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# What is the Difference?

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Marco Pagano
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Ailsa Roell

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**Marco Pagano**

Università Bocconi and Innocenzo Gasparini Institute for Economic Research

and

**Ailsa Röell**

Department of Economics and Financial Markets Group, London School of Economics

## 1 Introduction

In the 1980s, the practice of listing stocks in several exchanges has become more frequent, and as a result investors have gained access to alternative trading systems to exchange the same stock. For instance, French, Italian and Spanish "blue chip" stocks can now be traded in their domestic exchanges, organised as auction markets, as well as in the London SEAQ International market, which is a dealership market. The key difference is that while in auction markets all outstanding orders are transacted at a single price via a centralized mechanism, in dealership markets they are placed with individual dealers, who execute them at preset quoted prices.

Even within the context of a single exchange, it is becoming increasingly common to give traders a choice between alternative trading methods. For instance, the Paris and Madrid exchanges allow traders to choose between a batch auction at the beginning of the trading day, where all orders are transacted at a single market-clearing price, and a continuous auction, where incoming orders are automatically and instantly matched with the orders currently outstanding on the limit order book. Similarly, in Frankfurt stocks can be traded on the floor of the exchange, operating as an auction, or on a screen-based dealership market operated by the major German banks (so far, only outside the hours of the exchange). And in London, a continuous auction for small deals is under consideration.

It thus becomes important to understand which of the differences between these alternative trading technologies are economically meaningful and how they affect traders. At one extreme, one could for instance argue that the existing differences between trading systems are inessential, in that they lead to the same set of asset prices, the same allocation of resources and the same level of welfare for market participants. However, it would be hard to reconcile this view with the fact that some traders appear willing to move their trading activity from one market place to another in response to the emergence of new trading technologies. For example, the creation of the dealers' market of SEAQ International in London has drawn volume away from the auction markets of continental Europe. And the London market appeals to a specific group of traders, namely large institutional investors.

An understanding of the tradeoffs faced by individual traders in choosing between trading systems can give insights into a very topical issue: the distribution of asset trading across competing financial centres. Stock exchanges and their regulatory authorities are engaged in a continuing battle to attract trading activity and the associated rents: in previous work (Pagano and Röell 1990a, 1990c, 1991a), we have documented and analysed this process of regulatory competition in Europe.

The first step in the analysis is to describe the salient features of the various trading systems, and to pin down the major economic differences in their operation: Section 2 of the paper. In Section 3, we focus on three dimensions along which trading systems differ, looking at the effects on market liquidity for ordinary investors. Section 4 discusses the positive and normative issues that arise when the same assets are traded in several exchanges. Section 5 concludes the paper by pointing to directions for further research.

## 2 Alternative trading systems: description

We will distinguish between only three prototypical trading systems: a batch auction, a continuous auction and a dealer market.[1]

In a batch auction, agents submit price-quantity schedules to a central auction mechanism (auctioneer). All trades are executed at a common market clearing price[2]. Examples are the daily batch auctions in Paris, New York, Tokyo, Milan and Madrid.

In an electronic continuous auction agents submit orders to a centralised system which displays the best limit orders and automatically executes incoming market orders against them. As trades are executed, the transaction price and quantity are automatically displayed on-screen so that all market participants can trace the recent history of the order flow. Moreover, as in a batch auction, any agent is allowed to submit limit orders: there is "public limit order exposure".

[1] Whitcomb (1985) gives a detailed (but somewhat dated) survey of existing systems.

[2] In some batch auctions there is scope for revising orders in a tatonnement process during which tentative market clearing prices are called out.

Examples are the electronic systems based on Toronto's CATS now used in Paris and Madrid and planned for Milan. Order flow visibility in a continuous electronic auction is similar to that in the floor trading systems of the Chicago futures and options markets and the hybrid system of the New York Stock Exchange. Here presence on a centralised trading floor and/or ticker tape reporting ensures immediate trade publication. In an electronic dealership market, designated market makers display prices at which they are willing to buy and sell up to a specified size (i.e. they quote bid and ask price schedules) on an electronic screen. Orders are executed by telephoning a market maker who displays an attractive price (though for small orders there may be an automatic electronic order execution system in place). Note first that there is no public limit order exposure: all dealing is done via the market makers and orders from two members of the public cannot cross directly. Secondly, each order is satisfied separately by a single dealer, who does not know the price, size and direction of orders executed by other dealers until these are reported to the central authority and displayed on screen. Exchange authorities dictate the speed at which publication should take place; the permitted delay can vary from a few minutes to 24 hours or more. Examples of dealer markets are London's SEAQ and America's NASDAQ.

## 3 Alternative trading systems: analysis

In this section we analyse, in the context of a series of simple examples, how market liquidity and execution risk differ across the trading systems described above. Liquidity is measured by the average trading cost, i.e. the difference between the market price at which an order is executed and the "mid-price" (the expected price unconditional on the size and direction of the order). This difference arises when orders push the market price away from the pre-existing mid-price. Execution risk is the dispersion of the transaction price about its expected value to the trader.

Our discussion is organised into subsections dealing with the main functional differences between the different trading systems. Two of the differences that we consider are the speed of dissemination of order flow information (§3.1) and the extent of public limit order exposure (§3.3).

When we focus on these two, we find that dealership markets protect traders against execution risk but that ordinary traders incur lower average trading costs in the auction markets. But with regard to a third dimension, the degree to which traders' identities are known before trade (§3.2), we find that dealership and floor trading systems may provide cheaper service.

### 3.1 Prices are quicker to adjust to order flow information in a centralised market

One important difference between trading systems is the amount of information available at the time the price is formed. In most continuous auction markets, details of all deals are immediately publicised on-line. Similarly, in a batch auction the price aggregates information about the entire market's order flow. In contrast, in a dealership market such as that of London, publication of trading information concerning larger deals is quite leisurely, so that transaction prices are formed by a market maker before he becomes fully aware of his competitors' recent order flow. We present a simple example to show how the promptness of trade publication affects ordinary traders' trading costs and trading price risk.

Example. We consider a model in which market prices are set by risk neutral competitive speculators or "market makers", so that order flow exerts price pressure entirely because of its informational content, in the spirit of "Bagehot" (1971) and Glosten and Milgrom (1985). The security traded has a value (V) which may be high ($V_H$) or low ($V_L$) with probability ½ each. This is known exclusively to a risk neutral informed trader, who is present on the market with probability q and places a market order to buy or sell an amount that maximises his expected profit. With probability z an uninformed "liquidity" or "noise" trader arrives; he places a market order to buy or sell a unit with probability ½ each.

In a batch auction market, the price reflects the best estimate of the security's value, given total market demand. The different possible trading patterns and corresponding prices are derived in Table 1. The expected price paid by a liquidity buyer in the batch auction is:

$$\underline{V} + \text{‰}\, q \left[ \frac{2 - (q+z)}{q+z-2zq} \right] (V_H - \underline{V})$$

**PLACE TABLE 1 AROUND HERE**

In contrast, in a dealer market each order is to be filled at the quoted price for one unit: dealers do not, at the time of accepting a trade, know whether a second order has also arrived on the market, or its direction. Hence the ask price at which they are willing to offer one unit is the expected value of the security, given a buy order by a trader of unknown identity:

$$\frac{z\underline{V} + q V_H}{z + q} = \underline{V} + \frac{q}{z + q}(V_H - \underline{V})$$

Prices in a continuous auction will be a mixture of those prevailing in the two other forms of market organisation. The first trader to arrive transacts at the dealer market price; the second, at the batch auction price.

It is readily seen that the buyer's average price premium is lower in the batch auction than on the dealer market (and, of course, intermediate in the continuous auction):

$$\text{‰}\; q\left[\frac{2-(q+z)}{q+z-2zq}\right] \leq \frac{q}{z + q}$$

where equality obtains only if $q = z$ (a special case of a general condition for equality of average transaction costs in the three markets, given in Pagano and Röell (1991b)).

The example suggests that because in a dealer market the market makers have less information about recent trading history, they are forced to set spreads that are wider on average than in an auction market. This result can be generalised. In Pagano and Röell (1991b) we show that for any given pair of distributions of the order flow placed by one potential informed trader and one potential liquidity trader, the auction market is on average cheaper for the liquidity trader than the dealer market. This finding is, however, somewhat limited in scope and begs at least three questions. What if there is more than one trader of each kind? What if the informed trader's distribution of trades is not given, but differs across the two forms of market, as he optimally adapts his order placement strategy to the expected market pricing function? And lastly, how does the impact of trading system on trading costs differ across trades of different sizes? Even if liquidity traders taken together do better on an auction market, those with relatively larger trade sizes may benefit from a dealership market or vice versa (one can construct examples showing that this may go either way).

So much for average trading costs. What about "execution risk", that is, the riskiness of the transaction price? There is zero execution risk in the dealer market: the price obtained for a transaction depends only on its own size and direction. In the auction markets, however, the transaction price generally depends on the random order flow coming from other traders. Thus the dealer market dominates in terms of execution risk.[3]

An issue that is neglected in the above discussion is the strategic interaction among market makers who have differing information about the history of the order flow. Kyle (1987) and Röell (1988) analyse the following feature of a dealership market lacking prompt last trade reporting. When a market maker fills an order, he obtains information (namely, the size and direction of the order) which allows him to form a more accurate estimate of the security's value than his competitors. He can use that information, at the expense of his competitors, in subsequent trading and pricing decisions. The presence of such a "quasi-insider" amongst their number leads to more cautious equilibrium pricing by market makers and generally harms the liquidity of the market. In general, there is scope for more research concerning the effects of such differences in order flow information on the competitive behaviour of market makers. For example, in practice, market makers sometimes form informal alliances and warn each other about large orders overhanging the market. The incentives for, and effects of, such information sharing are underresearched.

We note lastly that our approach to trading costs may understate the disadvantages of a dealership market. Dennert (1990) examines a model in which traders can split up their orders and 'hit' several market makers simultaneously on the dealership market (in contrast, the models we have described assume that each trader brings his entire order to a single market maker). As Dennert shows, in the dealer market this possibility may exacerbate the effect that the imperfect aggregation of order flow information has on average trading costs.

### 3.2 In a dealers' market it is harder to trade anonymously

One advantage of the old fashioned floor trading systems is the opportunity to observe who trades what with whom, how urgently they seem to want to trade, etc. The new systems for electronic trade execution do not allow professional speculators to "weed out" obvious insiders as

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[3] One could argue that the auction price is more risky precisely because it is more informative, so that the subsequent holding period risk is correspondingly reduced. But in an auction market the end-of-holding-period price will be equally more informative, so that the net effect of the trading system on the holding period risk should be zero. This leaves us with the pre-transaction execution risk effect; in this regard the dealer market dominates.

easily, forcing them to trade on an equal footing with all comers. In contrast, dealership markets allow for some measure of telephone negotiation of prices so that better "inside-the-quotes" prices can be given to customers who do not seem to be trading on information. The ability of market makers to identify at least some traders as liquidity- or information-based before setting the market price can reduce average transaction costs for uninformed traders, as illustrated in the following extension of our simple example.

Example. Returning to the example of § 3.1, suppose that a proportion γ of the liquidity traders and λ of the information-based traders can be recognised as such by the dealers who set market prices. In the dealer market, the ask price for unidentified traders now becomes:

$$\underline{V} + \frac{(1-l)q}{(1-g)z + (1-l)q}(V_H - \underline{V})$$

Clearly, the market makers' ability to recognise insiders (λ>0) enables them to offer a better price to ordinary traders. As for their ability to recognise liquidity traders (γ>0), it helps those liquidity traders who are recognised (as they will be able to buy and sell at price $\underline{V}$) but harms those remaining liquidity traders who cannot prove that they are uninformed, and must pay the general market price. But the total cost to both sets of liquidity traders declines:

$$g.0 + (1-g)\frac{(1-l)q}{(1-g)z + (1-l)q} < \frac{q}{z+q}$$

The basic insight of this example, namely that speculators' ability to recognize traders enables them to offer a better price to liquidity traders, is developed further in Röell (1990). That model applies the idea of the example to an auction market where broker-dealers are able to gauge the motives behind their own customers' order flow and trade on own account, providing better terms for non-information based trades. As in the example, the main market liquidity (provided to unidentified traders) deteriorates but the terms of trade for identifiable liquidity traders improve, with a beneficial net effect on liquidity traders as a whole.

In general, however, an electronic auction market does not provide a means for communicating the trading motives or identity of traders to the market at large (beyond displaying brokers' codes alongside limit orders). A proposed mechanism for doing so by preannouncing trading intentions, the so-called "sunshine trading" discussed by Admati and Pfleiderer (1991) and

Gennotte and Leland (1990), has fallen foul of regulators who worry that such announcements may be used as a tool for market manipulation. And in any case, sunshine trading in a batch auction suffers from a credibility problem: every uninformed trader has an incentive to overstate the quantity he is planning to trade, in order to draw as many counterparties as possible into the market. Failing some mechanism to ensure that he trades as preannounced, market dealers may not take seriously the size of trade he announces.

### 3.3 Matching orders cannot cross directly in a dealer market

In this section we consider the impact of public limit order exposure: can ordinary traders' orders cross directly or must they always go through designated professional intermediaries, the market makers? A dealership market typically does not provide facilities for ordinary traders to expose their limit orders, so that it is impracticable and costly to bypass the market makers and find out whether there is a matching order available. In contrast, ordinary traders in an auction market may either trade directly with one another or transact with a professional intermediary.

In a dealer market, traders always pay the bid-ask spread even if a matching order is available. In return, dealers provide a service: by setting quotes in advance they insulate traders from adverse price shocks arising from order flow imbalances. In other words, as already argued in the model of § 3.1, dealers insure traders against execution risk.

In fact this point carries over to models without informed trading, such as the "inventory holding cost" model of market liquidity developed by Ho and Stoll (1980) and others. In that model, trades exert price pressure only because intermediaries are risk-averse and have to be compensated for taking on inventories of risky assets. Their compensation takes the form of a price premium (discount) when they are required to sell (buy). Pagano and Röell (1990b) use such a model to compare an auction and a dealership market, obtaining the same predictions as the adverse selection model: trading prices on the auction market are better on average but more risky. The normative issue then is: is it efficient for customers to buy insurance by trading on a dealership market, or would they prefer to bear the execution risk themselves and trade on the auction market? In the inventory cost model the relevant condition is that dealers must be sufficiently less risk averse than the customers, so that they provide the insurance at a low enough cost.

## 4 Competition among exchanges

So far we have treated the different trading systems as mutually exclusive. But in practice they do coexist, raising questions about their interaction. It is natural to ask whether trade will gravitate towards one or the other, eventually concentrating in a single marketplace, or whether different trading systems will coexist, catering to specific clienteles. The body of theoretical and empirical knowledge on which we can draw to address this question is still very limited. Nevertheless, some elements of the answer are starting to emerge.

One element is that trading in speculative markets is characterized by positive "thick market" externalities. The liquidity of the market is increasing in the number of participants, other things equal. Pagano (1989) shows that if agents can choose between two competing auction markets, in the absence of a transaction cost differential all trade will concentrate on a single market. In a similar vein, Admati and Pfleiderer (1988) show that trading activity gravitates to a single moment in the day when liquidity is expected to be highest.

But in reality other things are not equal. Competing markets differ not only in their "thickness" but also in other respects, such as trading technology, taxes and order processing costs; these may separate out specific clienteles. If there is a fixed cost differential between two auction markets, Pagano (1989) shows that in equilibrium they can operate in parallel: one attracts large traders, the other, small traders. Similarly, a centralised auction market can coexist with an "upstairs" search market, catering to small and large traders respectively.

Unfortunately there is very little theoretical analysis of competition between coexisting auction and dealership markets beyond the work of Kyle (1987) and Röell (1988). They argue that dealers who are not subject to mandatory last trade publication (such as market makers in non-British stocks on SEAQ International) can outcompete those who are (dealers in continental auction markets), harming the liquidity that the latter can provide. This raises the possibility of regulatory competition as exchanges vie for business (indeed, Pagano and Röell (1990c) suggest that the more transparent electronic trading system now used on the Paris bourse may have diverted trade away by facilitating off-exchange dealing).

So far, the European experience of the 1980s suggests that the two types of market are able to survive in parallel, attracting different clienteles: dealership markets for large institutional traders and auction markets for retail, individual investors. The functional differences between auction and dealership markets outlined in the previous sections may provide a starting point for understanding why this is so.

## 5 Conclusions and directions for future research

Financial economists are increasingly recognising that market outcomes can be affected by the way in which trade is organised, witness the rapid development of the "market microstructure" literature. However, we still know very little about the functional differences between different trading systems. As a result, we are ill-equipped to answer many empirically relevant questions. For instance, why do dealer markets appeal to large institutional investors while auction markets favour retail investors? Can we expect these clienteles to persist, or are they merely a feature of the transition to a concentrated market? What are the welfare effects of the disappearance of one or other market? Do dealers benefit from the informational externalities and liquidity offered by a parallel auction market, and is the liquidity of the auction market harmed by their competition? What are the likely effects of rule changes, such as tightening up the last trade reporting of London dealers?

This paper has highlighted three potentially important differences in the functioning of a batch auction, a continuous auction and a dealer market. We focused particularly on the information made available to market speculators in each system. Our analysis is still exploratory, and our list of differences is unlikely to be exhaustive. Moreover, their implications for many of the questions posed above are still to be worked out. But empirical work in this area is at least as important as progress on the theoretical front. Despite the wealth of quote and transaction data that is accumulating as a by-product of the competition among exchanges, there is a shortage of applied work on the liquidity and interaction of markets in cross-listed securities, especially in Europe.

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**Table 1 Batch Auction Market Prices as a Function of Total Demand**

| Noise trader's order | Informed trader's order | Total market demand | True value | Probability | Market price |
|---|---|---|---|---|---|
| Buy | Buy | +2 | $V_H$ | $\frac{1}{4}zq$ | $V_H$ |
| Buy | Sell | 0 | $V_L$ | $\frac{1}{4}zq$ | $\underline{V}$ |
| Buy | - | +1 | $\underline{V}$ | $\frac{1}{2}z(1-q)$ | $\underline{V} + \frac{(1-z)q}{z+q-2zq}(V_H - \underline{V})$ |
| Sell | Buy | 0 | $V_H$ | $\frac{1}{4}zq$ | $\underline{V}$ |
| Sell | Sell | -2 | $V_L$ | $\frac{1}{4}zq$ | $V_L$ |
| Sell | - | -1 | $\underline{V}$ | $\frac{1}{2}z(1-q)$ | $\underline{V} - \frac{(1-z)q}{z+q-2zq}(V_H - \underline{V})$ |
| - | Buy | +1 | $V_H$ | $\frac{1}{2}(1-z)q$ | $\underline{V} + \frac{(1-z)q}{z+q-2zq}(V_H - \underline{V})$ |
| - | Sell | -1 | $V_L$ | $\frac{1}{2}(1-z)q$ | $\underline{V} - \frac{(1-z)q}{z+q-2zq}(V_H - \underline{V})$ |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| - | - | 0 | $\underline{V}$ | (1-z)(1-q) | - |

Note: $\underline{V}$ is defined as the expected value $½(V_H+V_L)$.