Banks' shareholding in multilateral trading facilities and implications for historical exchanges: An industrial economics approach

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Abstract

The aim of this paper is to address banks' shareholding in Multilateral Trading Facilities (MTFs) and its implications for historical exchanges. We propose an oligopoly model with network effects to account for an exchange industry that is made up of two MTFs and an historical exchange. Based on the observation that banks are both owners and clients of MTFs, we examine banks' incentive to influence the pricing policy of MTFs. 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. We also demonstrate that accounting for banks' interest in MTFs' objective function acts as a competitive device that reduces the price and the profitability of the historical exchange.

JEL codes: G10 G23 G24 L10 L11 L22
Key words: banks, shareholding, historical exchanges, multilateral trading facilities, competition

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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 or historical 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. Their business model concentrates on low transaction costs and investments in technology to execute orders.

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 (created by Börse Berlin) and TOM (created by AbnAmro, BinckBank and Optiver), still operate in Europe, but BATS Chi-X Europe and Turquoise are the most important on European indices.[2] In 2015, BATS Chi-X Europe's and Turquoise's market shares amounted respectively to 12.46% and 6.60% on FTSE 100, 14.84% and 3.44% on CAC 40 and 12.77% and 4.11% on DAX 30. If we consider all the European markets and transparent venues that operate on these indices, BATS Chi-X Europe[3] has the major market shares with 11.61%.[4]

As a consequence, since 2007, the market shares of regulated venues on their respective indices like Euronext, LSE or Deutsche Börse have decreased. The historical venues went from an almost monopoly position to around 30% of market shares. More precisely, for LSE on FTSE 100, the market shares were 22.81% in 2013 and 28.17% in 2015. For Nyse Euronext, the market shares were 36.13% in 2013 and 34.80% in 2015 on CAC 40. For Deutsche Börse, the figures were respectively 31.98% and 27.73% on DAX 30. If we consider all the platforms and indices in Europe in 2015, the market shares for Euronext were 8%, 7.09% for LSE and 6.15% for Deutsche Börse, behind BATS Chi-X Europe with 11.61%.[5]

Observers and practitioners usually explain the success of MTFs and their adverse effects on historical exchanges by cost, technological or regulatory advantages.

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[2] Nyse Arca Europe, created by Nyse Euronext, has worked for five years, from April 2009 to 2014. It was closed down in May in connection with the sell of Euronext by ICE. Nasdaq OMX Europe closed down in 2010 due to fierce competition among low-cost trading platforms.

[3] It recently obtained the status of regulated market (registred invesment Exchange) in Great Britain.

[4] Source Fidesa and Agefi Hebdo 8, October 2015.

[5] Agefi hebdo 7-13 November, 2013 and 8 October, 2015.

Nevertheless, the specificity of MTFs and their impact on the exchange industry is also narrowly linked to an ownership issue. Firstly, one can observe that some MTFs are mainly owned by banks[6], which were also involved in their creation. MTFs were created by commercial or investment banks following MiFID to benefit from lower trading costs than on historical venues, for themselves and to ultimately respect the best execution principal for third parties.[7] Indeed, it is noteworthy that MTFs in Europe charge lower prices than regulated markets (Fioravanti and Gentil, 2011). Thus, MTFs operate at a loss and are subsidized by financial institutions or banks that route orders to the MTFs of which they are the main shareholders. Secondly, the way historical venues reacted to this new financial context also relate to ownership issues. The creation or the purchase of MTFs allows historical regulated markets to diversify their activities and services at lower cost. It also prevents them from the flight of customers to other low-cost trading MTFs, thus avoiding additional fee declines after those decided by some of them (Euronext: -30% in 2008 (Fleuriot, 2010)) in conjunction with the MiFID.[8] For example, to handle competition from MTFs, Nyse-Euronext has decided to launch its own MTF in 2009, Nyse Arca Europe and the dark pool Smartpool. LSE bought Turquoise in 2009 to strengthen its technological infrastructure.[9] Taken together, these observations suggest that shareholding structures are not neutral as regards the emergence of MTFs and their implication on the competitive structure of the exchange industry, and notably on historical exchanges. Moreover, this context of oligopolistic market and strategic interactions between platforms leads us to consider that these issues could be dealt with an industrial economics approach.

As far as we know, this approach has not yet been taken in the literature. The main strand of literature concentrates on microstructure issues. It examines the consequences of MTFs on market quality (trading fees, flows, liquidity, quotes, transparency), in line with previous articles on the natural tendency of markets to consolidate as a consequence of positive network liquidity externalities (Pagano, 1989), and on fragmented financial markets (Boehmer and Boehmer, 2004). This literature mainly deals with whether more competition following MiFID leads to more liquid markets and decreasing transaction costs (Gresse, 2011, 2014, Fioravanti and Gentile, 2011, Haas, 2007). Other studies focus on some specific MTFs and the consequences on historical venues' liquidity (Chlistalla and Lutat, 2011, for Chi-X and Euronext Paris; Spankowski and Wagener, 2012, and Riordan et al., 2011, for FTSE 100 stocks and Chi-X, BATS Europe and Turquoise). The main conclusion of these articles is that fragmentation or a larger number of locations to execute orders does not harm liquidity and that transaction costs globally decrease in all venues. This suggests that traders build trading strategies between

[6]For example, the % of ownership in Chi-X Europe (01/07/2010) is as follows: Citadei Derivatives Trading Limited 5.38%, Credit Suisse Finance 8.24%, GETCO Europe 14.33%, Instinet Holding 34.67%, Merrill Lynch UK Capital Holdings 8.23%, Morgan Stanley 5.37%, UBS AG London Branch 5.12%... The % of ownership in Turquoise (11/12/2011, except LSE 51%) is: Goldman Sachs UK 6.94%, Citigroup 5.48%, Deutsche Bank London Branch 7.05%, Morgan Stanley 5.48%, UBS AG London Branch 5.46%...

[7]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.

[8]The infrastructure on historical exchanges are still more cumbersome than on MTFs and do not allow huge fee declines.

[9]Since December 2009, Turquoise is mainly owned by LSE. LSE firstly owned 60 percent of Turquoise but in March 2010, it decided to sell 9% of the platform to three banks: Barclays, JP Morgan and Nomura.

MTFs and regulated markets not only on the basis of fees but also according to market frictions, volatility and price discovery. However, none of these investigations deals with the ownership structure of MTFs, neither examines its impact on historical exchanges.

The goal of this paper is precisely to fill this gap by examining how exchanges' shareholding structures affect competitive conditions among the exchange industry and, more especially, for the historical venues. In a previous article (Lahet and Vaubourg, 2015), we adopt an industrial approach and we transpose the two-sided market model of Armstrong (2006) to the MTF industry. We consider two MTFs in a duopoly and we introduce the notion that a participant in a MTF can also be its shareholder. We then study the influence of banks, both as shareholders and clients, on MTFs' objective function shape, pricing policy and profitability. Indeed, if banks are majority shareholders of MTFs, they may be tempted to urge the MTF they created and they own to reduce the level of fees for themselves as clients and to ultimately respect the best execution principal for third parties. So, they have the ability to urge the MTF to include in the objective function not only profit as shareholders but also their utility as clients of their own MTF. 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.

In the present article, we go beyond by considering the competition between two MTFs and an historical exchange (for example, Euronext or LSE). This configuration, which is closer to the functioning of a financial market place, allows to investigate how the emergence of MTF affects the historical exchange in terms of fees, profit and potential reactions. Our model is based on the idea that the behavior of MTF's shareholders crucially differs from the one of the historical exchange's. Firstly, free floatting on historical exhanges may be important, so the role of some shareholders may be diluted. Secondly, although some of them are banks, the shareholders of historical platforms do not particularly seek to lower fees and do not urge historical exchanges to propose even more significant fee reduction (beyond the one that had been observed on regulated markets consecutively to the MiFID). Indeed, on the one hand, some of the shareholders may already have preferential fees due to their membership conditions as clients and their historical relationships with the operator or their volume of trading. On the other hand, they may also belong to a group of reference shareholders, without any intention to benefit from lower fees when they participate in the venue, but rather to benefit from the political aspect of their investment. Let us consider Euronext for example. Since the initial public offering in 2001 (and until 2007), around 70% of the group's capital has been held in free floating. At the time of the public offering in 2014, the free float for Euronext was around 66%. Consequently, core or reference shareholders (BNP Paribas, Caisse des dépots et consignations, BPI France, Société Générale, Euroclear, ABN Amro, ASR Nederland, the public Belgium holding Société fédérale de participations et d'investissement, Banco BPI Pension Fund and Banco Espirito Santo) hold 33.36% of Euronext's capital. They made a convenant, ensuring that they would maintain their stake in Euronext during three years to improve the independence of Euronext and build the future of European exchanges. After this period of non transferability of capital, the government of the countries in which Euronext operates must maintain these shareholders in the capital. This should be not very difficult because these shareholders are major financial institutions in their country, some of them being public ones. Moreover, "it is clear that, for the reference shareholders, investing in Euronext is a political act and not an action of good management. But, for those who had the courage to invest, it is worthwile in terms of image and reputation. It is a manner to say: "I support the Economy and I am a key actor in the financial market place and the State policy.""[10] Hence, in this context of free floating and political convenant, it seems reasonable to consider that historical exchange's shareholders have not the objective to urge the platform to lower prices and to include in its objective function their utility as clients of the platform.

Based on this assumption, the article transposes the Salop's (1979) framework to the financial market industry. In an oligopoly model with network effects, 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. The key result is that the level of the importance of brokerage and trading activities for banks that are sharoholders of MTFs crucially determines the strength of competition within the exchange market, which in turn affects the profitability of the historical exchange. It suggests that the intensity of competition faced by the historical exchange does not only depends on cost or regulatory differences, as usually emphasized by observers, but also on the ownership structure of MTFs and the weight of profit compared to trading and brokerage activities in the revenue of their shareholders.

The remainder of the paper is organized as follows. In section 2, we present the assumptions. The model is solved in Section 3. In Section 4, we propose a discussion and a conclusion.

2 Assumptions

We consider a financial market made up of three exchange venues or platforms in an oligopoly: an historical exchange denoted by k (for example, Euronext or the London Stock Exchange) and two MTFs i and j (for example, Turquoise and BATS Chi-X Europe). Because the aim of the model is to show that the competitive advantage of MTFs can arise from other causes than cost, technological or regulatory differences, we assume that each platform incurs a unit functioning cost denoted c.

There also exist agents that participate in the financial market to route buying or selling orders. Following Salop (1979), they are uniformly and exogenously located on a circle of circumference 1. Agents incur a unit transport cost, denoted t. This parameter accounts for the degree of agents' subjective differentiation between platforms (in terms of ease of access or the order submission process for example), i.e., the degree of platforms' market power. Also located on the circle, the three platforms are equidistant from each other such that the distance between two platforms is $\frac{1}{3}$.

In this model, we address single homing: each agent chooses among the three platforms i, j and k to connect and place buying or selling orders on the venue. We denote p_i (resp. p_j

[10] Agefi Hebdo 19-25 June, 2014, 'Euronext: A l'offensive' by Anne-Laure Declaye.

and p_k) the fee charged to participants by the platform i (resp. j and k) to connect. Because we focus on participation or registration fees (i.e., fees charged to agents when they access the platform), the fees do not depend on trading volume. As depicted in Figure 1, the number of agents that prefer platform i to platform j (resp. k) is denoted $n_{i,r}$(resp. $n_{i,l}$), the number of agents that prefer platform j to platform i (resp. k) is denoted $n_{j,l}$ (resp. $n_{j,r}$), the number of agents that prefer platform k to platform i (resp j) is denoted $n_{k,r}$ (resp. $n_{k,l}$). The number of agents participating in the platform i (resp. j and k) is denoted by n_i (resp. n_j and n_k), with $n_i = n_{i,l} + n_{i,r}$, $n_j = n_{j,l} + n_{j,r}$ and $n_k = n_{k,l} + n_{k,r}$. The total number of agents is normalized such that $n_i + n_j + n_k = 1$.

Trading venues are characterized by the existence of liquidity externalities. As an increase in the participation of agents in a platform improves liquidity on this platform, agents positively value interacting with other agents.[11] We assume that the benefit enjoyed by agents from each other agent on the same platform 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 MTF i and by j the bank that is the main shareholder of MTF j. Banks also trade securities on the financial market and submit orders in their own MTF.[12] Hence, because they are both owners and clients of the MTF, banks have a special position. As owners of a MTF, banks' interest is to maximize the platform's profit. However, as clients, they are also concerned about the utility they obtain when submitting orders on the MTF.

Hence, as majority shareholders of MTFs, banks have the choice between two strategies to determine prices. On the one hand, they can let the MTF maximize profit without taking into account their interest as clients. On the other hand, banks have the ability to urge MTFs to include in the objective function not only their profit as shareholders but also their utility as clients. On the contrary, given the free floating in the historical exchanges' capital and the fact that, for some of them, there are reference shareholders that are more concerned by ensuring the independence of the platform than by their utility as a client of the historical exchange they own, we consider that the historical exchange k determines the level of p_k by maximizing its profit.

We denote U_i (resp. U_j) agents' utility on the platform i (resp j). Platform i' (resp. platform j's) profit is denoted Π_i (resp. Π_j), and bank i's (resp. j) total revenue, defined as the sum of profit and utility as clients, is denoted R_i (resp. R_j). We denote α as the weight of MTF profit in banks' revenue and $(1-\alpha)$ the weight of their utility as clients of the MTF 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 actor of the MTF: the lower α is, the more important these brokerage and trading activities are. Hence, $R_i = \alpha\Pi_i + (1 - \alpha)U_i$ and $R_j = \alpha\Pi_j + (1 - \alpha)U_j$. Finally, the profit of the historical platform k is denoted Π_k. Although it is not included in the historical platform's objective function, we also consider U_k, agents'

[11] As agents can route selling or buying orders simultaneously, it is not necessary to distinguish two different groups of sellers and buyers and to modelize cross externalities among agents from opposite groups.

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

utility when they trade on the historical exchange k.

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, the three platforms compete in prices. We examine Nash equilibria in each pricing subgame and in the full game.

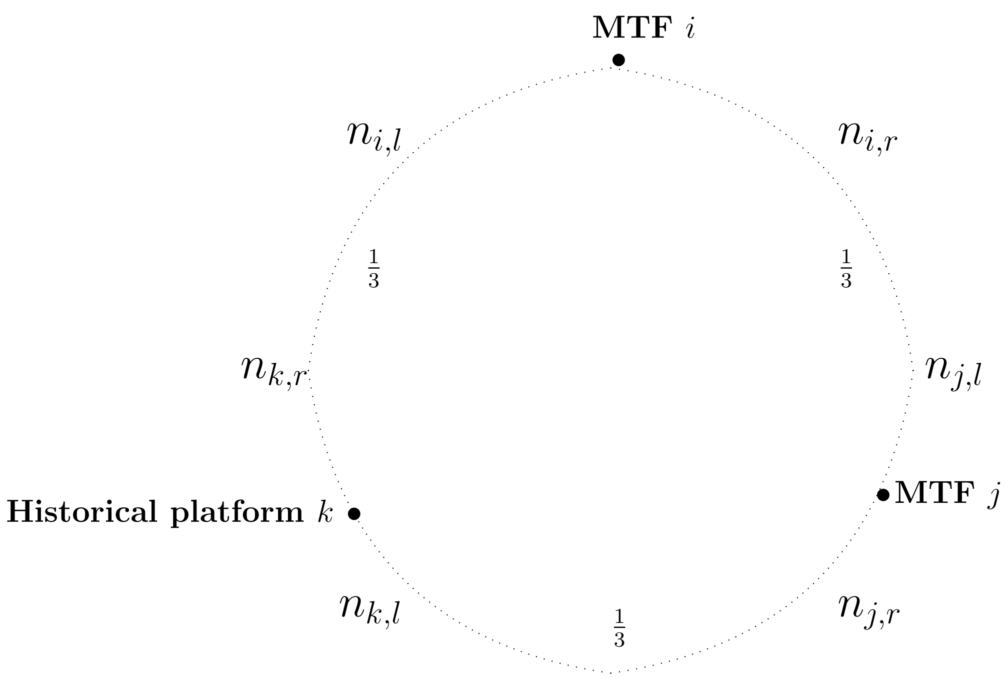

Figure 1: The structure of the exchange industry

3 Solving the model

We now solve the model. We first examine agents' participation. We then focus on equilibria.

3.1 Agents' participation

Due to the existence of liquidity externalities, agents' utilities on each platform can be written as follows:

$$U_i = (n_{i,r} + n_{i,l}) - p_i, \tag{1}$$
$$U_j = (n_{j,r} + n_{j,l}) - p_j, \tag{2}$$
$$U_k = (n_{k,r} + n_{k,l}) - p_k. \tag{3}$$

From Graph 1, we have $n_{j,l} = \frac{1}{3} - n_{i,r}$, $n_{j,r} = \frac{1}{3} - n_{k,l}$ and $n_{k,r} = \frac{1}{3} - n_{i,l}$. Hence, determining the expressions of $n_{i,r}$, $n_{i,l}$ and $n_{k,l}$ is sufficient to obtain agents' participation n_i, n_j and n_k.

Replacing $n_{j,l}$, $n_{j,r}$ and $n_{k,r}$ by their respective expression in (1), (2) and (3), we have

$$U_i = (n_{i,r} + n_{i,l}) - p_i, \tag{4}$$

$$U_j = (\frac{2}{3} - n_{i,r} - n_{k,l}) - p_j, \tag{5}$$

$$U_k = (\frac{1}{3} - n_{i,l} + n_{k,l}) - p_k. \tag{6}$$

The consumer that is indifferent between participating in platform i and participating in platform j, the consumer that is indifferent between participating in platform i and participating in platform k and the consumer that is indifferent between platform j and platform k satisfy respectively

$$U_i - tn_{i,r} = U_j - t(\frac{1}{3} - n_{i,r}), \tag{7}$$

$$U_i - tn_{i,l} = U_k - t(\frac{1}{3} - n_{i,l}), \tag{8}$$

$$U_j - tn_{k,l} = U_k - t(\frac{1}{3} - n_{k,l}). \tag{9}$$

From (7), (8) and (9), we obtain

$$n_{i,r} = \frac{1}{6} + \frac{U_i - U_j}{2t}, \tag{10}$$

$$n_{i,l} = \frac{1}{6} + \frac{U_i - U_k}{2t}, \tag{11}$$

$$n_{k,l} = \frac{1}{6} + \frac{U_k - U_j}{2t}. \tag{12}$$

Replacing U_i, U_j and U_k by their respective expression given in (4), (5) and (6), we determine agent's participation as a function of prices

$$n_{i,r} = \frac{3 + 6p_i - 6p_j - 2t}{18 - 12t}, \tag{13}$$

$$n_{i,l} = \frac{3 + 6p_i - 6p_k - 2t}{18 - 12t}, \tag{14}$$

$$n_{k,l} = \frac{3 + 6p_k - 6p_j - 2t}{18 - 12t}, \tag{15}$$

i.e.,

$$n_i = n_{i,r} + n_{i,l} = \frac{6 + 12p_i - 6p_j - 6p_k - 4t}{18 - 12t}, \tag{16}$$

$$n_j = n_{j,r} + n_{j,l} = \frac{6 + 12p_j - 6p_i - 6p_k - 4t}{18 - 12t}, \tag{17}$$

$$n_k = n_{k,r} + n_{k,l} = \frac{6 + 12p_k - 6p_i - 6p_j - 4t}{18 - 12t}. \tag{18}$$

Expressions (16), (17) and (18) will allow us to determine equilibria.

3.2 Equilibria

Turning to equilibria, we first address the second-stage subgames. Then, we consider the first-stage subgame.

3.2.1 The second-stage subgames

In this subsection, 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. In line with assumptions presented above, in the three cases, the historical exchange k maximizes profit.

(i) The subgame where both MTFs maximize profit

Because each MTF's objective function includes only the platform's profit, equilibrium prices p_i^*, p_j^* and p_k^* are set as follows:

$$p_i^* = \text{ArgMax } \Pi_i = \text{ArgMax } (p_i - c)n_i,$$

$$p_j^* = \text{ArgMax } \Pi_j = \text{ArgMax } (p_j - c)n_j,$$
$$p_k^* = \text{ArgMax } \Pi_k = \text{ArgMax } (p_k - c)n_k.$$

Substituting agents' participation n_i, n_j and n_k by expressions given in (16), (17) and (18), we obtain profits as functions of prices p_i, p_j and p_k. Deriving first-order conditions yields the following lemma:

Lemma 1 *For $t > \frac{3}{2}$ (H1)*[13]*, the subgame where both MTFs maximize profit has a unique equilibrium, given by*

$$p_i^* = p_j^* = p_k^* = \frac{-3 + 6c + 2t}{6},$$

$$n_i^* = n_j^* = n_k^* = \frac{1}{3},$$

$$\Pi_i^* = \Pi_j^* = \Pi_k^* = -\frac{1}{6} + \frac{t}{9},$$

$$U_i^* = U_j^* = U_k^* = \frac{5 - 6c - 2t}{6},$$

$$R_i^* = R_j^* = \frac{1}{6}(5 - 6c - 2t) + \alpha(-1 + c + \frac{4t}{9}).$$

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

Quite intuitively, prices increase with the agents' transport cost and the platforms' cost.

Remark 1. In the model of Salop (1979), in which there is no externality, equilibrium price and profit are given by $c+\frac{t}{3}$ and $\frac{t}{9}$ respectively. We obtain lower prices and profit than in Salop (1979) because in our model, agents are subsidized for the externalities they cause on other participants in the platform: reducing the price encourages agents to participate in trading venues. This effect increases the liquidity of platforms and their appeal for other agents. For the same reason, the introduction of liquidity externalities also decreases equilibrium profits compared to Salop (1979).[14]

Remark 2. Note that when one considers two (rather than three) profit-maximizing platforms in a duopoly, equilibrium price on both platforms is given by $\frac{-2+3c+2t}{3}$ and equilibrium profit by $\frac{2(t-1)}{9}$. Hence, in subgame (i), competition within the exchange industry is stronger than in the duopoly case, thereby leading to lower equilibrium price and profit.

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

Because MTFs i and j now maximize banks' revenue (while the historical exchange k still maximizes profit), we have:

$$p_i^* = \text{ArgMax } R_i = \text{ArgMax } \alpha(p_i - c)n_i + (1-\alpha)(n_i - p_i),$$

$$p_j^* = \text{ArgMax } R_j = \text{ArgMax } \alpha(p_j - c)n_i + (1-\alpha)(n_j - p_j),$$

$$p_k^* = \text{ArgMax } \Pi_k = \text{ArgMax } (p_k - c)n_k.$$

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

Lemma 2 *Under (H1) and for $\alpha > \frac{12t-6}{22t-21}$ (H2)[15], the subgame in which both MTFs maximize the bank's revenue has a unique equilibrium, given by*

$$p_i^* = p_j^* = \frac{12 - 27\alpha + 30\alpha c - 24t + 34\alpha t}{30\alpha},$$

$$p_k^* = \frac{6 - 21\alpha + 30\alpha c - 12t + 22\alpha t}{30\alpha},$$

$$n_i^* = n_j^* = \frac{3 + 12\alpha - 6t - 4\alpha t}{45\alpha - 30\alpha t},$$

$$n_k^* = \frac{-6 + 21\alpha + 12t - 22\alpha t}{45\alpha - 30\alpha t},$$

$$\Pi_i^* = \Pi_j^* = \frac{(-3 + 4\alpha(-3+t) + 6t)(12 - 24t + \alpha(-27+34t))}{450\alpha^2(-3+2t)},$$

[14] Armstrong (2006) obtains the same result when introducing cross-liquidity externalities in the duopoly model of Hotelling (1929).

[15] Under this condition, participation is positive on the three venues.

$$\Pi_k^* = \frac{(6 - 12t + \alpha(-21 + 22t))^2}{450\alpha^2(-3 + 2t)},$$

$$U_i^* = U_j^* = U_k^* = \frac{\alpha(-105 + c(90 - 60t) + 164t - 68t^2) + 6(5 - 14t + 8t^2)}{30\alpha(-3 + 2t)},$$

$$R_i^* = R_j^* = \frac{A + B + C}{450\alpha(-3 + 2t)},$$

with $A = 18(23 - 62t + 32t^2)$, $B = \alpha^2(1899 - 2976t + 1156t^2 + 450c(-3 + 2t))$, $C = -6\alpha(75c(-3 + 2t) + 4(87 - 158t + 68t^2))$.

Because MTFs' objective functions include not only their profit but also banks' utility as MTF clients, the equilibrium prices of MTFs i and j are lower than the price charged by the historical exchange k. As a consequence, participation in MTFs is larger than in the historical exchange. Hence, when banks' interest as clients are accounted for in the objective function of MTFs, the historical exchange becomes less attractive (both in terms of prices and liquidity).

For the same reason, MTFs' equilibrium prices are lower than in subgame (i). This result is in line with the idea that, because banks are shareholders of MTFs, they 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. Consequently, participations on MTFs are larger than in subgame (i). Moreover, because they maximize global revenue rather than profit, MTFs are less profitable (under H2) than in subgame (i). Finally, due to both reduced prices and improved liquidity, agents' utility on both MTFs is larger than in subgame (i).

Lemma 2 interestingly suggests that accounting for banks' interests as clients in MTFs' objective functions also affects the historical exchange. Because prices are strategic complements, the fee charged by the historical exchange is lower than in (i). However, the decrease in price induced by this (indirect) strategic complementarity effect is weaker than the one induced by the (direct) effect of including the shareholder's utility in the objective function. Hence, participation in the historical exchange k increases in a smaller extend than participation in MTFs i and j. This explains why participation in the historical exchange is weaker than in subgame (i) while participation in MTFs is larger. This finding is consistent with the observation that the market shares of historical venues such as Euronext or the London Stock Exchange significantly have decreased after the implementation of the MiFID.

We also observe that subgame (ii) induces lower profit for the historical exchange than in subgame (i). Moreover, it is straightforward that $\frac{\partial \Pi_k^*}{\partial \alpha} > 0$. Hence, when the weight of brokerage and trading activities in banks' revenue increases (i.e. when α decreases), competition within the exchange market is strengthened, thus reducing the profitability of the historical exchange.

Remark 3. Subgame (ii) without liquidity externality would consist to replace (4), (5) and (6) by $U_i = -p_i$, $U_j = -p_j$ and $U_k = -p_k$ respectively, and the maximization program by

$$p_i^{**} = \text{ArgMax } \alpha(p_i - c)n_i + (1 - \alpha)(-p_i),$$

$$p_j^{**} = \text{ArgMax } \alpha(p_j - c)n_i + (1 - \alpha)(-p_j),$$

$$p_k^{**} = \text{ArgMax } (p_k - c)n_k.$$

If $\alpha > \frac{6}{11}$, this yields a unique equilibrium whereby $\Pi_k^{**} = \frac{(6-11\alpha)^2 t}{225\alpha^2}$. It is straightforward that $\frac{\partial \Pi_k^*}{\partial \alpha} > \frac{\partial \Pi_k^{**}}{\partial \alpha} > 0$. This suggests that the adverse effect of α on the historical exchange's profit is amplified by the existence of liquidity externalities.

Finally, on the historical platform, the fall in price allows to balance the decrease in liquidity, thus improving agents' utility. Hence, including banks i and j's interests in the objective function of MTFs has positive externalities not only on MTFs' participants but also on the historical exchange's ones.

Taken together, these elements suggest that accounting for banks' interests as clients in MTFs' objective functions acts as a competitive device that affects the pricing policy and the profitability of the historical exchange.

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

Agents' utilities and agents' participation can be written as in subgames (i) and (ii). The maximization program becomes

$$p_i^* = \text{ArgMax } R_i = \text{ArgMax } \alpha(p_i - c)n_i + (1-\alpha)(n_i - p_i),$$

$$p_j^* = \text{ArgMax } \Pi_j = \text{ArgMax } (p_j - c)n_j,$$

$$p_k^* = \text{ArgMax } \Pi_k = \text{ArgMax } (p_k - c)n_k.$$

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

Lemma 3 *Under H1 and for* $\alpha > \frac{-3+6t}{-18+16t}$ *(H3)*[16]*, the subgame in which MTF j maximizes profit and MTF i maximizes the bank's revenue has a unique equilibrium, given by*

$$p_i^* = \frac{-9 + 24\alpha - 30\alpha c + 18t - 28\alpha t}{30\alpha},$$

$$p_j^* = p_k^* = \frac{-3 + 18\alpha - 30\alpha c + 6t - 16\alpha t}{30\alpha},$$

$$n_i^* = \frac{6 + 9\alpha - 12t + 2\alpha t}{45\alpha - 30\alpha t},$$

$$n_j^* = n_k^* = \frac{-3 + 18\alpha + 6t - 16\alpha t}{45\alpha - 30\alpha t},$$

$$\Pi_i^* = -\frac{(6 - 12t + \alpha(9 + 2t))(9 - 18t + 4\alpha(-6 + 7t))}{450\alpha^2(-3 + 2t)},$$

$$\Pi_j^* = \Pi_k^* = \frac{(3 - 6t + 2\alpha(-9 + 8t))^2}{450\alpha^2(-3 + 2t)},$$

[16]Under this condition, participation in the three venues is positive.

$$U_i^* = \frac{15 - 48t + 36t^2 - 2\alpha(45 - 64t + 28t^2 + 15c(-3 + 2t))}{30\alpha(-3 + 2t)},$$

$$U_j^* = U_k^* = \frac{3(5 - 12t + 4t^2) - 2\alpha(45 - 58t + 16t^2 + 15c(-3 + 2t))}{30\alpha(-3 + 2t)},$$

$$R_i^* = \frac{D + E + F}{450\alpha(-3 + 2t)},$$

with $D = 9(19-56t+36t^2)$, $E = 2\alpha^2(783-1062t+392t^2+225c(-3+2t))$, $F = -6\alpha(75c(-3+2t) + 4(63 - 97t + 42t^2))$,

$$R_j^* = \frac{G + H + I}{450\alpha(-3 + 2t)},$$

with $G = 18(13 - 32t + 12t^2)$, $H = -3\alpha(561 - 864t + 284t^2 + 150c(-3 + 2t))$, $I = 2\alpha^2(837 - 1158t + 368t^2 + 225c(-3 + 2t))$.

Because MTF i is the only platform to account for its shareholder's interests as clients, the price charged by MTF i is lower than the one charged by MTF j and the historical exchange k.

Let us now compare this subgame to subgame (i). First, we observe that the price charged by MTF i is lower than in subgame (i). As a consequence, agents' participation in MTF i is larger. Moreover, because it maximizes global revenue rather than profit, MTF i earns a lower profit. By contrast, because the clients' interest are implicitly accounted for in the objective function of MTF i, the utility of participants in MTF i is improved.

Turning to MTF j and the historical exchange k, which both maximize profit, we observe that because prices are strategic complements, p_j^* and p_k^* are lower than in subgame (i). However, as previously explained, the decrease in price induced by this (indirect) strategic complementarity effect is weaker than the one induced by the (direct) effect of including the shareholder's utility in the objective function. Hence, consecutively to reduced prices, participation in MTF j and the historical exchange k increases in a smaller extend than participation in MTF i. For this reason, participation in j and k is weaker than in subgame (i) while participation in i is larger. Finally, due to both lower price and lower participation (or liquidity), Π_k^* and Π_j^* are decreased compared to subgame (i).

It is also straightforward to show that the utility of participants in k and j is lower than in subgame (i) for large levels of platforms' market power (i.e., if $t > \frac{5}{2}$) while it is higher for weak levels of platforms' market power (i.e., if $\frac{3}{2} < t < \frac{5}{2}$). This suggests that the effect of the MTFs' pricing policy on the historical exchange's participants depends on the intensity of differentiation among platforms. The rationale for this result is based on the idea that the utility of participants in a given exchange is decreasing with the price charged on this exchange ("price effect") and increasing with its liquidity ("liquidity effect"). When platforms are strongly differentiated, the degree of competition among the exchange industry is weak. As a consequence, the pricing policy of MTF i has a weak impact on the pricing policy of the historical exchange k (and MTF j). Hence, for a given decrease in fee on MTF i (compared to subgame (i)), one observes a smaller decrease in fee on the historical exchange k and MTF

j. For this reason, on the historical platform k and on MTF j, the positive effect of reduced fees is dominated by the negative effect of decreased liquidity. By contrast, when platforms are weakly differentiated, the positive price effect is strong and dominates the negative liquidity effect, such that the utility of participants in k (and j) is ultimately improved.

Let us now compare subgame (iii) to subgame (ii). Because MTF j does not account for its shareholders' interests as clients, its price is larger than in subgame (ii). Hence, MTF j attracts less participants. Moreover, because it only maximizes profit and does not include its shareholder's interest as client in its objective function, the profit of MTF j is larger than in subgame (ii). Symmetrically, as clients' interest are not accounted for in the maximization program of MTF j, the utility of participants is decreased compared to subgame (ii).

Due to the strategic complementarity effect mentioned above, prices charged by i and k are larger than in subgame (ii). But for the same reason as above (the strategic complementarity effect is weaker than the effect of including the shareholder's utility in the objective function), despite higher prices, the market shares of platforms i and k are larger than in subgame (ii). Moreover, due to both larger prices and larger participation, the profit of MTF i and the historical exchange k is higher than in subgame (ii).[17] This suggests that because only one (rather than two) MTF includes banks' utility as clients in the objective function, competition within the exchange industry is soften, such that the situation of the platforms that only maximize profit (i.e., j and k) is improved compared to the subgame (ii).

As above, the utility of participants in i is higher than in subgame (ii) when platforms' market power is weak (i.e., if $\frac{3}{2} < t < \frac{5}{2}$) while it is lower when platforms' market power is strong (i.e., if $t > \frac{5}{2}$). The rationale for this result is as follows. When the degree of differentiation among platforms is weak (resp. strong), it is very easy (resp. difficult) to switch from one platform to another. As a consequence, the rise in price on MTF j induces a large (resp. weak) flight to MTF i. The increased participation in i dominates (resp. is dominated by) the rise in p_i^*, such that the utility of participants in i is ultimately improved (resp. reduced).

Finally, as regards participants in MTF j and the historical platform k, their utility is larger than in subgame (ii). This suggests that having only one (rather than two) banks' revenue-maximizing MTF softens competition within the exchange industry. For this reason, the pricing policy of MTF i implies weaker (positive) externalities on the utility of other platforms' participants compared to subgame (ii).

3.2.2 The first-stage subgame

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

$$\frac{1}{6}(5 - 6c - 2t) + \alpha(-1 + c + \frac{4t}{9}) > \frac{D + E + F}{450\alpha(-3 + 2t)},$$

[17]Mathematically, Π_i^* and Π_k^* are larger than in subgame (ii) if $\alpha > \frac{-3+6t}{-18+16t}$ and $\alpha > \frac{-9+18t}{-39+38t}$ respectively. Because under H1, we have $\frac{-3+6t}{-18+16t} > \frac{-9+18t}{-39+38t}$, these conditions always hold if H3 is verified.

with $D = 9(19-56t+36t^2)$, $E = 2\alpha^2(783-1062t+392t^2+225c(-3+2t))$, $F = -6\alpha(75c(-3+2t)+4(63-97t+42t^2))$, i.e. if,

$$\alpha > \frac{3(-19+18t)}{8(-9+8t)} \equiv \alpha_1.$$

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

$$\frac{A+B+C}{450\alpha(-3+2t)} > \frac{G+H+I}{450\alpha(-3+2t)},$$

with $A = 18(23-62t+32t^2)$, $B = \alpha^2(1899-2976t+1156t^2+450c(-3+2t))$, $C = -6\alpha(75c(-3+2t)+4(87-158t+68t^2))$, $G = 18(13-32t+12t^2)$, $H = -3\alpha(561-864t+284t^2+150c(-3+2t))$, $I = 2\alpha^2(837-1158t+368t^2+225c(-3+2t))$, i.e. if,

$$\alpha < \frac{12(t-1)}{-15+14t} \equiv \alpha_2.$$

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

$$\frac{1}{6}(5-6c-2t)+\alpha(-1+c+\frac{4t}{9}) < \frac{D+E+F}{450\alpha(-3+2t)},$$

and

$$\frac{A+B+C}{450\alpha(-3+2t)} < \frac{G+H+I}{450\alpha(-3+2t)},$$

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

Under H2 ($\alpha > \frac{12t-6}{22t-21}$), these conditions are summarized in Figure 2.

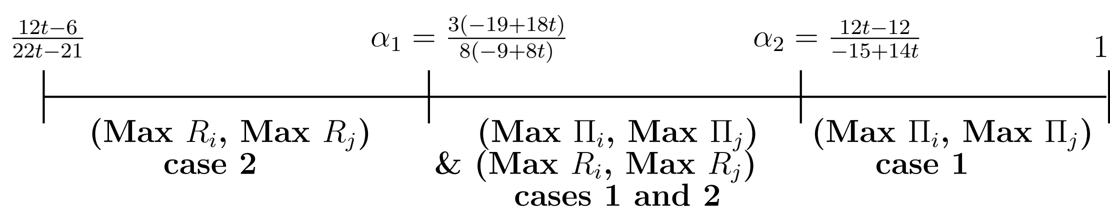

Figure 2: The first-stage game: equilibria according to the level of α

From Figure 2, we derive the following proposition:

Proposition 1 *Under H1 and H2, two thresholds* α_1 *and* α_2 *(with* $0 < \alpha_1 < \alpha_2 < 1$*) exist such that* *(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 some market configurations may exist where MTFs include banks' utility as clients in the objective function. The nature of subgame-perfect equilibria crucially depends 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 in which they maximize banks' revenues. When α is large, banks' brokerage and trading activities are not very important for banks and MTFs only maximize profit.

Let us also remind that, in line with Lemma 2, the profit of the historical exchange is lower in the (Max R_i, Max R_j) than in the (Max Π_i, Max Π_j) equilibrium. This suggests that there exist some market configurations that are harmfull to the profitability of the historical exchange. These configurations correspond to a large weight of brokerage activities in banks' revenue ($\alpha < \alpha_1$ or $\alpha < \alpha_2$). Indeed, in this case, banks are encouraged to include their interests as clients in MTFs' objective functions such that participation fees on these MTFs are reduced (for the banks themselves or to allow them to ultimately respect the best execution principal for third parties). As explained in Subsection 2.2 (ii), everything happens as if competition among the exchange industry were strengthened compared to the (Max Π_i, Max Π_j) equilibrium, thus leading to lower price and participation and, consequently, lower profit for the historical exchange. This finding is in line with the observed evolution of the financial sector since the implementation of the MiFID emphasize in the introduction. On the contrary, when the weight of brokerage activities in banks' revenue is weak ($\alpha > \alpha_1$ or $\alpha > \alpha_2$), banks do not include their utility as clients in MTFs' objective functions. In this case, the MTFs' choice not to include banks' utility as clients in their objective function is beneficial for the historical exchange.

Finally, the key result of Proposition 1 is that the level of α crucially determines the strength of competition within the exchange market, which in turn affects the profitability of the historical exchange. It suggests that the intensity of competition faced by the historical exchange does not only depends on cost or regulatory differences, as usually emphasized by observers, but also on the ownership structure of MTFs and the weight of trading and brokerage activities in the revenue of their shareholders (i.e. banks).

4 Discussion and conclusion

Our model leads to several results and conclusions.

Firstly, our model shows that competition among MTFs and the historical exchange prompts the latter to lower price, as, for example, did Euronext after the implementation of the MiFID in 2007.

Secondly, if MTFs do not include in their objective function the banks/shareholders' utility as clients, MTFs and the historical venue both aim to maximize profit, and this configuration is more profitable for the historical exchange. Indeed, our model indicates that the situations where the weight of brokerage and trading activities in banks' revenue is large induces a market equilibrium that is detrimental for historical exchanges' profitability. On the contrary, situations where this weight is weak lead to an equilibrium that is less harmful for historical platforms.

Thirdly, because both the ownership structure of MTFs and the weight of brokerage and trading activities in their shareholders' revenue are not neutral as regards the degree of competition within the exchange industry, we may conclude that historical platforms may restore their profitability by influencing both factors. For example, historical exchanges may become shareholders of MTFs. It has been the case of LSE with Turquoise since 2009. Taking a stake in MTFs can be interpreted as a way for historical exchanges to influence the value of α, i.e. to reduce the weight of brokerage and trading activities and to increase the weight of the profit in the global revenue of MTFs' shareholders. Doing this, historical exchanges create the conditions for the (Max Π_i, Max Π_j) equilibrium, which is more profitable for them than the (Max R_i, Max R_j) equilibrium. Another solution for the historical exchanges consists to create their own MTF, as did Börse Berlin[18] in 2008 with Equiduct or Nyse-Euronext in 2009 with Nyse Arca Europe. Creating a platform that has the legal status of MTF but that only includes the interest of its sole profit maximizing shareholder -the historical exchange- in its objective function can also be interpreted as a way to ultimately reach the (Max Π_i, Max Π_j) equilibrium.

Our model could be extended in several interesting ways. First, we could consider that banks take stakes in both MTFs and examine the implications of this cross-shareholding assumption on all platforms' price schemes and profitability. Second, we could consider that some banks take stakes in both MTFs and in the historical exchange as a core shareholder or in the free floating.

[18]It became a regulated market in Börse Berlin.

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APPENDIX

Table 1: 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)

$i \diagdown j$	Max Π_j	Max R_j
Max Π_i	$1/6(5-6c-2t)+\alpha(-1+c+\frac{4t}{9})$; $1/6(5-6c-2t)+\alpha(-1+c+\frac{4t}{9})$	$\frac{D+E+F}{450\alpha(-3+2t)}$; $\frac{D+E+F}{450\alpha(-3+2t)}$
Max R_i	$\frac{D+E+F}{450\alpha(-3+2t)}$; $\frac{D+E+F}{450\alpha(-3+2t)}$	$\frac{A+B+C}{450\alpha(-3+2t)}$; $\frac{A+B+C}{450\alpha(-3+2t)}$

with
$A = 18(23 - 62t + 32t^2)$,
$B = \alpha^2(1899 - 2976t + 1156t^2 + 450c(-3 + 2t))$,
$C = -6\alpha(75c(-3 + 2t) + 4(87 - 158t + 68t^2))$,
$D = 9(19 - 56t + 36t^2)$,
$E = 2\alpha^2(783 - 1062t + 392t^2 + 225c(-3 + 2t))$,
$F = -6\alpha(75c(-3 + 2t) + 4(63 - 97t + 42t^2))$,
$G = 18(13 - 32t + 12t^2)$,
$H = -3\alpha(561 - 864t + 284t^2 + 150c(-3 + 2t))$,
$I = 2\alpha^2(837 - 1158t + 368t^2 + 225c(-3 + 2t))$.