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The liquidity of dual-listed corporate bonds

Empirical evidence from Italian markets

N. Linciano, F. Fancello, M. Gentile, M. Modena

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La liquidità delle obbligazioni corporate negoziate su più mercati

Evidenze per il caso italiano

*N. Linciano, F. Fancello, M. Gentile, M. Modena**

Sintesi del lavoro

Il presente studio analizza la liquidità delle obbligazioni non governative con negoziazioni frammentate sui tre principali mercati italiani obbligazionari *retail* (DomesticMOT, ExtraMOT ed EuroTLX) dal 1° gennaio 2010 al 30 giugno 2013. Al fine di tener conto dei differenti aspetti della liquidità, sono stati utilizzati quattro indicatori: la percentuale di giorni di inattività (*zero-trade*), il *turnover ratio*, il *price impact* (stimato con la misura di Amihud) e il *bid-ask spread* (stimato con la procedura di Roll). Il riferimento contemporaneo ai quattro indicatori è giustificato dalle evidenze dell'analisi delle componenti principali della liquidità, che per i titoli analizzati risulta descritta in modo pressoché paritetico dalle quattro misure considerate. Le negoziazioni delle obbligazioni esaminate risultano frammentate alternativamente su due mercati: DomesticMOT ed EuroTLX, ovvero ExtraMOT ed EuroTLX. Per quanto riguarda il campione frammentato su DomesticMOT ed EuroTLX, la liquidità è simile sui due mercati in base agli indicatori *zero-trade* e *turnover ratio*, mentre appare superiore su EuroTLX con riferimento al *price impact* e al *bid-ask spread*. In relazione ai bond scambiati su ExtraMOT ed EuroTLX, la liquidità appare mediamente più elevata sul secondo mercato. Inoltre, in tutte le *trading venues*, la liquidità delle obbligazioni bancarie risulta inferiore a quella delle obbligazioni emesse da società non finanziarie, specialmente durante la crisi del debito sovrano. Lo studio evidenzia, altresì, che alcune caratteristiche dei titoli (come il lotto minimo di negoziazione, la complessità, la nazionalità e il settore dell'emittente) possono impattare in maniera diversa sulla liquidità a seconda della *trading venue*, suggerendo così che la microstruttura del mercato può rivestire un ruolo significativo. Anche l'analisi multivariata conferma tale evidenza, mostrando che, controllando per le caratteristiche dei titoli, la liquidità dipende dalla piattaforma di negoziazione. Infine, lo studio esamina gli effetti della frammentazione confrontando la liquidità delle obbligazioni bancarie scambiate contestualmente su DomesticMOT ed EuroTLX con la liquidità di obbligazioni bancarie simili ma negoziate solo su DomesticMOT. Le obbligazioni bancarie frammentate emesse da società italiane presentano livelli di liquidità simili o più elevati rispetto a quelle con scambi concentrati solo su DomesticMOT, mentre l'inverso vale per i titoli bancari esteri. L'effetto della frammentazione sulla liquidità delle obbligazioni, quindi, non è univoco, in quanto esso è probabilmente legato anche alle caratteristiche dei titoli, come ad esempio l'ammontare emesso (che, nel nostro campione, è maggiore per le banche italiane rispetto a quelle estere). Le evidenze riportate nel presente studio forniscono indicazioni importanti sul contributo che la trasparenza degli scambi e la microstruttura di una piattaforma di negoziazione possono apportare allo sviluppo di mercati secondari integrati. In tal senso, il lavoro è rilevante anche per gli aspetti di *policy*, riguardando un tema che il legislatore comunitario ha affrontato in occasione della MiFID, ossia la previsione di maggiore trasparenza anche per i mercati non azionari.

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The liquidity of dual-listed corporate bonds

Empirical evidence from Italian markets

*N. Linciano, F. Fancello, M. Gentile, M. Modena**

Abstract

The aim of this paper is to investigate the liquidity of non-government bonds fragmented across the three main Italian retail bond markets (DomesticMOT, ExtraMOT, and EuroTLX) from January 1, 2010 to June 30, 2013. In order to account for different aspects of liquidity, four measures are used: zero-trade, turnover ratio, price impact (Amihud indicator) and bid-ask spread (Roll indicator). The use of all these indicators is supported by the evidence of a principal component analysis, showing that liquidity of dual-listed bonds cannot be summarized by one single indicator over the sample period, since it results from the even contribution of the four measures. Fragmented bonds can be traded either on DomesticMOT and EuroTLX or on ExtraMOT and EuroTLX. As for bonds traded on DomesticMOT and EuroTLX, we find that liquidity is similar across the two venues when using zero-trade and turnover ratio, whereas it is higher on EuroTLX if we use price impact and bid-ask spread. As for the bonds traded across ExtraMOT and EuroTLX, liquidity is on average higher on EuroTLX. Moreover, irrespective of the trading venue, on average bank bonds turn out to be less liquid than non-financial bonds, especially during the sovereign debt crisis. We also show that securities' characteristics (such as minimum trading size, coupon type, complexity, issuer sector and nationality) may impact differently on liquidity depending on the trading venue, thus suggesting that market microstructure plays a relevant role. The multivariate analysis confirms this evidence, by showing that, controlling for bond characteristics, liquidity changes across trading venues. Finally, the paper investigates the effect of fragmentation by comparing the liquidity of bank bonds fragmented across DomesticMOT and EuroTLX with otherwise similar bank bonds traded on DomesticMOT only. We show that bonds issued by Italian banks traded on DomesticMOT and EuroTLX have similar or higher liquidity (depending on the measure adopted) than otherwise similar Italian bank bonds traded on DomesticMOT only, whereas the opposite result holds true for foreign bank bonds. Therefore, we do not find a clear-cut evidence on the effect of fragmentation on bond liquidity, because it is probably intertwined with bonds' attributes, such as the issue size (which, in our sample, is higher for the Italian bank bonds compared to the foreign ones). To our knowledge, this is the first paper to investigate the liquidity of dual-listed bonds and the impact of fragmentation on retail corporate bond markets, providing new empirical evidence on whether transparency and market microstructure rules may contribute to the development of an integrated secondary market. In this respect, the paper is relevant also on policy grounds, given that the recent MiFID review envisages greater transparency in non-equity markets.

JEL Classifications: G01, G10, G12, G18.

Keywords: liquidity risk, dual-listed bonds, corporate bonds, market microstructure, sovereign debt crisis.

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Contents

1 Introduction

The determinants of liquidity of corporate bond have long been of interest for regulators and academics. Liquidity is defined as the ability to trade quickly at a low cost (O'Hara, 1995). However, measuring liquidity is not simple, and different indicators, gauging immediacy (i.e. the speed with which orders can be executed), tightness (i.e., transaction costs), market depth and price impact, can be applied. Some of these indicators may in turn be calculated using either trade-based or order-based measures (which respectively can also be broadly defined as ex-ante and ex-post measures).

Liquidity is crucial for any trader/investor who has to decide the size, the timing and the venue of orders execution. In the European framework, the choice of the trading venue has become especially relevant since the introduction of the Directive 2004/39/EC (MiFID henceforth) in November 2007. MiFID set a new regulation of trading venues[1] and envisaged the abolition of the so called "concentration rule" (whereby investment firms were required to route client orders to regulated markets only). The new rules were aimed at promoting competition and, through this way, enhancing investors' protection.

When implementing MiFID, Italy decided to extend pre- and post-trade transparency rules to non-equity markets, although the Directive envisaged these rules for equity markets only. Moreover, the Italian securities regulator (Consob) issued a specific regulation, recommending that intermediaries adopt firm transparency measures in case of the distribution to retail customers of illiquid products (bank bonds, financial insurance products and derivatives).[2] The Italian legal framework was shaped by the sizable retail presence and participation in Italian bond markets. Indeed, direct retail holdings of corporate bonds, especially bank securities, are significantly more extensive in Italy than in other EU countries.[3] For these reason, corporate bond markets accessible by retail investors have proliferated. Nevertheless, illiquidity and infrequent trading remain an open issue and pose significant risks for investors' protection. Moreover, as it will be shown later on, a variable proportion of bonds trade on more than one venue, thus raising the question about whether and to what extent fragmentation impacts on liquidity.

Therefore, in the Italian context, the liquidity and fragmentation of corporate bonds across multiple trading venues remains a key policy issues. The point is relevant for issuers as well, since liquid markets may help banks and non-financial firms in raising debt capital, offering opportunities for diversification of funding sources.

1 In particular, the trading venues were classified into regulated markets, multilateral trading facilities (MTFs) and systematic internalizers.

2 Communication no. 9019104, "The duty of the intermediary to act with due correctness and transparency on distribution of illiquid financial products", 2 March 2009; this Communication forms part of the MiFID "level 3" measures for the Intermediaries' Regulation. The key point made by this regulation is that investors must have the possibility of disinvesting within a reasonable period of time and at a fair price.

3 At the end of 2013 Italian households' direct investment in corporate bonds accounted for about 14% of their financial wealth, equivalent to the figure referred to the Italian government bonds (Consob, 2013).

This paper investigates liquidity conditions and the determinants of trading of dual-listed bonds (i.e. whose trading is fragmented between two main trading venues). In particular, we study the liquidity of 409 bonds traded on EuroTLX (which is a multilateral trading facility or MTF) and either on DomesticMOT (a regulated market) or on ExtraMOT (an MTF) from January 1st, 2010 to June 30th, 2013. Since bonds traded on DomesticMOT were not traded on ExtraMOT and vice versa during the observed period, we have two samples of dual-traded securities: the first includes bonds traded on DomesticMOT and EuroTLX, while the second bonds traded on ExtraMOT and EuroTLX.

Liquidity is measured through four indicators: 1) the percentage of non-trading days (the so-called zero-trade statistics); 2) the turnover ratio (i.e. the ratio between turnover and outstanding amount), 3) the price impact (Amihud statistics); 4) the bid-ask spread estimated through the Roll statistics.

We show that for the first sample (of bonds traded both on DomesticMOT and EuroTLX) liquidity levels are similar across the two venues when using zero-trade and turnover ratio, whereas they are higher on EuroTLX if we use price impact and trading costs. However, bank bonds (representing 87% of the sample) are the main driver of these results, while for non-financial bonds DomesticMOT tend to be more liquid than EuroTLX. As for the second sample (bonds traded across ExtraMOT and EuroTLX), liquidity is on average higher on EuroTLX. Finally, irrespective of the trading venue, bank bonds turn out to be on average less liquid than non-financial bonds, especially during the sovereign debt crisis.

Differences in the liquidity of dual-listed bonds across trading venues might depend on microstructural features. Indeed, we show that securities' characteristics (such as minimum trading size, coupon type, complexity, issuer sector and nationality) may impact differently on liquidity measures depending on the trading venue. This suggests that market microstructure plays a relevant role. This evidence is confirmed by the multivariate analysis, which shows that controlling for bond characteristics liquidity conditions may change across trading venues.

Finally, the paper sheds light on the effect of fragmentation by comparing liquidity levels of bank bonds fragmented across DomesticMOT and EuroTLX with otherwise similar bank bonds traded on DomesticMOT only. We show that bonds issued by Italian banks traded both in DomesticMOT and EuroTLX exhibit similar or higher liquidity (depending on the measure adopted) than otherwise similar Italian bank bonds traded on DomesticMOT only, whereas we find and opposite results for bonds issued by foreign banks.

To our knowledge, this is the first paper to investigate the liquidity of dual-listed bonds and the impact of fragmentation on retail corporate bond markets, thus providing new empirical evidence on whether transparency and market microstructure rules may contribute to the development of an integrated secondary market. Indeed so far, given the size of the Italian public debt, the vast majority of the studies on the Italian case has focused on institutional trading on the government bond market, leaving overshadowed the retail side. In this respect, our paper has important policy implications given that the recent MiFID review envisages greater transparency in non-equity markets.[4]

The work is organized as follows. Section 2 summarizes the institutional features and the microstructure of DomesticMOT, ExtraMOT and EuroTLX. Section 3 details the data set. Section 4 describes the four liquidity indicators used in the paper (i.e., the turnover ratio, the Amihud statistic, the Roll indicator and the zero-trade index), and provides descriptive evidence on the evolution of liquidity of bonds in our sample over the period January 2010 – June 2013. Section 5 investigates the determinants of the probability of trading across the different trading venues applying a random effect panel logit model. Section 6 employs a matched sample approach to analyze the impact of fragmentation on liquidity for a sample of bank bonds traded on DomesticMOT. Section 7 concludes.

2 The Italian corporate bond markets: institutional and microstructural features

DomesticMOT, ExtraMOT and EuroTLX are the main Italian trading venues specialized on corporate bonds and targeted to retail investors.[5] MOT and ExtraMOT (respectively, a regulated market and an MTF) are owned and managed by Borsa Italiana SpA, while EuroTLX (an MTF) was owned by two major Italian bank groups (Unicredit and Intesa SanPaolo through Banca IMI Spa) till September 2013, when Borsa Italiana bought a majority stake.

MOT, established in 1994, is a regulated market divided in two segments (DomesticMOT and EuroMOT). MOT trades Italian and foreign government securities, corporate bonds of domestic and foreign issuers, supranational and asset-backed securities.[6]

On ExtraMOT, launched in 2009, bonds and other debt securities can be admitted to trading at the proposal of Borsa Italiana SpA or at the request of an intermediary, though such instruments must be already admitted to trading on a regulated market. However, since May 2011, unlisted bank bonds can also be admitted to trading on ExtraMOT, on request of the issuer.

The regulatory framework of the Italian bond markets is set by the MiFID and by the Italian law (Testo unico della finanza). As said, MiFID abolished the concentration rule and set mandatory pre- and post-trade transparency obligations for equity markets. However, member States were left free to extend such rules to non-equity platforms.[7] When transposing MiFID, the Italian legislator decided to use

4 See the ESMA Discussion paper available at http://www.esma.europa.eu/system/files/2014-548_discussion_paper_mifid-mifir.pdf.

5 We discarded a fourth trading venue for corporate bonds (HI-MTF) given its negligible market share.

6 Another difference is that Monte Titoli clears trades on DomesticMOT, while Euroclear and Clearstream clears trades on EuroMOT.

7 See art. 27-30 and 44-45 of Directive 2004/39/EC , and Chapter IV (on Transparency) of Commission Regulation (EC N° 1287/2006).

such option, though leaving to CONSOB the power to issue detailed regulation. In turn, CONSOB adopted a "flexible approach" whereby regulated markets, MTFs, and systemic internalizers (SIs) were required to establish and maintain differentiated transparency regimes. For MTFs, these requirements are weaker if the instrument is already listed on a regulated market. All trading venues were allowed to design their own pre-trade transparency rules, but these rules had to take into account the microstructure, the type of the financial instrument, the amount traded, and the market type.[8]

In all bond markets operated by Borsa Italiana (i.e. DomesticMOT and ExtraMOT), bonds are traded according to an order-driven market model. On DomesticMOT, it is envisaged the optional presence of a liquidity provider (or specialist), subject to specific minimum mandatory trading quantity quotations.[9] This requirement is stated also for ExtraMOT, although mitigated by the key provision that an intermediary shall act as a specialist only for those financial instruments for which the same intermediary has requested admission to trading.[10] Trading hours contemplate an opening auction phase (from 8am to 9am), and a continuous trading phase (from 9am to 5:30 pm), which takes place as soon as the initial auction is over. Borsa Italiana establishes the minimum trading size, according to the minimum lot size laid down in the bond rules and considering, among other things, cost effectiveness in order execution.

As for EuroTLX, the market microstructure is hybrid, with both order and quote driven features. Liquidity is guaranteed by a competitive and continuous auction mechanism (orders and quotes are matched according to price and time priority) and by the presence of at least one liquidity provider for each financial instrument[11] that must quote continuously a minimum quantity[12] during trading hours (i.e. from 9:00 to 18:00 in our sample period).[13]

8 See art. 79-bis, paragraph 2, of Legislative Decree no. 58 of 24 February 1998 - Consolidated Law on Financial Intermediation. Consob implemented this faculty in artt. 32 -34 of its Markets Regulation n. 16191 of 29 October 2007.

9 See for instance art. 4.4.1 of 2014 Borsa Italiana Market Rules.

10 See art. 300 on ExtraMOT 2010 Market Rules. Currently (2014) the specialist requirements apply also to financial instruments listed at issuers' request.

11 According to art. 2.2.2 of 2014 Market Rules (formerly art. 2.3.7 of TLX 2010 Market Rules), liquidity providers can operate as type-A market maker (with quote obligations for at least 250 securities already in 2010), or type-B market maker (currently with obligations for at least 30 securities), or as specialist. A specialist is a market member who undertakes to observe EuroTLX liquidity requirements solely with regard to (certificates and/or covered warrants and/or) bank bonds other than Eurobonds and/or other bonds: (i) issued by the same or by its controlled, controlling or affiliated company, or (ii) issued by other banking entities and placed by the Specialist or by its controlled, controlling or affiliated company among its clients or clients of such controlled, controlling or affiliated company or such company being part of the same banking group, or (iii) with regard to which any of the above mentioned entities committed itself vis-à-vis the issuer, other than a sovereign or a supranational entity or an agency, and/or vis-à-vis the intermediary to provide liquidity of the financial instrument in the secondary market. See definitions on TLX 2010 - 2013 Market Rules, in particular art. 3.32 for specific obligations/waivers and submission of bid offers only.

12 See art. 3.23 on TLX 2010 - 2013 Market Rules.

13 In 2010-2013, non-Eurobond bank bonds ended trading 30 minutes earlier (at 17:30). Currently (2014), continuous trading on EuroTLX takes place from 9:00 to 17:30.

Financial instruments are assumed to be liquid when admitted to trading on EuroTLX, but may become illiquid over time: therefore, EuroTLX informs on a continuous basis all direct members whether a financial instrument admitted to trading may be considered as sufficiently liquid. Borsa Italiana provides the same information, although on a monthly basis, through a performance indicator (ε) available to the specialists operating on ExtraMOT.[14] As pointed out later on (Section 4), these institutional features may play a role in affecting the liquidity level of the trading venues analyzed in this paper.

Finally, over our the sample period (January 2010 – June 2013), the market rules of the trading platforms have been updated or modified rather frequently, as well as the technical infrastructure supporting trading activity (the most relevant episode being the migration of trading from TradElect to Millennium electronic platform for all of Borsa Italiana cash markets in mid-2012). However, given that the majority of these changes occurred during the crisis period, it is difficult to disentangle their impact on liquidity levels from the effect of market turbulences.

3 The Italian dual-listed corporate bonds: the data set

The analysis developed in the next two Sections focuses on 409 dual-listed corporate bonds over the period January 1, 2010 – June 30, 2013. Dual-listed bonds are securities traded across two venues: either DomesticMOT and EuroTLX or ExtraMOT and EuroTLX (see Appendix 1 for more details on the sample selection).[15] Venues pairs are identified by taking into account that a bond listed on DomesticMOT cannot be traded on ExtraMOT and vice versa. The sample period starts from January 1, 2010 because the ExtraMOT segment was launched in the second half of 2009.

During the sample period, 100 bonds are traded across DomesticMOT and EuroTLX, while 309 securities are fragmented over ExtraMOT and EuroTLX (Table 1). The majority of the bonds negotiated on DomesticMOT and EuroTLX are issued by banks (87%), while the reverse holds true for the securities negotiated on ExtraMOT and EuroTLX (indeed, 66% of them are issued by non-financial firms).[16] In terms of trading volume, our sample is quite representative of the whole market, covering 37% of total trading for DomesticMOT, 95% for ExtraMOT and 26% for EuroTLX.

During the sample period, non-financial bonds show on average a higher residual maturity than bank bonds in all trading venues both for the whole market and for our sample (Figure 1). In particular, at the market level maturity ranges from 4.9 to 5.6 years of non-financial bonds (respectively, on EuroTLX and DomesticMOT), and

14 The indicator is a weighted average of the percentage of time of compliance with respect to quote obligation and, as far as the assessment of the compliance to the requirements set by Borsa Italiana is concerned, should not fall below 90%. See art. 14 of ExtraMOT Market Instructions (2010).

15 Of course, such bonds could also be traded in other venues, which however are neglected since they account for a marginal share of the executed trades.

16 The sample included also two bonds issued by insurance companies, which we dropped.

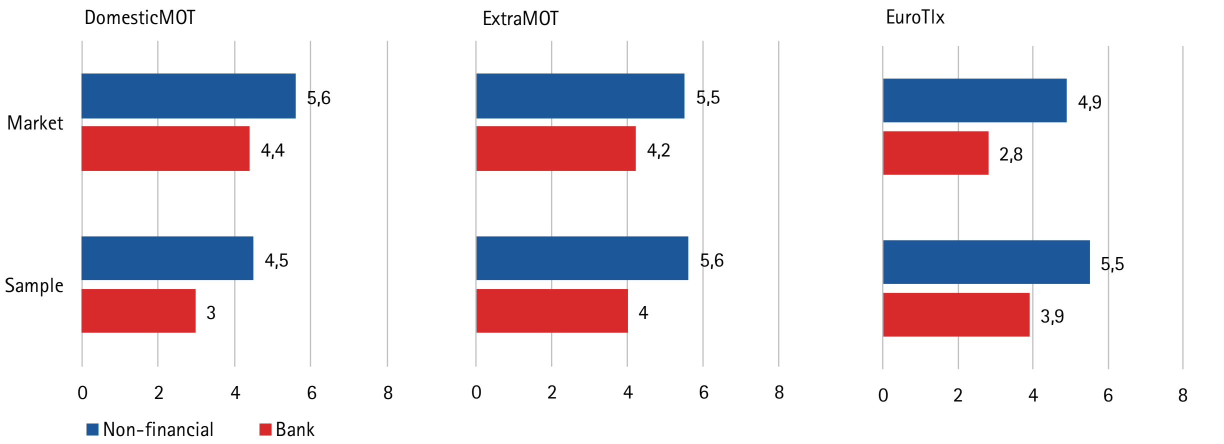
from 2.8 to 4.4 years of bank securities (respectively, EuroTLX and DomesticMOT). Data at sample level show a similar trend.[17]

Table 1 – Corporate bond turnover by trading venue and issuer sector
(January 2010 – June 2013; monetary values in million of euros)

market	issuer sector	whole market			sample			
		n° of bonds	turnover	*weight*	n° of bonds	turnover	*weight*	*coverage of market turnover*
DomesticMOT	bank	792	43.304	*81.9%*	87	10.019	*51.8%*	*23.1%*
	non-financial	18	9.581	*18.1%*	13	9.334	*48.2%*	*97.4%*
	total	*810*	*52.885*	*100.0%*	*100*	*19.353*	*100.0%*	*36.6%*
ExtraMOT	bank	109	4.926	44.9%	104	4.833	*46.4%*	*98.1%*
	non-financial	216	6.041	55.1%	205	5.581	*53.6%*	*92.4%*
	total	*325*	*10.967*	*100.0%*	*309*	*10.414*	*100.0%*	*95.0%*
EuroTLX	bank	4.635	136.898	81.0%	191	23.133	*53.5%*	*16.9%*
	non-financial	1.219	32.069	19.0%	218	20.114	*46.5%*	*62.7%*
	total	*5.854*	*168.967*	*100.0%*	*409*	*43.247*	*100.0%*	*25.6%*

Source: authors' elaboration on Consob internal database.

Figure 1 – Bond average residual maturity by trading venue and issuer sector
(January 2010 – June 2013; market and sample figures)



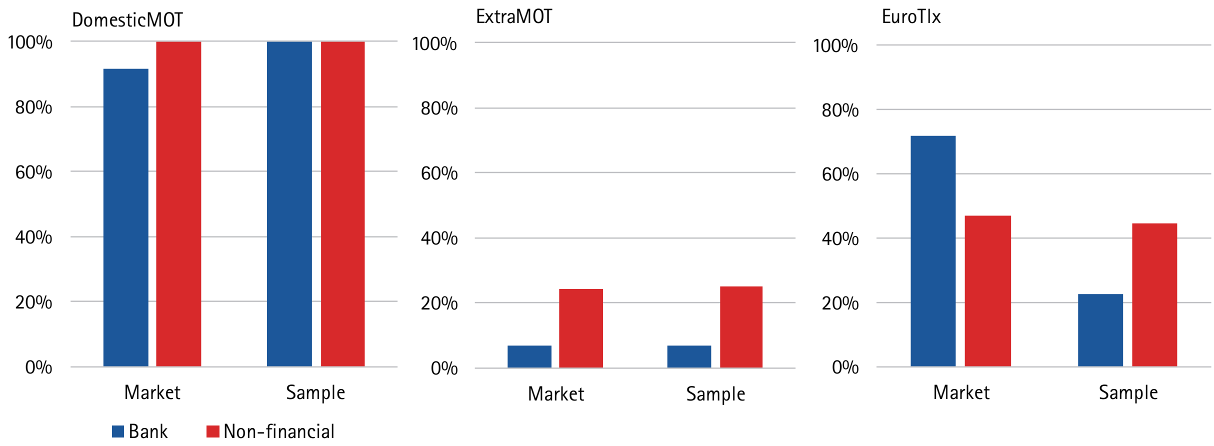
We also track data on minimum trading size (MTS), in order to test whether bonds more exposed to retail trading (i.e. securities with MTS equal to 1,000 euros) are less frequently traded and less liquid than bonds with higher MTS (typically 50,000 or 100,000 euro). When considering the whole market, bonds with 1,000 euro MTS represent more than 90% of total non-government bond turnover on DomesticMOT, 66% on EuroTLX, and 16% on ExtraMOT (Figure 2). Breaking down these figures by the issuer industry sector, bank bonds with 1,000 euros MTS account for 91% of

17 This evidence is also mirrored by the data on the maturity at issuance (available on request to the authors). In particular, both at the market and the sample level, maturity at issuance ranges from around 5 to 6 years for bank bonds (respectively, on EuroTLX and DomesticMOT), and from around 7 to almost 8 years for non-financial securities (respectively, DomesticMOT and ExtraMOT).

total bank bonds turnover on DomesticMOT, 72% on EuroTLX and 7% ExtraMOT; for non-financial issuers these figures are equal, respectively, to 51%, 47% and 24%. Data at the sample level exhibit a similar pattern, given that total turnover on DomesticMOT is almost entirely related to bonds with MTS equal to 1,000 euro, while bonds with a higher MTS capture a much larger share of trading volume on EuroTLX (30%) and on ExtraMOT (83%). Hence, these data indicate a much higher presence of retail investors on DomesticMOT than on ExtraMOT and EuroTLX.

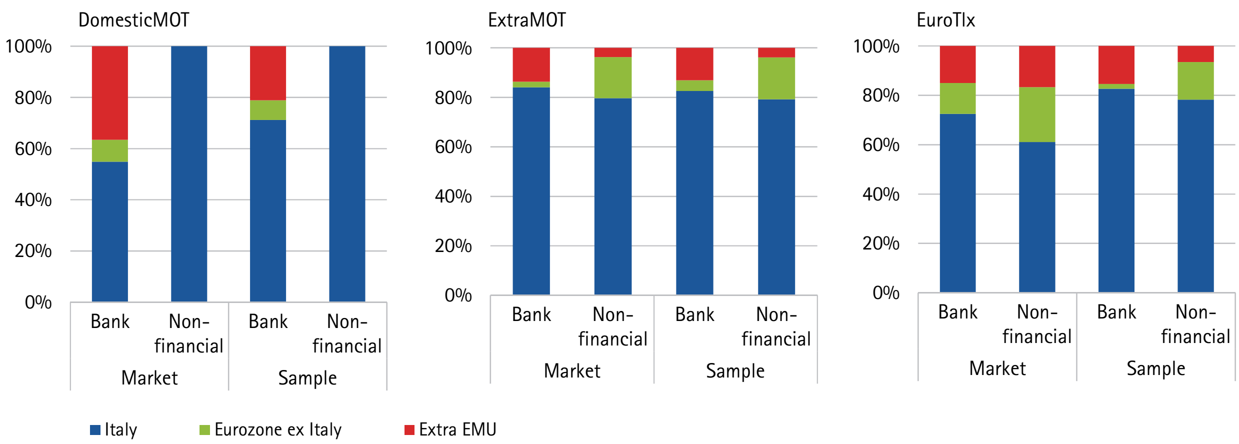
Figure 2 – Bond minimum trading size by trading venue and issuer sector
(January 2010 – June 2013; market and sample figures in percentage of turnover)

Minimum trading size =1,000 euro



Breaking down the turnover by issuer nationality, sample statistics are overall consistent with whole market data, apart from bank bonds traded in DomesticMOT (in our sample, Italian securities are overweighed) and non-financial bonds traded in EuroTLX (in our sample, Italian securities are overweighed; Figure 3).[18]

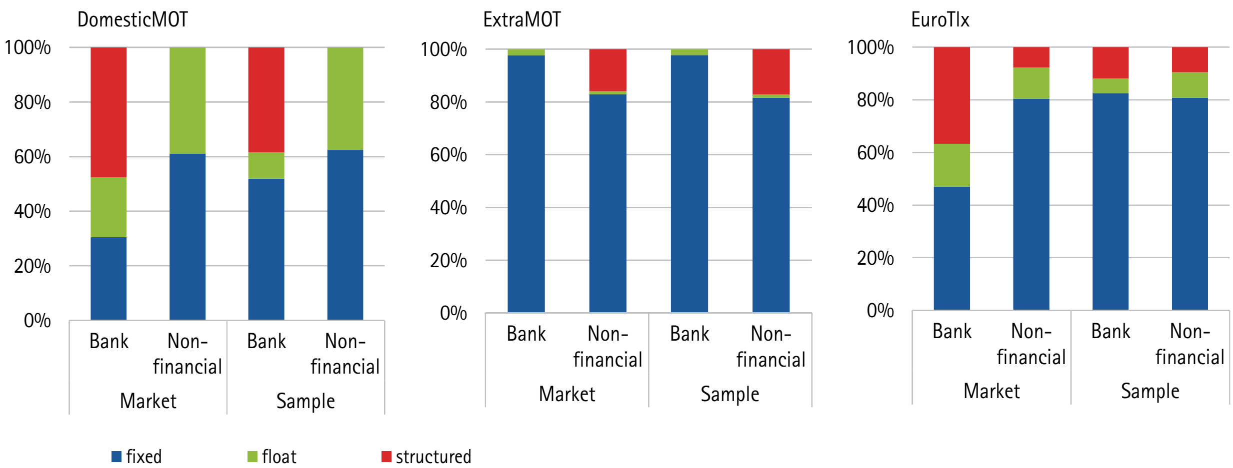
Figure 3 – Bond issuer nationality by trading venue and issuer sector
(January 2010 – June 2013; market and sample figures in percentage of turnover)



18 For the identification of the issuer nationality, see Appendix 1.

When considering coupon structure, our sample tracks closely the whole market too. On DomesticMOT, bank bonds are mainly represented by structured products[19] (48% of bank bond turnover), followed by fixed (30%) and floating rate securities (22%), whereas fixed coupon bonds predominate in the non-financial sector (Figure 4). Coupon structures look more conservative on ExtraMOT, with the greatest share of turnover referred to fixed rate coupon products (98% for bank bonds and 83% for non-financial bonds respectively). On EuroTLX, bank bonds have mainly fixed coupon (47% in terms of the sector's turnover), followed by structured products (37%), and floating rate bonds (16%).

Figure 4 – Bond coupon structure by trading venues and issuer sector
(January 2010 – June 2013; market and sample figures in percentage of turnover)

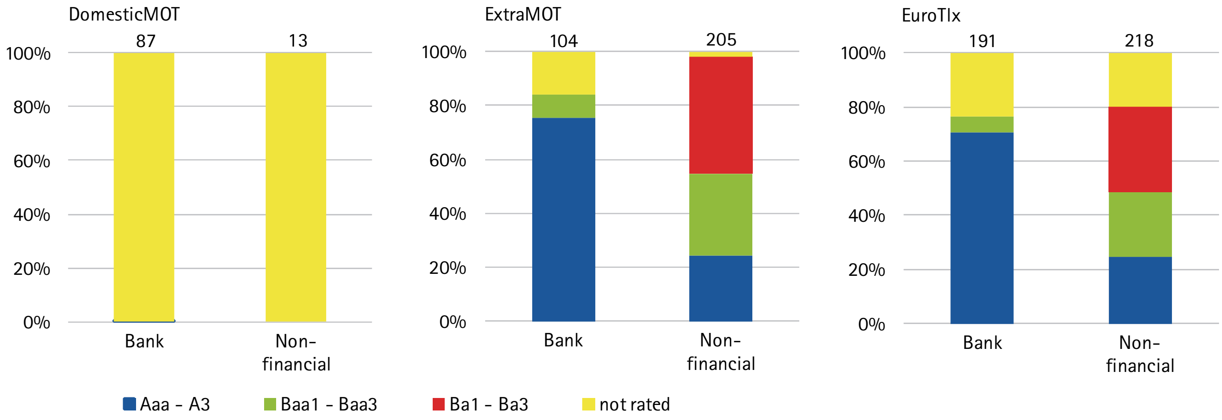


Finally, Figure 5 shows the distribution of trading volumes of bonds in our sample by official rating. Top rated (A–AAA) bank bonds register a significantly higher turnover than bonds with lower ratings a (B – BBB class) on both EuroTLX and ExtraMOT. On the contrary, B–BBB bonds show a higher turnover than top rated instruments on both EuroTLX and ExtraMOT. [20] As for DomesticMOT, all sample issues but one, belonging to rated issuers (mainly primary banks), were found to be not rated individually.

19 Incorporating a derivative or stochastic component.

20 We refer to the rating released by Moody's. Overall, rated securities account for roughly 43% of the total turnover on EuroTLX and ExtraMOT, while B–BBB rated bonds represent respectively 37% and 51% of turnover on EuroTLX and ExtraMOT subsamples.

Figure 5 – Dual-listed bonds by issue ratings, trading venues and issuer sector
(January 2010 – June 2013; in percentage of turnover; number of bonds are reported)



4 The liquidity of the Italian dual-listed corporate bonds over time and across trading venues

When measuring liquidity, academics and practitioners have long referred to three main concepts: depth, resiliency and tightness. Depth relates to the size of the orders above and below the best bid and ask prices, Resiliency measures the size of price adjustments in response to a large order flows (the order flow in response to price swings) and depends on the elasticity of supply and demand. Tightness proxies the trading costs incurred by investors in terms of the immediacy by which incoming market orders may be executed. In addition, one last straight liquidity indicator is simply trading frequency, given by the number of trades per time unit.

There are different ways to measure liquidity, all with strengths and weakness also in terms of data requirements and computational difficulties.[21]

In the present paper, we rely on four widely used indicators, each of them catching one of the four aspects of liquidity mentioned before. However, the choice of liquidity measures was also driven by data limitations. In particular, since we do not have access to order data, we could not compute measures based on bid-ask spreads.

First, in order to account for the depth of the order book we used the turnover ratio:

$$V_t = V_{id} = p_{id} * TV_{id}/AOi$$

21 For a discussion on the liquidity measures see, among others, Beber and Pagano (2008), Fleming (2003), Bao et al., (2008), Goyenko et al. (2009), Sarr and Lybek (2002), Lesmond et al. (1999), Hasbrouck (2004, 2009) and Lesmond (2005). Among the most recent contributions, based on the principal component analysis, see Nielsen et al. (2012), who obtain an efficient proxy of liquidity by using four indicators: Amihud (2002), implicit trading costs, turnover and zero-trade days proxies.

where p_{id} and TV_{id} are respectively the price and the traded volume corresponding to bond *i* on day *d* and AO_i the amount outstanding of bond *i*. In fact, the deeper is the order book the higher the trading volume and consequently the turnover ratio. As argued by several authors (Alexander *et al.*, 2000, among the others), low trading volume is important because it affects the inventory carrying costs of dealers, who pass them on to investors (as transaction costs), who in turn demand higher returns thus raising the cost of debt capital to issuers. However, as shown by the empirical evidence on the US markets, trading volume and turnover ratio tends to rise with default risk, interest rate risk and return volatility increase, and therefore, when using trading volume as a proxy for liquidity, one needs to control also for these factors.

The standard measure for resiliency is the Amihud (2002) price impact indicator, given by:

$$\mathrm{Illiq}_{id} = \frac{|r_{id}|}{TV_{id}}$$

where r_{id} is the return of bond *i* on day *d*, while TV_{id} is the daily volume of the same security and on the same day. If the market is liquid, large orders should not lead to significant price changes.

In order to capture tightness, we estimate the Roll (1984) indicator, which proxies the bid-ask spread, given by the covariance between consecutive daily price changes $(\Delta p_t, \Delta p_{t-1})$:

$$S = 2\sqrt{-\mathrm{Cov}(\Delta p_t, \Delta p_{t-1})}.$$

Finally, trading frequency is captured by a zero-trade day statistic (Z_i), equal to the percentage of days with no trading:

$$Z_i = \frac{NZR_i}{T_i}$$

where NZR is the number of days with no trades and T_i is the total number of trading days in the sample period.[22]

The liquidity of dual-listed bonds across trading venues

This paragraph analyses the liquidity levels of the dual-listed bonds as measured by the four indicators mentioned above (i.e. Amihud, Roll, turnover ratio and zero-trade) over the period January 1, 2010 – June 30, 2013. Liquidity statistics are reported both by pairs of trading venues (i.e. DomesticMOT and EuroTLX, on one

22 For all the indicators, we took the monthly averages of the daily measures within the sample period. Except for the turnover ratio, they should be interpreted as illiquidity indicators, i.e. liquidity decreases as they increase.

hand, and EuroTLX and ExtraMOT, on the other hand) and, for each pair of venues, by the issuer sector (i.e. bank and non-financial).

First, we test whether the liquidity of bonds in our sample is different across venues through a t-test on the difference between the means of the four liquidity indicators (Table 2).[23] Secondly, for each trading venue we check whether liquidity differ between bank bonds and non-financial bonds.

Table 2 shows that, apart from non-financial bonds traded on DomesticMOT and EuroTLX, all other bonds trade quite infrequently, since the average number of zero-trade days ranges from about 30% to more than 75% depending on the trading venue.[24]

Table 2 – Liquidity indicators of dual-listed bonds by trading venue and issuer sector
(average percentage values over the period January 1, 2010 – June 30, 2013)

DomesticMOT vs EuroTLX

	whole sample (n = 100)				bank bonds subsample (n = 87)				non-financial bonds subsample (n = 13)			
liquidity indicator	Amihud	Roll	Turnover	Zero-trade	Amihud	Roll	Turnover	Zero-trade	Amihud	Roll	Turnover	Zero-trade
DomesticMOT (a)	22.2%	47.9%	1.9%	28.9%	23.3%	53.2%	1.8%	33.6%	0.5%	23.6%	2.1%	0.2%
TLX (b)	8.8%	27.2%	1.6%	33.0%	11.6%	28.3%	1.7%	39.4%	1.4%	20.4%	0.8%	1.2%
(a) – (b) significant[1]	(*)	(*)			(*)	(*)			(*)		(*)	(*)
result	TLX more liquid	TLX more liquid	same liquidity	same liquidity	TLX more liquid	TLX more liquid	same liquidity	same liquidity	MOT more liquid	same liquidity	MOT more liquid	MOT more liquid

ExtraMOT vs EuroTLX

	whole sample (n = 309)				bank bonds subsample (n = 104)				non-financial bonds subsample (n = 205)			
liquidity indicator	Amihud	Roll	Turnover	Zero-trade	Amihud	Roll	Turnover	Zero-trade	Amihud	Roll	Turnover	Zero-trade
ExtraMOT (a)	28.9%	16.6%	0.1%	73.8%	16.3%	16.5%	0.2%	71.3%	35.8%	16.7%	0.1%	75.0%
TLX (b)	6.3%	25.1%	0.4%	48.1%	4.4%	26.7%	0.7%	43.5%	7.3%	24.3%	0.3%	50.4%
(a) – (b) significant[1]	(*)		(*)	(*)	(*)	(*)	(*)	(*)	(*)	(*)	(*)	(*)
result	TLX more liquid	same liquidity	TLX more liquid	TLX more liquid	TLX more liquid	ExtraMOT more liquid	TLX more liquid	TLX more liquid	TLX more liquid	ExtraMOT more liquid	TLX more liquid	TLX more liquid

Source: our elaborations on Consob database. [1] Sample average of the liquidity indicators computed on monthly data and in percentage values. N = number of bonds dual-listed on each pair of trading venues. (*) = Null hypothesis rejected at 95% confidence level. Higher values for Amihud, Roll, zero-trade indicators mean lower liquidity levels.

23 As a robustness check, here and in the following we performed both an independent and a dependent sample t-test. Moreover, t-test was performed also on a monthly basis, returning results similar to those reported in Appendix 3 (possible discrepancies are reported and discussed in the following).

24 On DomesticMOT the monthly average percentage of zero-trade days rises from 36% in 2010 to 46% at the end of June 2013 (i.e., in 2010 the average number of no trading days over a month was almost 8, while at the end of the first semester of 2013 it was 10). On EuroTLX, the zero-trade indicator goes from about 18% in 2010 to 68% in the first half of 2013 (i.e., over the sample time period the average number of no trading days on EuroTLX rose from almost 4 to 15). As for dual-listed bonds traded across ExtraMOT and EuroTLX, during the sample period the percentage of days with no trades in a month is permanently higher on ExtraMOT (ranging between 60% and 80% for both bank and non-financial bonds), while on EuroTLX it increased from around 20% to more than 50% for bank bonds and from 30% to 70% for non-financial securities.

Overall, taking the zero-trade and the turnover ratio indicators the liquidity of dual-listed bonds is not statically significantly different between DomesticMOT and EuroTLX, while it is higher on EuroTLX when measured through the Amihud and the Roll statistics. The same evidence holds also with respect to the subsample of bank bonds. For non-financial securities, liquidity is higher on DomesticMOT than on EuroTLX along three out of the four liquidity dimensions (i.e. except for Roll indicator, which is estimated to be equal across venues[25]), as shown also by Figure 6, plotting the monthly average liquidity levels by venue and sector over the sample time period.[26]

For each trading venue, we also check whether liquidity differs significantly between bank bonds and non-financial corporate bonds, through a t-test for the significance of the difference between the means. Over the sample period, liquidity as measured by Amihud, Roll and zero-trade statistics turn out to be always significantly different across bank and non-financial bonds (while the evidence is less clear-cut for the turnover ratio), being the former less liquid than the latter.

Liquidity conditions deteriorated on both trading venues, although to a different extent, especially in the second half of 2011 (when the sovereign debt crisis reached its height) and in the first half of 2012 (when market turbulences revived).

Taking the sub-sample of bonds traded on ExtraMOT and EuroTLX, we find that the former is less liquid than the latter, except when using Roll indicator. This might be partly due to the fact that the presence of a liquidity provider is optional on ExtraMOT, whereas it is compulsory on EuroTLX, as discussed in Section 2. Moreover, bank bonds are less liquid than non-financial securities according to all indicators except for Roll. Figure 7 shows that during the sovereign debt crisis, bank bonds traded on DomesticMOT and EuroTLX experienced a significant deterioration of liquidity, which at the end of June 2013 was still lower than in 2010.

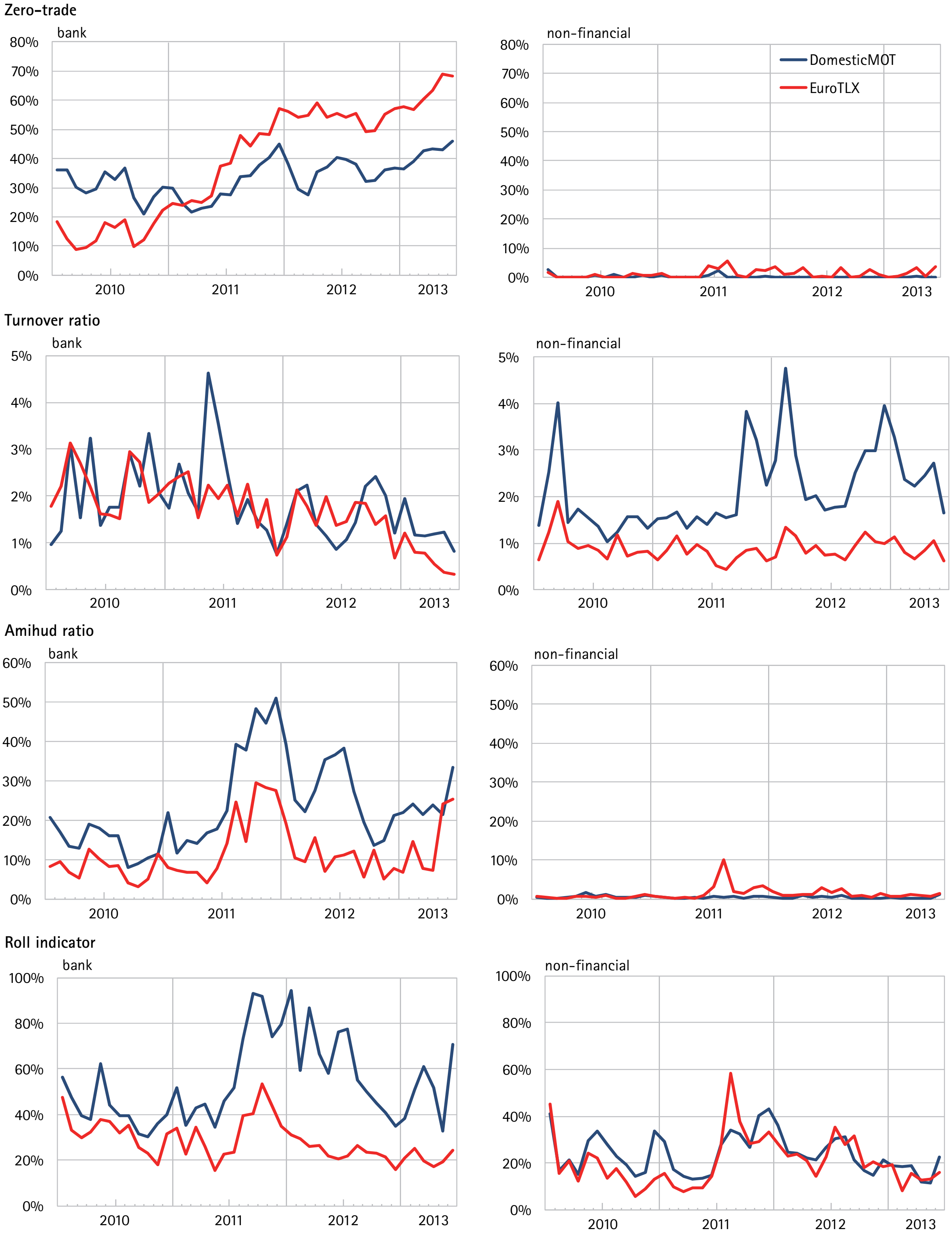
Difference in liquidity of dual-listed bonds should be driven essentially by differences in the microstructure of the trading venues. To gain some insight on this, we carried out a descriptive analysis of liquidity with respect to venues, controlling for four bonds' characteristics, i.e. the minimum trading size (MTS), issuer's nationality, coupon complexity and issuer's industry sector.[27] We show that bond characteristic may impact differently on liquidity depending on the trading venue, thus suggesting that the way microstructural difference impact on liquidity is not straightforward and relates to bonds attributes as well.

25 As for the t-test performed on a monthly basis, the Roll indicator would point to higher liquidity on DomesticMOT, although discontinuously.

26 This evidence must be interpreted cautiously since it refers to a very small sample (13 bonds; left hand side graphs). However, as already shown in Table 3, such sample accounts for more than 70% of the non-financial bonds listed on DomesticMOT and for more than 97% of the turnover of the whole market segment.

27 We also investigated the relationship between liquidity levels and issue size. However, because of the low variability in this attribute (since all bonds in our sample have a quite small issue size), no clear pattern was found.

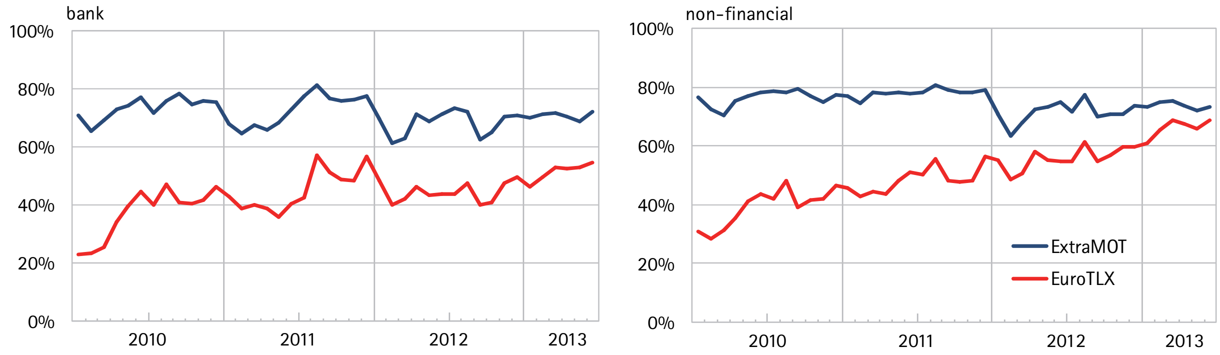
Figure 6 – Average liquidity levels of dual-listed bonds on DomesticMOT and EuroTLX
(monthly averages; percentage values)



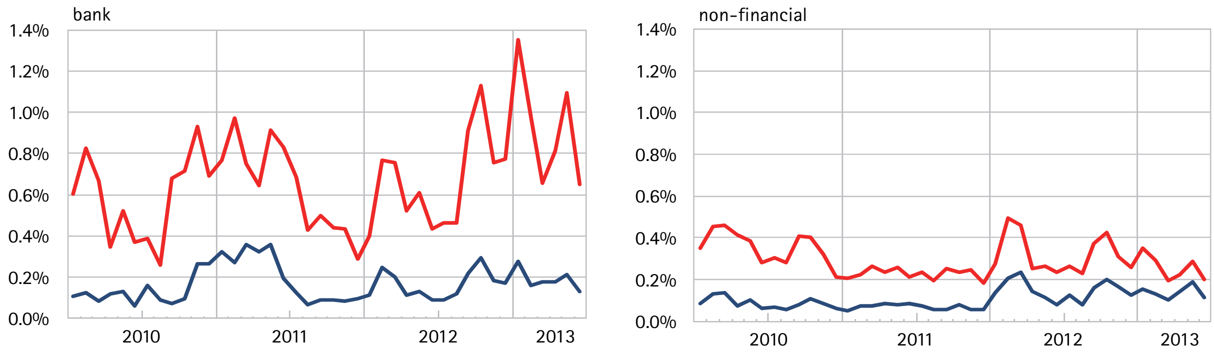
Source: our elaborations on CONSOB internal database on trading data. Indicators reported in the left graphs are calculated on a sample including 87 bank bonds traded across DomesticMOT and EuroTLX, while the indicators reported in the right graphs are computed on a sample including 13 non-financial bonds traded across DomesticMOT and EuroTLX.

Figure 7 – Average liquidity levels of dual-listed bonds on ExtraMOT and EuroTLX
(monthly averages; percentage values)

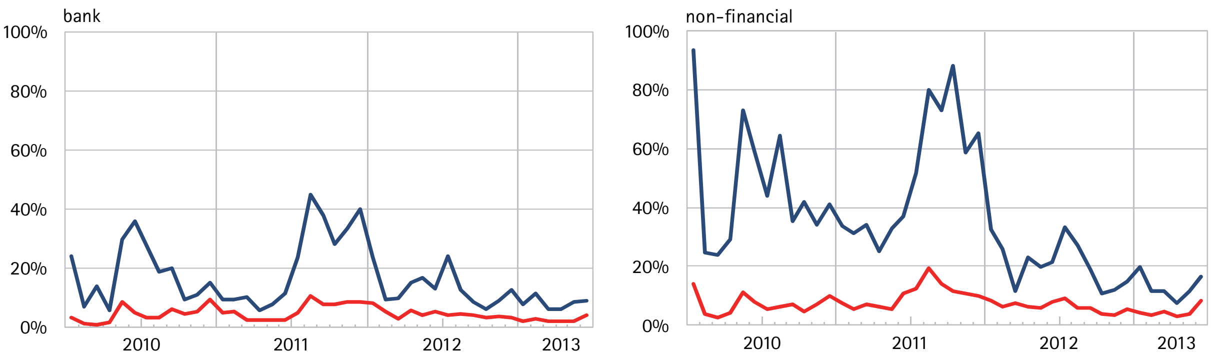
Zero-trade



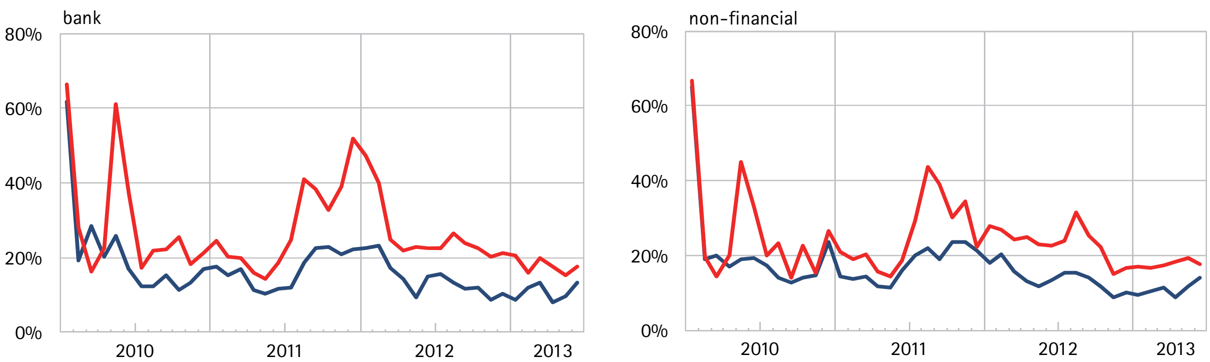
Turnover ratio



Amihud ratio



Roll indicator



Source: our elaborations on CONSOB internal database on trading data. Indicators reported in the left graphs are calculated on a sample including 104 bank bonds traded across ExtraMOT and EuroTLX, while the indicators reported in the right graphs are computed on a sample including 205 non-financial bonds traded across ExtraMOT and EuroTLX.

As for MTS, since almost all bonds fragmented across DomesticMOT and EuroTLX have MTS equal to 1,000 euro (so called retail bonds), the analysis will focus only on bonds traded across EuroTLX and ExtraMOT.

Using a t-test for the means, we test whether the liquidity differs across trading venues, controlling for issuer's industry sector and MTS. On average, as expected, a higher MTS is associated with higher liquidity. Liquidity increases with lower MTS only for non-financial bonds traded on ExtraMOT, when using the zero-trade indicator, and on EuroTLX, when using the Roll indicator, and for bank bonds traded on EuroTLX when using the zero-trade indicator (Appendix 2, Table a2.1). Moreover, as expected, retail bonds always have a higher price impact indicator, irrespective of the trading venue and the issuer's industry sector.

As for securities traded on both DomesticMOT and ExtraMOT, the evidence with respect to the issuer's nationality suggests bonds issued by Italian banks being on average more liquid than foreign bonds on DomesticMOT. Issuer's nationality is not associated with any significant difference in liquidity for bonds traded on EuroTLX (Appendix 2, Table a2.2, top panel).

Moreover, as for securities traded on both ExtraMOT and EuroTLX, Italian bonds are almost always significantly more liquid than foreign bonds on both venues.[28] Overall, domestic bonds seem to be more liquid than the foreign securities with respect to almost all the liquidity indicators and especially to the zero-trade index (Appendix 2, Table a2.2, bottom panel; if not otherwise specified, Table sections without available data are omitted).[29]

Finally, as for coupon complexity, on average bank plain vanilla bonds traded on DomesticMOT and EuroTLX are more liquid than structured bonds on DomesticMOT when turnover ratio and zero-trade are used. However, the same securities compare differently on EuroTLX, with structured bonds being more liquid than plain ones with respect to all indicators except for the zero-trade (Appendix 2, Table a2.3). On ExtraMOT and EuroTLX, simple non-financial bonds are almost always less liquid than complex coupon bonds.

In summary, while higher MTS is on average related to higher liquidity irrespective of the trading venues, other bond features such as issuer's industry sector and coupon complexity may impact differently on liquidity depending on the trading venues.

This may well be related to differences in the microstructure of the trading venues. In this respect, and with specific reference to ExtraMOT and EuroTLX, two

28 When comparing the values of each liquidity indicator across ExtraMOT and EuroTLX, the liquidity indicators perform much better on the latter for both bank and non-financial bonds, independently of nationality (again, this is in line with the evidence commented with respect to the whole sample; results available upon request to the authors).

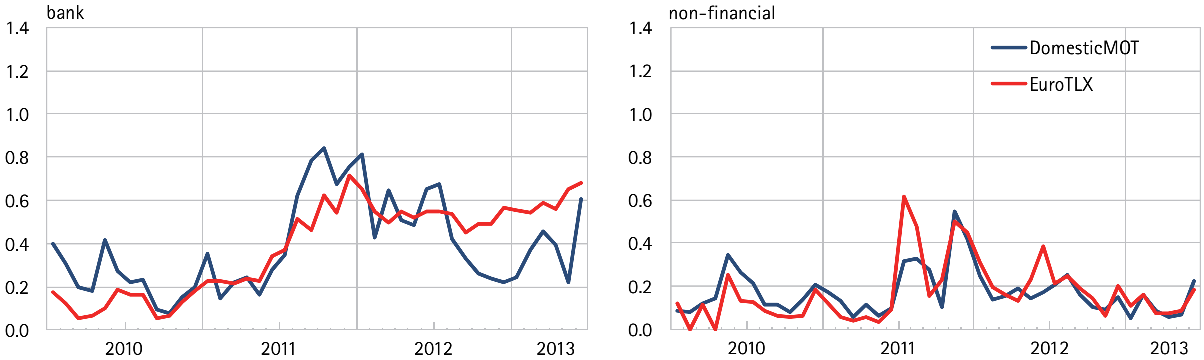
29 We performed also a t-test comparing the values of each liquidity indicator across the two venues (results available upon request). Italian bank bonds are more liquid on DomesticMOT when considering the Amihud and turnover ratio statistics, while Italian non-financial bonds are always more liquid on DomesticMOT except for the Roll indicator (which points to the same level of liquidity). Foreign bank bonds are characterized by similar values of zero-trade days and turnover ratio across venues, while price resiliency and round trip costs seem to be lower on EuroTLX.

elements need to be taken into account: first, EuroTLX rule stating that at least one liquidity provider must be present for each listed financial instrument; second, the stricter requirements envisaged for the compliance to liquidity provider's obligations envisaged by EuroTLX relative to ExtraMOT (and DomesticMOT as well) [30].

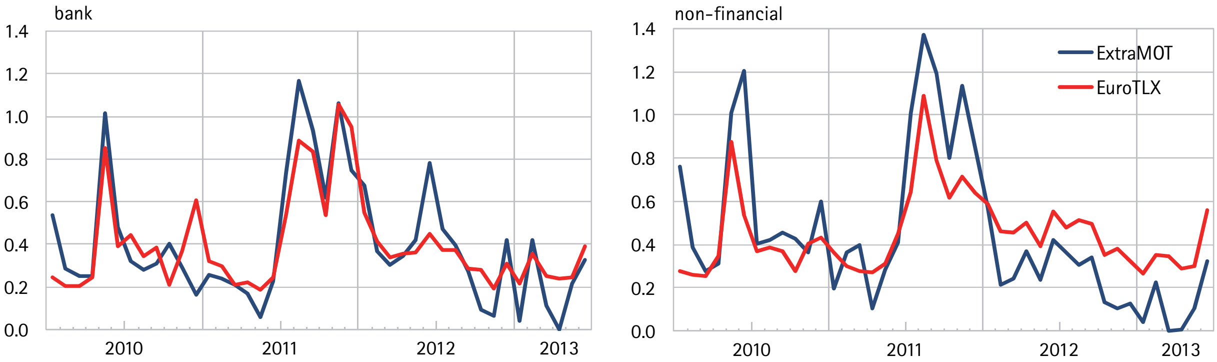
The evidence discussed so far is confirmed also by the result of the principal component analysis (PCA), combining the four liquidity indicators (m_k) into an aggregate (il)liquidity index (aggregate illiquidity indicator or AII).

Figure 8 – Aggregate illiquidity indicators stemming from principal component analysis

DomesticMOT and EuroTLX



ExtraMOT and EuroTLX



Note: the figure reports the normalized absolute value of the factor loading obtained by estimating the first principal component of four liquidity measures (percentage of days with zero-trade, price impact, turnover ratio and Roll indicator of bid-ask spread).

As expected, for all the trading venues, the AII achieves its highest values in coincidence with the sovereign debt crisis (in the period from July 2011 to January 2012). However, for both bank and non-financial bond, the liquidity deterioration has been more severe for bond traded on both ExtraMOT and EuroTLX than for bonds traded on both DomesticMOT and EuroTLX (Fig. 3). The divergence in the AII pattern is

30 Regarding microstructural issues, it might be observed that, in general, a market operator has to strike a balance between the goal of attracting as many traders as possible (improving liquidity to maximize turnover and its revenues) and the cost of providing the level of liquidity associated with its expected profit. Therefore, a relatively new market entrant (such as EuroTLX) might have chosen to apply a more stringent (although slightly more expensive) liquidity requirements set in order to challenge the market share of the incumbent market operator.

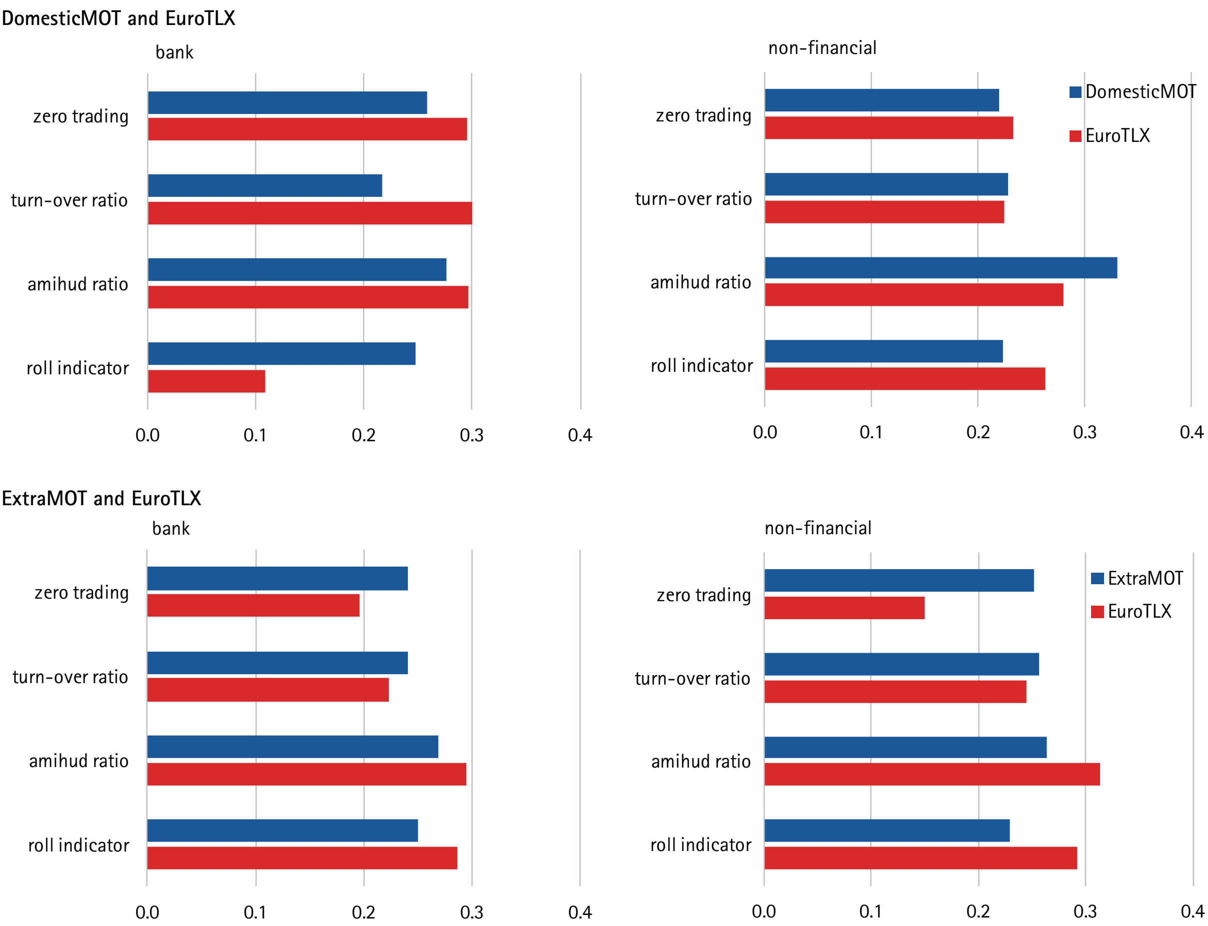
blurred when comparing EuroTLX and DomesticMOT, especially for non-financial bonds, while for bank bonds the AII worsened on EuroTLX with respect to Domestic-MOT since the second semester of 2012.

Finally, we checked how much the four liquidity indicators (percentage of days with zero-trades, price impact, turnover ratio and Roll indicator) contribute to AII by ranking the factor loadings of the first principal component:

$$AII_t = \sum_{k=1}^{4} w_k * m_{it}^k$$

where w_k are the factor loadings for the first principal component. The higher the factor loadings, the higher the importance of the corresponding indicator in driving the liquidity in each trading venue.

Figure 9 – Weights of liquidity indicators estimated by applying principal component analysis



Note: the figure reports the normalized absolute value of the factor loading obtained by estimating the first principal component of the selected liquidity indicators (depth, frequency of trades, price resiliency and roundtrip costs).

As shown in Figure 9, the contribution of the four liquidity indicators to the AII is quite homogeneous across trading venues and across industry sectors. Therefore, there is no single indicator acting as the main liquidity driver. In other words, over the sample time period, liquidity conditions of dual-listed bonds cannot be summarized by a single indicator, although a few dimensions may sometime play a slightly more relevant role.[31]

5 The determinants of trading across venues: empirical evidence for the Italian dual-listed corporate bonds

This Section discusses the results of the econometric analysis of the determinants of trading occurrence (defined as the probability of trading) for the 409 bonds in our sample. This approach builds on the evidence highlighted in the previous Sections that infrequent trading is a key feature of Italian corporate bonds.[32] Given that the four liquidity indicators used contribute homogeneously to determine the liquidity of dual-listed bonds, as shown by the principal component analysis above, we specified alternative models using as dependent variables the other liquidity measures previously illustrated. The results (available on request to the authors) are qualitatively similar to those stemming from the trade occurrence model. However, for the sake of simplicity, we report only the evidence referring to trade occurrence.

We test whether and to what extent a set of bond attributes and other controlling variables impact differently on the probability of trade occurrence depending on the trading venue. In fact, we have shown in previous Sections that bond characteristics may influence differently liquidity depending on the trading venues.

Before going through the empirical evidence, we report a brief survey of the literature on the determinants of liquidity conditions, which we followed to select the variables entering the empirical analysis.

5.1 The determinants of corporate bond liquidity: a survey of the literature

The empirical analysis of the liquidity on secondary bond markets has ascertained the role of bond characteristics, issuer attributes and market conditions. Most of the studies focused on the US markets, although a bunch of contributions analysed data on euro-denominated bonds (Annaert and De Ceuster, 1999; McGinty, 2001; Dìaz and Navarro, 2002; Houweling *et al.*, 2005; Petrella and Resti, 2013).

31 As for bonds traded across ExtraMOT and EuroTLX, liquidity is evenly driven by the four liquidity indicators on ExtraMOT, while on EuroTLX the Amihud and Roll indicators tend to be slightly more relevant. The contribution of the four indicators to the AII is quite homogeneous also for bonds traded across DomesticMOT and EuroTLX, although for bank bonds on EuroTLX the Roll indicator appears to contribute less to liquidity, while on DomesticMOT the Amihud ratio contributes slightly more to the liquidity of non-financial bonds.

32 The only exception is given by non-financial bonds traded simultaneously on DomesticMOT and EuroTLX.

Among the bond features, issue size is found to affect liquidity positively (Alexander *et al.*, 2000; Hong and Warga, 2000; Hotchkiss and Jostova, 2007; Petrella and Resti, 2013). This result is consistent with the market microstructure inventory models (for large issues transaction costs are lower because dealers may easily manage their inventory costs) as well as the lower-information-costs argument (large issues have less information costs, since more information is disseminated among investors and more investors own and analyze them). A third explanation refers to the fact that smaller issues are more easily absorbed by buy-and-hold investors who reduce trading and, hence, liquidity (see Houweling *et al.*, 2005, for references on these views). However, other authors find little support to these arguments by estimating a negative impact of the issued amount (McGinty, 2001).

As for residual maturity, the empirical evidence is conclusive in showing that it positively affects liquidity. Bonds tend to trade actively in the period immediately after the issuance but after a few months liquidity drops, either because they tend to be seized in buy-and-hold portfolios (Sarig and Warga, 1989) or because lead managers are committed to make market prevalently in newly issued bonds (McGinty, 2001). Therefore as residual maturity declines, trading volume is found to decrease (Alexander *et al.*, 2000; Hotchkiss and Jostova, 2007; Petrella and Resti, 2013), and bid-ask spreads to increase (Warga, 1992; Hong and Warga, 2000; see also Houweling *et al.*, 2005, for further references).[33]

Rating is usually found to be negatively correlated with turnover (i.e., the lower the rating the higher the turnover), thus reflecting a speculative component of trading. Moreover, the securities with a higher ex ante credit risk are more subject to speculation about possible future downgrades, which in turn determines more trading (Alexander *et al.*, 2000; Hotchkiss and Jostova, 2007; Petrella and Resti, 2013).

Also interest rate risk, measured by duration (sometimes proxied by the same time to maturity), may have an impact on liquidity. However, the evidence is not conclusive.[34] For instance, Alexander *et al.* (2000) find weak evidence of a positive effect on volume, while Petrella and Resti (2013) record a strong significant relationship. Hotchkiss and Jostova (2007) point out mixed results, depending on the rating and the coupon structure.[35]

Yield dispersion (so called "information risk"), which is a measure of market participants' agreement on the value of a bond, is another factor that may induce speculative trading and be related to liquidity (Houweling *et al.*, 2005; Hotchkiss and Jostova, 2007; Alexander *et al.*, 2000).

33 When the sample analyzed does not include newly issued bonds, some researchers define a threshold to mark old and young bonds: Alexander et al. (2000) used two years; Elton et al. (2002), Houweling et al., 2005 and Petrella and Resti (2013) one year; Ericson and Renault (2001) three months.

34 The interest rate risk is also captured the Fama-French slope factor, defined as the difference between the long term Treasury bond return and the one month Treasury rate at the end of the previous period (Houweling et al., 2005).

35 The coupon structure matters as long as callability modifies duration. The call option acts as an implied insurance by protecting the issuer from adverse interest rates changes ad is found to reduce trading volume.

Among the issuers' attributes, empirical studies considered whether companies have publicly traded equity. Under the hypothesis that private firms convey less information to the market, the consequent adverse selection costs should negatively affect the liquidity of their debt. However, the evidence is not clear-cut, being either weak (Fenn, 2000) or in contrast with this hypothesis (Alexander *et al.*, 2000). Issuer's industry sector may also be relevant, since it may reflect differences in industry regulation or market trends.

An area investigated by several authors is the correlation between bond and equity markets. Common factors such as firm specific news should drive joint reactions of returns and volumes of bonds and stocks (Hotchkiss and Ronen, 2002; Hotchkiss and Jostova, 2007). Other researchers show that non-financial bond liquidity is driven also by the liquidity of government bonds (De Jong and Driessen, 2006).

Another important issue is the role of market conditions, since the liquidity of an asset may change over time, especially during stress times. One way to capture the sensitivity of a given security to aggregate market liquidity conditions is to estimate a market liquidity model. This allows to disentangle the so-called systematic liquidity risk, which some authors refer to also as "commonality" (or "synchronicity") in liquidity (Kamara, Lou, and Sadka 2008, Acharya and Pedersen 2005; Brockman and Chung 2008, Karolyi, Lee, and Van Dijk 2012), from the idiosyncratic one. The impact of market stress on bonds' liquidity has also been estimated by taking into account the impact of global risk aversion, usually proxied by the so-called quality spread, i.e. the spread between BBB and AAA non-financial bonds' returns (Petrella and Resti, 2013). Indeed, the empirical literature has shown that the reaction to financial stress of low and high-yield bonds may differ: in fact, yields on BBB-rated issues tend to rise much more than AAA-rated ones, so that the gap between the two widens. Another proxy of market stress conditions is the spread between the rate at which banks can access central bank funding and a risk-free rate (i.e. the Ted spread for the US market or the Euribor-OIS spread for the European markets).

5.2 The model specification

To investigate the determinants of trade occurrence, we estimated a random effect panel logit model[36], which allowed to regress the probability of trading for each bond on each venue as follows:

$$Prob(trade_{i,t,venue}) = Prob(\alpha_i + \beta X_{it} + \varepsilon_{it} > 0)$$

where $trade_{i,j,t}$ is a dummy variable equal to one if there is at least one trade in the day t for the bond i on the venue j and zero otherwise. As said, we have three trading venues (DomesticMOT, EuroTLX and ExtraMOT), whereas the regressions run are

36 We discarded panel probit model since it did not guarantee convergence of the estimation algorithm, above all when run on the ExtraMOT sample. Fixed effect panel logit was discarded since it rose incidental parameter issues.

overall four, given that on EuroTLX are traded both bonds listed also in DomesticMOT and bonds listed in ExtraMOT. X_{it} is the vector of explicative variables, α and β are the vector of coefficients to be estimated. Finally, the cumulative distribution function of the error ε is logistic: $F(\varepsilon) = [1 + e^{-\varepsilon}]^{-1}$.

The explicative variables taken into consideration can be grouped into the following categories: bond characteristics; issuer attributes; market conditions.

The bond features include: the issue size, the complexity (bonds were regarded either as plain-vanilla or structured), time to maturity (expressed either in years or as a ratio to the total life of the product), and, when showing enough variability, the minimum trading size (i.e. a proxy allowing to distinguish between retail and non-retail securities).[37] As for time to maturity, both a linear and a quadratic relationship with the probability of trading were tested.[38] Also issue size and complexity entered alternative regressions, given that we found that for bonds in our sample they are highly correlated.

As for the issuer's attributes, we took into account nationality and industry sector. These variables entered the model specification separately from the issue size, with which they exhibit a strong cross-correlation. We also included the issuer's credit risk as proxied by three indicators: the issuer rating released by Moody's[39], the probability of default proxied by the expected default frequency or EDF[40] and the issuer's credit default swap (CDS) quotation. The official rating was updated whenever a change occurred. EDF exhibits a higher variability than the official rating, being defined over the issuers' specific characteristics (that is its capital structure) combined with its market value (that is the market value and the volatility of its assets). Lastly, CDS quotations add a measure of credit risk, capturing also the linkage between bond and CDS markets. The expected sign of the credit risk variables is ambiguous: if the volume, and therefore the probability of trade occurrence, rises as the bond ex ante risk rises then the impact should be positive; if this hypothesis does not hold, then we should observe the opposite sign. This ambiguity is higher for the CDS, because if an issuer is actively used as underlying for CDS this might raise bond liquidity of the same issuer, especially during financial crises and for investment grade securities, by preventing investors from fire sales (Massa and Zhang, 2012).

As for market conditions, we included the stock market volatility, the information risk (as proxied by bond daily closing price variability), the Italian sovereign CDS quotations and a financial crisis indicator. Sovereign CDS quotation, stock market volatility and the issuer's CDS quotations were included in alternative model specifications to avoid multicollinearity problems, given that they are highly correlated.

37 As mentioned above, this variable shows enough variability only for bonds traded on EuroTLX and ExtraMOT.

38 As an alternative to time to maturity, we used also the bond age (i.e. time since launch).

39 We map the Moody's rating scale with an increasing integer number, as it is frequently reported in the literature. We used the issuer ratings provided that all the securities in our data set are represented by senior unsecured bonds. In one case, the Moody's rating was not available and we used the S&P rating.

40 As measured by Moody's KMV.

The crisis indicator was defined through a data driven approach. The beginning and the end of the crisis were identified through a "market dependent periodization", i.e. by referring to the pattern of a financial stress index (Galliani *et al.*, 2013). As a stress index, we chose the quality spread, i.e. the risk-premium measured as the spread between the yields of AAA and BBB European non-financial bonds, and defined a crisis dummy variable equal to one when the index exceeded the third quartile of its sample distribution.[41] Following this approach, we identifies crisis spans from July 2011 to July 2012. Therefore our model specifications include the crisis dummy variable as defined above; this dummy was also interacted with a set of explicative variables ($\alpha * dummy_{crisis} * X_{it} + \beta X_{it}$) in order to test whether their impact on liquidity changes during financial turmoil.

Finally, we rule out some potentially explicative variables when they do not show enough variability (in particular, as mentioned above, MTS for bonds traded across DomesticMOT and EuroTLX, is equal to 1,000 euro for all securities but one) or they are highly collinear with other variables (issue size, which is correlated with the issuer nationality, issuer's sector and coupon structure for bonds fragmented across DomesticMOT and EuroTLX).[42]

5.3 The estimation results

Evidence from DomesticMOT and EuroTLX

The results of the regressions run on the sample of bonds traded on DomesticMOT and EuroTLX show that the probability of trading occurrence across the two trading venues is affected by a set of variables only partially overlapping (Table 3; see Appendix 3 for results referring to alternative model specifications in greater details).

Let us focus first on the statistically significant variables that have the same sign across the two venues. Bank bonds are estimated to be traded less frequently than non-financial bonds, while the opposite occurs when Italian bonds are considered. As expected, bonds with a higher residual maturity tend to be more frequently traded (as shown by the sign of the coefficients of *age*), while the bond price variability (*information risk*) tends to affect negatively the probability of trading.

41 Source: JP Morgan Maggie European credit risk index, daily data.

42 Correlation analysis pointed out that Italian bonds traded across multiple exchange platforms are characterized by a high amount outstanding. Structured securities are negatively highly correlated to the issue size, while corporate bonds' issue size is on average higher than bank bonds' issue size. Lastly, as expected, issuer Cds quotations, Italian sovereign Cds quotations and Italian stock market volatility are positively correlated. For DomesticMOT and EuroTLX sub-samples, we used also time dummy variables to account for the progressive reduction of the frequency of trades recorded on those venues over our sample period. However, the coefficients of such variables, although being significant and negative (thus confirming also the descriptive analysis reported in the previous Sections) are approximately equal to each other, thus suggesting that no time trend can be identified apart from that due to the crisis.

Let us now move to the statistically significant factors that have a different impact on liquidity depending on the trading venue considered (reported in bold in Table 3). Complex bonds are estimated to be less frequently traded with respect to plain vanilla ones on DomesticMOT, while the opposite holds true on EuroTLX. The increase of the issuer's credit default swap prices (*Issuer Cds quotations*) enhances liquidity only on DomesticMOT. Moreover, trade occurrence appears to be significantly and negatively influenced by rating announcements only on DomesticMOT but not on EuroTLX. Among the variables capturing the correlation between equity and bond markets, the evidence is mixed depending on the trading venue. While the information risk is predicted to lower the probability of trade occurrence both on DomesticMOT and EuroTLX, changes in the sovereign Cds quotations affect liquidity on EuroTLX only, whereas stock market volatility has a negative impact on the probability of trade occurrence only on DomesticMOT.

Table 3 – Determinants of trade occurrence on DomesticMOT and EuroTLX

Explanatory variables	DomesticMOT	EuroTLX
Issuer sector	Bank bonds estimated to trade less frequently than non-financial bonds; impact higher on EuroTLX	
Nationality	Italian bonds estimated to trade more frequently than foreign bonds; impact higher on EuroTLX	
Complexity (structured bonds)	**Structured bonds estimated to trade less frequently than plain vanilla ones**	**Structured bonds estimated to trade more frequently than plain vanilla ones**
Time to maturity	A less seasoned bond is estimated to be more frequently traded	
Issuer Cds quotations	**Positive impact**	**Statistically insignificant**
Issuer rating	**Probability of trading decreases for lower rated and downgraded bonds**	**Statistically insignificant**
Issuer EDF	Statistically insignificant	
Sovereign Cds quotations	**Statistically insignificant**	**Negative impact**
Information risk	Information risk lowers the probability of trade occurrence	
Stock market volatility	**Negative impact**	**Statistically insignificant**

Table 4 compares the impact of the financial market crises on the probability of trading on both DomesticMOT and EuroTLX (for more details see Appendix 3). The dummy *crisis* turns out to be statistically significant and, as expected, to have a negative sign, i.e. to lower the probability of trading on both venues. Moreover, it amplifies the impact of some explanatory variables, although not always in both venues (as shown by the coefficients of the variables constructed by interacting the *crisis* dummy by the explanatory variables). In particular, Italian bank bonds suffer from the deterioration of market conditions on EuroTLX only. Conversely, rating changes are estimated to have a higher impact during crisis times on DomesticMOT only.

Table 4 – Impact of sovereign debt crisis on trade occurrence on DomesticMOT and EuroTLX

Explanatory variables interacted with the dummy *crisis*	DomesticMOT	EuroTLX
Issuer sector	No significant change	Negative impact on bank bonds
Nationality	No significant change	Negative impact on Italian bank bonds
Complexity (structured bonds)	Statistically insignificant	
Time to maturity	Trade occurrence of less seasoned products tends to be lower	
Issuer Cds quotations	Negative impact	No significant change
Issuer rating	Downgrade/upgrade tends to lower/enhance trade occurrence	No significant change
Issuer expected default frequency	No significant changes	
Information risk	No significant change	Negative impact
Italian stock market volatility	No significant changes	

Evidence from ExtraMOT and EuroTLX

The econometric analysis for the subsample of bonds fragmented across ExtraMOT and EuroTLX show that the explanatory variables broadly exhibit the same impact, with the exception of those capturing residual maturity, the issuer industry sector and credit risk. In particular, on ExtraMOT the probability of trading rises with residual maturity, while the opposite holds true on EuroTLX; the issuer industry sector is relevant on EuroTLX only (where bank bonds are traded less frequently than non-financial bonds); rating announcements do not influence the probability of trade occurrence on ExtraMOT while they do on EuroTLX (Table 5, see Appendix 3 for more details).

Table 5 – Determinants of trade occurrence on ExtraMOT and EuroTLX

Explanatory variables	ExtraMOT	EuroTLX
Time to maturity	Negative impact	Positive impact
Issuer sector	Statistically insignificant	Bank bonds traded less frequently than non-financial bonds
Issuer nationality	Italian bonds are traded more frequently than foreign ones	
Complexity (structured bonds)	Statistically insignificant	
Lot size	Retail products tend to be more frequently traded	
Issue size	Bonds with higher amount outstanding tend to be more frequently traded	
Issuer Cds quotations	Positive impact	
Sovereign Cds quotations	Statistically insignificant	
Issuer rating	Statistically insignificant	Downgrades increase trade occurrence
Issuer expected default frequency	An increase of expected default frequency increases trade occurrence	
Information risk	Information risk increases trade occurrence	
Stock market volatility	Negative impact on trade frequency	

When we interact the dummy *crisis* with bonds' attributes, only a few of these have an impact on the probability of trade occurrence, which varies across trading venues. In particular, the effect due to the issuer's industry sector is negatively amplified during the crisis only on EuroTLX, where the probability of trading decreases for bank bonds during negative market conditions. Market turbulence is also predicted to lower the probability of trading of retail bonds (i.e. securities with MTS equal to 1,000 euros) on EuroTLX only. On the other hand, Italian bonds and complex bonds are predicted to experience a higher trading frequency during crisis periods on ExtraMOT only (Table 6).

Table 6 – Impact of sovereign debt crisis on trade occurrence on ExtraMOT and EuroTLX

Explanatory variables interacted with the dummy *crisis*	ExtraMOT	EuroTLX
Issuer sector	No significant change	Trade occurrence of bank bonds tends to be lower
Nationality	Trade occurrence of Italian bonds tend to rise	No significant change
Complexity	Trade occurrence significantly increases	No significant change
Lot size	Trade occurrence of retail product tends to increase	Trade occurrence of retail product tends to be lower
Issue size *Age*	The impact of the explanatory variable on trade occurrence tends to be higher	
Issuer Cds quotations *Issuer rating* *Issuer EDF* *Information risk* *Italian stock market volatility*	The impact of the explanatory variable on trade occurrence tends to be lower	

5.4 The marginal effects

The magnitude of the impact of the explanatory variables was quantified by estimating the average marginal effects of each significant variable on the probability of trade across DomesticMOT, EuroTLX and ExtraMOT. The analysis also allowed us to measure to what extent the crisis magnified the effect of the statistically significant variables (Appendix 3).

Some bonds' attributes, such as complexity and MTS, and some issuer's attributes, such as industry sector and nationality, are found to have the most relevant effect on the probability of trading.

Indeed, for bonds traded across DomesticMOT and EuroTLX the probability of trading for bank bonds decreases on average by -0.5 on EuroTLX. Regarding issuer's nationality, the most relevant impact on the probability of trade occurrence is found for Italian bonds traded on EuroTLX (+0.4 for bonds traded jointly on DomesticMOT and +0.5 for bonds traded jointly on ExtraMOT). As it has been already mentioned in the previous paragraph, structured bonds tend to be more frequently traded on EuroTLX, while the reverse is true on DomesticMOT. Indeed, the probability of trade occurrence for structured bonds increases by 0.4 on EuroTLX, while it decreases by 0.2

on DomesticMOT. Lastly, on average if MTS is equal to 1,000 euro, the probability of trade occurrence increases by 0.1 on ExtraMOT and by 0.5 on EuroTLX.[43]

Lastly, we measured the impact of the sovereign debt crisis (see Appendix 3). The results are mainly in line with the empirical evidences reported so far. As for bonds traded on DomesticMOT and EuroTLX, the crisis affects the explanatory variables in a different way across the two venues. On DomesticMOT, during the sovereign debt crisis the impact of the issuer Cds quotations reversed (i.e. became negative), whereas the negative marginal effects of rating and information risk widened. On EuroTLX, instead, the outburst of the debt crisis impacts is estimated to lower the probability of trading of Italian bank bonds (while trading of non-financial bonds is unaffected), whereas time to maturity loses statistical relevance with respect to tranquil periods, although it keeps showing a negative sign.

As for bonds dual-listed on ExtraMOT and EuroTLX, the sovereign debt crisis tends to raise the probability of trade occurrence of Italian retail structured bonds traded on ExtraMOT, whereas on EuroTLX financial market turbulence affects mainly the probability of trading of seasoned bonds (i.e. bonds with a lower time to maturity are traded more during crisis times).

6 The impact of fragmentation on liquidity: evidence from a matched sample of bank bonds

This Section compares the liquidity level of bank bonds fragmented across DomesticMOT and EuroTLX with otherwise similar bank bonds, which are traded only on DomesticMOT.[44] In order to carry out such a comparison, we resorted to the matched sample approach, given that no counterfactual evidence is available for fragmented bonds, i.e. it is not possible to observe their liquidity level if they were not traded on multiple venues. Matched sample techniques are frequently used in finance literature. In market microstructure studies, they allow to compare the execution costs on different exchanges or across various groups of securities by taking two groups of stocks that differ in their listing status and matching them in pairs according to various characteristics (Davies and Kim, 2009).

We focused on bank bonds because the sample size of non-financial bonds traded on DomesticMOT only was not suitable for the matching exercise. Indeed, during the sample period, non-fragmented bank bonds were 705 (i.e. 792 securities minus 87 fragmented bonds), whereas the number of non-financial bonds traded on DomesticMOT only was 5 (out of 18; see Table 1). Similarly, we neglected bonds

43 Less relevant, instead, are the quantitative impacts of issuer Cds quotations, information risk and Italian stock market volatility. Indeed, if the corporate credit default swap increases by 10 basis points, on EuroTLX the probability to have a trade rises only by 0.004 if we consider bonds traded also on DomesticMOT. Moreover, if Italian stock market volatility increases by 10 percentage points the probability of trade occurrence decreases only by 0.04 on DomesticMOT.

44 To be more precise, the matched bonds might actually be traded across DomesticMOT and trading platforms others than EuroTLX. However, given that the volumes exchanged on such platforms are not material, for the purpose of the present analysis we may regard the matched bonds as non-fragmented securities.

jointly traded on ExtraMOT and EuroTLX because the majority of the securities traded on the ExtraMOT are dual-listed (more precisely, 104 out of 109 bank bonds and 205 out of 216 non-financial bonds; see Table 1). Finally, we did not focus on EuroTLX alone because we aimed at comparing the liquidity conditions of dual-listed and non-fragmented bonds on a regulated market (i.e. DomesticMOT) rather than on an Mtf (i.e. EuroTLX), given the relevance of this topic on policy grounds.

Therefore, we applied the matching sample approach to 705 bank bonds traded on DomesticMOT only from January 2010 until June 2013 in order to draw a matched sample with the 87 securities jointly traded on DomesticMOT and EuroTLX. The non-fragmented securities account for about 90% of all outstanding bank bonds traded on DomesticMOT both in terms of total number of securities and of average market value, while the fragmented bonds correspond to 10% of the total number of securities and to 54% of the average total market value.[45]

Matching relied on a nearest-neighbor approach, minimizing the difference (matching error) between the two groups of bank bonds with respect to a set of criteria. Such criteria refer to both securities' and issuers' attributes. As for securities attributes, we considered the market value[46], the complexity (plain vanilla versus structured bond), time to maturity and MTS. As for the issuers' attributes, we took into account nationality (Italian versus foreigner) and rating.

The matching sample was constructed by minimizing the matching errors (i.e. the absolute distance) between matching pairs with respect to the characteristics mentioned above.[47] The matched pairs are reported in Appendix 4.

In order to assess the impact of fragmentation on liquidity levels, we compared the averages over the sample period of the four liquidity indicators for the dual-listed bonds with those computed for the non-fragmented securities. As a robustness check, we performed both the t-test and the Wilcoxon test (see Appendix 4, Table a4.2 for details). Moreover, given the evidence reported in Section 4 showing that Italian bonds traded on DomesticMOT are more liquid than foreign ones along all the liquidity dimensions but the turnover ratio, we also reported evidence for the subsample of Italian bank bonds (40 securities), in order to check whether they behave differently.

The results of the analysis show that the liquidity of non-fragmented securities is higher than that of dual-listed bonds for three out of four indicators (i.e. zero-

45 The average market value is computed over January 2010-June 2013 by taking into account market price and issue size.

46 The matching is based on the average bond market value (defined as the product of the amount issued by the market price) over the time period January 2010-June 2013. Market value was preferred to issue size as a matching criterion in order to select bonds which might be deemed similar also with respect to the market price trend. Moreover, the use of the market value is in line with Davies and Kim (2008), who matched stocks by their market capitalization and their market price.

47 Only two out of the six characteristics used to match pairs are computed as averages (i.e. market value and rating score). Therefore we could not apply a statistical test to evaluate the significance of the absolute distance between each pair of bonds. On the other hand we decided to use several attributes, besides market value and rating, after checking that relying only on market value and rating scores would have led to the selection of pair of bonds very different in terms of maturity, which in turn has a significant impact on the liquidity.

trade, turnover ratio and price impact), whereas the differences in the Roll indicator are not statistically significant. However, this evidence does not hold for the subsample of the Italian banks bonds: the liquidity of dual-listed securities as measured by the zero-trade, the price impact and the Roll indicators is higher than that of non-fragmented bonds, while the difference is not statistically significant when using the turnover ratio.[48] The discrepancies between the whole sample and the Italian sub-sample is due to the foreign securities, which on average are characterized by a lower market value and issue size[49] and are less liquid if fragmented.

As a robustness check, we run a multivariate model regressing the differences in the liquidity levels computed for the dual-listed and the non-fragmented bonds on the differences in the characteristics used to draw the matching sample (where applicable, that is with respect to bonds' market value, time to maturity and rating).[50] Such check is equivalent to test whether the assumption of perfectly homogenous securities holds or, in other words, whether discrepancies in the liquidity conditions across the two sample of securities are related to differences in their attributes or in the features of the trading venues. The estimation results show that neither for the whole sample nor the Italian sub-sample of bank bonds any of the variables used to draw the matching sample (i.e. market value, time to maturity and rating) may be deemed as jointly significant (at 5% confidence level). This confirms the hypothesis of homogeneity of non-fragmented matched securities and dual-listed bonds.

7 Final remarks

This paper investigates the liquidity conditions and the determinants of trading for a sample of non-government bonds fragmented across the main Italian retail bond markets (DomesticMOT, ExtraMOT, and EuroTLX) from January 1st, 2010 to June 30th, 2013. In order to account for different dimensions of liquidity, four measures are used: zero-trade, turnover ratio, Amihud and Roll indicator. Evidence of a principal component analysis supports the use of all these indicators, which over the sample period contributed evenly to the liquidity of dual-listed bonds. Moreover, we computed separately for bank bonds are non-financial bonds, in order to address differences in trading activity driven also by the industry sector of the issuer. Moreover, the impact of the sovereign debt crisis on liquidity levels is assessed.

48 This result was confirmed both by the t-test and the Wilcoxon test.

49 During the sample period, the Italian bank bonds have an average market value equal to 262 million of euros (versus 266 of the non-fragmented), while the figures of foreign securities amount to 144 and 146 million of euros respectively. Similarly, the fragmented Italian bank bond record an average issue size equal to 260 million of euros (versus 247 for the non-fragmented), while the corresponding figures for foreign securities amount to 141 and 95 million of euros respectively.

50 Multivariate regression differs from multiple regression in that several dependent variables are jointly regressed on the same independent variables. The individual coefficients and standard errors are identical to those that would be produced by estimating each equation separately, but the significance of the coefficients can be jointly tested across equations because also between-equation covariances are estimated. The multivariate regression was also confirmed by the Breusch-Pagan test, which was significant, thus pointing that the residuals of the explanatory variables are not independent of each other (see Appendix 5, Table 5.2 for more details).

Focusing on fragmented bonds and on their liquidity levels across different trading venues allowed us to test whether, in spite of fragmentation, Italian corporate bond markets may be regarded as integrated and competitive, thus fulfilling the objective pursued by the MiFID with the abolition of the concentration rule. This is a very relevant topic on policy grounds, which the Italian legislator dealt with by extending pre- and post-trade transparency rules to non-equity markets, though the Directive envisaged these rules for equity markets only.

Overall, the evidence is not clear-cut, depending on the liquidity dimension, on the issuer's sector and on the trading venue. Liquidity levels as measured by the zero-trade and the turnover ratio are homogenous across DomesticMOT and EuroTLX, whereas they are almost always higher on EuroTLX for bonds listed across ExtraMOT and EuroTLX. Moreover, in each trading venue bank bonds are less liquid than non-financial securities and seem to have suffered more, in terms of lower liquidity, during the sovereign debt crisis.

Moreover, both the univariate and the multivariate analysis highlighted that bonds' characteristic and market turbulences may impact differently on liquidity depending on the trading venue, thus pointing to the role of microstructural features, such as the presence of liquidity providers and the dissemination of information on the liquidity conditions of the financial instruments.

Finally, the paper sheds light on the effect of fragmentation by comparing liquidity levels of bank bonds fragmented across DomesticMOT and EuroTLX with otherwise similar bank bonds traded only on DomesticMOT. The impact of fragmentation seems to depend on bond attributes, being the issue size a key driver of liquidity. Indeed, depending on the indicator, Italian bank bonds – whose issued amount is higher than that of foreign bonds – do not seem to be negatively affected by fragmentation, whereas foreigner bonds are less liquid if dual-listed.

This study adds to the existing literature by providing new empirical evidence on the liquidity of Italian non-government bonds. Moreover, to our knowledge, it is the first to explore the impact of fragmentation on the liquidity of non-government bonds. It also supports the idea that transparency rules and market rules promoting liquidity provisions may contribute to the development of an integrated secondary bond market. To this respect, this work is also relevant on policy grounds, especially within the current European regulatory framework, which has recently undergone a change towards a greater transparency in non-equity markets.

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Appendix

Appendix 1

The sample selection: methodological issues

One of the key decisions about the analysis concerned which source has to be followed to classify a bond in terms of issuer's industry (sector of economic activity), country of issue, coupon type, etc.

As for the issuer's industry, between an institutional (formal) approach and a substantial approach, we decided to follow Borsa Italiana's intermediate classification, considering that: a) it offers a simple distinction between financial and non-financial sectors, by including almost only bank issuers in the former category and aggregates all other industries, with the residual exception of insurance, in the latter; b) although simplified, this approach is still satisfactory and realistic for our purposes; moreover, it is used for the bond description offered to retail investors by the market operator (and we have a specific interest for these investors); c) official classifications (such as the UIC one), at least for our purposes are based on a too much formal approach, resulting in a too generic attribution to macro-sectors (e.g. financial or non-financial companies); d) classifications offered by info providers (such as Reuters or Bloomberg), might be on the contrary too industry-specific[1], and beyond the scope of this study.

The choice between a formal versus a substantial approach in assigning an issuer to a specific industry or sector has a relevant impact on descriptive statistics and subsequent analysis, also considered the common practice followed by large companies to optimize their financial operations and issuance activity through a dedicated financial vehicle company (e.g.: Telecom XY Finance on behalf of Telecom XY)[2].

However, in reviewing Borsa Italiana's industry attribution for each bond in the market and sample list, we have corrected some patently wrong attributions (typically, a bank issuer classified as 'corporate', meaning 'non-financial', or vice-versa). These corrections may in turn account for further discrepancies with aggregate

1 In some cases they also might disagree on the ultimate financial or non-financial nature of the issuer.

2 For instance, a formal classification would consider these financial companies as part of the financial sector, along with banks and other monetary or credit institutions, whereas we believe that they represent a part of the telecom sector issuance activity and should be classified accordingly.

official market data on turnover[3], and obviously influence our subsequent analysis and conclusions, which deeply rely upon the key distinction between banking and corporate issuers.

Another possible source of uncertainty is the information concerning the issuer's country. Again, we prefer substance over form, using the (ultimate) parent company's country (of incorporation) rather than the vehicle's country (whereas the latter would be more meaningful if, for instance, we were more interested in focusing on how different fiscal regimes affect primary markets activity across countries). In this case, we have adopted Reuters's classification, finding it more detailed and complete than that provided by Borsa Italiana.

A third point was the classification of bonds according to their coupon structure. Even here, there were lots of options available from Reuters or Bloomberg (too many of Borsa Italiana's data were not available on our database on this point). As a result, we opted for the approach followed in Grasso, Linciano, Pierantoni and Siciliano (2010), which basically considers 'simple' and 'structured' bonds; the 'simple' class here is composed by fixed and floating rate coupon bonds (and implicitly including also zero coupon bonds), while the 'structured' category is more heterogeneous (including index linked, equity linked, step up, step down bonds (and, generally speaking, those bonds with a derivative component).

3 We also find a few ambiguous cases, however of little significance in terms of turnover.

Appendix 2

Table a2.1 – Liquidity of bonds fragmented across ExtraMOT and EuroTLX by lot size
(percentage values)

		Indicator	MTS<=1000[1]	MTS>1000[1]	Test significance	Results
ExtraMOT						
	bank	Amihud	47.3	16.3	(*)	Greater lot size more liquid
		Roll	62.2	57.1		Same liquidity levels
		Turnover	0.0	0.2	(*)	Greater lot size more liquid
		Zero-trade	72.0	71.7		Same liquidity levels
	non-financial	Amihud	51.2	5.7	(*)	Greater lot size more liquid
		Roll	64.4	56.8		Same liquidity levels
		Turnover	0.1	0.2	(*)	Greater lot size more liquid
		Zero-trade	73.4	76.5	(*)	Smaller lot size more liquid
EuroTLX						
	bank	Amihud	17.4	5.5	(*)	Greater lot size more liquid
		Roll	38.8	42.4		Same liquidity level
		Turnover	0.3	0.8	(*)	Greater lot size more liquid
		Zero-trade	40.2	45.9	(*)	Smaller lot size more liquid
	non-financial	Amihud	16.4	1.2	(*)	Greater lot size more liquid
		Roll	35.3	53.1	(*)	Smaller lot size more liquid
		Turnover	0.2	0.4	(*)	Greater lot size more liquid
		Zero-trade	45.7	45.3		Same liquidity levels

Source: our elaborations on Consob database. [1] MTS= Minimun trading size. Sample average of the liquidity indicators computed on monthly data in percentage values. (*) = Null hypothesis rejected at 95% confidence level. Higher values for Amihud, Roll, zero-trade indicators mean lower liquidity levels. All bonds fragmented across DomesticMOT and EuroTLX have a lot size lower than or equal to 1,000 euros and therefore are not eligible for the analysis herein reported.

Table a2.2 – Dual-listed bond liquidity by issuer's nationality
(percentage values)

	Indicator	Italian[1]	Foreign[1]	Test significance	Inference
DomesticMOT					
bank	Amihud	9.1	63.0	(*)	Italian bonds more liquid
	Roll	37.3	67.0	(*)	Italian bonds more liquid
	Turnover	1.8	2.0		Same liquidity levels
	Zero-trade	24.4	42.1	(*)	Italian bonds more liquid
EuroTLX (bonds also traded on DomesticMOT)					
bank	Amihud	20.2	22.7		Same liquidity levels
	Roll	51.9	45.4		Same liquidity levels
	Turnover	1.0	2.1	(*)	Foreign bonds more liquid
	Zero-trade	36.7	39.4		Same liquidity levels
ExtraMOT					
bank	Amihud	9.8	29.7	(*)	Italian bonds more liquid
	Roll	57.8	64.2		Same liquidity levels
	Turnover	0.3	0.0	(*)	Italian bonds more liquid
	Zero-trade	60.3	82.5	(*)	Italian bonds more liquid
non-financial	Amihud	14.2	55.3	(*)	Italian bonds more liquid
	Roll	59.1	67.6		Same liquidity levels
	Turnover	0.3	0.0	(*)	Italian bonds more liquid
	Zero-trade	55.7	83.6	(*)	Italian bonds more liquid
EuroTLX (bonds also traded on ExtraMOT)					
bank	Amihud	2.4	15.2	(*)	Italian bonds more liquid
	Roll	37.9	48.6		Italian bonds more liquid
	Turnover	1.3	0.1	(*)	Italian bonds more liquid
	Zero-trade	24.8	63.3	(*)	Italian bonds more liquid
non-financial	Amihud	3.4	17.7	(*)	Italian bonds more liquid
	Roll	45.9	37.7		Foreign bonds more liquid
	Turnover	0.7	0.1	(*)	Italian bonds more liquid
	Zero-trade	27.8	59.7	(*)	Italian bonds more liquid

Source: our elaborations on Consob database. [1] Sample average of the liquidity indicators computed on monthly data and in percentage values. (*) = Null hypothesis rejected at 95% confidence level. Higher values for Amihud, Roll, zero-trade indicators mean lower liquidity levels. All non-financial bonds fragmented across DomesticMOT and EuroTLX are Italian and therefore are not eligible for the analysis herein reported.

Table a2.3 – Liquidity by coupon structure of bank bonds fragmented across DomesticMOT and EuroTLX and of non-financial bonds fragmented across ExtraMOT and EuroTLX
(percentage values)

	Indicator	Plain vanilla[1]	Structured[1]	Test result	Basic inference
DomesticMOT					
bank	Amihud	60.2	27.8	(*)	Structured bonds more liquid
	Roll	54.9	51.5		**Same liquidity levels**
	Turnover	4.7	1.5	(*)	Plain bonds more liquid
	Zero-trade	14.8	42.5	(*)	Plain bonds more liquid
EuroTLX (bonds also traded on DomesticMOT)					
bank	Amihud	29.4	18.5	(*)	Structured bonds more liquid
	Roll	60.6	40.2	(*)	Structured bonds more liquid
	Turnover	0.6	2.0	(*)	Structured bonds more liquid
	Zero-trade	44.9	36.6		**Same liquidity levels**
ExtraMOT					
non-financial	Amihud	34.2	12.1	(*)	Structured bonds more liquid
	Roll	63.4	61.9		**Same liquidity levels**
	Turnover	0.1	0.3	(*)	Structured bonds more liquid
	Zero-trade	75.7	62.1	(*)	Structured bonds more liquid
EuroTLX (bonds also traded on ExtraMOT)					
non-financial	Amihud	11.4	6.4	(*)	Structured bonds more liquid
	Roll	41.7	36.1		**Same liquidity levels**
	Turnover	0.3	0.6	(*)	Structured bonds more liquid
	Zero-trade	50.7	34.5	(*)	Structured bonds more liquid

Source: our elaborations on Consob database. 1Sample average of the liquidity indicators computed on monthly data and in percentage values. (*) = Null hypothesis rejected at 95% confidence level. Higher values for Amihud, Roll, Zero-trade indicators mean lower liquidity levels. Both non-financial bonds fragmented across DomesticMOT and EuroTLX and bank bonds fragmented across ExtraMOT and EuroTLX are plain vanilla and therefore are not eligible for the analysis herein reported.

Appendix 3 – Estimation results

Table a3.1 – Determinants of trade occurrence on DomesticMOT and EuroTLX

Explicative variables	DomesticMOT Model (1)	EuroTLX Model (1)	DomesticMOT Model (2)	EuroTLX Model (2)
Bank	-3.9*** (1.0)	-5.6*** (1.1)	-5.0*** (1.0)	-7.3*** (1.2)
Bank*crisis	0.1 (0.2)	-0.6*** (0.2)	0.1 (0.2)	-0.6*** (0.2)
Nationality	2.0*** (0.4)	2.9*** (0.6)	-	-
Nationality*crisis	0.1 (0.1)	-0.3*** (0.1)	-	-
Nationality*Italian sovereign Cds	-	-	0.0001 (0.0003)	-0.002*** (0.0003)
Complexity	-1.4** (0.6)	3.0*** (0.8)	-1.5** (0.7)	2.8*** (0.9)
Complexity*crisis	0.01 (0.1)	0.01 (0.1)	0.09 (0.09)	-0.1 (0.1)
Age	-0.3*** (0.02)	-0.5*** (0.02)	-0.3*** (0.02)	-0.5*** (0.02)
Age*crisis	0.1*** (0.02)	0.1*** (0.02)	0.1*** (0.02)	0.1*** (0.02)
Issuer Cds	0.002*** (0.0003)	0.00003 (0.0004)	0.002*** (0.0003)	0.0006 (0.0003)
Issuer Cds*crisis	-0.003*** (0.0004)	-0.0003 (0.0004)	-0.003*** (0.0004)	-0.00005 (0.0004)
Information risk	-0.1*** (0.03)	-0.3*** (0.05)	-0.1*** (0.04)	-0.3*** (0.05)
Information risk*crisis	-0.1 (0.07)	-0.3*** (0.1)	-0.1 (0.07)	-0.3*** (0.1)
Italian stock market volatility	-2.4*** (0.3)	0.3 (0.4)	-2.4*** (0.3)	0.5 (0.4)
Italian stock market volatility*crisis	0.5 (0.4)	0.4 (0.5)	0.5 (0.4)	0.5 (0.5)
Constant	6.7*** (0.9)	4.0*** (1.0)	8.9*** (0.8)	7.2*** (0.9)
Number of observations	883	883	883	883
Number of bonds	100	100	100	100
ρ	0.5***	0.7***	0.6***	0.7***

Note: "**" indicates significance at the 5% level; "***" indicates significance at the 1% level. In parenthesis standard errors are reported. "ρ" is the proportion of the total variance contributed by the panel-level component; the significance of this parameter is verified by applying a likelihood ratio test which compares the pooled estimator with the panel estimator. If "ρ" is significantly different from zero, the use of panel estimation methodology is justified. Nationality is a dummy variable equal to one if the issuer of the bond is Italian; Complexity is a dummy variable equal to one if the bond is structured; Bank is a dummy variable equal to one if the bond was issued by a bank; Information risk stands for bond price volatility; Italian stock market volatility is the volatility of the FTSEMib implied in index stock prices; Crisis is a dummy variable equal to one if the risk-premium associated to low grade corporate bonds with respect to prime corporate bonds (JP Morgan Maggie European credit risk index) overcomes the III° quartile of its daily distribution.

Table a3.2 – Determinants of trade occurrence on ExtraMOT and EuroTLX

Explicative variables	ExtraMOT Model (1)	EuroTLX Model (1)	ExtraMOT Model (2)	EuroTLX Model (2)
Bank	0.02 (0.2)	-0.6** (0.3)	0.4 (0.3)	-0.2 (0.4)
Bank*crisis	-0.05 (0.04)	-0.5*** (0.04)	0.02 (0.04)	-0.5*** (0.04)
Nationality	2.4*** (0.2)	2.9*** (0.3)	-	-
Nationality*crisis	0.4*** (0.04)	0.0005 (0.04)	-	-
Nationality*Italian sovereign Cds	-	-	-0.00006 (0.0001)	0.0002 (0.0001)
Complexity	0.7 (0.5)	-0.2 (0.7)	0.8 (0.6)	-0.1 (0.8)
Complexity*crisis	0.2*** (0.1)	0.05 (0.08)	0.2*** (0.1)	0.05 (0.08)
Lot size	1.3*** (0.2)	3.2*** (0.3)	0.5*** (0.2)	2.2*** (-0.3)
Lot size*crisis	0.2*** (0.05)	-0.2*** (0.04)	-0.03 (0.05)	-0.2*** (0.04)
Issue size	0.5** (0.2)	0.8*** (0.3)	0.4 (0.3)	0.7** (0.3)
Issue size*crisis	0.03*** (0.004)	0.07*** (0.004)	0.04*** (0.004)	0.07*** (0.004)
Age	0.1*** (0.01)	-0.4*** (0.01)	0.1*** (0.01)	-0.4*** (0.01)
Age*crisis	0.06*** (0.01)	0.05*** (0.001)	0.1*** (0.01)	0.05*** (0.007)
Issuer Cds quotations	0.002*** (0.00009)	0.004*** (0.0001)	0.002*** (0.00009)	0.004*** (0.0001)
Issuer Cds quotations*crisis	-0.001*** (0.00009)	-0.002*** (0.0001)	-0.001*** (0.00009)	-0.002*** (0.0001)
Information risk	0.4*** (0.02)	0.4*** (0.03)	0.4*** (0.02)	0.4*** (0.03)
Information risk*crisis	-0.3*** (0.03)	-0.5*** (0.03)	-0.3*** (0.03)	-0.5*** (0.03)
Italian stock market volatility	-2.3*** (0.2)	-3.7*** (0.2)	-2.3*** (-0.2)	-3.7*** (0.2)
Italian stock market volatility*crisis	-1.4*** (0.3)	-1.4*** (0.3)	-1.2*** (0.3)	-1.4*** (0.3)
Constant	-14.7*** (4.3)	-18.5*** (6.1)	-10.1*** (5.4)	-14.0** (7.1)
Number of observations	883	883	883	883
Number of bonds	309	309	309	309
ρ	0.4***	0.6***	0.5***	0.6***

Note: "**" indicates significance at the 5% level; "***" indicates significance at the 1% level. In parenthesis standard errors are reported. "ρ" is the proportion of the total variance contributed by the panel-level component; the significance of this parameter is verified by applying a likelihood ratio test which compares the pooled estimator with the panel estimator. If "ρ" is significantly different from zero, the use of panel estimation methodology is justified. Nationality is a dummy variable equal to one if the issuer of the bond is Italian; Complexity is a dummy variable equal to one if the bond is structured; Bank is a dummy variable equal to one if the bond was issued by a bank; Lot size is a dummy variable which is equal to 1 if the bond's lot size is less or equal to 1,000 euro; Information risk stands for bond price volatility; Italian stock market volatility is the volatility of the FTSEMib implied in index stock prices; Crisis is a dummy variable equal to one if the risk-premium associated to low grade corporate bonds with respect to prime corporate bonds (JP Morgan Maggie European credit risk index) overcomes the III° quartile of its daily distribution.

Table a3.3 – Estimates of marginal effects

Explicative variables	Bonds fragmented on DomesticMOT and EuroTLX		Bonds fragmented on ExtraMOT and EuroTLX	
	DomesticMOT	EuroTLX	ExtraMOT	EuroTLX
Tranquil period of time				
Bank sector	-0.3***	-0.5***	-	-0.1**
Nationality	0.3***	0.4***	0.3***	0.5***
Complexity	-0.2***	0.4***	-	-
Lot size	-	-	0.1***	0.5***
Issue size	-	-	0.06***	0.1***
Age	-0.05***	-0.08***	0.01***	-0.07***
Issuer Cds quotations Quotations (b.p.)	0.0004***	-	0.0002***	0.001***
Issuer rating	-0.01***	-	-0.003**	0.04***
EDF(%)	-	-	0.01***	0.03***
Information risk (%)	-0.0001***	-0.0006***	0.0003***	0.0005***
Italian stock market volatility (%)	-0.004***	-	-0.002***	-0.006***
Crisis				
Bank sector	-0.3***	-0.6***	-	-0.1***
Nationality	0.3***	0.2***	0.4***	0.4***
Complexity	-0.2***	0.2***	0.1*	-
Lot size	-	-	0.2***	0.2***
Issue size	-	-	-	0.1*
Age	-0.03***	-0.06***	0.03***	0.06***
Issuer Cds quotations Quotations (b.p.)	-0.0003***	-	6.9e-07	0.0002***
Issuer rating	-0.02***	-	-0.005**	0.04***
EDF(%)	-	-	0.01***	0.04***
Information risk(%)	-0.0002***	-0.0006***	0.0002***	0.0001**
Italian stock market volatility (%)	-0.002***	-	-0.004***	-0.005***

Note: Bank sector is a dummy variable which is equal to one when the issuer belongs to the banking sector; Nationality is a dummy variable which is equal to one when the issuer is an Italian firm; Complexity is a dummy variable which is equal to one when the bond is structured; Lot size is a dummy variable which is equal to one when the lot size is less or equal to 1,000 euro; Issue size is the logarithm of the amount outstanding (euro); Age is the number of trading days from the issue date; Issuer Cds quotations is expressed in basis points; Issuer rating is expressed as a score; EDF is the expected default probability expressed in percentage values; Information risk is the bond price volatility expressed in percentage values; Italian stock market volatility is the volatility of the FTSEMib implied in index stock prices expressed in percentage values. Crisis is identified when the risk-premium associated to low grade corporate bonds with respect to prime corporate bonds (JP Morgan Maggie European credit risk index) overcomes the III° quartile of its daily distribution. Marginal effect is the change in the probability to have trade which corresponds to unit variation in an explicative variable by maintaining the others fixed. Regarding continuous explicative variables, average marginal effects, on the probability to have a trade, are reported. Concerning dummy variables, marginal effects represent the change in the probability to have a trade, when the explicative variable goes from zero to one.

Appendix 4

Table a4.1 – Matched pairs of fragmented and non-fragmented bank bonds traded on DomesticMOT

non-fragmented bonds					fragmented bonds				
ISIN	MV (bln euros)	maturity date	rating	lot size (euro)	ISIN	MV (bln euros)	maturity date	rating	lot size (euro)
Italian structured bonds									
IT0003035299	264	13-Dec-10	A2	1,000	IT0003738470	252	8-Nov-10	A2	1,000
IT0004053465	251	30-Jun-11	A2	1,000	IT0003747505	259	19-Jun-11	A2	1,000
IT0003035299	264	13-Dec-10	A2	1,000	IT0003747521	252	16-Nov-10	A2	1,000
IT0003035299	264	13-Dec-10	A2	1,000	IT0003750368	252	22-Nov-10	A2	1,000
IT0003035299	264	13-Dec-10	A2	1,000	IT0003754113	252	30-Nov-10	A2	1,000
IT0004053465	251	30-Jun-11	A2	1,000	IT0003754147	253	23-Jun-11	A2	1,000
IT0003035299	264	13-Dec-10	A2	1,000	IT0003759096	252	10-Dec-10	A2	1,000
IT0003933154	99	16-Nov-11	A2	1,000	IT0003764161	88	21-Jul-11	A2	1,000
IT0003035299	264	13-Dec-10	A2	1,000	IT0003765291	252	20-Dec-10	A2	1,000
IT0003035299	264	13-Dec-10	A2	1,000	IT0003792741	252	20-Jan-11	A2	1,000
IT0003933154	99	16-Nov-11	A2	1,000	IT0003799795	94	3-Feb-12	A2	1,000
IT0004036338	213	28-Apr-11	A2	1,000	IT0003801526	101	31-Jan-11	A2	1,000
IT0004036338	213	28-Apr-11	A2	1,000	IT0003805220	212	28-Feb-11	A2	1,000
IT0004576556	99	22-Mar-15	A2	1,000	IT0003806855	110	17-Feb-15	A2	1,000
IT0003933154	99	16-Nov-11	A2	1,000	IT0003810626	51	3-Mar-12	A2	1,000
IT0004036338	213	28-Apr-11	A2	1,000	IT0003812523	65	28-Feb-11	A2	1,000
IT0004036338	213	28-Apr-11	A2	1,000	IT0003827679	252	29-Apr-11	A2	1,000
IT0003821136	147	31-Mar-10	A2	1,000	IT0003832760	50	7-Apr-10	A2	1,000
IT0003821136	147	31-Mar-10	A2	1,000	IT0003842983	25	5-May-10	A2	1,000
IT0004053457	218	15-May-11	A2	1,000	IT0003846844	217	31-May-11	A2	1,000
IT0004713654	119	10-Jun-15	A3	1,000	IT0003855779	63	30-May-15	A2	1,000
IT0003933154	99	16-Nov-11	A2	1,000	IT0003855795	111	30-Jun-11	A2	1,000
IT0003740047	23	5-Oct-12	Aa3	1,000	IT0003883185	20	29-Jul-12	A2	1,000
IT0003740047	23	5-Oct-12	Aa3	1,000	IT0003890248	22	1-Sep-12	A2	1,000
IT0004854490	19	7-Dec-15	A3	1,000	IT0003935241	127	6-Dec-15	A2	1,000
IT0003933154	99	16-Nov-11	A2	1,000	IT0004057151	40	30-Jun-11	A2	1,000
IT0003657563	322	31-May-14	A2	1,000	IT0004309313	362	30-Apr-14	Baa1	1,000
IT0004375736	676	23-Sep-14	A2	1,000	IT0004315047	686	23-May-14	Baa1	1,000
IT0004429202	588	27-Feb-15	A2	1,000	IT0004452386	556	28-Apr-15	A2	1,000
IT0004642382	746	14-Oct-15	A3	1,000	IT0004464407	740	30-Jun-15	A2	1,000
IT0004642382	746	14-Oct-15	A3	1,000	IT0004669138	1436	13-Dec-15	A2	1,000
IT0001300992	95	22-Jan-19	A3	1,000	IT0004796451	101	3-Jun-18	A2	1,000

- continue -

Table a4.1 – Matched pairs of fragmented and non-fragmented bank bonds traded on DomesticMOT

non-fragmented bonds					fragmented bonds				
ISIN	MV (bln euros)	maturity date	rating	lot size (euro)	ISIN	MV (bln euros)	maturity date	rating	lot size (euro)
Foreign structured bonds									
IT0006714395	7	16-Apr-21	A2	1,000	DE000UB5WF78	15	1-Apr-21	A1	1,000
GB00B6HZ3D39	43	29-Jun-17	A2	1,000	DE000UB8DSR5	14	6-Jul-17	A1	1,000
GB00B6HZ2927	0.1	29-Jul-16	A2	1,000	DE000UU0E789	16	28-Sep-16	A1	1,000
IT0004332240	214	28-Mar-12	A3	1,000	IT0004176787	282	30-Mar-12	A3	1,000
IT0004372162	147	26-Jun-12	A3	1,000	IT0004218688	142	30-Mar-12	A3	1,000
NL0006136376	11	28-Dec-12	A2	1,000	IT0006620220	36	28-Dec-12	A3	1,000
IT0003793467	506	31-Jan-10	A3	1,000	IT0006623489	510	31-Jan-10	Baa1	1,000
IT0006630344	786	20-Jul-13	A2	1,000	IT0006623620	531	3-Jun-13	Baa1	1,000
IT0003806244	1010	28-Feb-10	A3	1,000	IT0006626201	1029	28-Feb-10	Baa1	1,000
NL0006136376	11	28-Dec-12	A2	1,000	IT0006627563	85	30-Mar-13	Baa1	1,000
IT0006636218	186	9-Jul-13	A3	1,000	IT0006628876	176	30-Mar-13	A3	1,000
IT0006636218	186	9-Jul-13	A3	1,000	IT0006632035	316	30-Apr-13	A3	1,000
NL0006136376	11	28-Dec-12	A2	1,000	IT0006632613	70	30-Apr-13	A3	1,000
IT0006636218	186	9-Jul-13	A3	1,000	IT0006632621	176	30-Apr-13	A3	1,000
IT0006636218	186	9-Jul-13	A3	1,000	IT0006635384	69	6-Jun-13	A3	1,000
IT0006636218	186	9-Jul-13	A3	1,000	IT0006635475	127	31-May-13	A3	1,000
IT0006636218	186	9-Jul-13	A3	1,000	IT0006636770	176	29-Jun-13	A3	1,000
IT0006636218	186	9-Jul-13	A3	1,000	IT0006638057	69	29-Jun-13	A3	1,000
IT0006636218	186	9-Jul-13	A3	1,000	IT0006638842	65	29-Jun-13	A3	1,000
IT0006636218	186	9-Jul-13	A3	1,000	IT0006640491	162	31-Jul-13	A3	1,000
IT0006636218	186	9-Jul-13	A3	1,000	IT0006640509	122	3-Aug-13	A3	1,000
NL0009569821	15	27-Oct-13	A2	1,000	IT0006643008	42	3-Aug-13	A3	1,000
NL0009569821	15	27-Oct-13	A2	1,000	IT0006643016	73	31-Aug-13	A3	1,000
NL0009569821	15	27-Oct-13	A2	1,000	IT0006646001	40	28-Sep-13	A3	1,000
IT0006673401	206	30-Sep-13	A2	1,000	IT0006646019	121	28-Sep-13	A3	1,000
IT0006630344	786	20-Jul-13	A2	1,000	IT0006664137	793	21-Jul-14	A1	1,000
NL0009058122	184	31-Jul-14	A2	1,000	IT0006664459	259	23-Jul-14	A1	1,000
NL0009294305	15	19-Apr-17	A2	1,000	IT0006719584	36	21-Apr-17	A1	1,000
NL0009403229	21	3-May-17	A2	1,000	IT0006719956	20	8-Jun-17	A1	1,000
IT0006719816	15	30-Jun-16	A2	1,000	IT0006720129	26	7-Jul-16	A2	1,000
NL0009597939	14	18-Oct-17	A2	1,000	IT0006721366	19	19-Oct-17	A1	1,000
IT0006602871	21	13-Mar-16	Baa1	1,000	IT0006721473	20	3-Nov-16	A1	1,000
NL0009487461	98	9-Jul-16	A2	1,000	NL0009537851	99	30-Sep-16	A2	1,000
NL0009597939	14	18-Oct-17	A2	1,000	NL0009537935	29	30-Sep-17	A2	1,000
NL0009487461	98	9-Jul-16	A2	1,000	NL0009537943	97	30-Sep-16	A2	1,000
NL0009560028	101	30-Sep-17	A2	1,000	NL0009560010	97	30-Sep-17	A2	1,000
IT0006716564	49	30-Oct-25	A2	1,000	XS0584356942	43	31-Jan-26	A3	1,000
GB00B78SXC73	7	23-Mar-18	A2	1,000	XS0625841142	20	10-May-18	A3	1,000
GB00B78SXC73	7	23-Mar-18	A2	1,000	XS0638296920	7	25-Jun-18	A3	1,000
GB00B6HZ2927	0.1	29-Jul-16	A2	1,000	XS0663929619	15	7-Sep-16	A3	1,000

- continue -

Table a4.1 – Matched pairs of fragmented and non-fragmented bank bonds traded on DomesticMOT

non-fragmented bonds					fragmented bonds				
ISIN	MV (bln euros)	maturity date	rating	lot size (euro)	ISIN	MV (bln euros)	maturity date	rating	lot size (euro)
Italian plain vanilla bonds									
IT0004807159	713	23-Mar-15	.	50,000	IT0004596133	501	20-Apr-12	.	50,000
IT0004779713	293	30-Jun-14	A3	1,000	IT0004540719	717	20-Nov-14	A2	1,000
IT0004855554	36	30-Nov-14	A3	1,000	IT0004540842	38	20-Nov-14	A2	1,000
IT0004842370	525	8-Oct-19	A3	1,000	IT0004608797	373	14-May-20	A2	1,000
IT0004842370	525	8-Oct-19	A3	1,000	IT0004645542	315	15-Nov-20	A2	1,000
IT0004780711	97	29-Jun-14	A3	1,000	IT0004725559	76	14-Jul-14	A2	1,000
IT0001223889	274	8-May-13	A2	1,000	IT0004760721	512	2-Sep-13	A2	1,000
IT0004842370	525	8-Oct-19	A3	1,000	IT0004863723	154	18-Oct-19	A2	1,000
Foreign plain vanilla bonds									
IT0004618507	22	28-Jun-16	A3	1,000	IT0006719428	18	14-Apr-16	A2	1,200
IT0004618507	22	28-Jun-16	A3	1,000	IT0006719436	36	14-Apr-16	A2	1,400
IT0004618507	22	28-Jun-16	A3	1,000	IT0006719444	44	14-Apr-16	A2	1,000
IT0004698178	278	3-Jul-16	A3	1,000	NL0009354505	201	22-Feb-16	A2	1,000
IT0004650781	79	22-Oct-20	A3	1,000	NL0009483825	251	22-Jun-20	A2	1,000
DE000UB2F5S4	74	29-Jul-17	A1	1,000	NL0009560002	93	30-Sep-17	A2	1,000
IT0004650781	79	22-Oct-20	A3	1,000	NL0009694272	101	14-Feb-21	A2	1,000

Table a4.2 – Liquidity indicators for banks bonds traded on DomesticMOT by fragmentation
(average percentage values over the sample period; January 2010 – June 2013)

Whole sample

liquidity indicator	parametric test (difference between average values): dual-listed average value (a)	non-fragmented average value (b)	(a)-(b)	not parametric Wilcoxon test (difference between distributions)	result
Zero-trade	33.6	27.3	***	3.6***	difference significantly different from zero and positive: dual-listed bonds are less liquid
Turnover	1.8	2.4	***	-3.5***	difference significantly different from zero and negative: dual-listed bonds are less liquid
Amihud	23.3	16.5	***	4.8***	difference significantly different from zero and positive: dual-listed bonds are less liquid
Roll	54.0	59.0		-0.2	not significantly different

Italian bonds

liquidity indicator	parametric test (difference between average values): dual-listed (a)	non-fragmented matched sample (b)	(a)-(b)	not parametric Wilcoxon test (difference between distributions)	result
Zero-trade	24.4	19.6	**	-5.7***	difference significantly different from zero and negative: dual-listed bonds are more liquid
Turnover	1.8	1.6		1.0	not significantly different
Amihud	8.7	13.3	***	-3.5***	difference significantly different from zero and negative: dual-listed bonds are more liquid
Roll	40	50	**	-3.0***	difference significantly different from zero and negative: dual-listed bonds are more liquid

Foreign bonds

liquidity indicator	parametric test (difference between average values): dual-listed (a)	non-fragmented matched sample (b)	(a)-(b)	not parametric Wilcoxon test (difference between distributions)	result
Zero-trade	42.1	23.0	***	5.2***	difference significantly different from zero and positive: dual-listed bonds are less liquid
Turnover	2.0	2.7	***	-3***	difference significantly different from zero and negative: dual-listed bonds are less liquid
Amihud	63.0	20.1	***	4.9***	difference significantly different from zero and positive: dual-listed bonds are less liquid
Roll	70	60		2.3**	not significantly different

Note: Non fragmented bonds are matched pairs with dual-listed securities on the basis of market value, maturity, rating, complexity, nationality of the financial instruments.(***) indicates that the difference between dual-listed and not fragmented bonds is significant at the 1% level; (**) indicates that the difference between dual-listed and not fragmented bonds is significant at the 5% level.

Table a4.3 – Test of homogeneity between matched pairs

	whole sample		Italian bonds	
	F-statistic	P-value	F-statistic	P-value
market value	2.3	0.07	1.4	0.3
rating	1.1	0.4	0.8	0.6
maturity	0.8	0.5	2.2	0.1

In the table we report F-statistics applied to the coefficients of a multivariate regression in which the relations among differences between matched pairs liquidity indicators and differences between matched pairs characteristics (market value, rating, maturity) are examined. The F-statistic allows to test the hypothesis that all the coefficients are jointly equal to zero.

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