Trading system competition and market-maker competition

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1. Introduction

The recent success of some alternative trading systems (ATSs) has had a strong impact on the traditional stock exchange industry and many observers expect even more dramatic changes in the future. This paper investigates the nature of competition between stock exchanges and ATSs and argues that the introduction of ATSs weakens the level of competition between market-makers in the traditional exchange.

According to a popular argument, competing stock markets lead to a fragmentation of the market and a reduction of liquidity which in turn increases spreads and search costs for traders and threatens the efficiency of the overall price discovery process. However, this argument is valid only in a world with high information barriers. With functioning arbitrage links between markets the traditional fragmentation argument breaks down.

This paper takes another view on stock market competition by looking in more detail at the different levels of competition. Stock markets offer a bundle of products and may best be described as a vertical production chain. The first element of the chain is the supply of immediacy by market-makers or individual traders. By providing privileges to certain members such as the specialists of the NYSE, the Nasdaq market-makers or the "Aktienbetreuer" on the German stock exchange, stock exchanges actively engage in the production of immediacy. The second element is the trading system. Different exchanges compete in technical dimensions such as speed, reliability and information services as well as in design dimensions such as the details of trading rules. The third element in the vertical production process is the settlement and clearing operation. Today, these functions may be provided by different entities. However, two of the three elements are often provided by one entity. For example, the German stock exchange is the owner of both the trading system and the clearing system. Another example is the in-house systems of banks that usually encompass the market-making function and the trading system function. Most European ATSs are at least partly owned by securities trading firms, indicating that the trading business may be more profitable if trading firms achieve control over trading systems. This paper concentrates on the relationship between trading systems on the one side and the business of making markets on the other side. The analysis shows that the two areas are interrelated. Changing the level of competition in the area of trading systems has an impact on the level of competition at the market-maker level.

Although the seminal work on collusive behaviour by Nasdaq market-makers by Christie and Schultz (1994) has directed much attention to the issue of competition between market-makers, this issue has so far received little attention in the theoretical literature. The market microstructure literature usually assumes either perfect competition between market-makers or monopolistic market-makers. This strand of the literature is not suited to studying the determinants of the level of competition between market-makers. Kyle (1989) models imperfect competition between informed investors but does not focus on imperfect competition between market-makers.

A paper by Dutta and Madhavan (1997) shows that implicit collusion between market-makers may occur when they compete by choosing intertemporal pricing strategies. The idea is that collusive equilibria may be sustainable if market-makers use tit-for-tat pricing strategies, ie penalising a deviation from the collusive equilibrium by quoting a low spread in later periods. However, collusion is only one out of many equilibria in their model. It is therefore difficult to draw conclusions on the impact of ATSs on the level of competition. In a different framework, Dennert (1993) shows that competition

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between a limited number of market-makers does not eliminate their profits when they use linear price schedules. However, he does not investigate the relation between competing stock markets and the level of market-maker profits. Kandel and Marx (1997) show that a Bertrand equilibrium with spread exceeding marginal cost may result from fixed minimum price increments. However, this paper is also not concerned with the issue of competition between trading systems. In a recent contribution, Hendershott and Mendelson (2000) analyse the interaction of dealer markets and crossing networks. They show that the introduction of a crossing network may increase or decrease the equilibrium spread in the dealer market. However, their model assumes Bertrand competition between market-makers which always ensures a zero profit equilibrium in which price equals average costs.

This paper presents a new approach to modelling the price setting behaviour of market-makers within a simple one-period framework. The paper deviates from the usual notion of Bertrand competition by assuming that market-makers who do not quote the best bid and ask prices still receive some order volume. Unlike Dutta and Madhavan (1997), the approach yields unique equilibria with non-zero profits for market-makers and allows an analysis of the impact of ATSs on equilibrium spreads and equilibrium market-maker profits.

Within the popular press, opposing views on the likely impact of ATSs on market spreads are expressed. Some commentators expect that increased competition among trading systems through the advent of ATSs would help to tighten spreads.[2] On the other hand, concerns have been raised that the vertical integration of trading services through the entry of bank-owned in-house trading systems will in the end lead to a monopolisation of the trading industry.[3] The European regulatory authorities currently follow a comparatively liberal policy and believe that a "laissez-faire" policy is best suited to promote competition among marketplaces and achieve economic efficiency. However, the European Commission has recently expressed concerns that the trend towards vertically integrated trading systems could dampen competition and is considering regulatory actions against vertical constraints in the stock exchange industry.[4] The model presented here elaborates this view by showing how vertical constraints in the form of order-preferencing arrangements between ATSs and market-makers may affect the level of competition between market-makers and increase the equilibrium spread in stock markets.

2. The regulatory situation

The European securities markets are characterised by regulatory fragmentation. Stock market regulation in Europe is usually shaped by three different kinds of regulatory bodies:

1. Institutions regulating insider trading and the flow of information from companies to investors (insider regulation).
2. Institutions regulating the capital adequacy of participants in the trading process (capital adequacy regulation).
3. Institutions which regulate stock exchanges or oversee the self-regulatory bodies of stock exchanges (stock exchange regulation).

As a new fourth body of regulation, one should mention the competition authorities, which have just recently begun to become interested in issues of stock market competition.

Unlike the situation in the United States, the bodies regulating stock exchanges work on a decentralised basis. This approach is sometimes called the "silo approach" to regulation since every authority is concerned with only one or few stock exchanges. An extreme example is the situation in Germany, where the local states have the duty of overseeing stock exchanges. This led to the curious situation of a local state government having to approve the planned merger of the German stock

[2] Moskowitz (2000).

[3] Munz (2001).

[4] Heusinger (2001b).

exchange with the London Stock Exchange - a decision which obviously affects the interests of much more people than the voters of the local state government.

Due to the decentralised nature of competition, the regulatory actions concentrate on the business processes within the particular regulated stock exchange. The competition between different exchanges naturally lies beyond the horizon of decentralised authorities. In other words: no institution is responsible for providing a fair level playing field between competing stock exchanges. The relations between competing stock exchanges are beyond the scope of today's stock market regulation.[5]

Regulatory councils such as the Federation of European Securities Commissions (2000), or the German Stock Exchange Council (2001) discuss at length the extent to which principles of stock market regulation should be applied to ATSs but are silent on the regulation of competition between trading systems. The discussion is mainly concerned with the threats to market integrity and systemic risk posed by the new trading platforms. There is little or no discussion on an economic role of protecting new trading platforms against the dominant incumbent exchanges or vice versa.

The issue of competition between trading systems requires a broader scope of regulation than currently practised. In particular, it raises the question of external effects in other areas as the current focus of the various regulators' investigations. This paper highlights one of possibly many external effects of trading system competition: a weakening of market-making competition. Although the conclusion will show that it is hard to draw clear regulatory implications from the analysis, some blind spots in the current regulatory landscape are identified by the analysis.

3. The impact of alternative trading systems on market-maker competition

The following model tries to explore the effect of introducing an ATS on the competition between market-makers. It is a very simplified and stylised, based on the following assumptions:

1. The market consists of two types of individuals: traders and market-makers. There is no asymmetric information about the value of stocks. All traders are thus liquidity traders.
2. Initially, stocks are traded in a pure dealer market (the incumbent market), in which two market-makers compete for order flow. Both market-makers simultaneously choose bid and ask quotes and commit to execute an unlimited order volume at this price.
3. Market-makers act as Bertrand competitors in the incumbent market, ie their action variable is the quoted spread. The market is in equilibrium when no market-maker wants to alter his own spread given the spread of his competitor.
4. When an ATS is introduced, every trader chooses one particular trading platform before he places his order.
5. In order to attract order volume, the ATS provides a best price guarantee, ie traders receive the same transaction price on both markets and thus are indifferent between both markets.
6. Traders cannot place limit orders within the spread on either the dealer market or the ATS.
7. Before the start of trading, a contract is signed between the ATSs and the market-makers which commits both market-makers to assume and execute all orders routed through the ATSs. For simplicity, we assume an equal division of the trading volume between both market-makers.[6] Note that the contractual allocation of the ATS's order flow to the individual market-makers takes place before the orders are placed by traders. It is this sequence of events which drives the main results of the model. By committing to buy a portion of the

[5] The "Committee of Wise Men" (2000) of the European Union has identified the urgent need to develop transnational regulation. However, given the legal and institutional barriers in the area of stock market regulators, the paper proposes to rely on competition policy as a complementary source of regulatory action.

[6] The model abstracts from any payments made to the ATSs for acquiring the order flow, which would lead to a redistribution of profits between the two parties but leave unaffected the overall profits. Examples are the German Quotrix system and the planned trading system of Knight. See Heusinger (2001a).

ATS's order flow before trading in the incumbent market takes place, the market-makers are able to precommit to pursue a less competitive pricing behaviour in the latter trading session. Intuitively, following aggressive pricing strategies in the incumbent market becomes less attractive because lowering the spread, ceteris paribus, leads to a smaller increase in volume as compared to the situation without the ATSs.

8. Market-makers' cost function is linear in turnover. The constant marginal cost may be interpreted as order-handling costs following the usual microstructure literature.

9. For simplicity, transaction costs are assumed to be zero for both markets.

10. In an important deviation from the usual Bertrand model, we assume that a market-maker quoting a lower spread does not lose all trading volume.

In traditional market microstructure models, the market-maker quoting the best bid or ask price attracts all trading volume. This assumption has the consequence that Bertrand competition drives down the spread until the spread equals marginal cost. A market spread exceeding the market-makers' marginal cost cannot be an equilibrium because every market-maker would have an incentive to slightly undercut his competitor(s). He loses little in terms of the spread reduction but gains a lot in terms of order volume because he is able to attract 100% of the trading volume. It follows that the only equilibrium is a symmetric equilibrium in which all market-makers set the same spread equal to marginal cost.

This extreme reaction of trading volume is unlikely to be a good description of real world markets. Although price priority rules ensure that limit orders with better prices are served before any other order with worse prices at any point in time, strict price priority is not a good market description when we are concerned about modelling spread setting strategies over somewhat longer time intervals. Suppose a market-maker is an employee of a securities trading firm and gets the order to follow a particular spread setting strategy, ie he will keep a spread of 100 base points. Suppose another market-maker working for another securities firm has an order to quote a 101 base point spread. Standard theory predicts that the second market-maker will not be able to do a single transaction. However, he can expect a non-zero turnover in real world markets for a number of reasons not acknowledged by the standard theory:

- At any specific point in time, competing market-makers may post different bid and ask quotes because of differences in their current inventory positions.
- Both market-makers may quote different bid and ask prices as they have different expectations about the fair (mid-market) value of the asset traded.
- After a transaction has erased an order from the order book, the market-maker will need some time to place a new quote there. Within this short time period, another market-maker, who is quoting a higher spread, may attract trading volume.
- Every market-maker must continuously update his bid and ask quote in order to adjust to changing market prices. If this adjustment does not take place exactly simultaneously, a market-maker with a higher spread will at some points in time quote the best bid or ask quote.

All these arguments support the view that the reaction of transaction volume to spread changes is less extreme in real world markets as compared with the usual Bertrand models. A good model of market-maker competition should have the property that expected trading volume is a smooth and decreasing function of the quoted spread, ie a market-maker quoting aggressively receives more, but not all trading volume.

In order to formalise this idea, assume that aggregate demand for dealer services is inelastic such that the aggregate trading volume is given by a constant X. Furthermore, the share of trading volume that a market-maker attracts is a smooth function of his own spread and the spread quoted by his competitor. For simplicity, assume that the fraction of trading volume attracted by each market-maker x_i is a linear function of the spreads s_i and s_j quoted by each market-maker:

$$x_i = ½ - s_i + s_j$$

When both market-makers set the same spread, they both receive 50% of the trading volume. If one of the market-makers lowers his spread, he is gaining market share but not the complete market and vice versa. Note that x_i and x_j sum up to one.

Finally, the cost function of market-makers is assumed to be linear with constant marginal cost of *c* per unit of trade. Each trader sets the profit maximising spread given the spread set by his competitor. We are interested in the equilibrium spreads of this Bertrand competition for order flow.

The profits of trader *i* given the spread chosen by trader *j,* is given by

$$\pi = x_i X^*(s_i - c)$$
$$= \left(\frac{1}{2} - s_i + s_j\right) X^*(s_i - c)$$

The market-maker sets the profit maximising spread. The first order condition is

$$\pi_i' = X\left(\frac{1}{2} - 2s_i + s_j + c\right) = 0$$

The two first order conditions of the market-makers define the two reaction functions of the game:

$$s_i = \frac{1}{4} + \frac{s_j}{2} + \frac{c}{2}$$
$$s_j = \frac{1}{4} + \frac{s_i}{2} + \frac{c}{2}$$

The symmetric equilibrium is given by the intersection of the reaction functions. In equilibrium, the spread exceeds marginal cost:

$$s_i = s_j = \frac{1}{2} + c$$

Equilibrium profit for each market-maker is given by

$$\pi_i = \pi_j = X\frac{1}{2}\left(\frac{1}{2} + c - c\right) = \frac{X}{4}$$

Bertrand competition in this setting does not erase market-maker profits. Due to the assumed market imperfections, market-makers are able to realise a profit margin in equilibrium.

Now, suppose that an ATS is introduced into this setting. The ATS convinces a fraction α of traders to direct their trades away from the incumbent market. It offers a best price guarantee stating that the trader pays the same spread as he would have received in the incumbent market. Due to the best price guarantee, traders are indifferent between both markets. The ATS then signs a contract with both market-makers in order to ensure the promised order execution. For simplicity, assume that the ATS charges the market-makers no fees for the right to execute the ATS's orders. This implies that any rents earned in the trading business stay with the market-markers and are not appropriated by the ATS. For simplicity, we assume a symmetric setting, ie both market-makers contract for half of the order volume generated by the ATS. Each market-maker's profit now has two components: the profits earned in the incumbent market and the profits earned on the contracted ATS's order flow. The profit earned on the ATS's orders depends on the benchmark price from the best price guarantee. When the two market-makers quote different prices, the derivation of the benchmark price is not trivial. We assume that the best price guarantee has the purpose of making traders indifferent between both markets. In order to ensure indifference, the benchmark price must be equated to the expected spread that the trader pays in the incumbent market. The benchmark price will be either s_i or s_j, depending on whether trader *i* or trader *j* is setting the spread at the moment when a liquidity trader enters his trade. Since both cases happen with probabilities x_i and x_j, we can compute the expected spread on ATS's orders earned by the market-makers:

$$s^{ATS} = x_i s_i + x_j s_j$$
$$= \left(\frac{1}{2} - s_i + s_j\right)s_i + \left(\frac{1}{2} - s_j + s_i\right)s_j$$

After the ATSs has been founded and the order flow has been contracted, the trading session starts and each trader again has to set a profit maximising spread. When setting their spread, the profit function of market-makers has changed as compared to the situation without an ATS for two reasons: they compete only for the remaining fraction of overall trading demand (1-α)*X* and when setting a price, they have to take into account the effect on the benchmark spread on the precontracted ATSs trading volume. The new profit function is:

$$\pi_i = (1-\alpha)X\left(\frac{1}{2} - s_i + s_j\right)(s_i - c) + \frac{\alpha}{2}X\left(s^{ATS} - c\right)$$

The first order condition after introduction of the ATSs becomes:

$$\pi_i' = (1-\alpha)\left[\frac{X}{2} - 2Xs_i + Xs_j + Xc\right] + \frac{\alpha}{2}X\left(\frac{1}{2} - 2s_i + 2s_j\right)$$

Solving for the new equilibrium as above, we find the new equilibrium spread:

$$s_{i,j}^{ATS} = \frac{1}{2} + c + \frac{\alpha}{4(1-\alpha)}$$

For the special case α = 0 (no trading volume contracted to the ATS), the equilibrium spread coincides with the above result for the market without ATSs. For positive α, the spread increases and is a monotonic function of α. Thus, market-makers are able to raise their spread in equilibrium due to the existence of an ATS with best price guarantee. The effect of introducing an ATS into the dealer market is a reduction of the level of competitiveness. The ATS allows market-makers to quote spreads which are closer to the monopoly situation. (As α approaches 1, the spread grows without bound. This result is due to the assumed inelastic demand for market-maker services which enables a monopolistic market-maker to demand an arbitrarily high spread.)

While the model is highly stylised and simple, the basic intuition for the spread increase after introducing an ATS is straightforward and continues to hold in many possible extensions of the model. When a trader calculates the marginal gain of lowering the spread in a situation without an ATS, he has to consider three effects. First, he earns a lower profit margin on his trading volume. Second, he enjoys an increase of trading volume because he attracts a larger market share. Third, he has to take into account the reaction of his competitor. Since the reaction functions have a positive slope, the competitor will also decrease his spread, resulting in a decline of trading volume. After the introduction of an ATS, the situation changes. Concerning the trading volume left in the dealer market, the same effects are present. However, the trader now has to take into account the additional effect on profits from his ATS's trading volume. Since the volume has been contracted in advance, there is only the price effect left: lowering the spread thus unambiguously decreases the profits from the ATS. The fact that he cannot gain more market share in the ATS's market makes a reduction of spreads less favourable ceteris paribus. In other words: the ATS serves as a precommitment device which weakens price competition in the later trading stage by lowering the returns from decreasing the spread.

Note that the model has a unique equilibrium that allows a clear-cut analysis of the effect of introducing an ATS. In a related model, Dutta and Madhavan (1997) show that order-preferencing arrangements increase the potential gains from collusion for individual market-makers. But their model has multiple equilibria and collusion is just one of them. Their model is also consistent with the empirical hypothesis that ATSs do not have any impact on the spread. Kandel and Marx (1997) also analyse the impact of order-preferencing arrangements within their model, which is qualitatively equivalent to introducing an ATS. They conclude that order-preferencing does not change the spread as long as the marginal market-maker has no preferenced orders. This result does not continue to

hold in the context of our model. Even if only one market-maker receives all ATS trading volume, the equilibrium spread in the market would increase as one of the two reaction functions shift. The result of Kandel and Marx depends on the usual Bertrand assumptions and therefore has little robustness when the individual demand curves become downward-sloping and smooth as assumed here.

4. Conclusion

As we have demonstrated, the introduction of alternative trading systems may have the undesired side effect of decreasing competition at the market-making level when ATSs use best price guarantees in conjunction with order-preferencing arrangements as often seen in European securities markets these days. If regulators try to intensify trading system competition by recognising or promoting ATSs, they may have to trade off the efficiency gains through intensified competition at the trading system level with a decrease of competition at the market-making level. If one tries to compare both effects in terms of practical importance, there is a clear indication that market-maker competition should be much more important than trading system competition: commissions for using a trading system are an order of magnitude lower than the bid-ask spread in most markets.

This poses the question of the raison d'être of ATSs: do these systems exist because they can successfully compete against inefficient and costly trading systems of traditional exchanges? Or are they better described as vehicles to increase market-maker profits by limiting the ex post competition for orders by using order-preferencing arrangements? The model outlined here suggests that the second motive may be a valid reason for founding ATSs. This view is supported by the fact that the owners of ATSs are almost always securities trading firms or banks actively engaged in securities trading. In conversations, some representatives of European ATSs openly admitted that the spread income made by selling the order flow to securities firms is much more important than economies realised in operating a cost-efficient trading system.

If the second motive of operating ATSs should be the dominant one, it is still an open question whether customers are worse off after introduction of an ATS and whether regulators should intervene in the competition between traditional exchanges and ATSs. As long as there is free entry into the market-making industry, any profits made on order-preferencing arrangements with ATSs should be competed away, presumably by the usual practice of paying the ATSs for the access to their order flow. Competition between market-makers should therefore ensure that profits are passed over to the operators of ATSs. However, there is competition between ATSs for customer order flow. This competition will ensure that the payments received by market-makers are passed over to brokers and finally reduce the commissions paid by customers for trading stocks. If one follows this view, the gains from monopolisation of the market-making process are passed back to the customer and help to lower the fixed transaction costs of placing orders.

Two final remarks on this chain of reasoning are in order. First, it is questionable whether competition on all levels works smoothly and ensures that the extra fee paid by customers for market-making services will in the end flow back to them in the form of lower brokerage costs. Frictions and rigidities in the vertical chain may well leave part of the rents within the securities industry. Second and more important, the argument highlights the importance of understanding the multidimensional nature of transaction costs paid for securities trading services. The overall cost of trading includes brokerage fees, fees and commissions for settlement and related services and finally the spread paid to market-makers. While fees are an obvious and transparent cost of transacting, many investors have only a limited understanding of the amount of money they pay for market-making services in the form of the bid-ask spread. The shift of trading volume away from traditional exchanges towards ATSs may result in a general shift of transaction costs away from transparent items such as brokerage fees towards non-transparent items such as the spread. Future regulation should ensure that customers have access to all necessary information in order to make an informed decision between trading systems.

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