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Transparency in the UK Bond Markets: An overview

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Financial Conduct Authority

Given the debate on transparency in non-equity markets associated with the Markets in Financial Instruments Directive (MiFID II), a sound understanding of how these markets operate today is needed to identify potential market failures and to assess the impact of proposed regulatory interventions. This paper uses the transaction reporting data available to the UK Financial Conduct Authority (FCA) to analyse the structure and characteristics of the UK-listed bond markets and highlight features that should be considered when designing transparency regimes aimed at improving market functioning. We observe significant diversity in the UK bond markets, with big differences between market participants, the way they trade and the risks of trading different instruments. While most bonds are only traded sporadically, some bonds are rather liquid and trade frequently at different venues. However, their liquidity profile varies widely during their lifetime. Most transactions in the UK-listed bonds in our sample are carried out off-exchange. We find that trading costs depend on transaction size, credit risk profile and maturity. We note that there is a moderate level of concentration of broker and market maker services but we have not carried out a full assessment of competition as part of this work.

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1. Introduction

The bond markets play an important role in allocating financial resources to firms and governments. Bond volumes outstanding exceed those of equity markets significantly; in 2012 the global equity market had a market capitalisation of US$55 trillion while the amounts outstanding on the global bond market equalled US$100 trillion.[1] Any regulatory change to the transparency requirements in this market should be properly calibrated and targeted at mitigating identified market failures. For example, market failures could be causing inefficiencies in the price formation process or preventing best execution, causing markets not to work well for their users. Clearly, a sound understanding of how these markets are operating today is essential for assessing changes to the bond transparency regime. Most transactions in bonds are carried out between broker-dealers and large institutions over-the-counter[2] with only limited levels of pre- and post-trade transparency.[3]

While there are no UK regulatory requirements on transparency for over-the-counter trading in bonds today, MiFID II will include a pre- and post-trade transparency regime for non-equity instruments admitted for trading on European Economic Area (EEA) trading venues. Trading off-exchange of these instruments will be subject to transparency requirements. The new requirements will take into account the liquidity of the instruments and the size of the transaction to balance the benefits of transparency against its possible adverse effects on liquidity. The details of the regime are still under negotiation.

The MiFID II Impact Assessment[4] provides a rationale for a transparency regime in securities markets based on the assumption that there are market failures that require regulatory intervention.[5] The main market failures described are related to asymmetric information, not all market participants are able to obtain the same level of information, and externalities, the supply of trade data and its quality is lower than what would be socially optimal. However, the impact assessment recognises that, even if a market failure is present, it is important to assess the optimal level of pre- and/or post-trade transparency across markets, as increased levels

1 Statistics reported by the World Federation of Exchanges and the Bank for International Settlements.

2 The International Capital Market Association (ICMA) explains on its website that in bond markets '… unlike equity markets there is seldom a continuous two-way market of buyers and sellers whereby a minor change in price by one or the other can result in a trade. Instead, liquidity is provided by dealers who operate in two ways. First they put their own capital at risk by, for example, buying bonds from an investor even if they do not have a buyer to whom they can sell-on the bonds. They take the risk that in due course they will find a buyer to whom they can sell the bonds at a profit. Second, they take an order e.g. from a client who wants to buy a quantity of a particular bond and will search the market for an investor who is prepared to sell the bonds.'

3 Transparency refers to the ability of participants to observe information regarding the trading process and current trading opportunities. Levels of transparency can be broadly categorised into pre-trade and post-trade transparency. Pre-trade (or ex-ante) transparency is where investors have access to quote information prior to trading, while post-trade (or ex-post) transparency refers to the information which is disseminated to investors and other market participants about trades which have already taken place.

4 See European Commission (2011).

5 The MiFID II Market Assessment provides the following rationale for a transparency regime in securities markets: 'The key rationale for transparency is to provide investors with access to information about current trading opportunities, to facilitate price formation and assist firms to provide best execution to their clients. It is also intended to address the potential adverse effect of fragmentation of markets and liquidity by providing information that enables users to compare trading opportunities and results across trading venues. Post-trade transparency is also used for portfolio valuation purposes. Transparency is crucial for market participants to be able to identify a more accurate market price and to make trading decisions about when and where to trade.'

of transparency could have negative effects on liquidity and on the competitive behaviour of participants.[6] For example, higher levels of pre-trade transparency may reduce the bargaining power of liquidity providers, potentially harming liquidity in some instruments (but it may also reduce transaction costs in others). Similarly, higher levels of post-trade transparency may expose market makers to predatory trading, again reducing their incentives to provide liquidity.[7]

Alternatively, the current market structures may be an efficient solution for the trading of differing types of instruments by a large variety of investors. Given the diversity in bond market instruments and participants, it is important to establish to what degree the market failures identified apply to different instruments and/or market participants.

To further this debate on transparency in non-equity markets, we use the transaction reporting data available to the Financial Conduct Authority (FCA) to analyse the structure and characteristics of the UK-listed bond markets.

While we cannot make any causal statement on the effects of transparency on measures of market quality, we provide an overview of the overall market and highlight features that should be considered when designing transparency regimes that aim to improve market functioning.

Our main findings are outlined as follows.

- We observe a large degree of diversity in the UK bond markets, with big differences between market participants, the ways in which they trade and the risks involved in trading different instruments. When setting appropriate levels of pre- or post-trade transparency, these markets' specific features should be considered (eg, size of the market, trading frequency, current levels of liquidity and type of participants).

- We show that trading costs have been decreasing over the sample period and depend on transaction size, bond riskiness and maturity.

- We provide some insights into the overall structure of the UK bond markets. The bond market seems to be structured like a spoke and hub system with most transactions carried out between broker-dealers and only few transactions carried out directly between the buy-side. When looking at broker-dealer concentrations we find moderate level of concentration, depending on the specific segments of the bond market.

We add to the existing studies by using a more granular dataset, with a better coverage of the bond markets in the UK to allow the study of additional characteristics such as fragmentation and concentration by instruments, counterparties and trading venues.

In section two, we briefly review the literature on the effects of transparency requirements on liquidity and competition in equity and non-equity markets. In section three, we analyse the UK bond markets by describing the dataset and providing major stylised facts. We then analyse the trading costs, measured by an estimated spread of corporate, financial and sovereign bonds over a benchmark. Finally, we describe the market structure of the UK-listed bond market.

6 In 2012, the ICMA did a survey on liquidity and transparency of the European corporate bond markets. For all respondents, the ICMA's main concern was market liquidity and the potential effect of transparency on this liquidity (see ICMA (2010)). The ICMA is running the survey again this year to help inform the debate on fragmentation and transparency.

7 See CESR/07-284b and CESR/09-348 for a more detailed assessment on the arguments for and against regulatory interventions.

2. Literature review

A number of academics and practitioners have analysed the likely effects of different transparency regimes in financial markets from theoretical and empirical perspectives. The empirical evidence on the effects of pre- and post-trade transparency is limited. This is partly due to structural changes in transparency being rare and the challenge of isolating the impact of transparency improvements. Therefore, most empirical analyses focus on individual markets or events.

In this section, we describe the main results of the literature, focusing on the specific characteristics of non-equity markets that should be taken into account when calibrating a transparency regime that protects investors and guarantees the smooth and efficient functioning of financial markets.

Transparency, information asymmetry and predatory trading

The literature on the relationship between transparency, information and market outcomes can be separated into two strands, information asymmetry and predatory trading. The former addresses the relationship between transparency and market outcomes in the context of agents possessing different information. The latter deals with the potential for some traders to exploit the information contained in the open positions of large traders and profit at their expense, if these positions become known to them.

The first strand of literature recognises that traders can be *informed* or *uninformed*. The effects of transparency on market outcomes then depend mainly on which type of trader is supplying liquidity and whether or not information acquisition is costly.

Informed traders generate an adverse selection problem to uninformed traders. If liquidity is supplied by uninformed traders, transparency reduces the opportunity for taking advantage of them. Transparency reduces this information problem and encourages participation from uninformed traders and, as such, overall liquidity (Pagano and Roell (1996)). If, on the other hand, liquidity is supplied by informed traders, then revealing information to the market reduces the incentive to gather information in the first place and the willingness of informed traders to trade. This has detrimental effects on liquidity (Rindi (2008)).

The second strand of literature analyses situations in which a trader needs to buy or sell a significant amount of a security in a given timeframe, which exposes them to predatory traders. For instance, a tracker fund may need to buy shares in a company that just became part of the tracked index or a hedge fund may need to liquidate positions if it thinks that a margin call is about to take place. If these situations are known by other – *predatory* – traders (eg, because transparency of trades implies that the trading book can be reconstructed) they can initially trade in the same direction as their *prey*. The price will move against the prey and will

overshoot the equilibrium price. This is possible as the activity of the prey has an impact on price and predators can 'ride the trend' until the prey has sold (or bought) the required amount of securities. The predators will then reverse the trade and profit from selling at a higher price or buying at a lower one (Brunnermeier and Pedersen (2005)).

There are two main reasons why predatory trading may be detrimental for the market. First, it could lead to contagion across the financial system if declining asset prices force a number of large traders to reduce their positions at the same time (negative feedback loops). Secondly, it could reduce liquidity in a manner similar to the 'information asymmetry' described above. If a trader acts as a market maker (and thus provides liquidity) and is therefore bound to be large and have instances where its trades will have to be in one direction, it may lose the incentive to provide liquidity in the first place.

Transparency and competition

Transparency may also affect the competitive behaviour of market participants. For market makers, pre-trade transparency can make the detection of deviations from collusive behaviour (implicit or explicit) easier and may facilitate oligopolistic coordination. Whitcomb et al (2003) examine the impacts of differing levels of transparency on the quotation behaviour of NASDAQ market makers and find that when quotes are anonymous market makers narrow the spreads.

There is also evidence for increased transparency improving competition in dealer markets. Green et al (2007) find that dealers in the US municipality bond market have market power, particularly for small- and medium-sized transactions.[8] They attribute this to the fact that less sophisticated investors face higher mark-ups in a bargaining market. Duffie et al (2005) show, in a theoretical model, that investors' bargaining power is improved if they can find other investors or market makers more easily. For example, sophisticated investors may have better access to competing market makers and, therefore, receive a tighter spread.

Biais et al (2006) argue that the prediction about the effect of changes to the transparency regime on competition in European corporate bond markets is ambiguous. Greater transparency may lead to a reduction in the number of dealers competing in this market due to liquidity providers being exposed to opportunistic traders, with detrimental effects for spreads and market liquidity. Alternatively, greater transparency may reduce adverse selection and search costs, leading to more competition. Bessembinder et al (2006) show that, although dealers and traders found trading more difficult under the Trade Reporting and Compliance Engine (TRACE) in the US corporate bond market, the concentration of trade volume for the largest 12 dealers fell from 56% to 44% after the introduction of TRACE (suggesting that increased transparency opened the market to competition and more dealers participating in the market leads to a more efficient market (as in Biais et al (2006)).

8 Green et al (2007) show that dealers in the opaque and decentralised municipality bond market earn lower average mark-ups on larger trades, even though they bear more risk on these trades. The Securities and Exchange Commission (SEC) (2004) finds that small trades had higher spreads than large trades and that customers making large trades were less likely to experience different prices than customers making small trades.

Transparency and market quality

To analyse the effects of transparency on market quality, transaction costs are used often as a proxy. Other variables to market quality examined in the literature are price dispersion and volume of trading. Some studies also analyse the effect of transparency on market participation of more and less informed traders; measures include concentration of large and small market participants and revenues of market-makers.

The most widely-studied case of a change in post-trade transparency in bonds markets is the introduction of TRACE in the US corporate bond market. With TRACE, these bond markets shifted from relative opacity to a phased public dissemination of trade data. With its introduction, the impact of transparency on transaction costs could be analysed empirically. Studies of TRACE conclude that mandated increases in post-trade transparency reduced transaction costs.[9] The estimates of magnitude of the impact differ, likely due to experimental design or methodology, and the reductions in transaction costs are greatest for smaller trade sizes. Moreover, Bessembinder at al (2006) find that the trade execution costs of some bonds not eligible for transaction reporting also fell, suggesting the presence of liquidity externalities.[10] As explained in FSA (2006), it is unlikely that the effects TRACE had on transaction costs in the US would be replicated by a similar system in the UK or Europe, due to differences in the structures and characteristics of the relevant markets.[11]

With respect to pre-trade transparency, Dunne et al (2006) examine a 'transparency event' which took place in one of the electronic markets for US Treasuries. They conclude that higher pre-trade transparency led to increased effective spreads.[12]

For equity markets, the literature on trade transparency comes to conflicting results. Foucault, Pagano and Roell (2013) present a theoretical model that shows that opaqueness reduces competition among dealers enabling them to price discriminate across different customers. Empirically, a study of the introduction of the New York Stock Exchange's (NYSE) OpenBook service in 2001 concludes that greater pre-trade transparency led to a decline in effective spreads (Boehmer et al (2005)). Whereas the opposite results were obtained by Madhavan et al (2005) for the Toronto Stock Exchange, by Scalia and Vacca (1999) for the Italian bond market and by Whitcomb et al (2003) for the NASDAQ.

The majority of the empirical studies conclude that findings from individual markets are difficult to generalise, as changes in transparency tend to have distinctive effects which depend on the characteristics of the financial instrument, market structure and institutional arrangement of the market. This further suggests that calibration of transparency measures need to carefully consider differences between these markets.

9 See Bessembinder et al (2006), Edwards et al (2007) and Goldstein et al (2007).

10 Cespa and Foucault (2014) provide a model that shows how such a liquidity externality can arise due to market transparency and how changes in regulation affecting the liquidity of one asset class can affect another asset class, even if the latter is not directly in the scope of the regulation.

11 The feedback statement summarises the responses to the FSA discussion paper (FSA (2005)). There was a concern that mandating pre-trade transparency may impact the existing complex market structures in a significant but unknown way and that post-trade transparency could have less impact on market structure but could decrease the provision of liquidity. The trade-off between transparency and liquidity was highlighted by many respondents.

12 The effective spread is widely used as a measure of execution costs and it is defined as twice the difference between the actual execution price and the market quote at the time of order entry.

3. The UK bond markets

The importance of the global bond markets has increased significantly in recent years. The Bank for International Settlement statistics show that the amounts outstanding on the global bond market increased from US$60 trillion in 2005 to US$100 trillion in 2012[13], an increase of above 65%.[14] The UK is one of the largest centres for issuance and trading of international bonds. TheCityUK (2012) estimated that in 2012 London accounted for 3% of the issuance, 13% of the amount outstanding and 70% of the secondary market turnover in international bonds.

Given the importance of the UK bond markets and the ongoing policy developments in the context of the MiFID II negotiations on trade transparency requirements, this paper tries to inform the debate by giving a detailed overview of the trading of UK-listed bonds in the UK and EU. Compared to the FSA discussion paper of 2005 (FSA (2005)) and the additional analysis made in the FSA feedback statement (FSA (2006)), here we use a more granular dataset with a better coverage of the markets that allows us to study characteristics such as fragmentation and concentration that were not covered in the FSA papers. These characteristics need to be considered when designing a transparency regime.

In this section, we describe our dataset and then give an overview of the UK bond secondary markets. We show which venues are used to execute trades of different sizes and who the counterparties to these trades are. We analyse the costs of trading as changes in transparency regimes aim to reduce transaction costs for the market overall or for certain market participants. We show that spreads vary by trade size, issuer characteristics and market characteristics. Trade transparency is likely to impact these transaction costs. Large informed orders, which constitute a large portion of all trades currently, is likely to become more expensive while small uninformed trades may become cheaper.

Data sources

Our analysis is based on a subset of a unique dataset, 'Sabre II', held at the FCA. Our subset consists of the UK-listed bond transaction reports from January 2008 to July 2011. Firms are required by regulation (MiFID and the FCA Handbook) to report certain details of their executed transactions involving 'any financial instrument admitted to trading on a regulated market[15] or prescribed market (whether or not the transaction was carried out on such market) or OTC derivatives the value of which is derived from or is otherwise dependent on an equity or debt-related financial instrument…' by the end of the following business day.[16] Sabre II also contains transactions involving different types of financial instruments (such as equities, indices, futures and options) but this data is not used here.

13 The BIS made some changes to the compilation of bond statistics in December 2012; therefore, figures for 2013 are not comparable.
14 This increase is probably related to the need of governments to finance increasing deficits after the financial crises of 2008.
15 It applies to regulated markets in the EU. For a list of regulated markets, please see: http://mifiddatabase.esma.europa.eu/
16 A detailed description of the content of the transaction reports can be found in the FSA's Transaction Reporting User Pack.

Each transaction report includes the date and trading time of the transaction, the name of the instrument and its international securities identification number (ISIN), the price, currency, quantity, maturity date and whether it was a buy or a sell. It also indicates who did the transaction (the reporting firm), with whom (counterparty 1) and, in the case of an agency trade, on behalf of whom (counterparty 2). It also discloses the name of the trading venue on which the transaction was made or whether it was off-exchange.

In our sample period, there are around 140 thousand different bonds in Sabre II. These include all UK bonds admitted to trading in any EEA regulated or prescribed market that were traded during the period. It also includes EEA non-UK bonds and some non-EEA listed bonds traded by UK regulated firms.[17] Therefore, with this information, we could take two approaches. We could analyse the UK-listed bonds traded in UK and the EU or analyse an important portion of the complete UK secondary bond market. In this paper, we will focus on the former, ie, UK-listed bonds traded in any EEA regulated/prescribed markets (UK and non-UK) or off-exchange by any EEA regulated firm.[18] Further work could be done using the second approach.

To extract the relevant information for the UK bond markets from Sabre II, we first match the information on bonds in Sabre II with the relevant information in the UK Listing Authority (UKLA) Official Lists.[19] All available lists from 2008 to 2011 are used to avoid excluding bonds that expired or were cancelled during the sample period. Approximately 11,000 different UK-listed bonds traded in this period.

To enhance our dataset with additional bond characteristics and daily price data, we then match our database to information available in the Thomson Reuters Datastream. The final dataset contains about 15 million transactions, with detailed information on trades of approximately 9,000 UK-listed bonds.

We take several steps to improve the quality of the data and control for outliers, errors and duplicates in the dataset. First, we exclude all transactions carried out on weekends and UK bank holidays. In our dataset, many trades will be reported twice, once from the buyer side and once from the seller side, so to avoid double counting we keep only the buyer side, ie transactions reported by the counterparty purchasing the bond. This procedure eliminates double-counting in cases where both counterparties are reporting to the FCA, but likely underestimates the total number of trades since sell-side transactions with a non-reporting counterparty are dropped.[20] We convert trades in US dollars and euros to British pounds using daily exchange rate data. Finally, we observe one firm executing a large number of very small transactions in June and July 2011 in one instrument on the London International Financial Futures and Options Exchange (LIFFE). As we do not know if this is due to misreporting, we drop all trades carried out on this exchange on the last two months of our sample period (June and July 2011).[21] Apart from this specific example, we do not see any evidence of potential high frequency trading (HFT) in the dataset. However, it is possible that HFT activity in the most liquid bond markets became more prevalent in more recent years. See, for example, Jiang et al (2013) for evidence of HFT in US treasury markets and Cardella et al (2014) for an explanation on why the corporate bond markets have only suffered modest changes in their trading process due to algorithmic trading.

17 The presence of some non-EEA listed bonds in the dataset can be explained by secondary listings in EEA regulated markets or by over-reporting of UK firms.
18 All bonds admitted to trading in an EEA regulated venue will be within the scope of MiFID II non-equities transparency regime. Therefore, all the bonds in our sample fall under the scope of this regime.
19 The Official List is a list of securities maintained by the FCA that meet the requirements to be listed.
20 There might also be double-counting of transaction carried out on behalf of a client if both principal and agent report their trades.
21 The transactions dropped represent less than 0.0001% of volumes traded in the relevant sample period.

When calculating volumes and trade sizes, to control for erroneous transaction reports, we exclude trades for which the unit price exceeds the Thomson Reuters default price on the day by more than 100% and trades for which the unit price is less than half the Thomson Reuters default price. For these variables, we also exclude trades for which the amount traded exceeds the total issue size of the bond and those for which the currency of reference price does not match the currency in which the trade is reported.

Stylised facts

The UK bond market is very diverse; the number of UK-listed bonds is large and they can have very different characteristics. Using the information available in Datastream, we can classify each bond by issuer type (sovereign, financial, corporate), residence of issuer, issue size and bond type (fixed rate, floating rate, zero coupon, etc).[22] (See Table 1.) By number of bonds, the vast majority of the UK-listed bonds in our sample are issued by financial institutions; sovereign bonds and corporate non-financial bonds comprise less than 20% of all bonds in the dataset. More than half of the bonds have an issue size of £100 million or above. Also, most bonds have fixed rates (41%), followed by a significant proportion with floating rates (33%). The UK bond markets are very international with around 37% of all bonds being issued by firms that are resident outside the UK and more than 60% of UK bonds being issued in foreign currency. A large share of trades (by number of trades) is carried out in currencies other than the British pound, in particular in US dollars and euros (Figure 1). On average, only 53% of trades are carried out in British pounds per day and this share does not change significantly throughout the sample period.

Table 1: Number of UK-listed bonds by issuer type, residence of the issuer, issue size bond type and currency

Issuer type		Residence of issuer	
Financial	79.0%	UK	63.2 %
Corporate non-financial	8.3%	USA	9.3 %
Sovereign	6.4%	Netherlands	3.4 %
Supranational	2.5%	Australia	2.6 %
Sub-sovereign	1.9%	Sweden	2.5 %
Agency	1.8%	Other	19.0 %

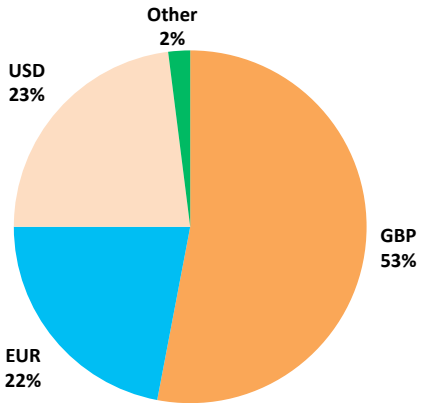
Issue size		Bond type	
< £1m	3.1%	Fixed rate	41.4%
£1m - £10m	13.6%	Floating rate	33.1%
£10m - £100m	30.5%	Index linked	12.7%
£100m - £1bn	44.9%	Zero coupon	11.1%
> 1bn	7.9%	Convertible	1.7%

22 The dataset has missing characteristics for a significant number of instruments. Information on the issuer type is missing in 50% of the bonds, the residence of the issuer in 60%, the issue size in 5% and the bond type in 4%. There was no missing information for currency. The statistics in Table 1 are calculated excluding bonds with missing values in the characteristic of interest; nevertheless, we cannot exclude the possibility that bonds with missing information are structurally different to those bonds with information available.

Currency	
GBP	39.5%
Euros	29.5%
US Dollar	22.1%
Other	8.9%

The statistics in this table are calculated excluding bonds with missing values in the characteristic of interest (see Footnote 22).

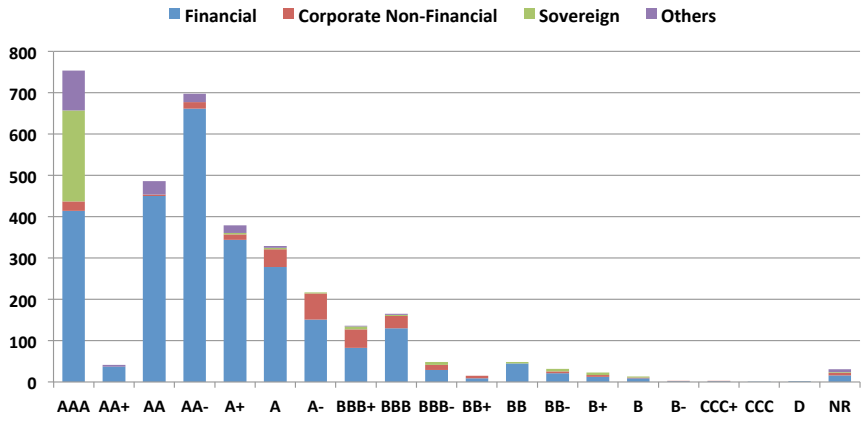
Figure 1: Number of trades by currency (as % of total)



Bonds also differ in their credit ratings and, therefore, their perceived risk. Most UK-listed government bonds are highly rated while corporate non-financial bonds seem to be more frequently, both in absolute and relative terms, in the middle of the investment grade segment (Figure 2). Analysis of the monthly total number of trades and total volume traded shows that most trading takes place in highly rated government bonds[23] (Table 2 shows the median total monthly values). In the financial and corporate non-financial bond sectors, medium rated bonds are the most actively traded in absolute terms. For corporate non-financial bonds, this result follows from the fact that most of these bonds are medium rated. In contrast, most of the financial bonds are highly rated but most of the trading is done on medium-rated bonds. So, when analysing the trading on relative terms, normalised by the relative number of bonds in each category, the prime sovereign bonds are the most actively traded followed by the medium and speculative grades of financial and corporate non-financial bonds (see Table A.1 in the annex).

23 We classify bonds using the S&P bond ratings as follows: prime (AAA), high grade (AA+ to AA-), medium grade (A+ to BBB-), speculative (BB+ to B-), vulnerable (CCC+ to C) and default.

Figure 2: Number of bonds by issue rating



The ratings are the S&P bond issue ratings at the first day of trading. Bonds without information on issue rating or issuer type are excluded.

Table 2: Median monthly number of trades and volumes in billion GBP by rating class

	Financial		Corporate non-financial		Sovereign		Other	
	(# of trades)	(volume)	(# of trades	(volume)	(# of trades	(volume)	(# of trades	(volume)
prime	1444	1.77	20	0.01	71122	359.09	688	0.22
high grade	5215	3.63	238	0.12		0.00	534	0.66
medium grade	18047	10.77	6792	2.35	277	0.28	195	0.147
speculative	2980	1.19	848	0.28	401	0.16		0.00
vulnerable	258	0.08	3	0.00		0.00		0.00
not rated	242	0.10	141	0.06		0.00	5	0.00

Medians of the total number of trades and volumes by month and rating class. Ratings are S&P bond ratings classified as follows: prime (AAA), high grade (AA+ to AA-), medium grade (A+ to BBB-), speculative (BB+ to B-), vulnerable (CCC+ to C), default and not rated. Bonds without information on issue rating or issuer type are excluded.

When analysing bonds, we observe that the majority of bonds trade less frequently than shares and are characterised by episodic liquidity. Different to equities, many investors hold bonds until maturity and, therefore, do not trade the bonds. Another explanation is that some credit default swaps (CDS) could be more liquid and easier to locate than the underlying reference bond (see, for example, Oehmke and Zawadowski (2014)), so traders could use them as substitutes. Firms and sovereigns also issue many different types of bonds, not all of which are traded actively. In general, trading frequencies vary over the lifetime of a bond, with most active trading taking place directly after issuance ('on the run' bonds). These facts make the design of transparency rules challenging.

In our sample, about 10% of the bonds trade only once in the whole sample period, 50% of them trade less than 50 times and less than 15% trade more than 1000 times. However, there is a high dispersion within each bond type.

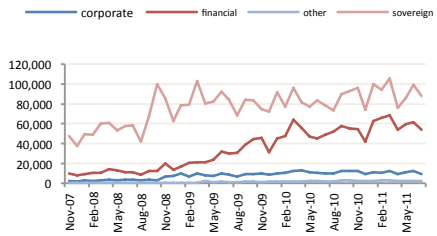
We also observe that trading is highly concentrated in a small number of bonds. Around 20% of all transactions in the dataset were carried out in about 20 highly-rated government bonds, 50% of all trades took place in less than 35 instruments and less than 1,000 instruments were responsible

for about 90% of all transactions. In the sample, most traded government and financial bonds traded on average about 6,500 and 1,200 times per month, respectively. In particular, corporate non-financial bonds are traded most frequently in the first month after issuance.

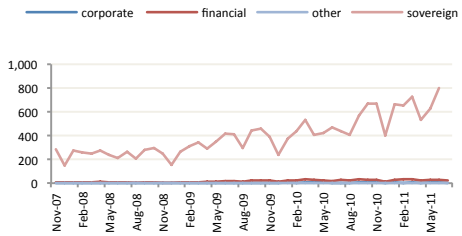
We observe similar characteristics when analysing the time series of the aggregated monthly number of trades and volume by sector. In aggregate, government bonds and bonds issued by financial institutions are the most actively traded instruments (Figure 3.a).[24] The largest total volumes traded are in sovereign bonds (Figure 3.b), indicating that the trade sizes of sovereign bonds are considerably larger than those for other types of bonds (Figure 4.a) on average. This finding seems to be driven by few large trades, since the median trade sizes are comparable across bond types for most of the sample period (Figure 4.b). Interestingly, monthly volumes of government bonds roughly doubled during our sample period, possibly reflecting increased issuance of government debt and investors' avoidance of more risky investments since the start of the financial crisis.

Figure 3: Aggregate number of trades and volume by month and issuer type

a) Number of trades



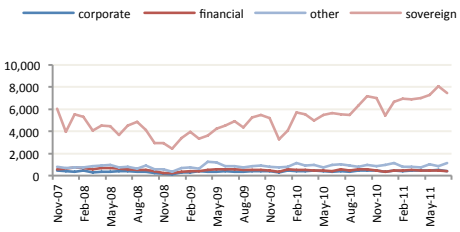
b) Volume (in billion GBP)



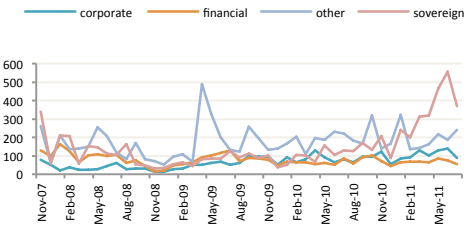
Bonds without information on issuer type are excluded.

Figure 4: Mean and median trade size by month and issuer type

a) Mean (in thousand GBP)



b) Median (in thousand GBP)



Bonds without information on issuer type are excluded.

The vast majority of bond trades in our sample are executed off-exchange or on the London Stock Exchange (LSE). Unfortunately, the data does not allow us to distinguish between bilaterally-arranged trades on the LSE and trades that were made on the electronic order book.[25] If we further analyse the distribution of trades by size over the most frequently used

24 On aggregate, the financial bonds trade more than the corporate non-financials, but this is mainly because the majority of bonds issued are financial ones.

25 Off-exchange transactions are reported as if they were carried out on a regulated market where a transaction, bilaterally agreed between the parties and executed off-book, is agreed by the parties to be reported under the rules of a regulated market/ multilateral trading facility (MTF).

trading venues (see Table A.2 in the annex), we find that some venues are more frequently used to execute large trades while others are predominantly used for retail sized orders (£100,000 being the threshold below which a bond trade is deemed to be of retail size).[26] For example, Extramot is the order book-driven corporate bond exchange of the Italian stock exchange, with high levels of pre- and post-trade transparency. Extramot provides for the presence of specialists who support the liquidity of the traded instrument. Most of the trades executed on this exchange are smaller than £100,000; large transactions are not executed on this trading venue. The distribution of the trading in the different venues also gives an overview of the current levels of pre- and post-trade transparency in the market, for example, LSE introduced an order book for retail bonds with higher levels of pre- and post-trade information (LSE, 2013).

We explore the different levels of transparency further by matching the sample bonds with price information provided by Thomson Reuters Datastream. For about 90% of trades, we were able to find end-of-day price-quotes, ie, we could obtain the Iboxx end-of-day mid-price, the Thomson Reuters default price or the official closing price. Therefore, some degree of information is available to some market participants but only to those subscribed to information services.

When looking at participants' primary FCA regulated activity type[27], we found that most trading is carried out by banks, followed by stockbrokers and market makers (see Table A.3 in the annex).[28] The classical buy-side investors, like financial advisers and investment managers, play a much smaller role.[29]

To summarise, when comparing corporate bonds (including financial ones) with sovereign bonds, we find that they differ in various aspects. The issue size is, on average, smaller for corporate bonds than sovereign bonds; while sovereign bonds are mostly larger than £1 billion, corporate bonds are mostly issued at sizes between £100 million and £1 billion. They also differ in terms of rating quality, with corporate bonds having lower ratings on average. Issuers of corporate bonds are mostly financial institutions, followed by utilities and other capital intensive industries and a same corporate issuer will usually issue various bonds with different characteristics (maturities, currencies, coupon structures, etc). While about half of the sovereign bonds in the sample are zero coupon bonds, most corporate bonds are floating rate bonds. Corporate bonds are also traded less frequently; some government bonds are traded regularly more than 1,000 times per month, while even the most actively traded corporate bonds rarely trade more than 1,000 times per month. The largest trades are most frequently executed off-exchange. Trade sizes vary substantially across and within asset classes with the largest trades occurring in sovereign bonds. These descriptive statistics emphasise how segmented the bond market is; any change to transparency requirements in this market could have a large impact on at least a subset of trades, traders and issuers.

26 'Under the Prospectus Directive, the regulatory regime distinguishes between 'wholesale' bonds, which are tradable in units of £100,000 or greater and 'retail' bonds tradable in smaller size' (see LSE (2013)).

27 Regulated activity is not necessarily the only activity of a firm, nor is it necessarily the activity under which the observed bond market trading would fall. However, it is the only categorisation available and gives a rough overview on which kinds of firms trade in the different segments of the bond market.

28 As explained in the data section of this paper, Sabre II reports each trade twice, once from the buyer side and once from the seller side. In this paper, we only look at the transactions reported by the counterparty purchasing the bond (buyer side) to avoid double counting. Therefore, when analysing the regulated activity of those firms trading, we only use information on the firms buying the bonds. We would not expect the results to change considerably if we also look at the sellers' side. Further analysis could be done to confirm this.

29 This result needs to be interpreted carefully as we are only looking at who is trading and not on behalf of whom. Even if the largest holders of bonds tend to be institutional investors, their trades may be executed by brokers/dealers and therefore reported by them.

An analysis of transaction costs

In this section, we assess market quality by looking at transaction costs measured by the spread over a variety of benchmark prices. The spread serves as a proxy for the bid-ask spread and for market impact costs. The bid-ask spread is the difference between the price offered for selling a bond and the price offered for buying a bond. It is both a measure of transaction costs and liquidity. Determinants of the bid- ask spread, commonly identified in the literature, are order processing costs, inventory costs and adverse selection.[30] We measure the costs of trading for each transaction i on day t for bond j as:

$$Spread_{it}^{j} = 2 \times Abs\left(\frac{transaction\ price_{it}^{j} - benchmark\ price_{t}^{j}}{benchmark\ price_{t}^{j}}\right)$$

where the benchmark price is either of the Datastream selected default price, the Iboxx mid-price, the Thomson Reuters evaluated mid-price or the daily average price of each bond using our dataset.[31] We recognise this is a rough measure as we compare intra-day prices with an end-of-day benchmark. A similar approach has been used, for example, in Hendershott and Madhavan (2014). An estimate of the bid-offer spread is analysed in a case study for one UK gilt (see Box 1) using intraday TradeWeb mid-prices.[32]

Table 3 shows summary statistics for each of the different spread measures and Figure 5 plots the average daily spread over time for corporate bonds (including financial ones). The spread estimates are not weighted by transaction size, ie, small trades receive the same weight as large trades. We can see that corporate bond spreads are typically larger than sovereign bonds spreads and peak during the financial crisis. Spreads are significantly higher for small transactions than for larger ones. This finding is robust throughout all measures of transaction costs. We also find trades carried out in UK pounds to be more expensive than trades carried out in euros, consistent with findings by Biais et al (2006).[33]

The differences in spreads for large and small transactions are consistent with findings on the US and European corporate bond markets (Biais et al (2006)) but not with evidence from stock markets where larger trades are typically more costly, presumably because of liquidity providers' risk of trading with informed traders. Possible explanations for this difference are high fixed and search costs in dealer markets, compared to electronic markets that may lead to market power for brokers dealing in retail-sized bonds. Different to equity instruments, adverse selection and inventory costs might not play a substantial role in the bond market allowing market participants to trade large amounts at lower transaction costs.

30 See, for example, Huang and Stoll (1997).

31 The Datastream selected default price is the best available price for a bond selected by Datastream. For liquid bonds, it is typically the composite bid price, the Thomson Reuters evaluation bid price or the Iboxx mid-price. The Thomson Reuters evaluated mid-price is derived from Thomson Reuters pricing service. For robustness of the spread over the average price, all bond-day observations with less than 10 trades per day are dropped. Also trades with spreads of more than 50% are dropped.

32 The UK gilt studied has the ISIN GB0031829509.

33 The authors explain this result with the fact that the European bond market is quite integrated so banks from one country can easily deal with investors from another country of the Eurozone.

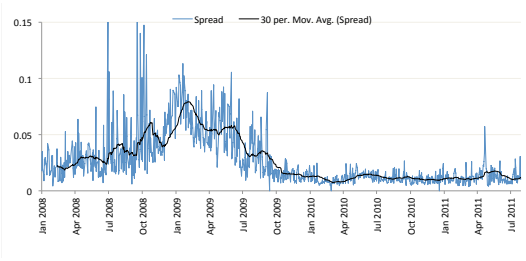
Table 3: Summary statistics of bond spreads

	Thomson Default	IBOXX	Thomson mid	Average price
Average spread				
Financial	0.0220	0.0177	0.0133	0.0071
Corporate non-financial	0.0197	0.0280	0.0100	0.0077
Sovereign	0.0110	0.0046	0.0134	0.0099
Total	0.0131	0.0076	0.0133	0.0093
Difference in spreads – small vs large trades				
small-large	0.0088***	0.0040***	0.0081***	0.0029***
Difference in spreads – currencies				
£-€	0.0033***	-0.0006***	0.0060***	0.0064***

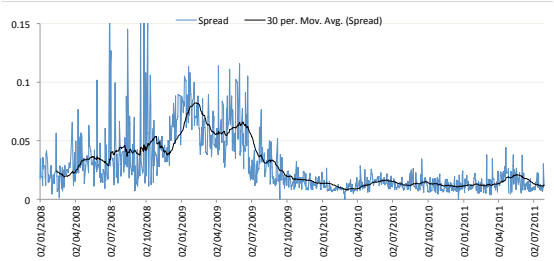
*Small are trades with values below £100,000; large are all other trades. *** represents significance at the 1% level.*

Figure 5: Corporate bond spreads

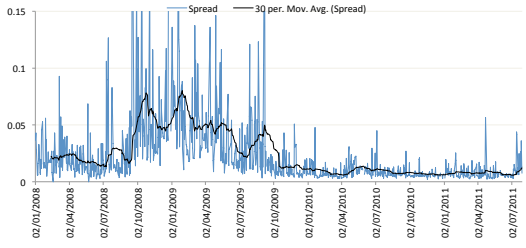
a) All



b) Nominal value: Less than £100,000



c) Nominal value: £100,000 to £1 million



d) Nominal value: Larger than £1 million

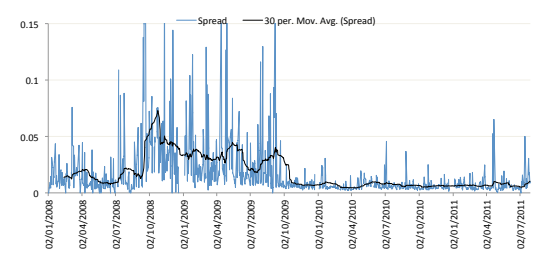
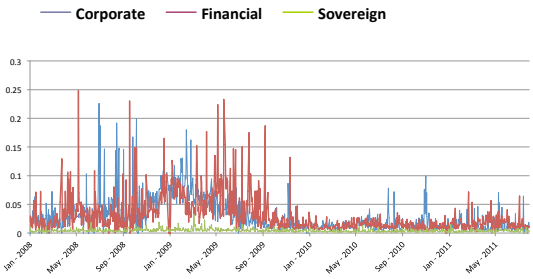


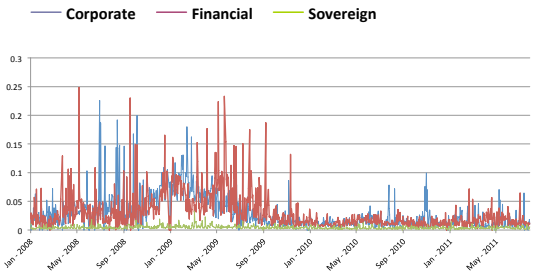
Figure 5 shows the average daily spreads of transactions carried out on-exchange and off-exchange by issuer type (see Table A.4 in the annex for an analysis by transaction size). We can see that spreads of transactions carried out over the counter (OTC) are marginally lower than of those carried out on trading venues. This result should be interpreted with care, given our measure of bid-ask spread and that we cannot distinguish between transactions carried out on an electronic order book and carried out bilaterally on the LSE. Additionally, the result may be partly explained because larger trades, which have smaller spreads, are more frequently traded OTC. Again, we see that transaction costs are decreasing with trade size.

Figure 6: Bond spreads by trading venue

a) OTC



b) On trading venues



To shed some more light on the different factors influencing trading costs, we regress our measures of bid-ask spreads on various bond and issuer characteristics (Table 4). We use different specifications based on the following regression:

$$\begin{aligned} Spread_{it}^{j} \;=\; & \alpha + \beta_1 \ln(issuesize^{j}) + \beta_2 maturity_t^{j} \\ & + \beta_3 age < 3\ months_t^{j} + \beta_4 medium_{it}^{j} + \beta_5 large_{it}^{j} \\ & + \beta_6 volatility_t^{j} + \beta_7 OTC_{it}^{j} + \sum_{n=1}^{16} \beta_{n+7} rating_n^{j} + \varepsilon_{it}^{j} \end{aligned}$$

where Spread is the cost measure for each transaction i on day t for bond j, issuesize is the amount issued in GBP, maturity is the number of months until redemption, age < 3 months is a dummy that indicates if the trade happened during the first three months after issuance, medium is a dummy indicating trades with amounts traded between £100,000 and £1 million, large is a dummy indicating trades above £1 million, volatility is the daily standard deviation of bond returns over a 250 day window, OTC is a dummy indicating if the transaction was carried out off-exchange and rating are dummies for each AAA to B- rating.

The model is estimated using ordinary least squares (OLS) where standard errors are clustered at the bond level. Date and industry fixed effects are used in some specifications.

If asymmetric information or inventory costs played an important role in determining transaction costs of bonds, we would observe larger spreads for riskier bonds. Under asymmetric information, dealers would only trade at a larger spread to avoid trading at an unfavourable price with an informed counterparty. Risk-averse dealers or dealers with only limited capital would demand a higher spread on riskier trades as compensation for their inventory being exposed to adverse price movements. Consistent with these two explanations, playing some role for the cost of trading, we see in the third column of Table 3 that spreads are larger for bonds with higher volatility and lower ratings. The bond-rating dummies excluded are those for unrated bonds. With a few exceptions, spreads seem to be decreasing in bond rating, as expected. Surprisingly, however, AAA-rated bonds are associated with larger spreads than bonds with lower rating.

We also find that other bond characteristics influence spreads. Issue size and maturity are significant determinants. Bonds have lower spreads in the first three months after issuance and the spread depends on the maturity of the bond. This is consistent with findings in other markets, for example, Fabozzi and Fleming (2000). Therefore, any transparency regime will have to take into account that bond liquidity is not static but changes over time.

Table 4: Regression of the average daily spread on issuer and bond characteristics

Variable	IBOXX	IBOXX	IBOXX	Thomson Default	Value Weighted average
ln(issue size)	-0.0041***	-0.0039***	-0.0032***	-0.0062	-0.0040
Maturity	0.0001***	0.0001***	-0.0000	0.0003	0.0002
age < 3 months	-0.0013***	-0.0005		-0.0028***	-0.0030**
Medium		-0.0012***	-0.0001***	-0.0042**	-0.0028**
Large		-0.0008***	0.0000	-0.0060**	-0.0065**
Bond volatility			0.8056***		
OTC		-0.0008***	-0.0010***	-0.0014***	-0.0001
AAA	-0.0029**	0.0001	-0.0030***	-0.0028	-0.0051**
AA+	-0.0235***	-0.0226***	-0.0229**	-0.0208**	-0.0171*
AA	-0.0161**	-0.0148*	-0.0133**	-0.0161*	-0.0163*
AA-	-0.0160**	-0.0132*	-0.0112*	-0.0152	-0.0189*
A+	-0.0161**	-0.0144*	-0.0129**	-0.0142	-0.0139*
A	-0.0173**	-0.0145*	-0.0093	-0.0160	-0.0158*
A-	-0.0138*	-0.0104	-0.0095	-0.0114	-0.0141
BBB+	-0.0162**	-0.0139*	-0.0132**	-0.0144	-0.0143
BBB	-0.0139*	-0.0119	-0.0108*	-0.0129	-0.0136
BBB-	-0.0195**	-0.0183**	-0.0184***	-0.0172	-0.0175*
BB+	-0.0035	-0.0029	-0.0336	-0.0120	-0.0143
BB	0.0411	0.0417	0.0486	-0.0077	-0.0158
BB-	0.2631***	0.2683***		-0.0020	-0.0094
B+	0.2938***	0.2946***	0.2677***	-0.0097	-0.0178
B				-0.0070	-0.0140
B-				-0.0206	-0.0147
Constant	0.1039***	0.1011***	0.0808***	0.1794*	0.0971
Date fixed effects	Yes	No	Yes	No	No
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
R2	0.4359	0.3835	0.3424	0.0372	0.0318
# observations	2,808,184	2,808,184	2,313,485	3,999,4850	4,124,069

*Issue size is the amount issued in GBP. Maturity is the number of months till redemption. Medium are trades with amounts traded between £100,000 and £1million. Large are trades above £1million. OTC is a dummy that takes value one if the transaction was carried out off-exchange. AAA to B- are S&P bond rating dummies with the dummy for unrated bonds omitted. Dummies are used to specify the industry (ie, technology takes value one if the issuer is from the technology sector). Standard errors are clustered at the bond level. *, **, and *** represent significance at the 10%, 5% and 1% levels, respectively.*

In columns two to five of Table 4, we regress the spread on bond characteristics as well as on trade size dummy variables and on a dummy variable that takes value one if the trade is carried out OTC and zero otherwise. Confirming our previous analysis, we see that large trades have lower spreads compared to small trades. It is however important to keep in mind that trade size is a choice variable of investors, eg, informed investors may choose to split orders to achieve better execution prices and this (and counterparties' reaction to it) may be reflected in spreads.

We also see lower spreads for trades carried out OTC. These relationships hold when controlling for time and bond characteristics. When interpreting the coefficients, it is important to note that trading costs are determined endogenously, eg, traders will select the platform/counterparty that offers the cheapest way to execute their trade. At the same time, the prices offered by brokers/market makers will differ depending on factors such as the information content of the trade and the riskiness of the bond traded. Regressing the trading costs on market features such as the chosen venues or trade sizes only provides us with a descriptive analysis of the market, it does not allow for causal arguments about the relationship between market features and the costs of trading, ie, the fact that OTC trades are carried out at a lower spread than on-exchange trades does not imply that moving an on-exchange trade to the OTC market would reduce transaction costs.

Market structure of the UK-listed bond market

As explained before, both asymmetric information and competition are impacted by market transparency. More transparency could increase competition, but it could also lead participants to exit the market, adversely affecting competition. We have also seen that asymmetric information plays a role in the bond market, with spreads being influenced by overall market conditions and bond ratings. We have seen evidence of spreads depending on transaction sizes and varying by venue. Bargaining power of brokers/dealers and market makers in certain segments of the UK bond market may be a reason for these observations. Therefore, we take a closer look at the market structure and the market shares of the different market participants.

To look at the market structure we use FCA internal classifications to identify reporting firm type and counterparty type. One should note however the potential shortcomings of these classifications: First, the FCA classification links a firm to its primary regulated activity which can only be seen as a rough proxy of the capacity in which it is trading. Second, we can identify only a subset of all counterparties (ca. 60%), which may bias the results.

We find that almost 90% of all trades have a broker-dealer as the reporting firm. 60% of trades are done between broker-dealers, about 30% between asset managers and broker-dealers, and only 0.5% of transactions are carried out directly between asset managers. We therefore see a market structure in which broker-dealers play a central role in facilitating trades.

An initial inspection of the data suggests that concentration of broker-dealers varies by segment within the UK-listed bond market. For sovereign bonds, the 10 most active market participants are responsible for about 50% of all trades recorded; in the corporate bond market, the most active 10 participants executed about 40% of all trades. At LSE and off-exchange, the cumulative share of the ten largest traders was 60% and 55%, respectively. Of all transactions carried out through Tradeweb 97% could be attributed to the ten largest traders.

While this analysis gives an initial overview of concentration, more work would be necessary to understand how competition in the market actually operates and if there are any detrimental effects on investors. To define the relevant economic market for a certain bond or group

of bonds, one would need to assess—among other things—the willingness of investors to substitute from these bonds to alternative investments. One would also need to consider additional factors, such as network and reputational effects, economies of scale or other entry barriers, and how they affect concentration and ultimately competition in these markets.

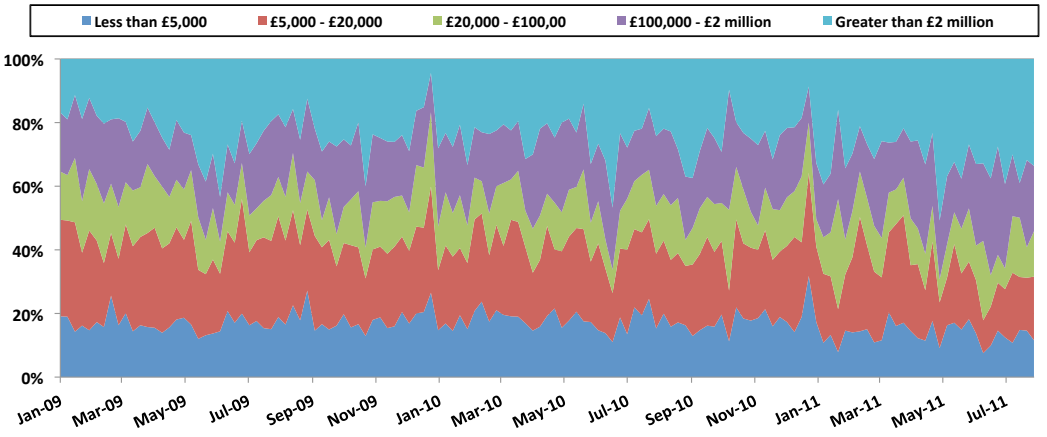
Box 1

An analysis of a single UK gilt

As a case study, we analyse the trading activity of one UK benchmark gilt to explore, in depth, some features that are likely to be important when developing a transparency regime, ie, transaction size and cost of trading. Benchmark bonds are usually liquid instruments that, in normal circumstances, have very little risk attached to them; the selected bond had these characteristics. We also chose a bond that at least at some time was in the 5 or 10 year maturity bracket and issued after the beginning of 2002 ie, after the advent of the euro. The selected bond was issued on 24 July 2002, pays a coupon of 5%, expires 7 September 2014 and had an initial issue amount of £37.4 billion. Trading activity is episodic, fluctuating from several million pounds of activity one day to billions of pounds the next one.

Trading in this gilt covers the full continuum of trade sizes (Figure 7). Retail value transactions are important, constituting more than half of all transactions in this instrument. While retail size transactions constitute an important part of the market for this bond, we observe from Figure 7 that their importance has been declining and that trading activity has become increasingly dominated by large value transactions.

Figure 7: Trends in transaction value



We now try to assess market quality by looking at transaction costs measured by the bid-ask spread. Since we do not observe price quotes, we calculate the bid-offer spread for each transaction as twice the absolute difference between the transaction price and the contemporaneous mid-price. We obtain this last information from TradeWeb, which provided us with a time series of bid, ask and mid-prices corresponding to the nearest minute of each of the FCA transaction records. If these mid-prices reflected the true value, this procedure would yield the spread a buyer or seller would have to pay for carrying out the transaction. The time series goes from January 2009 to August 2011.

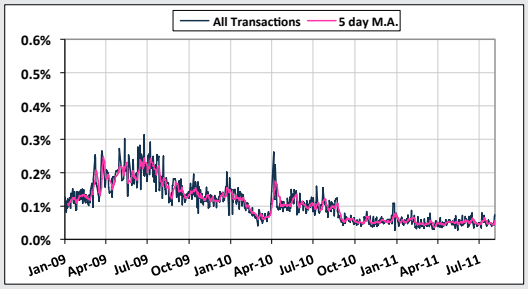
Figure 9.a reports the daily average bid-ask spread based on all transaction reports for the UK benchmark bond from January 2009 to July 2011. It is clear that the average spreads became much tighter over the period, declining from an average value of 20 basis points (bps) to 5 bps.

Overall, the cost of trading in this gilt has fallen on average over this period. When examining the spreads of different transaction sizes, on the basis of the nominal value of the transaction, there is a clear size effect.

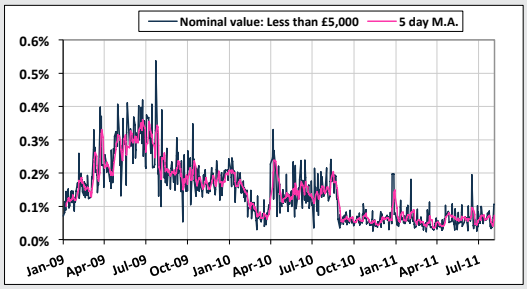
Figure 8 shows that, as the nominal value of the transaction increases, the observed spreads (and their volatility) decrease. This suggests that spreads are tighter for larger transactions. For instance, the average spread for transactions over £2 million was 6 bps and thus approximately one-third of the size of the average spread for transactions less than £5,000 (15 bps). However, spreads on the retail side have dropped significantly over time, possibly a consequence of increased competition and the introduction of electronic trading platforms.

Figure 8: Daily average observed spreads for the UK bond by market segment

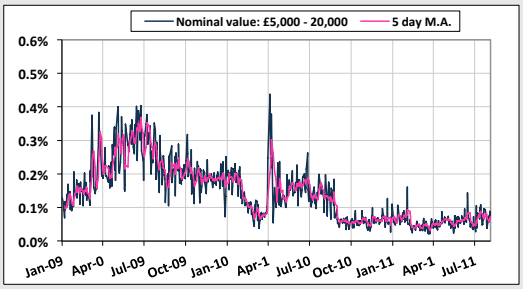
a) Nominal value: All



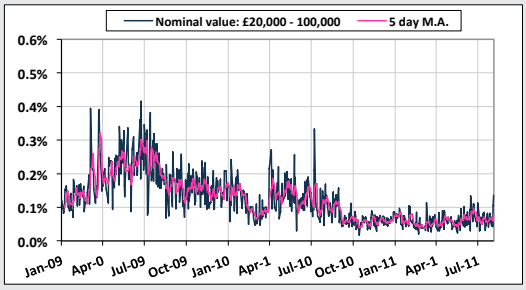
b) Nominal value: Less than £5,000



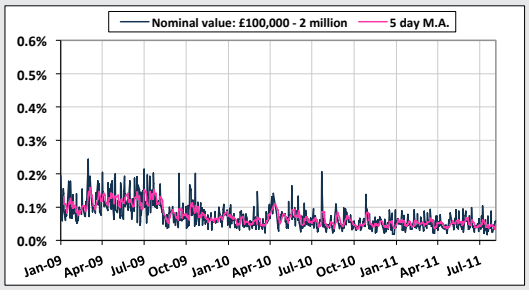
c) Nominal value: £5,000 to £20,000



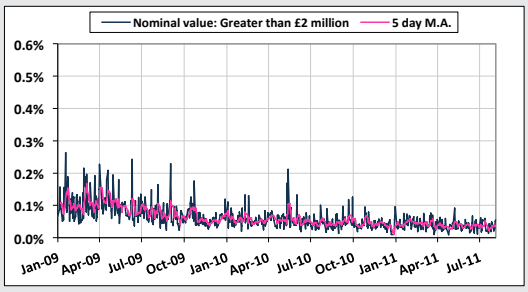
d) Nominal value: 20,000 to £100,000



e) Nominal value: £100,000 to £2 million



f) Nominal value: Larger than £2 million



While this work gives an initial overview of concentration, more work would be necessary to define the appropriate markets and to better identify liquidity providers in each segment. The analysis presented in this section focuses on the degree of concentration in the UK bond market but the use of HHIs is only one factor to assess competition and the well-functioning of a market. To understand how competition in the market actually operates and if there are any detrimental effects on investors, a more comprehensive assessment would be required. This would need to consider additional factors, such as network and reputational effects, economies of scale or other entry barriers, and how they affect concentration and ultimately competition in these markets.

4. Conclusions

Using a very granular and comprehensive dataset, the FCA's transaction reports, we analyse the structure and characteristics of the UK-listed bond market to get an initial insight into the fragmentation and level of competition in these markets. Overall, bond market characteristics vary considerably across and within types. While most bonds are only traded episodically, some bonds are rather liquid and trade frequently at different venues, in various sizes, and at different points of their lifetime. Most transactions are large and carried out off-exchange. Stockbrokers, market makers and wholesale banks are the most important counterparties in each of the different segments of the market. There is also an active retail segment, with niche trading venues focusing on it.

Transaction costs in our sample, measured by spreads over a benchmark price, are negatively related to the overall transaction size across many venues. This seems to be a stylised fact that can be observed in many bilateral markets and may, at least in part, be explained by market power on the side of brokers and market makers. We find that transaction costs react to measures of risk in the predicted way; riskier bonds with lower ratings are traded with larger spreads. Transaction costs do also vary over the lifetime of a bond, highlighting the difficulty of setting appropriate transparency requirements. Eventually we find that transaction costs seem to have been decreasing over time.

On transparency, we found that price quotes for a large proportion of bond trades can be observed by market participants, for example, through Markit's Iboxx. This indicates that some level of pre-trade transparency is a reality for a large share of instruments for at least those investors subscribed to this kind of information services.

We see that trades of large and very large sizes are a key feature of UK bond markets and we would expect post-trade transparency requirements to impact the willingness of counterparties to carry out these transactions and, therefore, impact market quality. However, we have not analysed in detail the hedging behaviour of market participants, eg, the speed at which dealers reduce risky positions on their books. Further analysis would be necessary related to such specific MiFID II proposals.

Changes to the transparency regime could have an effect also on competition in the bond markets, eg, by improving the comparability of prices for investors. However, the expected effect of higher levels of transparency is not unambiguously positive. We provide an initial analysis of the overall structure of the UK bond market and of the level of concentration of broker-dealers. We see a spoke and hub system where broker-dealers play a central role in facilitating trades. Concentration is moderate but we cannot exclude the possibility that some market participants have market power in some segments of the bond market. Further work is needed to examine how competition actually operates in these markets and if there is any detrimental effect on consumers. Future research would have to define the appropriate markets, look at possible entry barriers and address the causal effect of concentration on measures of market quality, eg, by looking at external shocks to the number of dealers in a particular market segment.

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Annex 1

Table A.1: Median monthly volume and number of transactions per bond

Type/ Rating		prime	high grade	medium grade	speculative	vulnerable	default
Financial	(volume in million GBP)	4.3	3.2	10.6	12.2	4.3	0.0
	(number of transactions)	3.49	4.54	17.78	30.41	13.57	0.0
Corporate Non-Financial	(volume in million GBP)	0.5	6.5	11.4	15.1	0.2	
	(number of transactions)	0.86	12.52	33.13	44.63	3	
Sovereign	(volume in million GBP)	1,639.1		10.5	9.9		
	(number of transactions)	323.22		10.25	23.58		
Other	(volume in million GBP)	2.3	11.5	5.2			
	(number of transactions)	7.09	9.37	7.22			

This table shows the median monthly volume in billion GBP and number of transaction normalised by the number of bonds in each category for each issuer type category and rating. Ratings are S&P bond ratings classified as follows: prime (AAA), high grade (AA+ to AA-), medium grade (A+ to BBB-), speculative (BB+ to B-), vulnerable (CCC+ to C), default. Sample period is January 2008 – July 2011.

Table A.2: Number of trades by trading venue and size bucket

Venue	<= £1th	£1th < size <= £10th	£10th < size <= £100th	£100th < size <= £1m	£1m < size <= £10m	> £10m
Panel a: Sovereign						
Off-Exchange	20.74%	44.55%	46.46%	43.61%	79.16%	91.08%
BGC Brokers	0.01%	0.55%	1.48%	2.35%	1.21%	0.24%
Boerse Frankfurt	0.09%	0.01%	0.00%	0.00%	0.00%	0.00%
Boerse Stuttgart	0.15%	0.02%	0.00%	0.00%	0.00%	0.00%
Brokertec Europe	0.00%	0.15%	4.46%	6.55%	0.60%	0.00%
GFI Creditmatch	0.00%	0.08%	0.56%	0.33%	0.01%	0.00%
LSE	62.06%	24.65%	26.79%	36.16%	10.16%	0.00%
Marketaxess Europe	0.02%	0.11%	0.02%	0.00%	0.00%	0.00%
Tradeweb Europe	6.83%	25.46%	13.80%	2.69%	5.22%	2.67%
WCLK *Platform*	0.00%	0.06%	1.77%	3.36%	0.00%	0.00%
Other	10.11%	4.37%	4.66%	4.93%	3.64%	6.01%

Venue	<= £1th	£1th < size <= £10th	£10th < size <= £100th	£100th < size <= £1m	£1m < size <= £10m	> £10m
Panel b: Corporate						
Off-Exchange	60.78%	86.17%	90.17%	91.79%	95.14%	100.00%
BGC Brokers	0.00%	0.20%	0.01%	0.00%	0.00%	0.00%
Boerse Frankfurt	0.51%	0.04%	0.08%	0.00%	0.00%	0.00%
Boerse Stuttgart	1.66%	0.12%	0.00%	0.00%	0.00%	0.00%
Eurotlx	3.72%	0.09%	0.01%	0.00%	0.00%	0.00%
LSE	25.00%	4.39%	3.30%	6.54%	4.86%	0.00%
Marketaxess Europe	0.65%	2.42%	0.00%	0.00%	0.00%	0.00%
Tradeweb Europe	1.36%	3.41%	0.00%	0.22%	0.00%	0.00%
Other	6.32%	3.15%	6.43%	1.45%	0.00%	0.00%
Panel c: Financial						
Off-Exchange	49.90%	84.41%	85.29%	91.95%	98.26%	97.04%
BGC Brokers	0.00%	0.27%	0.64%	0.12%	0.00%	0.00%
Boerse Frankfurt	1.73%	0.17%	0.01%	0.00%	0.00%	0.00%
Boerse Stuttgart	4.00%	0.21%	0.00%	0.00%	0.00%	0.00%
Brokertec Europe	0.00%	0.07%	0.14%	0.02%	0.00%	0.00%
Eurotlx	8.89%	0.23%	0.00%	0.00%	0.00%	0.00%
Extramot	1.58%	0.00%	0.00%	0.00%	0.00%	0.00%
GFI Creditmatch	0.03%	1.82%	4.94%	1.36%	0.00%	0.00%
LSE	25.44%	4.15%	3.35%	4.67%	1.57%	2.96%
Marketaxess Europe	0.58%	2.21%	0.85%	0.07%	0.00%	0.00%
Tradeweb Europe	1.28%	3.89%	1.81%	0.38%	0.00%	0.00%
Other	6.58%	2.56%	2.98%	1.44%	0.17%	0.00%

The trading venues displayed are the ones most frequently reported, all other venues are grouped into 'other'. The first panel displays sovereign bonds, the second panel corporate non-financial bonds and the third panel bonds issued by financial institutions. Each panel shows the percentage of trades carried out in each trading venue for each trade size over the full sample period.

Table A.3: Number of trades by reporting firm type and size bucket

Category	<= £1th	£1th < size <= £10th	£10th < size <= £100th	£100th < size <= £1m	£1m < size <= £10m	> £10m
Panel a: Sovereign						
Other	0.6%	0.9%	1.2%	1.1%	0.3%	0.0%
Advising And Arranging Intermediary	1.3%	5.6%	3.4%	2.9%	0.9%	0.0%
Bank (Other Than Wholesale Only)	28.2%	49.8%	38.7%	30.3%	40.0%	37.9%
Corporate Finance Firm	4.3%	1.9%	0.1%	0.0%	0.0%	0.0%
Discretionary Investment Manager	6.3%	5.5%	4.0%	1.6%	1.3%	0.1%
Financial Adviser	1.8%	0.0%	0.0%	0.0%	0.0%	0.0%
Market Maker	10.6%	13.2%	15.9%	15.8%	7.5%	0.1%
Non- Discretionary Investment Manager	0.7%	4.2%	3.6%	1.4%	1.5%	0.0%
Stockbroker	44.7%	5.7%	1.1%	0.1%	0.0%	0.0%
Wholesale Market Broker	0.8%	8.3%	25.6%	40.1%	8.8%	0.0%
Wholesale Only Bank	0.8%	4.8%	6.3%	6.7%	39.7%	61.8%
Panel b: Corporate						
Other	1.1%	2.6%	3.3%	0.1%	0.0%	0.0%
Advising And Arranging Intermediary	2.2%	4.1%	4.5%	3.5%	7.8%	6.3%
Bank (Other Than Wholesale Only)	34.3%	40.8%	36.6%	36.1%	62.4%	53.1%
Corporate Finance Firm	0.8%	0.2%	0.1%	0.0%	0.0%	0.0%
Discretionary Investment Manager	6.2%	8.3%	9.3%	16.4%	0.0%	0.0%
Market Maker	14.6%	17.6%	14.7%	18.0%	9.8%	21.9%
Non- Discretionary Investment Manager	0.3%	1.6%	2.6%	8.6%	0.0%	0.0%
Stockbroker	33.7%	3.9%	1.5%	1.9%	0.0%	0.0%
Wholesale Market Broker	2.8%	13.0%	19.3%	5.7%	6.9%	0.0%
Wholesale Only Bank	4.1%	7.9%	8.0%	9.6%	13.1%	18.8%

Category	<= £1th	£1th < size <= £10th	£10th < size <= £100th	£100th < size <= £1m	£1m < size <= £10m	> £10m
Panel c: Financial						
Other	2.4%	2.8%	4.0%	2.0%	2.6%	1.2%
Advising And Arranging Intermediary	1.5%	2.8%	3.3%	3.3%	7.1%	7.6%
Bank (Other Than Wholesale Only)	31.0%	40.5%	34.6%	40.6%	51.2%	52.3%
Discretionary Investment Manager	4.9%	6.5%	7.1%	9.1%	1.4%	5.2%
Financial Adviser	3.1%	0.1%	0.0%	0.2%	0.0%	0.0%
Market Maker	14.1%	17.5%	14.9%	17.5%	12.2%	14.5%
Non- Discretionary Investment Manager	0.3%	1.5%	2.1%	3.7%	0.1%	0.0%
Stockbroker	33.9%	4.1%	1.7%	1.1%	0.5%	0.0%
Wholesale Market Broker	3.3%	14.0%	22.2%	12.7%	16.7%	14.5%
Wholesale Only Bank	5.6%	10.1%	10.2%	9.8%	8.1%	4.7%
Wholesale Only Bank	5.6%	10.1%	10.2%	9.8%	8.1%	4.7%

Reporting firm industry is the primary FCA regulated activity of the reporting firm. The first panel displays sovereign bonds, the second panel corporate non-financial bonds and the third panel bond issued by financial institutions. Each panel shows the percentage of trades carried out by each firm type for each trade size over the full sample period.

Table A.4: Average spreads by trading venue and size bucket

Venue	<= £100th	£100th < size <= £1m	£1m < size <= £10m	£10m < size <= £100m	£100m < size <= £1b	> £1b	All sizes
On-exchange	0.0177	0.0110	0.0069	0.0046	0.0040	0.0188	0.0140
Off-Exchange	0.0158	0.0110	0.0080	0.0066	0.0088	0.0115	0.0113
All	0.0173	0.0110	0.0074	0.0054	0.0070	0.0161	0.0131

Bond spreads are equally weighted *and calculated over the* Thomson *Reuters default price.*

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