SETS.

[41] See «Market Square up to Change», Financial News, October 5th, 1998. According to a study by Board and Wells (1998), SETS account for a very large proportion (67.6% in value) of trades below 0.5NMS (trades for 2000 to 25,000 shares) and a relatively large proportion (46.5% in value) of trades between 0.5NMS and 1NMS (25,000 to 75,000 shares). But more than 97% by value of trades larger than 2NMS are conducted away from SETS.

tendency to fragmentation. As an attempt to solve this problem, the minimum order size has been suppressed in June 1998 and the maximum order size is now equal to twenty NMS (see also Section 4.3).

In addition, the London Stock Exchange does not enforce any rules regarding the prices at which trades conducted outside SETS can take place. Those trades can be executed at any price, though, in practice, price formation is mainly established through the order book, with 75% of all business being conducted at order book prices[42].

In Germany, fragmentation of the order flow arises from the possibility for orders to be directed either to XETRA or to the floor of one of the eight Stock Exchanges. Furthermore, member firms can trade OTC without any restrictions on trading prices. According to recent estimates, 25% of the trading volume for stocks in DAX and 74% of the trading volume for stocks in MDAX are realized through floor trading[43]. As in London or Amsterdam, no price link is enforced between XETRA and the floors, which may lead to discrepancies in the prices posted in these two trading venues[44]. As for OTC trading, no figures (prices or volumes) are available. OTC trading is reported at the end of the trading day, as part of the total trading volume. According to our estimations for October 1998[45], OTC trading represents 70% of total trading volume for the biggest stocks.

5.2.2 The role of dealers

As previously mentioned, some of the trading systems (namely NSC, XETRA, and TSA) allow dealers (so-called *Animateurs* in NSC, *Betreuers* in XETRA and *Hoekleden* in TSA) to provide additional liquidity for small capitalization or less liquid stocks. These dealers are compensated for the services they provide by receiving privileges. These privileges and the corresponding obligations significantly differ among exchanges. Table 6 provides a summary of these obligations and privileges.

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[42] Review & consultation, Stock Exchange Electronic Trading Service, London Stock Exchange. See also Board and Wells (1998).

[43] Source: DBAG. In addition, we calculated the turnover in value captured by XETRA for DAX stocks based on real time data from October 15 to November 12, 1998. We found that on average 76% of all transactions in value for these stocks was taking place in XETRA.

[44] For instance the newspaper Welt Am Sonntag of Saturday, November, 7, 1998 reports price discrepancies larger than 1%.

[45] We calculated OTC turnover for the nine largest market capitalizations using real time data for October, 1998.

The Paris Bourse introduced Registered Dealers Agreements (RDAs') in 1992 in order to improve liquidity of medium and less liquid stocks[46]. Under RDAs', *Animateurs* (one or more per stock) continuously have to post bid and ask quotes for a minimum amount which varies according to stock liquidity[47] with a maximum spread of 5% (2% for more liquid stocks). They have similar obligations in the pre-trading phase before call auctions. It is important to note that these offers are made within the limit order book of each stock. Thus Animateurs directly compete with other limit order traders. Market surveillance checks in continuous time that they comply with these obligations. As a compensation, *Animateurs* do not pay trading fees. Furthermore the Animateur of a stock has the possibility of signing a liquidity agreement with the major shareholders of the company and other financial intermediaries. Under this agreement, the Animateur and the other participants in the agreement commit capital in order to sustain the liquidity of the stock in which the Animateur makes the market. They do not have other privileges over market participants[48].

In contrast with NSC's Animateurs, *Betreuers* (one or more per stock) in XETRA are not obliged to continuously post bid and ask quotes for a minimum quantity. They are only required to respond to members' requests (indication of buy or sell interest) by entering a two-side quote (with a maximum spread of 2.5% to 5% depending on stocks) within a fixed period of time and for a minimum amount[49]. They must also place orders during the pre-trading phase in call auctions. Their performance is checked on a monthly basis. As a compensation, *Betreuers* do not pay trading fees. They also have knowledge of the identity of the member making a request. Finally, in call auctions, they have priority of execution for the surplus remaining at the end of the call auction (during the Order Book Balancing Phase) with a maximum possible trade size per *Betreuer* (20 times the minimum quote size).

5.2.3 Transparency

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[46] In 1998, 225 stocks are traded with RDAs'.

[47] These amounts are respectively FF50,000 for stocks that trade continuously (liquid stocks) and FF20,000 for stocks that only trade in call auctions (less liquid stocks).

[48] For stocks that trade on the Nouveau Marché, market makers have similar obligations. They are required to post bid and ask quotes for a minimum quantity that varies from 100 to 1000 shares depending on the stock price with a maximum spread of no more than 10%. They also make similar offers 15 minutes prior to each call auction. As a compensation, market makers do not pay trading fees and can be the counterparty of all trades (even for principal trades conducted by other members if they wish so).

[49] These amounts vary from DM 20,000 to DM 60,000 depending on stocks

The transparency of a market is the amount of information regarding the trading process, available to participants. Transparency is a fundamental issue in the design of markets and plays a critical role in the price discovery process. It is useful to distinguish between *pre-trade* and *post-trade* information. Pre-trade information is the information available to traders (members and public investors) concerning the orders which are currently standing in the market and the prices at which incoming orders are likely to be executed. Post-trade information is the information available to traders about the details of past transactions (prices, volumes). The exchanges that are reviewed in this paper do not offer the same level of pre-trade and post-trade information to all market participants.

Pre-Trade Information

Table 7 in the Appendix provides an overview of the rules pertaining to pre-trade transparency in the continuous trading periods of NSC, SETS, SWX, TSA and XETRA.

The information provided by market organizers can vary according to the type of participant. As a general rule, member firms have access to more information than public investors. They can observe the entire limit order book. Furthermore in NSC they have access to brokers-ID. In the Amsterdam Stock Exchange, the Hoekman knows the identities of the traders placing orders but this information is not (automatically) available to other traders. In XETRA, Betreuers know the identity of the members placing a request.

The information made available to public investors significantly differs across markets. With this respect, pre-trade transparency in SWX and XETRA is low, since public investors only have access to the best bid and ask prices and the quantities offered at these prices[50]. In contrast, pre-trade transparency is high on SETS since all limit orders are displayed. NSC and TSA are in an intermediate situation since public investors observe a subset of all limit orders posted in the market, namely the five best ask and bid prices on each side of the market.

Some trading systems offer the possibility of partially controlling the information available to other traders. In particular, traders can submit hidden limit orders. A hidden limit order is

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[50] The Deutsche Börse is considering the possibility of disseminating the five best limits to public investors.

composed of two parts: (i) one part, which is publicly displayed and (ii) another part that is not displayed[51]. The hidden part is displayed only after the first part executes. Harris (1996) argues that hidden orders are used as defensive strategies against the *free option problem* faced by limit order traders. As the value of the free option increases with asset volatility, he predicts that hidden orders must be used more frequently in a high volatility market. In line with this prediction, Harris (1996) finds empirically, using Paris Bourse data, that both the fraction of hidden orders and the size of the hidden part increase with volatility. Using Paris Bourse data, Duteil and Vacheron (1996) show that hidden orders can also reduce price impacts.

Call markets starts with a pre-trading phase during which traders can submit, modify or cancel orders. Market organizers can provide two types of information during this phase (See Table 8): (a) information on the orders submitted to the market and (b) information on the Indicative Equilibrium Price. The Indicative Equilibrium Price is the price at which trades would be conducted if the opening occurred at that precise instant. In SETS, the book is opened (all orders are disclosed). On the contrary the book is closed (no order disclosed) in SWX and XETRA. In TSA, the book is opened to members, 5 minutes before the opening. In NSC, the system broadcasts all updates in the order book and all the orders which would not be executed at the Indicative Equilibrium Price. NSC and SWX publish an Indicative Equilibrium Price during the entire pre-opening period. On the contrary, the Indicative Equilibrium Price in XETRA is published a few minutes before market clearing.

Post-Trade Information

Market organizers must choose the speed with which (i) the price of a transaction, (ii) the size of the transaction and (iii) (maybe) the identities of the parties involved in the transaction will be published.

In all the markets, publication of trades of small and medium sizes is immediate. On the contrary, publication of large trades can be delayed. Publication of large trades is problematic. Actually it jeopardizes the ability of a market maker involved in the block trade to unwind his position in good conditions. Thus quick publication can ultimately result in bad prices for block trades.

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[51] Exchanges impose minima on the hidden part (e.g. it must be at least equal to 100 trading lots in SWX). The hidden part can lose time priority (as in NSC) or not.

However, large trades are informative. For prices in the central limit order market to reflect the information contained in these trades, a quick publication of the price and the size of the block trade is necessary. Timely publication is also necessary in order to prevent counterparties in a block trade from trading on their superior information. This can ultimately impair the liquidity of the central limit order book, by increasing the adverse selection risk faced by limit order traders. Given these costs and benefits of quick publication of large trades, exchanges allow traders to delay publication of the large trades in which they are involved. The conditions under which this delay can occur and its duration vary across exchanges, however (See Table 9).

5.2.4 Clearing and settlement

Clearing and settlement procedures are important features of a trading system because the cost of clearing and settlement is part of the total trading cost. The Central Securities Depositories (CSDs') are the firms in charge of the clearing and settlement functions. They often offer additional services such as custody, corporate dividends processing or coupons payments etc…These firms are in general distinct from the Stock Exchanges although the latter can own a stake in their domestic CSD.

In all the trading systems considered in this paper, clearing and settlement is fully computerized (see Table 12). But these systems feature 2 important differences with respect to clearing and settlement. First the *settlement cycles* differ between the trading systems. The Swiss exchange has a unique feature: a simultaneous, final, irrevocable delivery versus payment which allows traders to trade, pay, deliver and receive confirmation of the transaction in less than 10 minutes. For the other exchanges, it takes between 2 to 5 days in order to clear and settle a transaction. Second, in some CSDs' (namely SICOVAM and NEGICEF), only net trades are settled whereas the other CSDs' (e.g. CREST) practice trade by trade gross settlement. Netting reduces trading costs since fees are only charged on net trade and not trade by trade.

These differences in settlement and clearing rules across countries are a major obstacle to the emergence of a single European CSD. However a single CSD might be a more efficient way to clear and settle trades in Europe, especially with the development of cross-border trading (see Giddy, Saunders and Walter (1996)).

Finally it is worth stressing that only the Paris Bourse and the Amsterdam Exchanges have a Central Clearing House that guarantees the final settlement of trades between members. Since traders do not deal with one another but with the clearing house, there is no risk of payment or delivery failure. Such a guarantee limits the credit risk, which naturally arises in an order driven market since traders cannot choose their counterparty.

5.3 Other features of European equity trading systems.

The previous section has described the main features of the new equity trading systems in Europe and how they differ across exchanges. These systems are characterized by many other trading rules, which also influence the price formation process. We now describe these rules.

5.3.1 Price determination in Call markets

In all the trading systems that we have reviewed, the clearing price in call auctions is chosen in such a way that it maximizes trading volume. There might be several prices that satisfy this requirement, however. In such a case, additional criteria must be used to set the clearing price. As shown (in a simpler environment) by the theory of double-auctions[52], these secondary criteria can potentially influence traders' bidding behaviors and thus are important for price formation.

In the Paris Bourse and XETRA, the second criterion is to minimize *surplus*, i.e. the number of shares that could trade at the clearing price but cannot find sufficient quantity on the opposite side of the market. If there is more than one price that satisfies this second criterion, the system selects the price which is the closest to the last traded price (previous closing price in general). In SETS, the auction price is the average of all eligible prices (i.e. all the prices that maximize trading volume) rounded up to the nearest tick. In SWX, only the principle of volume maximization is used. Finally, in TSA, the choice of the clearing price, in the set of eligible prices, is at the Hoekman's discretion.

5.3.2 Order Types

The traders have access to a large variety of orders to carry out their trade. The different possible

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[52] See Satterthwaite and Williams (1991), for instance.

types of orders are described in Tables 10.1 and Tables 10.2 in the Appendix. Limit orders and market orders are two main types of orders. A limit order specifies a price and the maximum quantity a trader is willing to buy or to sell at this price. A market order is an order to buy or to sell a given quantity at any price. As a consequence, a market order can trigger the execution of several limit orders as it walks up or down the book. The Paris Bourse offers the possibility of submitting «At market orders». These market orders only execute against the best quotes. The unfilled part of the order is automatically transformed into a limit order. Some trading systems (NSC, XETRA) allow traders to use orders that must be executed entirely or not at all («Fill or Kill Orders»). Furthermore NSC, XETRA and SWX offer the possibility of submitting stop orders. A stop order is an order that becomes activated when the price of the stop order is reached. A buy (sell) stop market order is transformed into a buy (sell) market order when it is activated. A buy (sell) stop limit order is transformed into a limit price (at the stop price) when it is activated.

Note that the set of eligible orders that can be different in continuous auctions and in call auctions. For instance, in SETS, traders can only use limit orders in the opening call auction.

5.3.3 Priority Rules

Priority rules specify the sequence in which limit orders are executed. In all trading systems, price priority is enforced. According to this rule, buy orders with higher prices take precedence over buy orders with lower prices and vice versa for sell orders. When several orders are placed at the same price, *secondary priority rules* are used. Time priority is the secondary priority rule that is used in all the systems considered in the paper. According to this rule, orders, at a given price, are executed in sequence according to their arrival time[53].

The choice of secondary priority rules is important because it influences the traders' incentives to provide liquidity (Harris (1990), Angel (1997)). A strong argument in favor of time priority is that it encourages price competition among traders. Actually late limit order traders must improve upon existing quotes in order to increase their execution probability. Accordingly, using data from the Toronto Stock Exchange, Penchapagesan (1997) finds that quote improvements are indeed more frequent when time priority is enforced than when it is not.

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[53] Execution priority can be contingent on the nature of the order, however. For instance, in NSC, SWX and TSA, displayed orders have priority over hidden orders at a given price.

5.3.4 Tick Size

In securities markets, traders must post their offers on a pre-specified price grid. The *tick size* is the increment between two successive prices on this grid. The tick size is in general a step function of the stock price and is chosen by the exchange. For instance in XETRA, the tick size is equal to 0.01 DM for stocks with prices lower than 100 DM and is equal to 0.05 DM for stocks with larger prices and on the Paris Bourse, the tick size varies from 0,001 euro to 0,50 euro depending on stock price (See Table 11).

The tick size is an important variable of choice for market designers. Actually it puts a floor on the minimum size for the bid-ask spread. As such it influences the size of the trading costs. Several Stock Exchanges have reduced their tick sizes recently[54]. For the Toronto Stock Exchange, empirical studies[55] find a decrease in the quoted and effective spreads following the decrease in the tick size in April 1996. They also find a decrease in quotation size, however. In fact a too small tick size can impair market quality. Harris (1996) argues that a sufficiently large tick size is necessary for time priority to be meaningful. Furthermore a large tick size protects limit order traders against the free option problem. Harris (1996) finds that limit order traders display their orders more and post orders for larger sizes when the relative tick size is large. Cordella and Foucault (1997) show analytically that a large tick size induces traders to post more rapidly competitive offers. For this reason, they find that the tick size that minimizes trading costs is always strictly positive.

5.3.5. Trading Halts and Circuit-breakers

All the trading systems resort to trading halts. Trading halts are triggered when the deviation of the last transaction price from a reference price exceeds a threshold chosen by the exchange. For instance, in NSC, the trading halt occurs for liquid stocks («Continu A») when the price deviates by more than 10% from the closing price of the previous trading day. Trading restarts after 15 minutes and the two subsequent deviations cannot be larger than 5%. For medium liquidity stocks («Continu B»), the initial authorized maximum deviation from the closing price is 5%, trading restarts after 30 minutes and the subsequent two deviations are limited to 2.5%.

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[54] For instance, the AMEX in 1992, the Toronto Stock Exchange in 1995 and the NYSE in 1997.
[55] See Bacidore (1997) and Ahn, Cao and Choe (1996), for instance. Harris (1997) provides a survey.

The reference price, the duration of the halt and the authorized deviation vary across exchanges. For instance in SETS, the reference price is the first trading price of the day and the maximum authorized deviation is 20%. The duration of the halt is 10 minutes. XETRA is unique in that, for this trading system, the maximum authorized deviations for each stock are not publicly known. TSA bans program trading if AEX index rises or falls by 2%, or more, within 15 minutes. A trading halt for all stocks is then implemented and lasts 15 minutes. All trading activity is stopped if the index rises or falls by more than 5%.

6. Conclusion.

In this paper, we have described the organization of trading in the major European Stock Exchanges (in term of market capitalization, number of listings and market turnover). Each of these Stock Exchanges has introduced a new trading system in recent years, for all or part of the listed stocks. These new trading systems are essentially electronic order-driven markets, but allow the intervention of dealers. Although the organization of trading in the European exchanges is becoming increasingly similar, we have emphasized that major differences remain between the trading rules. In particular, the level of order flow consolidation and the level of transparency still vary across European exchanges.

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8. Appendix.

Appendix A: Définitions.

Order-driven markets

In order-driven markets, all potential buyers and sellers can directly trade together. To this end, public investors (or their brokers) post offers to buy or to sell, for given quantities («limit orders»). The set of all buy and sell offers, at a given point in time, is called the limit order book. A trade takes place when a buy offer and a sell offer cross. In general, traders can also submit buy or sell orders at any price («market orders»)[56]. These orders are executed immediately at the best available prices in the market. The auction can take place at one physical location (e.g. a trading floor) or/and through a computer network.

Order-driven markets can be organized either as *call markets* or *continuous order-driven markets*. In a call market, orders accumulate over time. At specific points in time (e.g. at the beginning and at the end of the trading day), the orders are executed at a single price. This price is in general[57] chosen such that it maximizes the trading volume[58]. Buy orders with a lower price and sell orders with a higher price are executed. On the contrary, in continuous markets, a trade takes place every time two orders can be executed against each other.

Quote-Driven Markets

In a quote-driven market, public investors (or their brokers) cannot trade directly among themselves. In order to carry out a transaction, they must contact a dealer who uses his own inventory in order to execute the trade. Dealers post ask and bid prices and the number of shares they are willing to trade at these prices. Depending on the organization of the market, these quotes are firm or indicative. In general dealers must post quotes for a minimum size. Trades are ultimately conducted by telephone[59].

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[56] We describe in Section 5.3.2 the different types of orders in order-driven markets.
[57] The clearing price is not always determined in the system, however. In crossing networks, the clearing price is the price posted in another marketplace.
[58] In absence of price discreteness, this price would be the price such that the number of buy orders is equal the number of sell orders.
[59] In some dealer markets (e.g. Nasdaq), small orders can be executed automatically against dealers'quotes.

Table 1: European Equity Trading Systems

Country	Stock Exchange	Trading System(s)	Signification of the acronym	Implementation date	Securities traded on the System
France	Paris Bourse	NSC	Nouveau Système de Cotation	1994*	ALL
Germany	Frankfurt Stock Exchange Berlin Stock Exchange Bremen Stock Exchange Dusseldorf Stock Exchange Hanover Stock Exchange Hamburg Stock Exchange Munich Stock Exchange Stuttgart Stock Exchange	XETRA and Floor Floor Floor Floor Floor Floor Floor	eXchange Electronic TRAding	1997 (XETRA)	ALL
Netherlands	Amsterdam Stock Exchange	TSA	Trading System Amsterdam	1994	ALL
Switzerland	Swiss Exchange	SWX	SWiss eXchange	1995	ALL
U.K.	London Stock Exchange	SETS SEAQ SEAQ-I SEATS-PLUS	Stock Exchange Electronic Trading Service Stock Exchange Automated Quotation SEAQ-International	1997 1986 1985	FTSE 100 (+≈30 stocks) Large and medium-sized domestic companies not in FTSE 100. Foreign companies Small companies

*NSC upgrades CAC, the previous electronic trading system of the Bourse, introduced in 1986.

Table 2.1 Trading Mechanism and Stock Type*

Segmentation according to Market Capitalization

	Companies Capitalization	Name of Trading Segment	Type of Trading Mechanism
Amsterdam Stock Exchange	All capitalization	Segmentation is based on stock liquidity	See next table
Germany	• Large • Medium • Small/High Growth	• Official markets (Amtlicher Handel and Geregelter Markt) • Official markets (SMAX) • Neuer Markt	? Order-Driven Market (XETRA) and Floor Trading ? Order-Driven Market (XETRA) with possibility of market-making («Betreuers) and Floor Trading ? Order-Driven Market (XETRA) with possibility of market-making («Betreuers») and Floor Trading
London Stock Exchange*	• Large • Medium • Small	• Main Market (Official Market) • Main Market (Official Market) • AIM	- Order-Driven (SETS) or quote-driven Market (SEAQ) according to market liquidity - Order-Driven (SETS) or quote-driven (SEAQ) according to market liquidity ? Order-Driven and Quote-driven with one dealer per stock (SEATS-PLUS).
Paris Bourse	• Large • Medium • Small/High Growth	• Premier Marché • Second Marché • Nouveau Marché	- Order-Driven Market (NSC) - Order-Driven Market (NSC) with possibility of one dealer per stock («Animateur ») - Call Market (NSC) at the open and close with market making in between call auctions.
Swiss Exchange	All capitalization	No segmentation based on stock capitalization	- Continuous order-driven market (SWX)

*Some markets have specific trading segments for foreign stocks (e.g. SEAQ-I in the London Stock Exchange). We do not mention these segments in Table 1.

Table 2.2: Trading Mechanism and Types of Stocks (Ctd.)

Segmentation according to Liquidity

	Stock Liquidity	Trading Segment	Type of Trading Mechanism
Amsterdam Stock Exchange	• High Liquidity • Medium and Low Liquidity	• AEX and AMX stocks • Other stocks	? Continuous Order-Driven Market, automatic execution. ? Order Book managed by Hoekman
Germany	• High Liquidity • Medium Liquidity • Low Liquidity	• N/A • N/A • N/A	? Continuous Order-Driven Market (XETRA) and Floor Trading ? Continuous Order-Driven Market (XETRA) with possibility of market-making («Betreuers) and Floor Trading ? One or several call auctions per day (XETRA) with possibility of market-making («Betreuers») and Floor Trading
London Stock Exchange	• High Liquidity • Medium Liquidity • Low Liquidity	• N/A • N/A • N/A	? Continuous Order-Driven Market (SETS) ? Quote-Driven Market (SEAQ) ? Continuous Order-Driven and Quote-driven with one dealer per stock (SEATS-PLUS).
Paris Bourse	• High Liquidity • Medium Liquidity • Low Liquidity	• Continu A • Continu B • Fixing A	? Continuous Order-Driven Market (NSC) ? Continuous Order-Driven Market (NSC) with possibility of one dealer per stock. («Animateur»). ? Two call auctions per day (NSC) with the possibility of one dealer per stock «Animateur».
Swiss Exchange	• All levels of liquidity	• No segmentation based on stock liquidity	Continuous order-driven market (SWX)

Table 3: Trading Mechanism and Order Sizes

	Categories of Order Sizes	Type of Trading Mechanism
NSC	• Large orders > 1 NBS* (for most liquid stocks only) • Medium-sized and small orders	? Principal trading or limit order book . ? ? Limit order book or Principal trading within limit order book
SETS	• Very large orders> 20 NMS**. • Large orders (> 8NMS) and Medium-Sized orders • Small orders	? Principal trading. These trades are not eligible on SETS. ? Principal trading or limit order book. WPA for orders > 8xNMS*** ? Retail Service Providers (principal trading) or limit order book.
SWX	• Large orders > *CHF* 200,000 • Medium-Sized orders • Small orders	? Principal trading or limit order book ? Limit order book Odd lots executed in a separate limit order book
TSA	• Wholesale orders > *f* 250,000 to *f* 1,250,000 according to stocks. • Medium sized-orders • Retail orders	? Principal trading or limit order book with one specialist per stock («Hoekman»). ? Limit order book with one specialist per stock («Hoekman»). ? Executed against specialist's position at best bid and ask prices.
XETRA	• Large Orders • Medium-sized Orders • Small Orders	? Limit Order Book or «Vermittlungs –und Suchmarkt»*** ? Limit Order Book and/or principal trading. ? Call markets and/or principal trading.

*NBS: «Normal Bloc Size». The NBS is the minimum order size for an order to be eligible as a block trade. See footnote 19.

** NMS: «Normal Market Size». One NMS represents at least 2% of a security's average trading volume.

*** Worked Principal Agreements (WPA) are described in Section 5.2.

**** «Vermittlungs –und Suchmarkt»: block trading facility which will be implemented with XETRA Release 4.

Table 4: Trading Mechanism and Time of the Trading Day

In the next Table, we just consider the use of call auctions for stocks traded in continuous time either in an order-driven market or a quote-driven market.

Use of Call Market in: Trading Systems	*Market Opening*	*Market Closing*	*Intraday (combined with continuous trading)*
NSC	Yes	Yes	No
SETS	Yes	No	No
SWX	Yes	Yes	No
TSA	Yes (price is determined by Hoekman)	No	No
XETRA	Yes	Yes	Yes

* Except for OTC trades that have the following characteristics. They must be at least equal to FF50m in value or 2% of the company's capital for stocks with a market capitalization equal to or greater than FF1bn and 5% of the company's capital otherwise.

Table 6: Role of Dealers

	Obligations	Privileges
NSC		
Principal traders	- No specific obligations: can trade all stocks on own account at best market prices	- No privileges
Block traders *(for most liquid stocks)*	- No specific obligations: can trade blocks on own account at prices at or within Weighted Average Spread	- Publication delay if trade as principal
Animateurs	- Continuously post bid and ask quotes for a minimum quantity and a maximum spread - Make similar offers before call auctions	- No trading fees - Pool of liquidity (cash and shares) may be provided by major shareholders (liquidity agreement)
SETS		
Retail Service Providers	- No specific obligations: can execute retail orders on own account at best market prices	- No privileges
Principal traders	- No specific obligations: can execute large trades on own account - For WPA: price and size improvements must be provided	- Publication delay
SWX	- No specific obligations	- No privileges
TSA		
Hoekman	- Continuously post bid and ask quotes - Trade only when insufficient order flow - Trade only with members (restricted capacity) - Execute odd lots on its own account	- Fee (high courtage fee) when acts as principal - Can freeze the order book when quote is lifted or hit - Only one Hoekman per stock
Principal traders *(Retail orders)*	- Can trade for own account at prices at or within best bid and ask prices with order book interaction.	- No privileges
Principal traders *(Wholesale orders)*	- No specific obligation: can trade on own account at any price.	- No privileges
XETRA		
Betreuers	- Post two-sided quotes when requested by members - Post two-sided quotes in call auctions	- No trading fees - Knowledge of the identity of the trader placing a request - Preferential access to surplus in call auctions

Table 7: Pre-Trade Transparency in Continuous Order-Driven Markets

	NSC		SETS		TSA		SWX		Xetra	
	Members	*Investors*	*Members*	*Investors*	*Members*	*Investors*	*Members*	*Investors*	*Members*	*Investors*
Limit Order Book	Full Book	5 Best Bids and Offers	Full Book	Full Book	Full Book	5 Best Bids and Offers	Full Book	Best Bid and Offer	Full Book	Best Bid And Offer
Identities of Liquidity Providers	Yes	No	No	No	Depends[*]	Depends*	No	No	No**	No
Hidden Orders	Yes		No		Yes***		Yes****		No	

*The «Hoekman» always knows the identity of the traders submitting orders. The traders who post limit orders can decide to reveal their identity to the market.

** «Betreuers» have access to brokers ID who make a quote request.

*** Hidden orders in TSA will be introduced in 1999. They will be called «Drip-In-Orders» .

****Hidden orders are marked as such in the order book.

Table 8 (ctd.): Pre-Trade Transparency in pre-trading phase of Call Auctions

	NSC	SETS	SWX	TSA	Xetra
Order Book	Opened*	Opened	Closed	Closed**	Closed
Indicative Equilibrium Price	Yes	No***	Yes	Yes****	Yes*****

* Only orders that would not be executed at the Indicative Equilibrium Price (IEP) are disclosed. In addition to the IEP, the total trading volume that would be eligible for trades at IEP is revealed.
** The entire book is revealed to members only 5 minutes before call.
*** The LSE does not disseminate the indicative equilibrium price but data vendors can.
**** 5 minutes before call for members only.
***** Only during the call phase, which lasts 5 to 11 minutes depending on stocks.

Table 9: Price and Publication of Large Orders

	Publication Delay for Block Trades	Block Price
NSC	*Order Size < 5 NBS:* ? 2 hours if broker acts as counterparty ? Immediate if broker acts as agent *Order Size > 5 NBS* ? Next morning if broker acts as counterparty ? Immediate if broker acts as agent *Structural blocks** - Immediate or T+2 if member acting as principal has not offset his position	(i) No obligation to execute offers posted at better prices in the limit order book. ?ii? Block price must be inside the weighted average spread, that is computed using the best ask and bid prices in the limit order book up to NBS**. (iii) Structural block prices can be within +/-10% of the best bid and ask quote
SETS***	*Ordinary risk trade*: Immediate publication. *Worked Principal Agreement*: End of the trading day or once 80% of the transaction is offset	(i) No obligation to execute offers posted at a better price in the limit order book. (ii) No price link with central limit order book
SWX	30 minutes.	(i) No obligation to execute offers posted at better prices in the limit order book. (ii) Rule of Best Execution: Same execution prices as those that could be realized in limit order book.
TSA	Publication of wholesale trades at the end of trading day.	Wholesale orders can be executed at any price
XETRA	N/A	N/A

*The value of a structural block must represent at least 2% of the company's capital or be greater than FF50m for a stock with a market capitalization larger than FF1bn. It must be at least 5% of the company's capital otherwise.

** A larger spread (SuperWAS) is computed for block trades larger than 5NBS on request to SBF. These trades can be executed at prices within +/-5% of best bid and ask prices.

*** Different publication rules are used for stocks that trade in SEAQ (See Pagano and Steil (1995)).

Table 10.1: Order Types during Continuous Trading Periods

Definitions:

Limit Order: an order that specifies a price and the maximum quantity a trader is willing to buy or to sell at this price.

Market Order: an order to buy or to sell a given quantity at any price.

At Market Order: an order to buy or to sell a given quantity at the best posted quotes. The unfilled part of the order is automatically transformed into a limit order.

Stop Market Order: an order that is transformed into a market order when the market price reaches the price of the stop order.

Stop Limit Order: an order that is transformed into a limit order when the market price reaches the price of the stop order.

Fill or Kill Order: an order for a given quantity that is executed entirely or not at all.

Execute or Eliminate Order: a fill or kill order that can be partially executed. The unfilled part is canceled.

	NSC	SETS	SWX	TSA	XETRA
Limit Order	Yes	Yes	Yes	Yes	Yes
Market Order	Yes	Yes	Yes	Yes	Yes
At Market Orders	Yes	No	No	No	No
Stop Market Order	Yes	No	Yes	No	Yes
Stop Limit Order	Yes	No	Yes	No	Yes
Fill or Kill Orders	Yes*	No	No	No	Yes
Execute or Eliminate orders	Yes	Yes	Yes***	No	Yes

*In NSC, Fill or Kill orders are called All or None Orders.

** In NSC, Execute or Eliminate Orders are called Fill *and* Kill Orders.

*** In SWX, Execute or Eliminate Orders are called Accept Orders.

Table 10.2: Order Types in Call auctions

	NSC	SETS	SWX	TSA	XETRA
Limit Order	Yes	Yes	Yes	Yes	Yes
Market Order	Yes	No	Yes	Yes	Yes
At Market Orders	Yes	No	No	No	No
Stop Market Order	Yes	No	No	No	Yes
Stop Limit Order	Yes	No	No	No	Yes
Fill or Kill Orders	No	No	No	No	No
Execute or Eliminate orders	No	No	No	No	No

Table 11: Tick Sizes

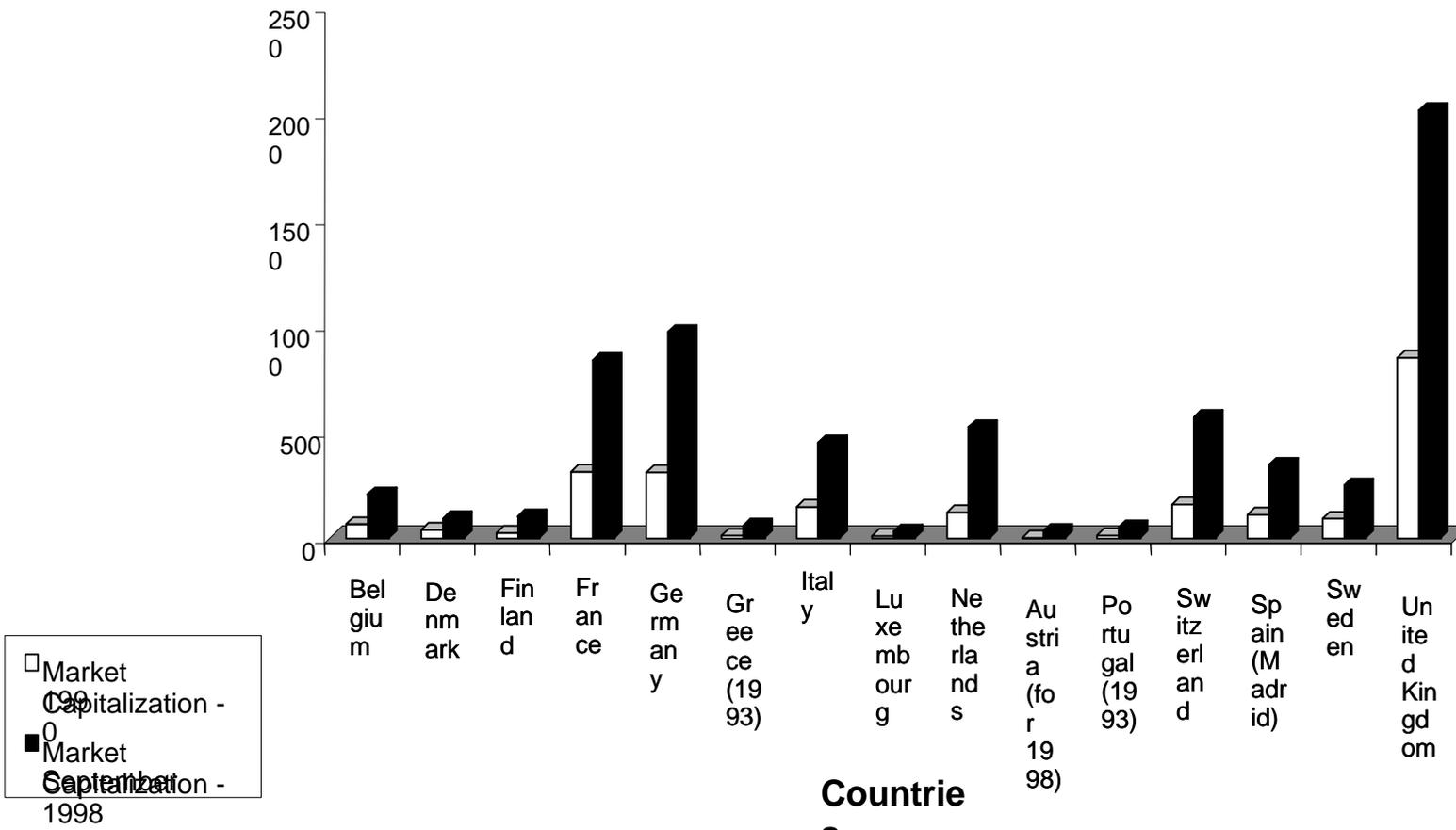| NSC (in Euro)	SETS (in £)	SWX (in CHF)	TSA (in Euro)	XETRA (in DM)
$P < 50 : 0.01$ $50 \leq P < 100$euro: 0.05euro $100 \leq P < 500$: 0.10euro $500 \leq P : 0.50$	$P < 500 : 0.25$ $500 \leq P < 1000$: 0.5 $1000 \leq P$: 1	$P < 10$: 0.01 $10 \leq P < 100$: 0.05 $100 \leq P < 250$F:0.25 $250 \leq P < 500$F: 0.5 $500 \leq P < 5000$F: 1 $5000 \leq P$: 5	$P < 1 : 0,01$ $P > 1 : 0,10$	$P < 100 : 0.01$ $100 \leq P : 0.05$

Table 12: Clearing and Settlement

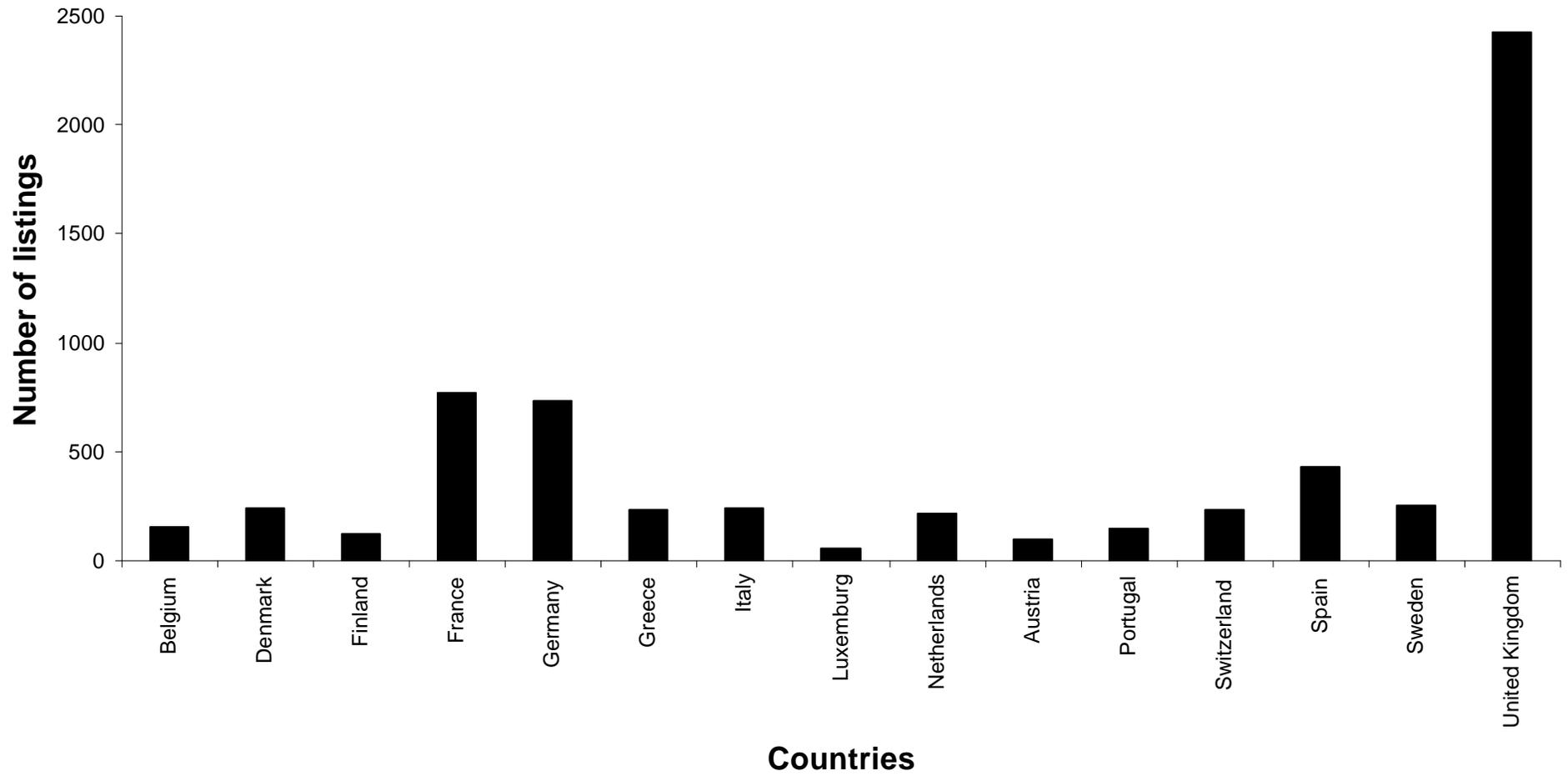|	Amsterdam Exchanges	Deutsche Börse	London Stock exchange	Paris Bourse	Swiss Exchange-SWX
Fully computerized	Yes (Through NEGICEF)	Yes (Through DBC)	Yes (Through CREST)	Yes (Through RELIT/RGV)	Yes (Through SECOM)
Settlement Date	T+3	T+2	T+5	T+3**	Immediately after each transaction ; SFI-DVP (Simultaneously final irrevocable delivery versus payment)
Netting	Yes	No*	No	Yes	No
Central Securities Depository	NEGICEF	DBC	CREST	SICOVAM	SEGA
Clearing house	Yes (AEX-Effectenclearing)	No	No	Yes (SBF-Paris Bourse)	No

* Trade by trade settlement for securities but net settlement for cash payments.

** Except for the Monthly Settlement Market for which clearing and settlement take place at the end of the month.

Figure 1: Market Capitalization of European Exchanges (in USD Billion) (Domestic Shares)

Legend:
- ☐ Market Capitalization - 1990
- ■ Market Capitalization - September 1998

Y-axis: 0, 500, 1000, 1500, 2000, 2500

Countries (X-axis): Belgium, Denmark, Finland, France, Germany, Greece (1993), Italy, Luxembourg, Netherlands, Austria (for 1998), Portugal (1993), Switzerland, Spain (Madrid), Sweden, United Kingdom

Countries

Figure 2: Listings in European Markets - September 1998
(Domestic Companies)
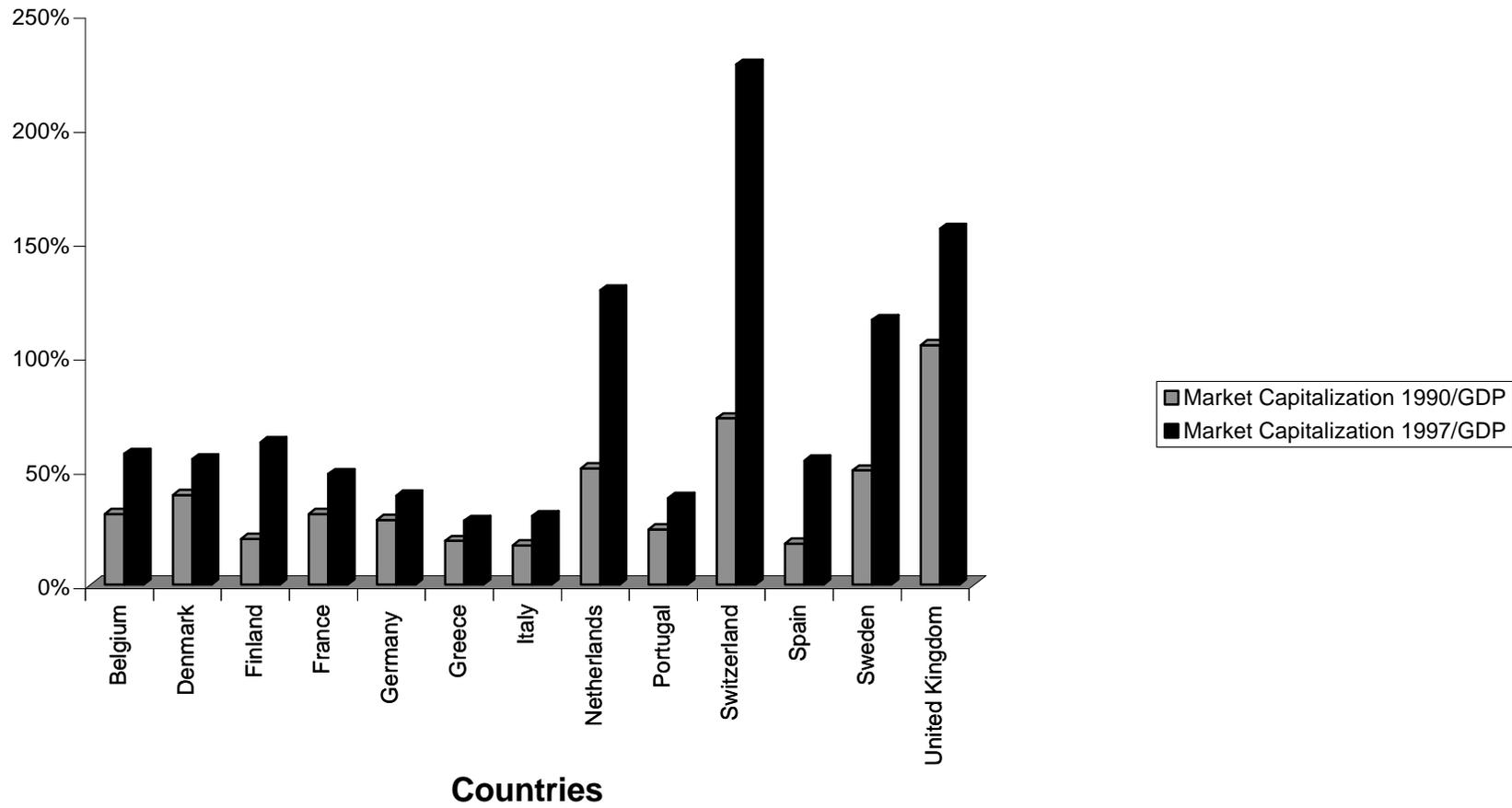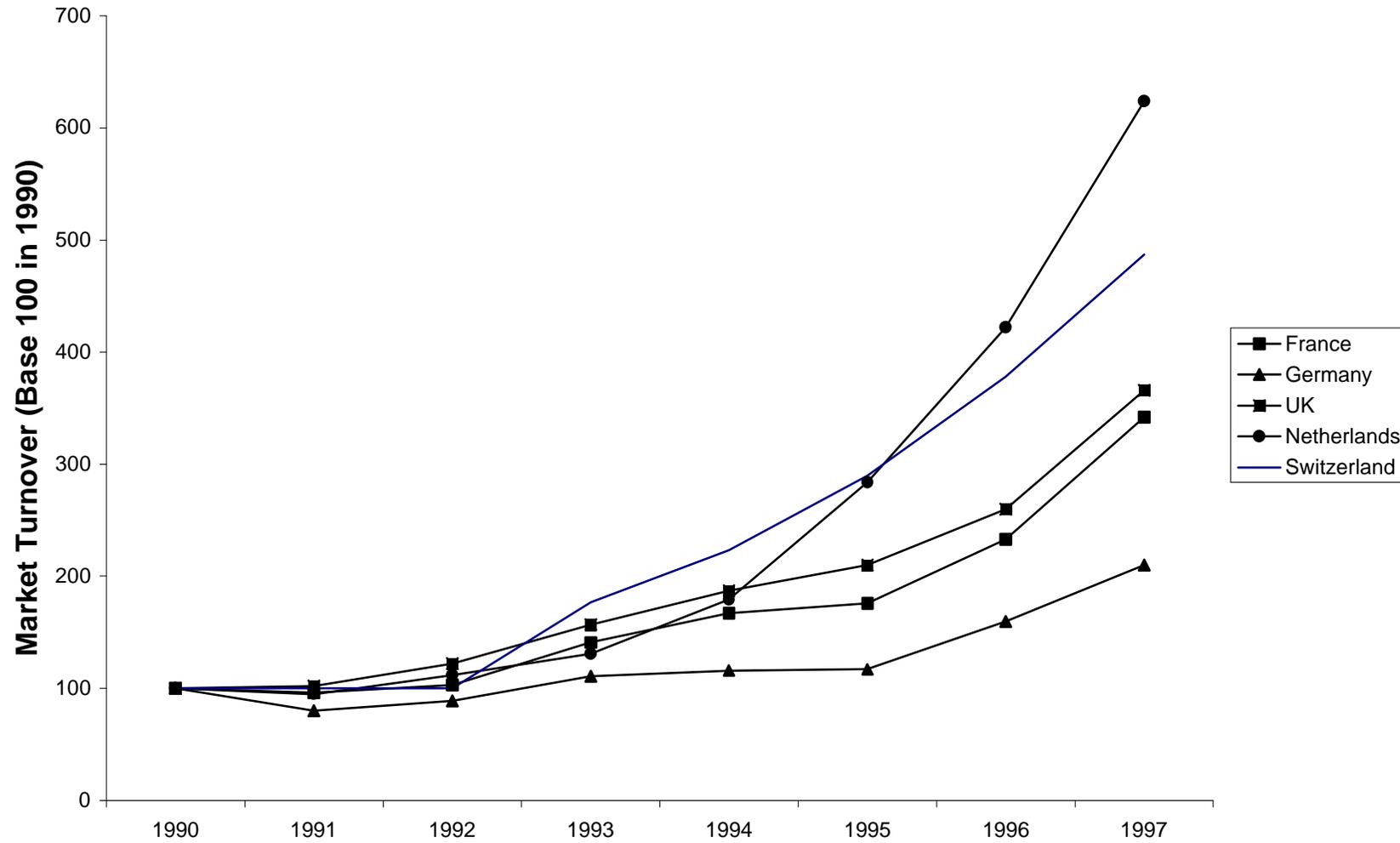
**Figure 3: Market Capitalization/GDP
(Domestic Shares)**

Figure 4: Evolution of Market Turnover

Figure 5: Market Turnover - 1997
(in USD million)