

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 the pricing policy of MTFs. When MTF are owned by banks, an equilibrium emerges where both MTFs include banks' utility as clients in their objective function, leading to low fees and negative profit. Because banks submit orders on platforms at lower cost, their global revenue is larger than if they had not stake in a MTF. This explains why banks were at the origin of the creation of MTFs and why they maintain their stake in MTFs 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 at removing remaining barriers to the supply of cross-border securities-related financial services and creating 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 on trading venues. Consequently, under this European regulation, newly created trading electronic platforms or multilateral trading facilities (MTFs), such as BATS Chi-X Europe and Turquoise, are now allowed to directly compete with regulated markets. Chi-X Europe represents the merge in 2011 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 ones.

In this paper, we focus on two aspects of MTFs, which are seldom examined in the literature. First, one observes that some MTFs are mainly owned by banks, which were also at the origin of their creation. Banks' shareholding in MTFs is all the more striking as they also massively route orders to these MTFs for their own account or on their clients' behalf (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 parties¹. Second, it is noteworthy that due to low prices, MTFs in Europe are rarely profitable. Moreover, due to low fees and despite weak fixed costs and increasing trading volume, MTFs regularly incurred losses.

The goal of this paper is precisely to investigate this specificity and to examine the implications of MTFs' ownership by banks on their pricing policy and profitability. To do so, we refer to the literature on two-sided markets, on 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 gives value to the other group, two-sided markets are associated with specific class of network externalities, called cross externalities. For this reason, the attractiveness of the platform for agents of one group largely depends on the participation of agents of the other group. As shown by Armstrong (2006) in a duopoly model, participation fees charged to agents when they access the platform are lower 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 analyse financial markets externalities. Wright (2004) points out trading venues as examples of two-sided market which allows security issuers and investors to interact, giving birth to liquidity externalities. Foucault et

¹The best execution principle imposes to choose the venue which is the best for the clients in term of transaction costs, quality, speed of execution, etc.

al. (2013) and Skjeltorp et al. (2013) 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 situations where the 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. We transpose the formalization of Armstrong (2006) to the MTF industry and investigate the consequences of banks' shareholding on MTFs' prices and profitability. We show that banks' shareholding in MTFs crucially affects the pricing policy of MTFs. When MTFs are owned by a bank, there exists an equilibrium where both MTFs include banks' utility as a client in their objective function, thus leading to low fees and negative profit. Nevertheless, because banks are charged lower fees when they route orders, their global revenue is larger than if they had not stake in a MTF. This explains why banks were at the origin of the creation of MTFs in Europe and why they maintain their stake in these MTFs despite negative profit.

The remainder of the paper is organized as followed. In section 2, we propose an overview of the European MTF industry. In Section 3, we review the literature. Section 4 presents the model. Section 5 concludes.

2 The European MTF industry: an overview

In this section, we propose an overview of the European MTF industry. First, we emphasize the importance of MTFs among lit venues, i.e. transparent trading platforms, in Europe. Second, one observes that, because of the level of the fees and despite a rise in trading volumes, MTFs end up making losses. The last stylized fact is that MTFs are mainly owned by banks which are also clients of the MTFs they own.

MTFs are low-cost trading electronic platforms that were created immediately after the implementation of the MiFID in Europe. They have globally induced a significant decrease in regulated stock exchanges' market shares. As mentioned in Table 1, several MTFs still operate in Europe but Bats Chi-X Europe and Turquoise are the main MTFs operating in European markets². Bats Chi-X Europe has become the largest European equities exchange by market share and value traded. It represents the merge in 2011 of the two leading pan-European MTFs, BATS Europe and Chi-X Europe. Based in London, it offers trading in more than 1,800 of the most liquid equities across 25 indexes and 15 major European markets, as well as ETFs (Exchange trading facilities) and ETCs (Exchange traded commodities) and international depositary receipts. It allows cost-effective access to other MTFs and 13 primary exchanges (for more details concerning the launch, see Hoffmann 2013). Turquoise Global Holding Limited (TGHL) also contributes to increase competition in the secondary trading of European equities. It offers competitive pricing and innovative services, concerning equity and index derivatives and covers some 2000 securities over 19 countries, including all major European markets.

²While Equiduct was created by Börse Berlin, Nyse Arca was funded by Nyse Euronext. The MTF Nasdaq OMX Europe closed down in 2010 because of fierce competition between low-cost trading platforms.

FTSE		
	2013	2012
LSE	22.81	22.66
Bats Chi-X Europe	9.40	10.90
Turquoise	4.36	2.65
Equiduct	0.03	0.07
Nyse Arca	0.01	0.03
CAC40		
	2013	2012
Nyse Euronext	36.13	31.52
Bats Chi-X Europe	11.81	10.72
Turquoise	5.10	2.78
Equiduct	0.79	0.81
Other	0.01	0.04
DAX30		
	2013	2012
Deutsche Börse	31.98	32.25
Bats Chi-X Europe	10.62	10.98
Turquoise	3.16	2.26
Equiduct	0.15	0.06
Nyse Arca	0.01	0.01
Other	0.36	0.37
Eurostoxx50		
	2013	2012
Nyse Euronext	13.27	11.76
Deutsche Börse	11.47	11.02
Bats Chi-X Europe	11.46	10.32
Borsa Italiana	6.03	5.54
Madrid	5.26	5.43
Turquoise	3.31	2.02
Equiduct	0.29	0.25
other	0.30	0.50

Table 1 – Market shares of main lit trading venues on European Indices (October 2013), in %, source: Fidessa and Agefi Hebdo (7-13 November 2013)

Another noteworthy stylized fact concerning European MTFs is that, despite very weak fixed costs (see Table 2), they mainly operate at a loss. Although in 2013, BATS Chi-X Europe has generated profits (the second quarter profits have been 7.8 million dollars), in 2012, losses were 4.67 million dollars. Before the merge, BATS Europe had never generated profits and Chi-X Europe only generated profit in 2010 (800 000 pound sterling), followed by huge losses in 2011 (10 million pound sterling). For year 2008, Turquoise’s losses before tax were 15.7 million pound sterling³. These losses mainly result from a very low pricing policy. Overall, there are four types of fees on average monthly activities: listing fees (which only apply on regulated markets, on which firms can issue equities); trading fees (according to the level of liquidity and transaction value); connectivity fees (members are charged for their order entry session, connections, and access to the Web-based version of the trade confirmation system) and clearing and settlement costs. It is very difficult to get accurate data about fees charged by trading venues and to compare fees across MTFs and regulated markets. However, the literature provides some partial information about the pricing structure of MTFs. For example, according to Fleuriot (2010), during the first three quarters of 2008,

³Since the merge, the results of Turquoise are less obvious to interpret because they are combined with those of the LSEG (London Stock Exchange Group).

the average execution cost of a round-trip trade was between 0.25 and 0.30 basis points on MTFs whereas it was between 0.80 (Deutsche Börse, LSE, Euronext) and 2.90 (Greece) basis points on regulated markets. Despite some differences in venues practices, Fioravanti and Gentile (2011) calculate trading fees and provide a very interesting comparison between the fees charged by MTFs and those charged by regulated markets in 2010 (see Table 3). Net trading fees, calculated for MTFs as the sum between fees (positive figures) paid by liquidity takers and fees or rebates (negative figures) granted to liquidity providers (on average around 0.1 bps of the transaction value) were lower than trading fees collected by regulated markets (on average around 1bp). As underlined by Spankowski and Wagener (2012), Hoffman (2013) and Chlistalla and Lutat (2011), these results suggest that MTFs clearly adopt a liquidity make/take fee scheme while regulated markets adopt a traditional fee structure without any fee discrimination between liquidity providers and takers. Finally, AMF (2009) concludes that MTFs offer the best prices and the best volumes once out of ten times concerning CAC40 equities, against once out four times for Nyse-Euronext. This may explain why Nyse-Euronext has decided to lower some transaction fees ahead of November 2007 MiFID deadline (-30% in 2008 according to Fleuriot 2010) and to launch its own MTF Nyse Arca and the dark pool Smartpool. It may also explain why LSE, which wanted to strengthen its technological infrastructure, bought Turquoise.

	Liquidity taker	Liquidity provider	Total trading fees	Fixed annual costs
Chi-X	0.30	-0.20	0.10	0
Turquoise	0.28	-0.20	0.08	0
Bats Europe	0.28	-0.18	0.10	0-6.00
LSE	0.31	0.31	0.62	75.00
Deutsche Borse	0.48	0.48	0.96	28.00
Euronext	0.65	0.65	1.30	12.00
Borsa Italiana	0.40	0.40	0.80	177.00
Bolsa de Madrid	0.40	0.40	0.80	19.00

Table 2 – Investors trading fees (basis point with respect to the transaction value) and venues fixed annual costs (thousand euros), source: Fioravanti and Gentile (2011), p.11.

The last interesting stylized fact relates to the shareholding of MTFs. As reported in Table 3, MTFs are mainly owned by banks. Chi-X Europe was created in 2007 by Instinet, a subsidiary of the Japanese Holdings Nomura, and a consortium of 12 financial institutions: BNP Paribas, Citadei, Citigroup, Credit Suisse, Fortis, GETCO Europe Ltd, Goldman Sachs, Merrill Lynch, Morgan Stanley, Optiver, Societe Generale, UBS. BATS Europe was established in 2008 by a leading US operator of stock and options markets, Bats Global Markets. On December 1st, 2011, BATS Global Markets acquired Chi-X Europe from the consortium to give birth to Bats Chi-X Europe. Turquoise was initially funded by nine investment banks (BNP Paribas, Citigroup, Credit Suisse, Deutsche Bank, Goldman Sachs, Merrill Lynch, Morgan Stanley, Societe Generale, UBS). Since December 2009, it is mainly owned by LSE. LSE firstly owned 60% of Turquoise but in March 2010, it decided to sell 9% of the platform to three banks: Barclays, JP Morgan and Nomura. Consequently, there are twelve investment banks that are now shareholders of Turquoise. As indicated in Table 3, nine banks (Morgan Stanley, Merrill Lynch, Credit Suisse, Citigroup, Goldman Sachs, UBS, BNP, SG and Nomura) owned shares simultaneously in the two main MTFs, Turquoise and Chi-X Europe.

The fact that banks own MTFs is all the more striking that they also massively route orders to these MTFs, for their own account and for the account of third parties (Hautcoeur et al. 2010, AMF 2009). For example, the twelve shareholder banks of Turquoise belong to the list of the trading members published on the former Turquoise's website.

All in all, the MTF's shareholding by banks may explain the MTFs' pricing policy mentioned above for at least two reasons. First, if they submit orders for their own account, banks may be enticed to put pressure on the MTF to benefit from a lower fee. If they route orders for the account of third parties, they are required to apply the principle of best execution, which imposes to choose the execution venue that is the best for their clients in terms of transaction costs, quality, speed of execution... Hence, if banks are MTF's shareholders, they may be enticed to choose the MTF they own and decrease the level of fees charged on this MTF to ultimately respect the best execution principle. Taken together, these reasons may partly explain the low pricing scheme practiced by MTFs. They may also explain why banks are encouraged to become shareholders of MTFs. If they are able to influence the pricing policy of the MTF they own, their global revenue will be increased for three reasons. First, they benefit from lower fees when they route orders for their own account. Second, they benefit from a rebate when they provide liquidity. Third, their MTF is more attractive for clients because they provide them lower prices for the execution of their orders. In other words, banks make losses as shareholders but earn profit as a client of their own MTFs. The goal of this paper is precisely to formalize this relationship between MTFs' ownership by banks and their pricing policy.

Chi-X Europe (01/07/2010)		Turquoise (11/12/2011)	
Shareholder name	% of ownership	Shareholder name	% 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 3 – Ownership of Chi-X Europe and Turquoise, in %, source: authors calculations from firms documents.

3 Literature

Our analysis mainly relates to two streams of the literature. The first one relates to the consequences of the MiFID on European market microstructures. The second one refers to the literature on two-sided markets.

3.1 The impact of MTFs on European financial market microstructure

A first strand of literature concentrates on microstructure issues and examines the consequences of MTFs on market quality (trading fees, flows, liquidity, quotes, transparency) (Haas, 2007). This literature mainly deals with whether more competition following MiFID leads to more liquid markets and decreasing transaction costs. Gresse (2014) uses panel regressions on a sample of 140 stocks concerning FTSE 100, CAC 40 and SBF 120 indexes between October 2007 and three one-month periods in 2009. Firstly, she finds that market fragmentation (measured by the inverse of the Herfindahl-Hirschman index) improves local (only on the regulated exchange) and global (on all venues) liquidity. However, fragmentation is shown to reduce market depth for small stocks. Secondly, comparing the beginning and the end of the observed periods, she finds that implicit transaction costs of a round trip trade, measured by quoted spreads, decrease while market competition becomes fiercer⁴. More precisely, the strongest evolution is observed on the FTSE 100 index, for which the average global quoted spread fell from 9.21 to 5.43 bps while the average local quoted spread fell from 9.21 to 7.07 bps. This fall is stronger for large caps in 2009, for which competition from Chi-X was particularly fierce. She concludes that competition among lit venues induces a reduction in implicit transaction costs, especially for traders who invest the most and on several platforms. In the same vein, Fioravanti and Gentile (2011) use a sample of 50 stocks included in the Stoxx Europe 50 index, from the beginning of 2008 until February 2011. They measure fragmentation with the inverse of the Herfindahl-Hirschman index and account for liquidity using quoted spreads and a ratio of daily return over trading volume. They also examine displayed depth at the best prices, measured by the average of bid and ask multiplied by the quantities of stocks potentially available for trading corresponding to the best bid and the best ask observed at a given minute. Their empirical analysis reveals that increasing fragmentation leads to narrower quoted spreads, reduced ratio of daily return over trading volume and increased depth at the best prices. Moreover, liquidity increases with trading volume, market capitalisation but decreases with volatility. The authors add that the increase in liquidity could be due to the diffusion of high frequency trading which potentially boosts trade.

Some other articles focus on competing pre-trade transparency venues in visible order books (i.e., regulated markets and MTFs) and dark trading (i.e., dark pool and OTC⁵). Using data 52 Dutch mid- and large-cap stocks from January 2006 to the end of 2009, De

⁴Quoted spread is calculated as the difference between the highest bid price and the lowest ask price across all competing platforms, divided by the median value.

⁵On this issue, see also Gomber et al. (2011).

Jong et al. (2011) resort to multivariate panel regressions. They show that the existence of MTFs improves global liquidity (the optimal degree of visible fragmentation improves global liquidity by 35% compared with a completely concentrated market) whereas dark trading has a detrimental effect (an increase of one standard deviation of dark pool trading volume lowers global liquidity by 9%). When fragmentation is the most efficient in terms of liquidity improvement, spreads reduce by 6.8 bps compared with a completely concentrated market. Moreover, despite increased fragmentation in large stocks during the sample period, the level of liquidity is doubled. Local liquidity is lowered, so that market participants do not take same advantages from fragmentation. Using data from the first ten months of 2010, Brandes and Domowitz (2011) go further and focus on transaction costs incurred by investors across regulated markets, MTFs and dark pools. Transaction costs decreased in all venues. These of dark pools are 13% lower than those of regulated markets and 18% lower than those of MTFs. The authors also reveal that MTFs exhibit average costs that are 5% higher than those of regulated markets. However, they obtain the reverse result for year 2009. This emphasises that due to strenghtened competition from MTFs, regulated markets reacted by improving their trading costs and services. For this reason, transaction costs in all venues have decreased.

Other studies focus on some specific MTFs. Chlistalla and Lutat (2011) examine the consequences of the entry of a new venue, Chi-X, on the liquidity of Euronext Paris. Conducting regressions on a sample of 37 stocks related to the CAC40, the authors compare liquidity on two periods: 60 days before the entry of Chi-X, and 30 days following the entry. They show that the effect on liquidity differs according to stock categories. Because, in 2007-08, trading activities in Chi-X appeared to be focused on the top liquids of the CAC 40, the emergence of a new competitor generates a significant stimulus only for the liquidity of most actively traded stocks in the CAC 40, inducing tighter quoted spreads and greater depth of the order book to execute an order of 100,000 euros. Finally, the authors conclude that investors transaction costs have been significantly reduced consecutively to the entry of Chi-X. Nevertheless, the ability to benefit from competition among platforms and improved liquidity requires that investors have access to several venues. This engenders new (and perhaps significant) access costs such that the smallest investors may be excluded from the benefits of competition between venues. Spankowski and Wagener (2012) use a sample of 69 FTSE 100 stocks traded on the LSE and the three largest MTFs, Chi-X, BATS Europe and Turquoise, between January and December 2009. They reveal that spreads decrease on all platforms, suggesting that the quality of all trading venues have improved. The authors go further using an intraday analysis to compare platforms. Intraday patterns for each indicator (trading volume, market shares, quoted spreads, ratio of daily return over trading volume) converge across platforms from Q1 2009 to Q4 2009. This indicates that platforms mature and grow jointly. However, intraday patterns of trading volume differ among the LSE and MTFs. While the trading volume exhibits a U-shape on the LSE, one observes an increase in trading volume on MTFs only in the second half of the trading day. In other words, in all venues, trading volume increases in the afternoon, which can be associated to the US market opening and investors prefer trading on the regulated market at opening and closing time, whereas they switch to MTFs during the day. The authors thus conclude that investors rely on the price formation process of regulated

markets in periods of increased volatility and price uncertainty. In a same way, Riordan et al. (2011) study the market quality of FTSE 100 components traded on a regulated market (the LSE) and on three MTFs (Chi-X, BATS and Turquoise). They find that Chi-X was the most liquid platform in term of quoted spreads in April/May 2010. Orders are more likely to be routed to MTFs when MTFs offer better prices (tighter spreads and deeper order) relative to the LSE. Investors tend to resort to the LSE in times of high volatility for high volume stocks. Based on a VAR analysis and identifying which trading venues quotes ‘move first’, the authors suggest that Chi-X and the LSE lead in terms of trade and quote based price discovery. For example, in April /May 2010, on Chi-X, 44.6% of total information was captured into prices compared to 34.6% on the LSE, 12.9% on BATS and 7.8% on Turquoise. Comparing these results with April/May 2009, the authors find that market quality improved on each trading venue despite a more fragmented market. They finally conclude that MTFs significantly contribute to equity market quality.

All in all, a lot of articles point out that fragmentation or a larger number of locations to execute orders does not harm liquidity and that transaction costs globally decrease in all venues. They also reveal that before the merge, Chi-X was the most competitive platform. But the impact of competition from newly created MTFs seems to be heterogeneous across large and small stocks. Moreover, having access to all venues may engender new costs, notably for smaller investors. Finally, traders seem to build trading strategies between MTFs and regulated markets not only on the basis on 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 quality.

3.2 The two-sided market approach of the financial industry

MTFs can also be analyzed by referring to industrial economics and the literature on two-sided markets, defined as markets which involve two groups of agents who interact through a platform (Evans 2003, Roson 2005, Rochet and Tirole 2006). Because the participation of each group gives value to the other group, two-sided markets are associated with a specific class of network externalities, called cross externalities. For this reason, the attractiveness of the platform for agents of one group largely depends on the participation of agents of the other group. As shown by Armstrong (2006) in a duopoly model, participation fees (i.e., fees charged to agents when they access the platform) are lower than without any externality effects. Armstrong (2006) also demonstrates that participation fees charged to agents from one group decrease with how their participation is valued by the opposite group.

There exist many well known examples of two-sided markets: videogames, media, night-clubs, real estate agencies... But very few financial industries are analyzed using such a perspective. The financial sector that has been the most often interpreted as a two-sided market is the industry of payment card, which involves two groups of agents, cardholders and merchants (Rochet and Tirole 2006, Chakravorti and Roson 2006). As shown by Rochet and Tirole (2003), the pricing structure of these two sided markets is characterized by the existence of membership fees (paid by users to their bank), merchants discount (paid by merchants to their financial institution) and interchange fees (paid by one bank to the other for accepting

the payment). The literature focuses on the effects of competition in payment card systems on agents' welfare and examines how these markets should be regulated (Rochet and Tirole 2002, Guthrie and Wright 2007, Carbò-Valverde et al. 2009).

Trading venues also exhibit the characteristics of two-sided markets. As underlined by Wright (2004), they can be analyzed as intermediaries which allow security issuers and investors to interact. Securities issuers benefit all the more from the stock market when a large number of investors also participate in the market and *vice-versa*. Trading venues are also characterized by the existence of liquidity externalities among liquidity demanders and suppliers. According to Foucault et al. (2013), differentiating fees charged to liquidity makers and takers allow trading venues to influence the speed of liquidity provision (by liquidity makers) and consumption (by liquidity takers). When there is an increase in the liquidity takers' reaction to liquidity changes, one observes an intensification of market orders and liquidity consumption. Hence, the market becomes more liquid, which provides new trading opportunities for liquidity makers. They submit new market orders, thus raising the liquidity of the platform and the ability of liquidity takers to consume liquidity. This finally improve trading intensity and the profitability of platforms. Using a data set on shares quoted on the NASDAQ market from October 2010 to March 2011, Skjeltorp et al. (2013) provide empirical support to the existence of such cross-sided liquidity externalities among liquidity makers and liquidity takers. Notably, they show that a decrease in liquidity takers' fee by the trading venue allows to increase not only the speed of liquidity consumption by liquidity takers but also the speed of liquidity provision by liquidity makers.

However, these approaches do not allow to investigate the specificity of MTFs and to account for situations where the owner of the trading venue can also be a client of this platform. The goal of this paper is to fill this gap. The following section presents the theoretical model we use to investigate the consequences of banks' shareholding in MTFs on MTFs' profitability and pricing policy.

4 The model

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

4.1 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^6 . There also exists two groups of agents denoted 1 and 2, which participate in MTFs to route a buying or a selling order. For example, type 1 agents are buyers while type 2 agents are sellers. Agents 1 and 2 are uniformly located on a unit segment while platforms are located at each of its

⁶It seems reasonable to assume that the technology and the business model of platforms are very similar such that they incur the same cost. Anyway, considering that platforms' unit cost are different does not change qualitatively our findings.

extremities. 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 order submission process for example), i.e., the degree of platforms' market power.

In this model, we deal with single homing: agents 1 (resp. agents 2) choose between platforms i and j to connect and place a buying (resp. a selling) order on the venue. To do this, they are charged a trading 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 place a buying order and $p_{2,i}$ (resp. $p_{2,j}$) the fee charged to agents 2 by the platform i (resp. j) to place a selling order. We assume that fees do not depend on the 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 of sellers to find a counterparty, and *vice versa*. For convenience and without loss of generality, we assume that the benefit enjoyed by agents from each agent on the other side is 1.

Each MTF is assumed to have a unique shareholder which is a bank. We denote by i the bank which is the owner of platform i and by j the owner of platform j . Banks trade securities in financial markets and participate in their own MTF to submit orders⁷. We assume that banks are buyers such that they belong to the group 1⁸. Because they are both owner and client of the MTF, banks have a special position. As owners of a MTF, banks' interest is to maximize the platform's profit. But as clients, they are also concerned about the utility they obtain when submitting orders on the platform. Hence, banks have the choice between two strategies. On the one hand, they can let their MTF maximize profit without taking into account their interest as clients. On the other hand, they can encourage the MTF to include in their objective function not only their profit as shareholders but also their utility as participants.

The model has two stages. First, platforms choose whether or not to urge the MTF to include the clients' utility into their objective function. Then, platforms compete in prices. 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 's and MTF j 's profits are denoted Π_i and Π_j respectively, while banks' total revenues, defined as the sum of their profit and their utility as a client, are denoted R_i and R_j respectively. We examine Nash equilibria in each pricing subgame and in the full game.

⁷Everything 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' transport cost was so large that each MTF had a monopoly power on its shareholder.

⁸Considering that banks are both type 1 and type 2 agents does not qualitatively change our results.

4.2 Equilibrium

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

4.2.1 The second-stage subgames

In this section, we consider successively the three following cases: the subgame where both MTFs include only the platform's profit in their objective function, the subgame where both MTFs include the platform's profit and the type 1's utility, and the subgame where one MTF only includes the platform's profit while the other one considers both the platform's profit and the type 1's utility.

(i) The subgame where no MTF includes the agents 1's utility in the objective function

Agents' utilities can be written as follows:

$$U_{1,i} = n_{2,i} - p_{1,i}, U_{1,j} = n_{2,j} - p_{1,j}, U_{2,i} = n_{1,i} - p_{2,i}, U_{2,j} = n_{1,j} - p_{2,j}. \quad (1)$$

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

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

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

$$\begin{aligned} \{p_{1,i}^*, p_{2,i}^*\} &= \text{ArgMax}\Pi_i = \text{ArgMax}(p_{1,i} - c)n_{1,i} + (p_{2,i} - c)n_{2,i}, \\ \{p_{1,j}^*, p_{2,j}^*\} &= \text{ArgMax}\Pi_j = \text{ArgMax}(p_{1,j} - c)n_{1,j} + (p_{2,j} - c)n_{2,j}. \end{aligned}$$

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

Lemma 1 *For $t > 1$ (H1)⁹, the subgame where no MTF internalizes the participants' utility has a unique equilibrium, given by*

$$\begin{aligned} p_{1,i}^* &= p_{2,i}^* = p_{1,j}^* = p_{2,j}^* = c + t - 1, \quad \Pi_i^* = \Pi_j^* = t - 1, \\ n_{1,i}^* &= n_{2,i}^* = n_{1,j}^* = n_{2,j}^* = \frac{1}{2}, \quad U_{1,i}^* = U_{2,i}^* = U_{1,j}^* = U_{2,j}^* = \frac{3}{2} - c - t, \quad R_i^* = R_j^* = \frac{1}{2} - c. \end{aligned}$$

⁹Under this condition, equilibrium prices and profits are positive and the second-order condition is satisfied (the trace of the Hessian matrix is negative and its determinant is positive).

This subgame refers to the equilibrium obtained by Armstrong (2006). Prices increase with the agents' transport cost and the platforms' cost. Moreover, in line with a standard result 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 increases the liquidity of the MTF and makes it more attractive for the agents of the other group.

(ii) The subgame where both MTFs include the agents 1's utility in the objective function

Agents' utilities and agents' participation can be written as in subgame (i). However, because MTFs take the agents 1's utility into account, equilibrium prices are determined by including the platform's profit and the type 1's utility in objective functions¹⁰:

$$\begin{aligned} \{p_{1,i}^*, p_{2,i}^*\} &= \text{ArgMax}R_i = \text{ArgMax}(p_{1,i} - c)n_{1,i} + (p_{2,i} - c)n_{2,i} + n_{2,i} - p_{1,i}, \\ \{p_{1,j}^*, p_{2,j}^*\} &= \text{ArgMax}R_j = \text{ArgMax}(p_{1,j} - c)n_{1,j} + (p_{2,j} - c)n_{2,j} + n_{2,j} - p_{1,j}. \end{aligned}$$

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

Lemma 2 *Under H1, the subgame where both MTFs include agents 1's utility in the objective function has a unique equilibrium, given by*

$$\begin{aligned} p_{1,i}^* &= p_{1,j}^* = c - t - 1, \quad p_{2,i}^* = p_{2,j}^* = c + t, \quad \Pi_i^* = \Pi_j^* = -\frac{1}{2}, \\ n_{1,i}^* &= n_{2,i}^* = n_{1,j}^* = n_{2,j}^* = \frac{1}{2}, \quad U_{1,i}^* = U_{1,j}^* = \frac{3}{2} - c + t, \quad U_{2,i}^* = U_{2,j}^* = \frac{1}{2} - c + t, \\ R_i^* &= R_j^* = t - c + 1. \end{aligned}$$

It is interesting to compare this equilibrium with the one obtained in the subgame (i). When both MTFs include the type 1 agent's utility in their objective function, the price charged to agents 1 is lower than when the client's utility is not taken into account. Lemma 2 also indicates that there are cross subsidies between both types of agents. Because type 1 agents are charged lower fees, it becomes less necessary to attract them by encouraging type 2 agents to participate in the platform. This allows platforms to balance lower prices charged to agents 1 by higher fees charged to agents 2¹¹. One can also note that, in contrast with Lemma 1, prices $p_{1,i}^*$ and $p_{1,j}^*$ are decreasing in t : the higher the market power of platforms, the lower fees charged to agents 1. Indeed, when t is large, the pressure to charge high prices is strong, which contradicts banks' interest as MTFs' clients. Platforms thus counter this effect by reducing their fees. Finally, in line with stylized facts given in introduction, it is noteworthy

¹⁰When 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.

¹¹This effect vanishes when it is assumed that banks submit not only a buying but also a selling order. But this does not challenge our main result, which is that platforms charge lower fees and earn negative profit.

that the pricing policy described in Lemma 2 implies negative profit for MTFs. However, because banks benefit from lower fees when they submit an order, their total revenue is larger than when their utility as a client is not taken into account in the objective function.

(iii) The subgame where MTF i includes the agents 1's utility in the objective function

Agents' utilities and agents' participation can be written as in subgames (i) and (ii). While equilibrium prices in MTF j are set by considering only the platform's profit, equilibrium prices in MTF i are determined by including not only the platform's profit but also the agents 1's utility:

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

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

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

Lemma 3 *Under H1, the subgame where MTF i includes the agents 1's utility in the objective function while MTF j does not has a unique equilibrium, given by*

$$\begin{aligned} p_{1,i}^* &= c - 1 - \frac{t}{3}, \quad p_{2,i}^* = c - \frac{1}{3} + t, \quad p_{1,j}^* = c - 1 + \frac{t}{3}, \quad p_{2,j}^* = c - \frac{2}{3} + t, \\ \Pi_i^* &= \frac{4t^3 - 15t^2 - 6t + 15}{18(t^2 - 1)}, \quad \Pi_j^* = \frac{10t^3 - 12t^2 - 9t + 12}{18(t^2 - 1)} \\ n_{1,i}^* &= \frac{5t^2 - 4}{6(t^2 - 1)}, \quad n_{2,i}^* = \frac{3t^2 + t - 3}{6(t^2 - 1)}, \quad n_{1,j}^* = \frac{t^2 - 2}{6(t^2 - 1)}, \quad n_{2,j}^* = \frac{3t^2 - t - 3}{6(t^2 - 1)}, \\ U_{1,i}^* &= \frac{2t^3 + (9 - 6c)t^2 - t - 9 + 6c}{6(t^2 - 1)}, \quad U_{2,i}^* = \frac{-6t^3 + (7 - 6c)t^2 + 6t - 6 + 6c}{6(t^2 - 1)}, \\ U_{1,j}^* &= \frac{-2t^3 + (9 - 6c)t^2 + t - 9 + 6c}{6(t^2 - 1)}, \quad U_{2,j}^* = \frac{-6t^3 + (5 - 6c)t^2 + 6t - 6 + 6c}{6(t^2 - 1)}, \\ R_i^* &= \frac{10t^3 + (12 - 18c)t^2 - 9t - 12 + 18c}{18(t^2 - 1)}, \quad R_j^* = \frac{4t^3 + (15 - 18c)t^2 - 6t - 15 + 18c}{18(t^2 - 1)}. \end{aligned}$$

According to Lemma 3, MTF i charges a lower price to agents 1 than MTF j . As explained above, this is balanced by a higher price charged to agents 2. It is also noteworthy that the participation of type 1 in MTF i is higher than in MTF j , thus making MTF i more attractive for agents 2. For this reason, the participation of agents 2 is also higher on MTF i than on MTF j . Finally, it can be easily shown that $\Pi_j > \Pi_i$ and $R_i > R_j$ ¹². As explained above, the

¹² $\Pi_j - \Pi_i = \frac{6t^3 + 3t^2 - 3t - 3}{6(t^2 - 1)}$. The numerator of this expression equals 3 for $t = 1$ and is increasing for $t > 1$. Hence $\frac{6t^3 + 3t^2 - 3t - 3}{6(t^2 - 1)} > 0$ and $\Pi_j > \Pi_i$. Symmetrically, $R_i - R_j = \frac{2t^3 - t^2 - t + 1}{6(t^2 - 1)}$. The numerator equals 1 for $t = 1$ and is increasing for $t > 1$. Hence $\frac{2t^3 - t^2 - t + 1}{6(t^2 - 1)} > 0$ and $R_i > R_j$.

bank which includes agent 1's utility in the objective function earns lower profit but higher global revenue than its rivale.

The equilibrium described in Lemma 3 can be interestingly compared to the one obtained in subgame (i). Because MTF i internalizes type 1 agents' utility, it charges them a lower fee than in subgame (i). This is balanced by a higher price charged to type 2 agents. 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 their utility allows type 1 agents to benefit from a lower price 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 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).

4.2.2 The first-stage subgame

We now turn to the first-stage subgame. The first-stage subgame is described in Table 4. 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	$\frac{1}{2} - c ; \frac{1}{2} - c$	$\frac{4t^3+(15-18c)t^2-6t-15+18c}{18(t^2-1)} ; \frac{10t^3+(12-18c)t^2-9t-12+18c}{18(t^2-1)}$
Max R_i	$\frac{10t^3+(12-18c)t^2-9t-12+18c}{18(t^2-1)} ; \frac{4t^3+(15-18c)t^2-6t-15+18c}{18(t^2-1)}$	$t - c + 1 ; t - c + 1$

Table 4 – The first-stage game: banks' equilibrium revenues

From Table 1, we derive the following proposition:

Proposition 1 *The full game has a unique subgame-perfect equilibrium (Max R_i , Max R_j) where both MTFs include the type 1's utility in the objective function.*

Proof. See Appendix.

Proposition 1 interestingly accounts for the specificities of European MTFs. It shows that when they are both owner and client of a MTF, banks have strong incentive to encourage MTFs to internalize their interest as participants. As explained above, including the type 1's utility into account in the MTF's objective function results in lower fees for agents 1, thus reducing the MTF's profit. However, as the bank submits an order at lower cost, its global revenue is increased and this, all the more when the rival MTF also internalizes the type 1 agents' utility. For this reason, at the equilibrium, both MTFs include the type 1's utility in their objective function.

Finally, it is interesting to examine whether owning the MTF in which it participates is more profitable for a bank than remaining a client without any shareholding. If it does not take any stake in a MTF, a bank's utility as a client is $\frac{3}{2} - c - t$. If a bank becomes owner

of the MTF, its global revenue is $t - c + 1$, which is larger than its utility as a client. This allows us to yield the following proposition:

Proposition 2. *Under H1, banks' total revenue is higher when banks own the MTF on which they submit an order than when they do not own it.*

Proposition 2 explains why banks were strongly encouraged to exploit the possibility offered by the MiFID to create their own MTF. Once the MiFID was adopted in Europe, banks launched their own MTFs such as Turquoise or Chi-X. Since their creation, these platforms have regularly lost money. Although banks' profit is negative, being able to influence the fee charged to participants allows the bank to route orders at lower cost, such that their global revenue is higher. This explains why banks are finally encouraged to take a stake in MTFs.

5 Conclusion

The goal of this paper was to propose a two-sided market model to account for the observation that European MTFs, such as Turquoise or BATS-Chi X Europe, are owned by banks which also participate in these MTFs for own account or on client behalf. We consider two MTFs in a duopoly and we show that when banks are shareholders of these MTFs, an equilibrium emerges where both MTFs include banks' interest as clients in their objective function. As shareholders, banks earn negative profit but as participants, they benefit from lower fees. This finally results in larger global revenue. Our model thus explain why banks were at the origin of the creation of MTFs and why they have an incentive to maintain their stake in these MTFs despite negative profit.

Our model could be interestingly extended in several 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 in our model an historical platform, such as Euronext, to investigate the effect of introducing a third venue, which also allows IPOs and securities issuing, on MTFs' behaviour. Finally, it would be interesting to formalize more explicitly the bargaining game between banks and MTFs concerning the inclusion of clients' interest in their objective function.

Appendix

Proof of Proposition 1

First, the equilibrium where no MTF takes type 1 agents' interest into account is not a full game equilibrium because both MTFs have interest to deviate. This can be shown by proving that $\frac{10t^3+(12-18c)t^2-9t-12+18c}{18(t^2-1)} > \frac{1}{2} - c$. We have $\frac{10t^3+(12-18c)t^2-9t-12+18c}{18(t^2-1)} - (\frac{1}{2} - c) = \frac{10t^3+3t^2-9t-3}{18(t^2-1)}$. The numerator of this expression equals -1 for $t = 1$ and is increasing in t for $t > 1$. Hence under H1, $\frac{10t^3+3t^2-9t-3}{18(t^2-1)} > 0$ and $\frac{10t^3+(12-18c)t^2-9t-12+18c}{18(t^2-1)} > \frac{1}{2} - c$.

Then, the equilibrium where one MTF includes the type 1 agents' utility in the objective function while the other one does not is not a full game equilibrium because the latter has interest to deviate. This can be shown by proving that $\frac{4t^3+(15-18c)t^2-6t-15+18c}{18(t^2-1)} < t - c + 1$. We have $\frac{4t^3+(15-18c)t^2-6t-15+18c}{18(t^2-1)} - (t - c + 1) = \frac{-14t^3-3t^2+12t+3}{18(t^2-1)}$. The numerator of this expression equals -2 for $t = 1$ and is decreasing in t for $t > 1$. Hence under H1, we have $\frac{-14t^3-3t^2+12t+3}{18(t^2-1)} < 0$ and $\frac{4t^3+(15-18c)t^2-6t-15+18c}{18(t^2-1)} < t - c + 1$.

Moreover, because as shown above, we have $t - c + 1 > \frac{4t^3+(15-18c)t^2-6t-15+18c}{18(t^2-1)}$. Hence, no bank has interest to deviate from this equilibrium. Finally, the subgame where both MTFs include the participants' interest in the objective function is the subgame-perfect equilibrium.

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