Banks' shareholding in multilateral trading facilities: A two-sided market perspective

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Abstract

The aim of this paper is to account for the observation that banks are both owners and clients of Multilateral Trading Facilities (MTFs) which were created in Europe after the implementation of the Markets in Financial Instruments Directive (MiFID). Using a duopoly model of two-sided markets, we show that banks' participation in MTFs crucially affects their objective function shape, pricing policy and profit. We show that when brokerage and trading activities are particularly important for banks' revenue compared to their profit as MTF operators, some market outcomes may emerge, whereby both MTFs include banks' interest as clients in their objective function. In these situations, although they earn negative profit as shareholders, banks benefit from lower fees as MTF's clients. This finally results in larger global revenue. This may explain why banks are at the origin of the creation of MTFs and why they maintain their stake despite negative profit.

JEL codes: G10 G23 G24 L10 L11 L22

Key words: banks, shareholding, multilateral trading facilities, two-sided markets

1 Introduction

The Markets in Financial Instruments Directive (MiFID), applicable in November 2007, aims to remove the remaining barriers to the supply of cross-border securities-related financial services and create a single securities market in Europe. The objective is to promote cross border competition in secondary securities (primarily equity) markets on the basis of three pillars: increased competition on a level playing field between trading venues, enhanced market efficiency and liquidity and better investor protection through improved transparency about trading venues. Consequently, under this European regulation, newly created trading electronic platforms or multilateral trading facilities (MTFs) are now allowed to compete directly with regulated markets. MTFs, which can be operated by investment firms or market operators, are similar to regulated markets in matching buying and selling orders: they allow the trading of securities that are admitted to trading on regulated markets. However, they are subject to different regulations and have no listing process.

BATS Chi-X Europe and Turquoise provide good examples of such trading platforms. BATS Chi-X Europe represents the 2011 merger of the two leading pan-European MTFs: BATS Europe (established in 2008 by BATS Global Market, a leading US operator of stock and options markets) and Chi-X Europe (created in 2007 by Instinet and a consortium of twelve financial institutions). Turquoise was initially funded by nine investment banks. Since December 2009, it has been mainly owned by LSE (51% since March 2010). Several other MTFs, such as Equiduct and Nyse Arca, still operate in Europe, but BATS Chi-X Europe and Turquoise are the most important. In 2013, BATS Chi-X Europe's and Turquoise's market shares amounted to 9.40% and 4.36% on FTSE, 11.81% and 5.10% on CAC40 and 10.62% and 3.16% on DAX30 respectively.[1]

This paper focuses on two aspects of MTFs, that few previous studies have examined. First, one observes that some MTFs are mainly owned by banks, which were also involved in their creation (see Table 1, in the appendix). For example, before the merger with BATS, BNP Paribas' ownership in Chi-X Europe was 1.89%. The stake was 8.24% for Credit Suisse, 8.23% for Merrill Lynch, 5.37% for Morgan Stanley and 5.12% for UBS. Similarly, Citigroup's stake in Turquoise has been 5.48% since 2011 whearas the stake has been 7.05% for Deutsche Bank and 3% for Barclays and JP Morgan.[2] Banks' shareholding in MTFs is all the more striking because they also route many orders to these MTFs for their own account or on behalf of their clients (AMF 2009). If banks are shareholders of MTFs, they may be tempted to urge the MTF they own to reduce the level of fees for themselves as clients and to ultimately respect the best execution principal for third parties.[3]

Second, it is noteworthy that MTFs in Europe charge lower prices than regulated markets. Although acquiring accurate data about connectivity and trading fees charged by trading venues is very difficult, Fleuriot (2010) indicates that, during the first three quarters of 2008, the average execution cost of a round-trip trade was between 0.25 and 0.30 basis points on MTFs

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[1]Source Fidesa and Agefi Hebdo 7-13 November 2013.

[2]Source: Authors' calculation, from MTF's financial statements.

[3]The best execution principle requires choosing the best venue for the clients in terms of factors such as transaction costs, quality and speed of execution.

whereas it was approximately 0.80 on regulated markets such as Deutsche Börse, LSE and Nyse-Euronext. In the same vein, AMF (2009) concludes that MTFs offer the best prices and the best volumes concerning CAC40 equities one in ten times, which is close to what regulated markets are proposing (one out of four times for Nyse-Euronext). Due to low fees and despite weak fixed costs and increasing trading volume, MTFs regularly incurred losses. For example, Turquoise's losses before tax were approximately 15.7 million pounds in 2008 and BATS Chi-X Europe's losses were 4.67 million dollars in 2012. Before the merge in 2011, BATS Europe never generated profit and Chi-X Europe earned profit in only 2010 (800,000 pounds), followed by huge losses in 2011 (10 million pounds).[4] One possible rationale for this market outcome is that because banks own the MTFs in which they participate as clients, they are able to influence the MTF pricing policy towards lower fees. Consequently, according to the weight banks attribute to their profit as shareholders and operators of MTFs compared to their utility as clients of MTFs (which depends on the relative importance of brokerage and trading activities for them), the banks' profit may be reduced whereas their utility and global revenue (defined as the sum of utility and profit) may increase.

This paper aims to account precisely for the influence of banks, both as shareholders and clients, in MTFs' objective function shape, pricing policy and profitability. We refer to previous studies on two-sided markets, in which two groups of agents interact through an intermediary called a platform (Evans 2003, Roson 2005 and Rochet and Tirole 2003, 2006). Because the participation of each group contributes value to the other group, two-sided markets are associated with a specific class of network externalities, called cross externalities. Therefore, the attractiveness of the platform for agents of one group largely depends on the participation of agents of the other group. As revealed by Armstrong (2006) in a duopoly model, participation fees charged to agents when they access the platform are lower than without any externality effects. The author also demonstrates that participation fees charged to agents from one group decrease with the way their participation is estimated by the opposite group. Few articles resort to a two-sided market perspective to analyze financial markets externalities. Wright (2004) notes trading venues as examples of two-sided market that allows security issuers and investors to interact, creating liquidity externalities. Foucault, Kadan and Kendel (2013) and Skjeltorp, Sojli and Wah Tham (2012) focus on interactions between liquidity makers and takers and examine their impact on the speed of liquidity provision and consumption, the intensification of market orders and new trading opportunities. However, this literature does not account for the situations where a participant in a platform is also its owner.

To fill this gap, we introduce the notion that a participant in a platform can also be its shareholder in a two-sided market model. Transposing the Armstrong's (2006) framework to the MTF industry, we demonstrate that if brokerage and trading activities are important for banks' revenue compared to their profit as MTF operators, some market configurations may emerge, where both MTFs include banks' interest as clients in their objective function. In this case, MTFs' profit can be negative. However, because banks benefit from lower fees as MTFs' participants, they eventually earn substantial global revenue. The remainder of the paper is organized as follows. In section 2, we present the model. Section 3 concludes the paper.

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[4]Since the acquisition by LSE in 2009, the profit of Turquoise is less obvious to interpret because it is combined with the profit of LSEG (London Stock Exchange Group).

2   The model

We now turn to the theoretical model. We first present assumptions and then focus on the equilibrium of the model.

2.1   Assumptions

Following Armstrong (2006), we consider two MTFs i and j in a duopoly. This assumption accounts for the structure of the European MTF industry which is dominated by two platforms, Turquoise and BATS Chi-X Europe. Each platform incurs a unit cost denoted c.[5] Two groups of agents also exist, denoted 1 and 2, that participate in MTFs to route buying or selling orders. For example, type 1 agents are buyers and type 2 agents are sellers. Agents 1 and 2 are uniformly and exogenously located on a unit segment and platforms are located at each extremity. Agents incur a unit transport cost, denoted t. This parameter accounts for the degree of agents' subjective differentiation between both platforms (in terms of ease of access or the order submission process for example), i.e., the degree of platforms' market power.

In this model, we address single homing: agents 1 (resp. agents 2) choose between platforms i and j to connect and place buying (resp. selling) orders on the venue. To do this, they are charged a fee by the platform. We denote $p_{1,i}$ (resp. $p_{1,j}$) the fee charged to agents 1 by the platform i (resp. j) to connect and place buying orders and $p_{2,i}$ (resp. $p_{2,j}$) the fee charged to agents 2 by the platform i (resp. j) to connect and place selling orders. Hence, following Armstrong (2006), we focus on participation or registration fees, i.e., fees charged to agents when they access the platform. For this reason, the fees do not depend on trading volume. The number of agents 1 participating in the platform i (resp. j) is denoted $n_{1,i}$ (resp. $n_{1,j}$) and the number of agents 2 participating in the platform i (resp. j) is denoted $n_{2,i}$ (resp. $n_{2,j}$). The total number of agents 1 and 2 is normalized such that $n_{1,i} + n_{1,j} = 1$ and $n_{2,i} + n_{2,j} = 1$.

Trading venues are characterized by the existence of cross liquidity externalities. In each group, agents positively value interacting with agents from the opposite group. Indeed, an increase in the participation of buyers increases the probability that sellers will find a counterpart, and *vice versa*. It seems reasonable to consider that liquidity externalities are valued similarly by buyers and sellers. To avoid unnecessary complexity, we assume that the benefit enjoyed by agents from each agent on the other side is 1.

Each MTF is assumed to have a majority shareholder, which is a bank. We denote by i the bank that is the main shareholder of platform i and by j the bank that is the main shareholder of platform j. Banks trade securities in financial markets and participate in their own MTF to submit orders.[6] For convenience, we assume that banks are buyers and belong to the group 1.[7] Because they are both owners and clients of the MTF, banks have a special position. As owners

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[5]It seems reasonable to assume that the technology and the business model of platforms are very similar such that they incur the same cost. Differences in platforms' unit cost do not qualitatively affect our findings.

[6]Everything happens as if, due to habits, close relationships between the bank and the platform or banks' better knowledge of their own platform's functioning, banks' transportation costs was so large that each MTF had a monopoly power on its shareholder.

[7]The fact that banks are both type 1 and type 2 agents does not qualitatively change our results.

of a MTF, banks' interest is to maximize the platform's profit. However, as clients, they are also concerned about the price they are charged and the utility they obtain when submitting orders on the platform. Hence, banks have the choice between two strategies. They can let MTFs maximize profit without taking into account their interest as clients. Conversely, because they are majority shareholders of MTFs, banks have the ability to urge them to include in the objective function not only their profit as shareholders but also their utility as participants (which corresponds to the utility of type 1 agents). We denote $U_{1,i}$ (resp. $U_{1,j}$) agents 1's utility on the platform i (resp j) and $U_{2,i}$ (resp. $U_{2,j}$) agents 2's utility on the platform i (resp j). Finally, MTF i' and MTF j's profits are denoted Π_i and Π_j respectively, and banks' total revenues, defined as the sum of their profit and their utility as clients, are denoted R_i and R_j respectively. We denote α as the weight of MTF profit in banks' revenue and $(1-\alpha)$ the weight of their utility as clients of the platform in banks' revenue, with $0 < \alpha < 1$. Parameter α accounts for the importance of brokerage and trading activities for banks as clients compared to profit as an operating member of the MTF: the lower α is, the more important brokerage and trading activities are.[8] Hence, $R_i = \alpha\Pi_i + (1-\alpha)U_{1,i}$ and $R_j = \alpha\Pi_j + (1-\alpha)U_{1,j}$.

The model has two stages. First, banks choose whether to urge or not the MTF to include their utility as clients into their objective function. Then, platforms compete in prices. We examine Nash equilibria in each pricing subgame and in the full game.

2.2 Equilibrium

We now solve the model. We first examine the second-stage subgames. We then consider the first-stage game.

2.2.1 The second-stage subgames

In this section, we consider the three following cases: the subgame where both MTFs only maximize profit, the subgame where both MTFs maximize the global revenue of banks, and the subgame where one MTF maximizes profit and the other maximizes bank revenue.

(i) The subgame where both MTFs maximize profit

Agents' utilities can be written as follows:

$$U_{1,i} = n_{2,i} - p_{1,i}, U_{1,j} = n_{2,j} - p_{1,j}, U_{2,i} = n_{1,i} - p_{2,i}, U_{2,j} = n_{1,j} - p_{2,j}. \tag{1}$$

Following Armstrong (2006), we rely on the Hotelling specification to determine agents' participation:

$$n_{1,i} = \frac{1}{2} + \frac{U_{1,i} - U_{1,j}}{2t}, n_{1,j} = \frac{1}{2} + \frac{U_{1,j} - U_{1,i}}{2t}, n_{2,i} = \frac{1}{2} + \frac{U_{2,i} - U_{2,j}}{2t}, n_{2,j} = \frac{1}{2} + \frac{U_{2,j} - U_{2,i}}{2t}. \tag{2}$$

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[8] For example, in 2013, Société Générale earned 945 million euros from brokerage activities while their profit as a shareholder of BATS Chi-X Europe can be approximated to 0.53% x 16.9 million pounds = 9 million pounds (0.53% being the ownership percent indicated in Table 1 and 16.9 million pounds the profit of Bats Chi-X Europe in 2013). This can be interpreted as a low level of α.

Because each MTF's objective function includes only the platform's profit, equilibrium prices $p_{1,i}^*$, $p_{1,j}^*$, $p_{2,i}^*$ and $p_{2,j}^*$ are set as follows:

$$\{p_{1,i}^*, p_{2,i}^*\} = \text{ArgMax } \Pi_i = \text{ArgMax } (p_{1,i} - c)n_{1,i} + (p_{2,i} - c)n_{2,i},$$

$$\{p_{1,j}^*, p_{2,j}^*\} = \text{ArgMax } \Pi_j = \text{ArgMax } (p_{1,j} - c)n_{1,j} + (p_{2,j} - c)n_{2,j}.$$

From (1) and (2), we determine each agent's participation as a function of prices. Substituting for profit expressions, we derive first-order conditions. Thus, we obtain the following lemma.

Lemma 1 *For $t > 1$ (H1)[9], the subgame where both MTFs maximize profit has a unique equilibrium, given by*

$$p_{1,i}^* = p_{2,i}^* = p_{1,j}^* = p_{2,j}^* = c + t - 1,$$

$$n_{1,i}^* = n_{2,i}^* = n_{1,j}^* = n_{2,j}^* = \frac{1}{2},$$

$$\Pi_i^* = \Pi_j^* = t - 1,$$

$$U_{1,i}^* = U_{2,i}^* = U_{1,j}^* = U_{2,j}^* = \frac{3}{2} - c - t,$$

$$R_i^* = R_j^* = \frac{3}{2} - c - t - \frac{5}{2}\alpha + 2\alpha t + \alpha c.$$

This subgame refers to the equilibrium obtained by Armstrong (2006). Prices increase with the agents' transport cost and the platforms' cost. Moreover, consistent with the standard results of the literature on two-sided markets, each group of agents is subsidized: prices charged to the agents of one group is reduced by the amount of externality (i.e., 1) they cause on each agent of the other group. Reducing the price charged to the agents of one group encourages them to participate in the trading venue. This effect increases the liquidity of MTFs and their appeal for the agents of the other group.

(ii) The subgame in which both MTFs maximize the bank's revenue

Agents' utilities and agents' participation can be written as in subgame (i). However, because MTFs now maximize banks' revenue, we have:[10]

$$\{p_{1,i}^*, p_{2,i}^*\} = \text{ArgMax } R_i = \text{ArgMax } \alpha[(p_{1,i} - c)n_{1,i} + (p_{2,i} - c)n_{2,i}] + (1 - \alpha)(n_{2,i} - p_{1,i}),$$

$$\{p_{1,j}^*, p_{2,j}^*\} = \text{ArgMax } R_j = \text{ArgMax } \alpha[(p_{1,j} - c)n_{1,j} + (p_{2,j} - c)n_{2,j}] + (1 - \alpha)(n_{2,j} - p_{1,j}).$$

Proceeding in the same way as in (i), we obtain:

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[9]Under this condition, the second-order condition is satisfied (the trace of the Hessian matrix is negative and its determinant is positive).

[10]When banks are assumed to be both type 1 *and* type 2 agents, banks' objective functions also include agents 2's utility, i.e. $n_{1,i} - p_{2,i}$ and $n_{1,j} - p_{2,j}$ respectively.

Lemma 2 *Under H1, the subgame in which both MTFs maximize banks' revenue has a unique equilibrium, given by*

$$p_{1,i}^* = p_{1,j}^* = \frac{-2t - \alpha + \alpha c + 3\alpha t}{\alpha}, \ \ p_{2,i}^* = p_{2,j}^* = \frac{2 - 3\alpha + \alpha c + \alpha t}{\alpha},$$

$$n_{1,i}^* = n_{2,i}^* = n_{1,j}^* = n_{2,j}^* = \frac{1}{2},$$

$$U_{1,i}^* = U_{1,j}^* = \frac{4t + 3\alpha - 2\alpha c - 6\alpha t}{2\alpha}, \ \ U_{2,i}^* = U_{2,j}^* = \frac{-4 + 7\alpha - 2\alpha c - 2\alpha t}{2\alpha},$$

$$\Pi_i^* = \Pi_j^* = \frac{(t-1)(-1+2\alpha)}{\alpha},$$

$$R_i^* = R_j^* = \frac{4t + 5\alpha - 2\alpha c - 12\alpha t - 7\alpha^2 + 2\alpha^2 c + 10\alpha^2 t}{2\alpha}.$$

It is interesting to compare this equilibrium with the one obtained in the subgame (i). When both MTFs include the banks' utility (i.e., the type 1 agent's utility), in their objective function, the price charged to agents 1 is lower than when the bank's utility is not taken into account. Lemma 2 also indicates that cross subsidies exist between both types of agents. Because type 1 agents are charged lower fees, attracting them by encouraging type 2 agents to participate in the platform becomes less necessary. This effect allows platforms to balance lower prices charged to agents 1 with higher fees charged to agents 2 ($p_{1,i}^* < p_{2,i}^*$ and $p_{1,j}^* < p_{2,j}^*$).[11]

Moreover, in contrast with Lemma 1, if α is sufficiently low (i.e., $\alpha < \frac{2}{3}$), prices $p_{1,i}^*$ and $p_{1,j}^*$ are decreasing in t. The higher the market power of platforms, the lower the fees charged to agents 1. Indeed, when t is large, the pressure to charge high prices is strong, contrary to banks' interest as MTFs' clients. If banks' utility represents a large part of banks' revenue, platforms balance this effect by reducing the fees charged to agents 1.

Finally, consistent with the stylized facts explained in the introduction, the pricing policy described in Lemma 2 induces negative profit for MTFs if $\alpha < \frac{1}{2}$, i.e., if brokerage and trading activities for banks as participants in MTFs represent a large share of their revenue. However, comparing equilibrium revenues in subgames (i) and (ii) respectively indicates that, in this case, due to lower participation fees, banks earn a larger revenue than when their utility as clients is not included in MTFs' objective function.

(iii) The subgame in which MTF j maximizes profit and MTF i maximizes the bank's revenue

Agents' utilities and agents' participations can be written as in subgames (i) and (ii). The maximization program is as follows:

$$\{p_{1,i}^*, p_{2,i}^*\} = \text{ArgMax } R_i = \text{ArgMax } \alpha[(p_{1,i} - c)n_{1,i} + (p_{2,i} - c)n_{2,i}] + (1 - \alpha)(n_{2,i} - p_{1,i}),$$

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[11]This effect vanishes when it is assumed that banks submit not only a buying but also a selling order. However, this phenomenon does not challenge our key result.

$$\{p_{1,j}^*, p_{2,j}^*\} = \text{ArgMax } \Pi_j = \text{ArgMax } (p_{1,j} - c)n_{1,j} + (p_{2,j} - c)n_{2,j}.$$

Proceeding in the same way as in subgames (i) and (ii), we obtain:

Lemma 3 *Under H1 and for $\alpha > \frac{2}{5}$,[12] the subgame in which MTF i maximizes profit and MTF j maximizes the bank revenue has a unique equilibrium, given by*

$$p_{1,i}^* = \frac{-4t - 3\alpha + 3\alpha c + 7\alpha t}{3\alpha}, \ p_{2,i}^* = \frac{4 - 7\alpha + 3\alpha c + 3\alpha t}{3\alpha},$$

$$p_{1,j}^* = \frac{-2t - 3\alpha + 3\alpha c + 5\alpha t}{3\alpha}, \ p_{2,j}^* = \frac{2 - 5\alpha + 3\alpha c + 3\alpha t}{3\alpha},$$

$$n_{1,i}^* = \frac{2 + \alpha}{6\alpha}, \ n_{2,i}^* = \frac{1}{2}, n_{1,j}^* = \frac{-2 + 5\alpha}{6\alpha}, n_{2,j}^* = \frac{1}{2},$$

$$U_{1,i}^* = \frac{8t + 9\alpha - 6\alpha c - 14\alpha t}{6\alpha}, \ U_{1,j}^* = \frac{4t + 9\alpha - 6\alpha c - 10\alpha t}{6\alpha},$$

$$U_{2,i}^* = U_{2,j}^* = \frac{-2 + 5\alpha - 2\alpha c - 2\alpha t}{6\alpha},$$

$$\Pi_i^* = \frac{-4t + 3\alpha + 5\alpha t - 12\alpha^2 + 8\alpha^2 t}{9\alpha^2}, \ \Pi_j^* = \frac{2t + 6\alpha - 10\alpha t - 15\alpha^2 + 17\alpha^2 t}{9\alpha^2},$$

$$R_i^* = \frac{16t + 33\alpha - 18\alpha c - 56\alpha t - 51\alpha^2 + 18\alpha^2 c + 58\alpha^2 t}{18\alpha},$$

$$R_j^* = \frac{16t + 39\alpha - 18\alpha c - 62\alpha t - 57\alpha^2 + 18\alpha^2 c + 64\alpha^2 t}{18\alpha}.$$

Because it includes the bank's utility as a client in the objective function, MTF i charges agents 1 less than MTF j. As in Lemma 2, this effect is balanced by a higher price charged to agents 2. It is also noteworthy that the participation of type 1 agents in MTF i is higher than in MTF j ($n_{1,i}^* > n_{1,j}^*$), thus making MTF i more attractive for agents 2. Hence, two effects are at play in the participation of agents 2. As explained above, a higher price is charged on MTF i than on MTF j but MTF i is more attractive than MTF j. Both effects balance each other such that the participation of agents 2 is the same on both MTFs. Finally, it can be easily demonstrated that $\Pi_j > \Pi_i$ provided α is sufficiently low ($\alpha < \frac{2t}{3t-1}$), which indicates that if brokerage and trading incomes represent a large proportion of banks' revenue compared to profit as platform operators, the MTF that includes the bank's utility as a client in the objective function charges less agents 1 and is less profitable than the MTF that only maximizes profit. From elementary calculus, we also have $R_i > R_j$. Hence, the MTF that includes the bank's utility as a client in the objective function earns a lower profit but higher global revenue than its rivale.

The equilibrium described in Lemma 3 can be compared to the one obtained in subgame (i). Because MTF i internalizes banks' utility as clients (i.e., agents 1's utility), it charges a

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[12]This condition ensures that $n_{1,j}^* > 0$.

lower fee to agents 1 than in subgame (i). This effect is balanced by charging agents 2 a higher price. Hence, because prices on each platform are strategic complements, platform j charges a lower (resp. higher) fee to agents 1 (resp. agents 2) than in subgame (i). In other words, the fact that platform i internalizes the bank i's utility allows type 1 agents to be charged less on platform j.

The same reasoning applies when comparing subgames (iii) and (ii). Because MTF j does not internalize type 1 agents' utility, it charges them a higher price than in subgame (ii). This effect is balanced by a lower fee paid by agents 2. Hence, because prices on MTF i and j are strategic complements, platform i charges a higher (resp. lower) price to agents 1 (resp. agents 2) than in subgame (ii).

2.2.2 The first-stage subgame

We now turn to the first-stage subgame. The first-stage subgame is described in Table 2, in the appendix. Using Table 2, we can consider the three following cases:
- case 1: (Max Π_i, Max Π_j) is a subgame-perfect equilibrium if

$$\frac{3}{2} - c - t - \frac{5}{2}\alpha + 2\alpha t + \alpha c > \frac{16t + 33\alpha - 18\alpha c - 56\alpha t - 51\alpha^2 + 18\alpha^2 c + 58\alpha^2 t}{18\alpha},$$

i.e., if $\alpha > \frac{8t}{11t-3} \equiv \alpha_1$.

- case 2: (Max R_i, Max R_j) is a subgame-perfect equilibrium if

$$\frac{4t + 5\alpha - 2\alpha c - 12\alpha t - 7\alpha^2 + 2\alpha^2 c + 10\alpha^2 t}{2\alpha} > \frac{16t + 39\alpha - 18\alpha c - 62\alpha t - 57\alpha^2 + 18\alpha^2 c + 64\alpha^2 t}{18\alpha},$$

i.e., if $\alpha < \frac{10t}{13t-3} \equiv \alpha_2$.

- case 3: (Max Π_i, Max R_j) (or (Max R_i, Max Π_j)) is a subgame-perfect equilibrium if

$$\frac{3}{2} - c - t - \frac{5}{2}\alpha + 2\alpha t + \alpha c < \frac{16t + 33\alpha - 18\alpha c - 56\alpha t - 51\alpha^2 + 18\alpha^2 c + 58\alpha^2 t}{18\alpha}$$

and

$$\frac{4t + 5\alpha - 2\alpha c - 12\alpha t - 7\alpha^2 + 2\alpha^2 c + 10\alpha^2 t}{2\alpha} < \frac{16t + 39\alpha - 18\alpha c - 62\alpha t - 57\alpha^2 + 18\alpha^2 c + 64\alpha^2 t}{18\alpha},$$

i.e., if $\alpha < \alpha_1$ and $\alpha > \alpha_2$. Because $\alpha_2 > \alpha_1$, this situation is not possible.

Noting that $\frac{1}{2} < \alpha_1 < \alpha_2 < 1$, these conditions are summarized in Figure 1.

From Figure 1, we derive the following proposition:

Proposition 1 *Two thresholds α_1 and α_2 (with $0 < \alpha_1 < \alpha_2 < 1$) exist such that*
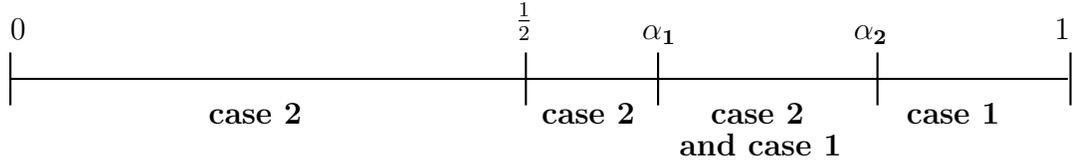
Figure 1: The first-stage game: equilibria according to the level of α

(a) if $\alpha < \alpha_1$, the full game has a unique subgame-perfect equilibrium (Max R_i, Max R_j) where both MTFs maximize banks' revenue,

(b) if $\alpha_1 < \alpha < \alpha_2$, the full game has two subgame-perfect equilibria: (Max R_i, Max R_j), where both MTFs maximize banks' revenue, and (Max Π_i, Max Π_j), where both MTFs maximize profit,

(c) if $\alpha > \alpha_2$, the full game has a unique subgame-perfect equilibrium (Max Π_i, Max Π_j), where both MTFs maximize profit.

Proposition 1 demonstrates that subgame-perfect equilibria crucially depend on the level of α. When α is low, i.e., when brokerage and trading activities are important for banks compared to their profit as MTF's operators, banks' utility as clients is included in the MTF's objective function. When the level of α is intermediate, two equilibria can emerge: one, in which MTFs only maximize profit, and another that include banks' utility as clients in the objective function. When α is large, banks' brokerage and trading activities are not very important for banks. For this reason, the utility linked to these activities is not taken into account in the MTF's objective function. Finally, the main result of Proposition 1 is that some market configurations may exist where MTFs include banks' utility as clients in the objective function.

Moreover, recalling Lemma 2, that in the case of the (Max R_i, Max R_j) equilibrium, MTFs' profit is negative if $\alpha < \frac{1}{2}$. Hence, we can conclude that, when α is low, i.e., when the weight of brokerage and trading activities in banks' revenue is sufficiently large, both MTFs include banks' utility as clients in the objective function *and* incur losses. Interestingly, this result accounts for the observed market outcomes whereby banks that own BATS Chi-X Europe or Turquoise earn negative profit as shareholders while benefiting from lower fees as participants to these platforms.

3   Conclusion

This paper aimed to account for the observation that European MTFs, such as Turquoise or Chi-X Europe, are owned by banks that also route orders on these MTFs for their own account or on behalf of clients. Considering a two-sided model in a duopoly, we investigate the influence of banks, both as shareholders and clients, in MTFs' objective function shape, pricing policy

and profitability. We demonstrate that when brokerage and trading activities are particularly important in banks' revenue compared to their profit as MTF operators, some market outcomes may emerge, in which both MTFs include banks' interest as clients in their objective function. Although they earn negative profit as shareholders, banks benefit from lower fees as MTF's clients. This effect eventually results in larger global revenue. Our model thus explains why banks were behind the creation of MTFs and why they have an incentive to maintain their stake in these MTFs despite negative profit.

Our model could be extended in several interesting ways. First, we could consider that banks take stakes in both platforms and examine the implications of this cross-shareholding assumption on MTFs' price schemes and profitability. Second, we could introduce an historical platform, such as Euronext, to investigate how a third venue, which also allows IPOs and security issuing, affects MTFs' behavior.

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Appendix

Table 1: Ownership of Chi-X Europe and Turquoise, in %
Source: Authors calculations from firms' documents.

Chi-X Europe (01/07/2010)		Turquoise (11/12/2011)	
Shareholder name	% of ownership	Shareholder name	Share of ownership
ABN AMRO Clearing Bank NV	1.21	London Stock Exchange LSE	51
BNP PUK Holding Limited	1.89	Goldman Sachs Strategic Investments (UK) Limited	6.94
Citadel Derivatives Trading Limited	5.38	Citigroup Financial Products Inc	5.48
Citigroup Financial Products Inc	1.32	Credit Suisse Finance (Guernsey) Limited	3.24
Credit Suisse Finance (Guernsey) Limited	8.24	Deutsche Bank AG, acting through its London Branch	7.05
GETCO Europe Limited	14.33	Merrill Lynch UK Capital Holdings	4.88
Goldman Sachs Strategic Investments (UK) Limited	0.52	Morgan Stanley Holdings	5.48
Instinet Holding, Inc	34.67	UBS AG London Branch	5.46
International Algorithmic Trading GmbH	0.9	BNP Paribas Arbitrage SNC	0.52
Jane Street Holding, LLC	1.6	SG Option Europe SA	0.95
Merrill Lynch UK Capital Holdings	8.23	Barclays Bank PLC	3
Morgan Stanley Co International pic	5.37	JP Morgan Financial Investments Limited	3
Nomura International Pic	0.23	Nomura European Investment Limited	3
Ogier Nominees (Jersey) Limited 5.13			
Optiver Holding BV	5.13		
SG Option Europe, SA	0.53		
UBS AG London Branch	5.12		

Table 2: The first-stage game: banks' equilibrium revenues (The first entry in each cell corresponds to the bank i's equilibrium total revenue while the second entry corresponds to the bank j's equilibrium global revenue.)

$i \setminus j$	Max Π_j	Max R_j
Max Π_i	$\frac{3}{2} - c - t - \frac{5}{2}\alpha + 2\alpha t + \alpha c$; $\frac{3}{2} - c - t - \frac{5}{2}\alpha + 2\alpha t + \alpha c$	$\frac{16t+39\alpha-18\alpha c-62\alpha t-57\alpha^2+18\alpha^2 c+64\alpha^2 t}{18\alpha}$; $\frac{16t+33\alpha-18\alpha c-56\alpha t-51\alpha^2+18\alpha^2 c+58\alpha^2 t}{18\alpha}$
Max R_i	$\frac{16t+33\alpha-18\alpha c-56\alpha t-51\alpha^2+18\alpha^2 c+58\alpha^2 t}{18\alpha}$; $\frac{16t+39\alpha-18\alpha c-62\alpha t-57\alpha^2+18\alpha^2 c+64\alpha^2 t}{18\alpha}$	$\frac{4t+5\alpha-2\alpha c-12\alpha t-7\alpha^2+2\alpha^2 c+10\alpha^2 t}{2\alpha}$; $\frac{4t+5\alpha-2\alpha c-12\alpha t-7\alpha^2+2\alpha^2 c+10\alpha^2 t}{2\alpha}$