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European Corporate Bond Markets: transparency, liquidity, efficiency

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1. Introduction and summary[1]

1.1 The role and structure of corporate bond markets

The bond market plays a very important role in the financial systems of our economies. Bond markets bring lenders and borrowers together. They allow lenders to invest in relatively low risk assets and borrowers to obtain funds in relatively liquid markets. Bond markets are important in determining the prices of other assets, and bank interest rates usually follow market-determined interest rates on bonds. The prices determined in the bond markets affect household decisions to save and the corporate sector's investment decisions.

In the United States, the bond market is about the same size as the stock market (Figure 1, Panel A). In Europe, bonds amount to approximately two-thirds of the total amount of securities outstanding (Figure 1, Panel B). But the distribution of the total debt differs significantly between Europe and the United States. In Europe, the bond market is dominated by government bonds and bonds issued by financial intermediaries. In the United States, the proportion of bonds issued by the non-financial corporate sector is much larger. In addition, municipal bonds and agency bonds are major components of this market.

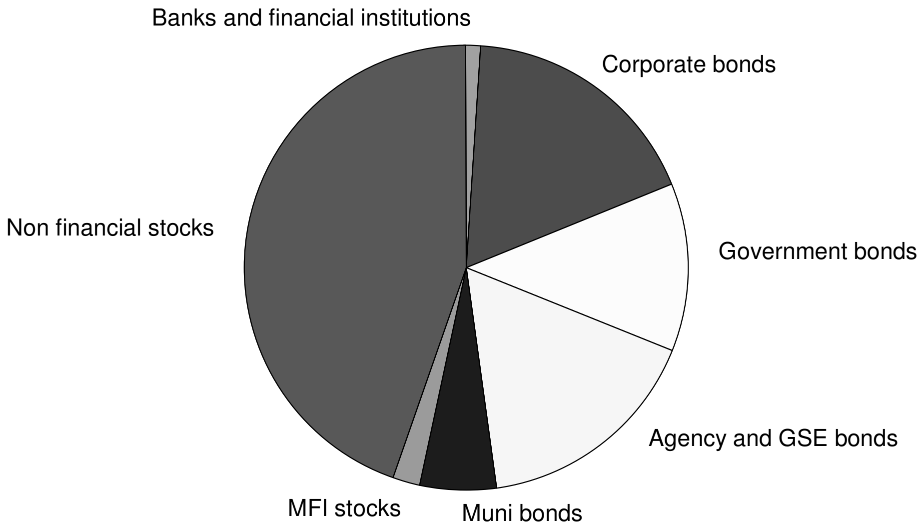
A market so important should operate well. For the bond market, this means both efficiency and liquidity. Efficient bond prices, incorporating all available information, will be better signals to investors and savers than if the markets did not incorporate relevant information fully into prices. Liquid bond markets bring transactions costs down for investors, who therefore achieve greater gains from trade, and they minimise the cost of funds to firms.

Despite the key role of the bond markets, there has been much less academic attention devoted to bond markets than to equity markets. The big gap is in empirical work, and the main reason for this is data availability. Since the 1990s, several stock exchanges (including the London Stock Exchange, the New York Stock Exchange, and the Paris Bourse) have disseminated rich, high-frequency data. Many academic studies have relied on these datasets to illuminate the operation of the stock markets. We now have well-defined measures of transactions costs (e.g., the effective spread – see below), and numerous empirical studies documenting the consequences of several features of the design of these markets (for a survey, see Biais, Glosten and Spatt, 2005). In contrast, there are only a few studies on the bond market, most of these on US Treasuries. But this market is extremely liquid and active, and liquidity is likely to be very different in this setting than for corporate and municipal bonds.

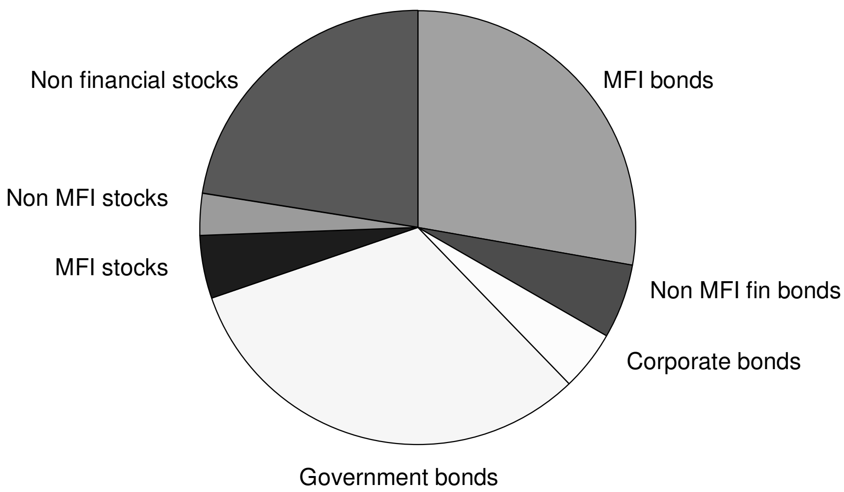
[1] We are very grateful for the help we have received throughout this project from those who have guided it on behalf of the commissioning organisations: Samantha Barrass, Jane Lowe, Richard Britton, and Gordon Midgley have been especially helpful and generous with their excellent comments on our work and their assistance in obtaining data and access for us to those we have interviewed. David Self (ICMA) and David Mark (IIC) have been extremely helpful in providing rich data sets and a lot of their time to discuss them with us. John Hale and Bertrand Huet have also contributed helpful comments. We also appreciate very much the time and thought that our interviewees gave us; we would be pleased to credit them all by name, but that is precluded by our assurance of confidentiality to them. Anil Shamdasani of CEPR put the manuscript in shape for publication, and Viv Davies of CEPR oversaw the administration of the project.

Figure 1: Amount outstanding of stocks and bonds in 2005, by issuer type

A: USA (Source: FED)



B: Euro zone (Source: ECB)



Not only is the bond market less researched than the stock market, it is also vastly different. While the bulk of stock trading is conducted on electronic limit-order books (such as, e.g., Xetra or Nasdaq/Inet), corporate bonds are mostly traded over-the-counter (OTC). Quotes are posted by professional intermediaries: dealers or market makers. Investors contact dealers on the phone, through the intermediation of brokers, or via specialized proprietary electronic communications networks. While stock markets often involve multilateral anonymous communication, corporate bond markets often rely on bilateral non-anonymous communication.

The efficiency of these OTC dealer markets has become an important issue for regulators, investors, and financial institutions. It would be extremely useful to understand the price formation and liquidity supply process in this market. Does it differ from its counterpart in the stock market? If there are differences, are they due to the characteristics of the securities traded, or the microstructure of the market, or the composition of the investor clientele? Is the market structure itself an efficient response to the natural lack of liquidity of corporate bonds, or should it evolve towards more transparency, possibly with more electronic platform trading? Would that increase liquidity and efficiency?

This report deals only with the secondary markets. We offer no evidence and make no judgements here about the quality of the primary markets.

1.2 Transparency in the corporate bond markets

The transparency of the secondary markets for corporate bonds is currently heavily debated, on both sides of the Atlantic. Is the current level of transparency optimal? Or should it be raised? And in this case, will such a change emerge spontaneously from market forces, or is regulatory intervention necessary?

There are at least two types of transparency. Markets are ex-ante (or pre-trade) transparent when investors have access to quote information before trading. Ex-post (or post-trade) transparency refers to the dissemination of information about trades to market participants. These broad categories themselves must be refined. For example, ex-ante transparency is greater if the observable quotes are firm, or if the identity of the agent posting the quote is known, or if all orders are visible (as opposed to hidden). Also, the greater the population of investors observing ex-ante quotes or ex-post-trades information, the greater the level of transparency.

So there are several forms of pre-trade transparency. Do we request that before trading at a price, this price should be announced to all market participants? In that case, do we announce the size of the deal and the participants in the trade? And then do we request that, if someone has a better offer, he or she should be allowed to step in? Or do we mean that answers by dealers to request for quotes should be publicly disseminated?

Similarly, there are several degrees of post-trade transparency, depending on a number of variables. What is reported? – just the transaction price (or rather the yield spread relative to Treasury)? What about the quantity traded? Is there at least an indication of the size of the trade, e.g., below 500,000, between 500,000 and 1 million, above 1 million? Should the direction of the trade also be reported? And with what delay should the information be disseminated?

1.3 Consequences of transparency for market structure

Post-trade transparency, in the forms outlined above, is to some extent separable from other aspect of market microstructure. The market can be order- or quote-driven, electronic-, telephone-, or floor-based. It does not really matter. These features of the market, as well as the offers and the negotiations between the traders, and their information sets, are the inputs of the trade. The price and the quantity exchanged are the output. Post-trade transparency relates only to the output, it remains agnostic about the input.

In contrast, pre-trade transparency relates directly to the inputs of the trade. Changing the degree of pre-trade transparency would require intervening in the microstructure of the market. For example, consider a purely telephone-based dealer market. It is not clear how such a market would support pre-trade transparency. Important changes to its microstructure would be needed. On the other hand, in an electronic limit-order book, pre-trade transparency would be easy to implement.

1.4 The desirability of greater transparency

To assess the case for regulatory intervention to raise transparency, we shall use theory, empirical work, and the results of extensive consultations with market participants. We should stress here that a priori reasoning will not be sufficient, because the arguments can go both ways. For example, as we shall see, theory suggests that transparency may reduce adverse selection, and that in turn will reduce bid-ask spreads on average. Greater transparency may also reduce search costs for investors. Then investors search more, this increases competition among dealers, and that narrows spreads too.

On the other hand, greater transparency could reduce the supply of liquidity. Once a liquidity supplier has purchased securities, he usually endeavours to resell at least part of the purchase, to manage inventory. If his competitors have observed this initial trade, however, they may be tempted to react opportunistically. Knowing he needs liquidity and is willing to pay for it, they will raise its price. Thus after large trades in transparent markets, liquidity suppliers trying to unwind inventory can be in a weak bargaining position. This will increase the margin they will require from investors to offer liquidity in the first place.

Another argument against greater transparency is that it could reduce information acquisition and revelation in the market place. Because transparency reduces the rents earned by informed traders, it reduces the incentives to acquire information.

1.5 Structure of the report

In Section 2.1, we review these and other arguments based on theoretical modelling, and in Section 3 we propose our own model of transparency, liquidity and information in dealer markets. This model is fairly technical, but it has a straightforward conclusion: that the equilibrium level of information acquisition in a transparent market is lower than in an opaque market, while liquidity will be higher in the transparent than in the opaque market. On the other hand, the amount of information actually revealed will depend on the precise characteristics of the market, and we cannot know a priori whether the more transparent market will yield more or less information revelation.

In Section 2.2, we discuss the existing empirical work on these issues, which mainly comes from the American corporate bond markets. In 2002, the Securities and Exchange Commission and the National Association of Securities Dealers launched a system mandating increased transparency for the corporate bond market, through the Trade Reporting and Compliance Engine (TRACE). This has generated a huge volume of data that has been available to researchers. The studies we review find that increased post-trade transparency through TRACE has been associated with lower bid-ask spreads, but not with higher trading volume.

Section 4 discusses the microstructure of European corporate bond markets: how they differ from equity markets; the roles of dealers and electronic trading; regulation; the retail market; and credit default swaps (CDS).

In Section 5 we conduct our own empirical analysis of the European corporate bond market. Using a new, extensive quotes and trades dataset, we find that spreads increase with maturity and default risk and decrease with trade size. Euro-denominated corporate bonds have tighter spreads than sterling-denominated bonds. The liquidity of euro-denominated bonds compares favourably to that of their post-TRACE US counterparts. This is consistent with the presence of a large pool of potential buyers and sellers in the unified euro-area market, attracting competitive dealer liquidity. As theoretical analyses based on asymmetric information would suggest, trades have significant information content, especially for bonds with low credit ratings. Finally, it takes more than one day for the information content of a trade to be impounded fully in market prices – this could result from limited post-trade transparency.

Section 6 summarizes and analyzes our extensive interviews with market participants. Overall, firms believe the market works satisfactorily; sell-side firms are somewhat more positive than buy-side. And most firms do not have strong views on post-trade transparency. Buy-side and smaller firms are more positive here, sell-side and large firms more negative, in some cases strongly so.

Given the current structure of the European corporate bond market, it would take large changes to implement pre-trade transparency, and such changes do not seem to be called for. Our findings suggest that competition is a key driver of liquidity, so public policy should focus on openness and competition. More post-trade transparency could increase competition and hence liquidity; but it could also lead participants to exit from the market, thereby reducing competition and liquidity. Although the effects are therefore ambiguous, we see a case for introducing limited post-trade transparency, either market-led – if incentives permit – or specified by regulation, and we suggest the form that such transparency might take.

2. Previous work on transparency in securities markets

This review of the literature relevant to transparency is necessarily to some extent technical. It does, however, give us hypotheses on what we should expect to observe with changes in transparency – whether imposed by regulators or evolving endogenously in the markets – and also guidelines for our own empirical work. As with much of economic analysis, subtle differences in assumptions, different datasets, or different empirical techniques can give apparently conflicting conclusions. One of our tasks is to suggest reasons why different answers may emerge and how this should affect our own approach to the European corporate bond markets.

2.1 Theoretical analyses

Theoretical analyses have emphasized different aspects of liquidity. This has led to a set of results that is very rich but not unambiguous. We summarize this work by stating its main conclusions.

Transparency can enhance liquidity, insofar as it mitigates adverse selection.

Different information across traders about the value of the assets traded in the market reduces liquidity. To the extent that greater transparency reduces such information asymmetries, it can improve liquidity. Pagano and Roëll (1996) model transparency as the degree to which the size and current direction of the order flow is visible to the competing liquidity suppliers. They note that this relates both to pre- and post-trade transparency. Information about order flow is enhanced if liquidity suppliers can observe trades. All participants also get more information if they can observe the pricing behavior of the liquidity suppliers, from which they can infer at least partly the order flow liquidity suppliers have received. Pagano and Roëll find that greater transparency generates lower trading costs for uninformed traders on average, although not necessarily for every trade size.

Transparency reduces the incentives to acquire information. This can have ambiguous consequences for market quality.

As mentioned above, transparency reduces the profits of the informed agents. To the extent that these agents consume liquidity by placing limit orders, transparency reduces spreads, and thus enhances liquidity for the uninformed liquidity demanders. While many models in market microstructure assume informed agents demand liquidity (e.g., Kyle (1985), Glosten and Migrom (1985) and Biais, Martimort and Rochet (2000)), in practice these agents are likely to also provide liquidity. After all, informed agents are in a good position to place limit orders without being exposed to adverse selection.

Like Grossman and Stiglitz (1980) and Kyle (1989), Rindi (2002) assumes that limit orders are placed both by informed and uninformed agents, while market orders are placed by exogenous liquidity traders. As Grossman and Stiglitz (1980), she endogenizes the proportion of informed agents, by imposing the equilibrium condition that limit order traders be indifferent between purchasing the private signal and not purchasing it. In this framework, she considers different liquidity regimes.

Rindi finds that when information acquisition is endogenous, transparency has ambiguous consequences for market quality. It can actually reduce liquidity for the market orders of the liquidity traders. The intuition is the following. As mentioned above, informed limit order traders are in a good position to supply liquidity: they are not exposed to adverse selection, and they are less reluctant than uninformed traders to take inventory positions, since, for them, the conditional variance of the value of the asset is relatively low. Hence, by deterring information acquisition, transparency can reduce the supply of liquidity.

Transparency can reduce liquidity if it increases inventory costs.

Another argument against transparency is that it could deter liquidity supply. Once a liquidity supplier has purchased shares, she usually endeavors to resell these, to manage her inventory. If her competitors have observed this initial trade, however, they may be tempted to react opportunistically. Knowing she needs liquidity, and is therefore willing to pay for it, they will price it at an expensive rate. Thus after large trades in transparent markets, liquidity suppliers can be in a difficult bargaining position to unwind their inventory. This will increase the margin they will require from investors to offer liquidity initially.

Transparency can improve risk-sharing if it deters gaming.

Naik, Neuberger, and Viswanathan (1999) offer an interesting counterargument to this reasoning. They note that lack of transparency will encourage strategic behavior. In an opaque market, the large, potentially informed investor will initially contact one dealer. The latter will slowly unwind this large trade, by several trades, with different dealers and at different points in time. In each of these transactions, the trader will seek to minimize price impact. Hence she will strategically reduce the size of the trade. This will reduce the overall risk sharing gains from trade in the market place, and, in that sense, its liquidity. In contrast, in transparent markets, as such gaming is made impossible, risk sharing can be greater.

Transparency can improve liquidity if customers have to search for the best quotes.

Biais (1993) compares fragmented opaque markets to transparent centralized markets. In the latter, dealer quotes are fully observable to all participants, i.e., there is full pre- and post- trade transparency. In the former, firm dealer quotes can be obtained only after calling the dealers. Pre-trade transparency in this context has a potential impact on competition among dealers. In a transparent market dealers observe each others' quotes, and can undercut each other. In an opaque market, dealers do not observe each others' quotes. As they are uncertain about the willingness of their competitors to trade (e.g., because they do not know their inventory positions) this affects their quoting strategies.

Biais (1993) shows that, in this context, if customers can freely contact the dealers to ask for their quotes, and then allocate their trade to the best quote, transparency is irrelevant, i.e., the expected spread is the same in the two market structures.

Yin (2005) analyzes the case where customers must pay a search cost to shop around dealers and inquire for their quotes. He shows that, in this case, the transparent market is more liquid than the opaque, fragmented, market. In the latter, since it is costly to search for quotes, customers may end up choosing to trade with a dealer even if he does not have the best quotes. This reduces the incentives of the dealers to post the best quotes, i.e., this reduces competition between dealers. Consequently this widens spreads.

Anonymity can have ambiguous effects on liquidity.

Foucault, Moinas and Theissen (2005) offer a very interesting analysis of the consequences of anonymity for liquidity in limit order markets.

Placing limit orders can be costly, as it can expose the trader to the risk of being executed when the market is moving against him. This is the so-called free-option problem, first identified by Copeland and Galai (1983). In Foucault et al. (2005) there is asymmetric information among limit order traders, which sounds like a reasonable assumption. More precisely, some limit order traders are better informed about the volatility of the asset, and hence about the magnitude of the free option problem.

The authors assume that market participants know who is better informed about volatility. When the market is anonymous, market participants cannot tell if limit orders have been placed by informed or uninformed liquidity suppliers. In contrast, if the market is not anonymous, when better-informed traders post orders the other market participants can conduct inferences about the informational content of these quotes. If the informed limit order traders place tight quotes, this signals that they perceive that the free option risk is limited. This invites the less informed liquidity suppliers to also place quote and compete to supply liquidity. Such competition is costly for the informed liquidity suppliers. To avoid it, they will behave strategically. When they privately observe that volatility is low, they will mix between tight quotes (revealing their information) and wide quotes (similar to those they would have placed if they had observed that volatility was large). The authors call this “bluffing.”

Thus, anonymity will affect traders’ strategies, and correspondingly market liquidity. But its effect is ambiguous. Informed liquidity suppliers always bid more aggressively (i.e. bluff less frequently) when their identities are concealed because their attempt to manipulate uninformed traders' beliefs is less effective in an anonymous environment. Hence, to the extent that it reduces “bluffing,” anonymity can increase liquidity. But to the extent that it reduces competition, it reduces liquidity.

Information is a public good, so the optimal level of transparency might not emerge spontaneously.

An important issue is whether optimal transparency can be expected to emerge naturally from market forces. On one hand, market venues compete to attract orders and customers. To the extent that transparency is valued by the market, they will find it profitable to supply it. This is illustrated by the recent development of electronic trading platforms, which have indeed increased transparency. This has been driven by market forces. On the other hand, transparency implies that information about trades between two parties is transmitted to third parties. This clearly involves externalities. Economic theory has shown that, with externalities, optimal outcomes can fail to emerge naturally from market interactions. Those who benefit from the public good or externality do not pay for it, so that its supply is below the optimal level. This could call for some regulatory intervention, but intervention into the microstructure would require deep knowledge of the workings and needs of the market.

It might be in the interest of liquidity suppliers to provide post-trade information.

Chowdry and Nanda (1991) offer an interesting counter-argument to the above reasoning. They study an extension of the Kyle (1985) model where there are two market centres. They analyze how strategic informed traders will submit orders to the two markets. They consider the dynamic case, where the private information of the strategic trader is long lived and there are several opportunities to trade. In this context they shed interesting light on the economic forces which might provide incentives to liquidity suppliers to disseminate post-trade information. They show that a trading centre where liquidity suppliers disseminate post-trade information is less attractive to informed traders. This release of information reduces the profits the informed agent can make in the other market centre. Hence, by disseminating post-trade data, liquidity suppliers deter informed traders and thus reduce adverse selection. This results in enhanced liquidity. Of course, this result holds only if it is in the interest of the liquidity suppliers that adverse selection be reduced.[2]

Conclusion of the review of theoretical analyses of transparency in financial markets

These theoretical analyses of transparency point at several interesting effects, but they do not deliver a clear-cut policy implication. They identify cases and reasons why transparency enhances liquidity and welfare, as well as cases and reasons why it reduces liquidity and welfare. This underscores that opacity is not necessarily a market failure in itself. The ambiguity of the theoretical results also implies that, to evaluate fully the consequences of transparency for bond markets, we must turn to empirical studies.

Also, when reflecting upon the implications of this theoretical literature for bond markets, one should bear in mind that the basic assumption in several models is that there is asymmetric information among investors about the value of the security. These models are relevant for the present analysis only to the extent that such information asymmetry is prevalent in the bond market. Now, the optimal financial contracting literature has shown that corporate bonds are designed to minimize adverse selection, relative to stocks (see, e.g., Myers and Majluf (1984), DeMarzo and Duffie (1999) and Biais and Mariotti (2005).) It could still be the case that some adverse selection issues still arise in the trading of corporate bonds. But the relevance of that hypothesis should be tested empirically.

2.2 Empirical studies of securities markets

Changes in pre-trade transparency have had various effects in different stock markets.

Boehmer, Saar and Yu (2005) study the introduction of Open Book on the NYSE in 2001. This system allows traders off the floor of the NYSE to observe depth in the book in real time at each price level for all listed stocks. Before the introduction of Open Book, only the best bid and ask quotes were electronically disseminated. They find an increase in the frequency of small limit orders and of cancellations after the introduction of Open Book. Increased transparency enhanced the ability of investors to monitor, work and cancel their limit orders. This attracted more limit orders in the book.

[2] Biais, Martimort and Rochet (2005) analyze liquidity supply in a limit order book. They show that limit order traders earn greater profits when the market order trader is informed than when there is no information asymmetry. This is because adverse selection makes limit order traders reluctant to compete aggressively, and thus results in relatively large spreads and low depth.

Correspondingly, the authors find that greater price transparency led to a decline in effective spreads. Consistent with the analysis of Pagano and Roell (1996), they also find that greater transparency made prices more informationally efficient.

But Madhavan, Porter and Weaver (2005) obtain opposite results for the Toronto Stock Exchange. They study a change in market structure which occurred in 1990. At the time, on the Toronto Stock Exchange, actively traded stocks were traded on the floor (similarly to the NYSE), while less active stocks were traded on the computerized system, CATS. The new electronic system, called Market By Price, began real-time dissemination of the depth and quotes up to four levels in the book. This applied both to CATS and the floor. They find that execution costs increased after the rule change.

The results of these two papers are somewhat hard to reconcile. Note however that the results of Madhavan et al. (2005) rely on data from 1990. Clearly, electronic and computerized information and communication systems were much more developed in 2001 than in 1990. It is those systems which enabled traders and investors on the NYSE to monitor the market, place and cancel orders when Open Book was introduced. In contrast, in 1990, the ability of remote traders to take advantage of increased transparency on the TSE was reduced.

In the London Stock Exchange changes in post-trade transparency did not alter liquidity.

The empirical evidence in Gemmill (1996) is consistent with the view that transparency at least does not reduce liquidity. Gemmill (1996) analyzes liquidity in the London Stock Exchange under three publication regimes: from 1987 to 1988 dealers had to immediately report their trades, from 1991 to 1992 they had to do so within 90 minutes, while from 1989 to 1990 they had 24 hours to do so. He finds that there is no significant gain or loss in liquidity from delayed publication of block trades, as the spreads and the speed of price adjustment are not affected by the disclosure regime.

In Euronext, anonymity improved liquidity but reduced the informativeness of quotes.

Foucault, Moinas and Theissen (2005) analyze the regime change which took place in Paris in 2001, as limit orders became anonymous. They find that the switch to anonymity has improved liquidity but reduced the informativeness of the bid-ask spread.

Conclusion of the review of empirical studies of transparency in the stock market.

These empirical results are also somewhat ambiguous. Perhaps the equity markets are already so transparent that marginal changes in transparency cannot have strong significant consequences. Also, the benefits of transparency may be related to the context in which the market operates. The comparison of the TSE in 1990 and the NYSE in 2001 suggests that traders and investors will take advantage of pre-trade transparency to post limit orders and thus enhance liquidity only if information technology enables them to interact efficiently with the market. The results from Euronext suggest that anonymity does not harm liquidity, and those from the London Stock Exchange in the 1980s and 1990s suggest that liquidity in the block market is not clearly affected by ex-post transparency.

2.3 The microstructure of the bond market: lessons from empirical studies of the US markets

For stock markets, a rich set of empirical microstructure studies is available, characterizing transactions costs and shedding light on the consequences of various features of the design of markets. For bond markets, in contrast, there are only very few empirical microstructure studies. This is because, until recently, high frequency datasets were not available for bonds. Some interesting studies have focused on Treasury bond markets, where data were released somewhat earlier than for corporate and municipal bond markets. As far as we know, only US data have been available so far. Hence, the literature surveyed in this section studies only the US market.

2.3.1 Methodology

Price impact measures in stock markets.

Empirical studies of liquidity and transactions costs in equity markets have taken advantage of the rich data available for these markets. For example, for Euronext, the NYSE, or Inet, researchers can use tick-by-tick data on the limit orders and the best quotes in the book, and a time stamped record of all trades, with price and quantity. Furthermore, in these markets, for a large number of stocks, transactions are very frequent.

Using such rich data, market microstructure researchers have developed measures of transactions costs which relate transaction prices and quotes. Denote by A_t and B_t the bid and ask quotes prevailing at time t. The corresponding midquote m_t is the average of the bid and ask quote. If there is a trade at time t, at price P_t, its price impact is $| P_t - m_t |$. Proxying the fundamental value of the stock by m_{t+s}, observed s units of time after the trade, one can decompose the price impact into a temporary component: $|P_t - m_{t+s}|$, and a permanent one: $|m_{t+s} - m_t|$.

Different data in corporate and municipal bond markets and stock markets.

The situation is quite different in the bond market. Until recently, tick-by-tick transaction datasets were not available to researchers, and there were in general no widely disseminated firm quotes. Hence, it would be difficult to estimate price impacts in the way described above. Furthermore, transactions frequency is much lower in bonds than in stocks. For example, in Edwards, Harris and Piwowar (2005), the median number of trades per bond and per day is less than one. Therefore, when studying bonds, one must design statistical and econometric approaches adequate to deal with infrequent data and lack of firm quotes. In the remainder of this subsection, we describe the different approaches which have been taken in the literature.

Realized bid-ask spread per bond per day.

Chakravarty and Sarkar (1999) and Hong and Wang (2000) estimate the spread by computing the difference between the average sale price and the average purchase price of a bond on a particular day. This method requires at least one purchase and one sale of a bond on a given day. This requirement eliminates over 90% of the observations (for which trades on a given day were only on one side of the market, i.e., only purchases or only sales). It also induces a bias towards more active bonds.

The regression approach to the effective spread in bond markets

When the researchers observe transactions prices, and the direction of the trade (buy or sell) they can use a regression approach (see Schultz (2001), Goldstein, Hotchkiss and Sirri (2005) and Bessembinder, Maxwell and Venkataram (2005)). For example, in Goldstein, et al., effective spreads are estimated by regressing the difference between the transaction price for a customer and an estimated bid price on a dummy variable that equals one for customer buys and zero for customer sells:

$$[\textit{customer trade price} - \textit{bid price}]_i = \alpha_0 + \alpha_1 D_i\, Buy + \varepsilon_i$$

The difficulty in implementing this approach is that one must use estimated rather than actually observed dealer bid prices. For this study, Goldstein, Hotchkiss and Sirri (2005) use dealer bid prices reported by Reuters for the end of day prior to the transaction.

Estimation of spreads from dealer round trip trades

Green, Hollifield and Schurhoff (2004) and Goldstein, Hotchkiss and Sirri (2005) measure the spread as the difference between what a customer pays and receives for a fixed quantity of a bond. They identify instances where the same par value of the same bond is purchased and sold in a short time period. Keeping the time interval short implies that such factors as interest rate and credit changes are unlikely to be significant. One difference between these two approaches is that the former observes the identity of the dealer (and thus can impose that the same dealer be involved in the purchase and the sale), while the latter does not.

The time series approach

Edwards, Harris and Piwowar (2004) and Harris and Piwowar (2004) specify a time series model. Simplifying slightly, their approach is as summarized below. These papers assume that, absent transactions costs and market frictions, the return on the bond between time t and time s can be modelled as a linear combination of (1) the return on the bond index, (2) the return on a portfolio long on the long term bonds and short on the short term ones, (3) the return on a portfolio long on the highly rated bonds and short on the low quality bonds, and (4) a noise term. Denote the vector of these explanatory variables by X_{ts} and denote the noise term by e_{ts}. In addition, they assume that, to trade size S_t, at time t, customers pay a transaction cost modelled as follows:

$$C(S_t) = c_0 + c_1\,(1/S_t) + c_2 \log(S_t) + c_3 S_t + c_4 S_t^{\,2}$$

While a little bit ad hoc and complicated, this specification is quite flexible. Finally this leads to a regression of the return on the bond price between time t and s, onto the transactions costs and control variables. If we denote by Q the indicator variable taking the value 1 if the customer buys and -1 if she sells, the regression model is:

$$r_{ts} = \beta' X_{ts} + c_0\,(Q_s - Q_t) + c_1\,(Q_s / S_s - Q_t / S_t) + c_2\,[Q_s \log(S_s) - Q_t \log(S_t)] + c_3\,[Q_s S_s - Q_t S_t] + c_4\,[Q_s S_s^2 - Q_t S_t^2] + e_{ts}.$$

Comparison and remarks about these different approaches

All these approaches rely on the observation of the direction of customer trades (whether it was a purchase or a sale). It seems that without this information it would be rather difficult to estimate transactions costs in bond markets.

Both the dealer round trip approach and the average realized spread method define time windows, for example one day or two days, during which there must be two trades on opposite sides of the market, e.g., one customer purchase and then a customer sale. For many bonds, there is most of the time either no trade or a single trade on a given day. Thus researchers face a trade-off between the costs and benefits of short windows. They make the two transactions more comparable, but they reduce the sample size and can bias the sample towards more active bonds. To assess the robustness of the method, Goldstein, Hotchkiss and Sirri (2005) consider two cases: in the first they require that the dealer completes the round trip in one day, in the second they require the round trip to be completed in five days. Fortunately the results are remarkably similar across methods (see Table 6, Panel A and Panel B in Goldstein, Hotchkiss and Sirri (2005).)

One advantage of the regression approach and its extension by Harris, Edwards and Piwowar, is that it does not require that one buy and one sell be observed on the same day (or during a similar time window). The regression method and the time series approach have each their advantages. The advantage of the former is its clarity and simplicity (qualities which usually go along with robustness). But its drawback is that it relies on previous quotes, which may be difficult to observe or noisy. The drawback of the time series approach is that it is a little complicated, but its advantage is that it incorporates in the regression for one bond useful information from other bonds and indexes.

2.3.2 Results for the US municipal bond market

As explained in Green, Hollifield and Schurhoff (2004), because they are tax exempt, munis are held in large measure by individual investors (35% in 2001), insurance companies (10%) or personal trusts. Such investors could differ from the typical investors in stock markets, either because they are less sophisticated (individuals) or because they are unlikely to desire to trade frequently (insurance companies). Here market makers play a key role in providing intertemporal intermediation and price discovery services. Because the secondary market for munis has been traditionally opaque, empirical research has been very scarce until the last years. In recent years, however, the self-regulatory authority in this market, the Municipal Securities Rulemaking Board (MSRB), has released very rich data, which enabled researchers to undertake several fascinating studies. This shed new light on the workings of the muni market, as summarized below.

Harris and Piwowar (2004)

Harris and Piwowar (2004) obtained data from the MSRB, which requires that dealers report all trades by midnight of the trade date. They provided Harris and Piwowar with data from November 1999 to October 2000. The data included for each trade the date and time, the par value traded, the dollar price traded, the reporting dealers' identities, and indicators for customer and interdealer trades. For customers the data identified whether the customer was the buyer or the seller. After excluding bonds with missing data, they came up with a sample of 167,851 bonds, representing 5,399,283 trades.

Most bonds in the Harris and Piwowar sample average less than one transaction per week. Bonds ranked above the 99.9th percentile in trading activity trade on average less than six times per day. The average bond price in the sample is 96.50, representing a slight discount from a hundred dollar face value. The sample included both retail and institutional trades. The latter are defined as trades larger than 100,000 dollars. The median size for retail trades is $20,000, while its counterpart for institutional ones is $200,000.

Harris and Piwowar find that municipal bonds are more expensive to trade than equity. Effective spreads average 2% for retail size trades of $20,000 and about 1% for institutional trade size of $200,000. In contrast with results obtained in the literature for stock markets, small trades incur greater transactions costs than large ones. Also in contrast with the case of equities, actively traded bonds are not less expensive to trade than inactive ones. In addition, Harris and Piwowar find that bond liquidity increases with credit quality, decreases with instrument complexity, time to maturity and time since issuance.

Green, Hollifield and Schurhoff (2004)

Like Harris and Piwowar, Green and his coauthors use data provided by the MSRB. Their dataset records every trade between May 1, 2000 and July 31, 2001. They find that on average a bond has approximately 6 trades in the first 10% of its life. After that trading activity is very small. By the time the bond is half way to maturity there is on average less than one trade every 10 months.

Using the dealer round trip approach discussed above, Green, Hollifield and Schurhoff (2004) find an average effective spread of 2.1%. They too find higher transactions costs for smaller trades than for larger trades.

They also offer an interesting discussion of the inventory risk borne by the dealers in this market. Are the effective spreads a reward for large inventory risk? A priori this seems unlikely, as municipal bonds are much less risky than stocks, and yet command larger spreads. In practice, they find that the overall frequency of loss for dealer round trips is 1.4%. In addition, while dealer markups decline with trade size, risk does not. Thus, for dealers, the largest trades are both less profitable and riskier.

Conclusion on the liquidity of the municipal bond market

The results obtained by Harris and Piwowar (2004) and Green, Hollifield and Schurhoff (2004) are remarkably similar, in spite of the different methods used in the two papers. This convergence of the results speaks in favor of their robustness. Overall, they suggest the Municipal Bond market is highly illiquid, and dealers earn significant markups. Such low liquidity may stem from the lack of transparency of this market. The opacity is such that it is very difficult for retail traders to estimate the market valuation of the security. This puts them in a weak bargaining position. To the extent, however, that the level of transparency did not vary in this market during the data collection period of these two studies, it is impossible to be confident that the results are driven by the opacity of the market. The case of the corporate bond market, which we discuss below, is quite different.

2.3.3 Results for the US corporate bond market

Corporate bonds are not tax exempt. Correspondingly, they have a very different investor basis from munis. According to Schultz (2001), in 1997 individual investors owned only 9% of the total, while institutions held the remaining 91%. Among the latter, life insurance companies were the biggest holders (32%), while private pension funds owned 10% of the bonds, and foreign investors held 16%. Like the muni market, the secondary market for bonds has traditionally been rather opaque, but its transparency has been raised drastically in the previous years. Below, we summarize the research papers which have documented this evolution.

Early studies relying on institutional trades

Schultz (2001) offers one of the earliest empirical studies of the microstructure of the bond market. His analysis covers institutional trades of corporate bonds over 1995-1997. The data was provided by Capital Access International, and includes transactions by insurance companies, mutual funds and public pension funds. The records consists of the trade date, the identity of the institution, the identity of the dealer, the bond's cusip number, whether the trade is a buy or a sell, the face value of the traded bonds and the actual dollar value of the trade.

Since the data correspond to institutional transactions, trade size is very large. The median dollar amount of the bond trades is $1,513,000. This is much larger than the figure reported above for the muni bonds dataset, and it is also significantly larger than the figure obtained by Keim and Madhavan (1997) for institutional equity trades, which was on the order of $200,000.

As for munis, most of the trading happens at the beginning of the life of the bond. For example, half the trades in bonds issued with 20 years to maturity took place in the first three years after the bonds were issued. The paper also notes that the dealership activity is quite concentrated. The top twelve dealers traded 72% of the total, and the most active one (Merrill Lynch) traded 10.2% of the total.

For these institutional trades, Schultz (2001) finds an average bid ask spread of $2.60 per bond. Like the above discussed muni market studies, he finds that costs decline with trade size. He also finds that costs are lower for large institutions.

Chakravarty and Sarkar (2003) rely on similar data. They find an average spread of 0.23% for municipal bonds, 0.21% for corporate bonds – which is very similar to the results obtained by Schultz. As in the case of the muni market, such similarity in results, in spite of different methods, suggests the findings are robust.

More recent studies, documenting the impact of TRACE

In January 2001, the SEC approved rules requiring the NASD to report all over-the-counter secondary market trades in a specified set of bonds. Correspondingly, in 2002, the National Association of Securities Dealers began a program of increased transparency for corporate bonds, known as the Trade Reporting and Compliance Engine (TRACE). Initially trades were to be reported within one hour and fifteen minutes. At the July 2002 start of TRACE, post-trade information was publicly disseminated only for very large and high-quality issues. Post-trade information dissemination for the other bonds was phased in later. Several researchers have studied the consequences of this regulatory reform.

Edwards, Harris and Piwowar (2004) obtained reports on every bond trade reported to TRACE in 2003. At that time, for bonds with dissemination requirements, the TRACE system disseminated transaction prices no later than 45 minutes after the trade. The dataset used by Edwards et al. include the price, time and size of the transaction, as well as the side on which the dealer participated. They rely on a sample of 6,649,758 trades in 16,746 bonds, representing 5 trillion dollars of volume. Unlike the corporate bond market studies reported above, these data include retail as well as institutional trades. More than 60% of the trades are for less than $100,000 dollars, though most of the volume is in institutional sized trades. Edwards et al. also note that, on average, bonds in their sample traded 1.9 times a day and that trades were clustered: the median bond traded only on 23% of all days in the sample.

Edwards et al. estimate the bid-ask spread for a retail order size of $20,000 at 1.38% of price (138 basis points). This is much larger than the average spread for retail trades in the equity market, which is approximately 0.4%. This ranking is surprising, as one would expect spreads to increase in risk and adverse selection, which are likely to be greater for stocks than for bonds. Note also that the average retail spread for municipal bonds (discussed above) is greater than its counterpart for corporate bonds. Again, this is surprising, as default risk is on average much lower for municipal bonds than for corporate bonds.

For trades of $200,000 the average spread is estimated at only 0.54%. Similarly to the municipal bond market, and similarly to the results of Schultz (2001), Edwards et al. find that spreads in the corporate bond market decrease with trade size. This contrasts strikingly with the results obtained in the equity market.

Edwards et al. also estimate a cross sectional regression (across bonds), where the dependent variable is the spread and explanatory variables include characteristics of the bond (such as its credit rating or time to maturity) and two indicator variables characterizing whether the bond price was transparent, either in TRACE or in the NYSE ABS system. They find that such transparency significantly reduces the spread.

The analysis of Edwards, Harris and Piwowar (2004) is complemented by a fascinating real scale experiment conducted by Goldstein, Hotchkiss and Sirri (2005). As mentioned above, in 2002, the NASD required that transaction prices be reported and disseminated. Initially, however, this was effective only for very large and highly rated bonds. For other bonds some market participants feared that transparency could jeopardize liquidity. To study this point, and decide whether transparency should be required for all bonds, the authors designed an experiment, in collaboration with NASD. They formed a sample of 90 BBB rated bonds, for which transparency was introduced. They also collected data for a matched sample of 90 bonds, for which transparency was not introduced. By comparing liquidity in the treatment and control samples, the authors are able to identify the effect of increased (ex-post) transparency. This experimental approach brings important additional information relative to the cross-sectional approach of Edwards et al. In addition to these 90 bonds, the authors have also collected data on 30 rather illiquid bonds.

Goldstein, Hotchkiss and Sirri (2005) find that, for all but the smallest trade size group, spreads decrease for bonds whose prices become transparent more than for the control set of non disseminated bonds. This effect is strongest for intermediate trade sizes: for trades between 51 and 100 bonds, relative to their controls, spreads on the 90 disseminated bonds fall by approximately 30 basis points more (per $100 dollars face value). On the other hand, Goldstein et al. find that transparency does not affect trading volume. Furthermore, they find no significant effects of increased transparency for very infrequently traded bonds.

While these results point in the same direction as those of Edwards et al., there are some differences. Goldstein et al. find a drop in spreads ranging from 0 to 55 bp, varying across trade sizes. Edwards et al. find a drop of 10 bp across the range of trade sizes. The difference in results may reflect the different experimental design or empirical methods.

Bessembinder, Maxwell and Venkataraman (2005) complement the two papers discussed above by focusing on institutional trades. They rely on the National Association of Insurance Commissioners transaction data in corporate bonds (cf. Schultz (2001) and Chakravarty and Sarkar (2003)). Bessembinder et al. compare bonds with prices disseminated by TRACE to non-disseminated bonds. For bonds subject to TRACE reporting, they find a reduction in spreads equal to 50% of pre-TRACE transactions costs. Similarly to Goldstein et al., they also find a decrease in transactions costs for bonds that are not subject to TRACE reporting. While spreads are reduced by about 13 basis points for TRACE bonds, they drop by approximately 8 basis points for non-TRACE bonds.

2.3.4 Assessment of empirical work on US corporate bond markets

The set of empirical results obtained for the microstructure of the US corporate bond markets is remarkably convergent (see their summary in Table 1). In spite of differences in datasets and methods, all studies find greater spreads than for equities, and all find that spreads decrease in trade size. Both findings are inconsistent with the view that spreads ought to be increasing in risk or adverse selection, since these variables should be greater for stocks and also for larger trades. Pointing in the same direction is the finding by Green et al. that there is no association between spreads and market makers losses. There is also remarkable convergence among the three studies focusing on the impact of TRACE: all find that transparency reduced spreads. These studies, based on 2003 data, may to some extent reflect some features of the market at that time, in particular the perception of default risk and its evolution. The controlled experiment of Goldstein et al. (2005) does to some extent control for that, however.

Some puzzles remain. Why does transparency not affect liquidity for less liquid bonds (as found by Goldstein et al.)? Why does transparency not affect trading volume in corporate bonds (as also found by Goldstein et al.)? Is it because trading volume is not affected by transactions costs? Is it because the drop in transactions costs associated with transparency is too small to affect volume? Why do less liquid bonds have similar (or tighter) spread sizes to very liquid bonds (Goldstein et al.)? What does this suggest about the determinants of spreads in the corporate bond market? How does this relate to the fact that transparency did not affect liquidity for these less liquid bonds?

Table 1: Summary of the empirical results obtained for the US bond market

	Paper	Data	Spread decrease with trade size?	Retail spread	Institutional spread	Trade frequency	Transparency reduces spreads?
Muni. Bonds	Harris & Piwowar (2004)	All trades, Trade direction.	Yes	2% for size of $20,000	1% for size of $200,000	< 1 trade per week	n.a
	Green & al (2004)	Idem	Yes	2.5%	1%		n.a
Corp. Bonds	Schultz (2001)	Institutional trades, Trades direction.	Yes	n.a	.2%		n.a
	Chakravarty & Sarkar (2003)	Idem	n.a	n.a	.21%		n.a
	Edwards et al. (2005)	All trades, Trades direction.	Yes	1.38% for size of $20,000	0.54% for size of $200,000		Yes (by 10bp)
	Goldstein et al. (2005)	Idem	Yes	1.62% For size between $10,000 & $20,000	0.49% for size between $250,000 & one mio		Yes (by between 0 and 55 bp)
	Bessembinder et al. (2005)	Institutional trades, Trades direction					Yes (by 5 to 13 bp)

Further research is needed to clarify these points. Also note that these studies consider only post-trade transparency. The role of pre-trade transparency is a potentially important and still under-researched issue.

2.4 Conclusions from the empirical literature

Some interesting conclusions emerge from the literature. The empirical results obtained in the context of the US bond market seem quite supportive of the notion that transparency raises liquidity. This contrasts somewhat with the relatively mixed results obtained on the theory side or by empirical studies of stock markets. Another striking contrast between empirical results from the bond market and their stock market counterpart is the finding that, in the former, spreads are decreasing with trade size, while in the latter they are increasing. Why is there such a contrast between the stock and bond markets?

One possibility is that the economics of the bond market microstructure is very different from that of the stock market. It could be that in the bond market there is no adverse selection but there are large fixed costs to handle trades. The other possible explanation is that the driving force behind spreads in the bond market is the market power of the dealers. This market power is large with retail investors, hence large spreads, and limited with large investors, hence smaller spreads.

To disentangle the two possible interpretations, it is useful to consider the results obtained by the three studies focusing on the impact of TRACE. Again, there is remarkable convergence between these studies. All three find that transparency reduces spreads. While this is consistent with the market power interpretation, it is not in line with the fixed costs interpretation.

The empirical results discussed above are based on a relatively small number of studies, however, relying on an even smaller number of distinct datasets. It would be extremely valuable to assess their out-of-sample robustness by studying other datasets. We also need an empirical analysis of the microstructure of the European bond market. How does the microstructure of the European bond market compare to its US counterpart? What can appropriate data tell us about its liquidity and efficiency? Do we observe the same stylized facts in Europe as in the US? This report addresses these questions directly in Section 4, using an appropriate European dataset. First, however, we turn to our own theoretical analysis, which partly underlies our empirical approach.

3. Transparency, liquidity and information in dealer markets: a theoretical analysis

3.1 Introduction

The goal of this Section is to provide a simple theoretical framework to analyze the consequences of opaqueness and transparency in dealer markets, such as the bond market. The theory we present here is designed to apply to the secondary market for corporate bonds in Europe.We conducted extensive interviews with buy and sell-side participants in the European bond market (see Section 6) and thereby identified some essential features of dealer markets, which are captured by our model:

- Customers request quotes from dealers, describing the size and direction of the order.
- Dealers respond to these requests for quotes by posting bid or ask prices simultaneously and independently. These quotes are firm, and the customer allocates the order to the best quote.
- There is no pre--trade transparency, in the sense that the customer does not see quotes before submitting the request for quotes. Neither do the dealers see the quotes of their competitors.

In addition, we assume that dealers privately acquire information. This results in differences of information across dealers. In this context, our theoretical analysis delivers the following results. After the initial information acquisition stage, some dealers end up with better signals than the others. This creates a winner's curse problem for the latter. They risk getting a better fill rate for less profitable trades. To make up for these losses, relatively uninformed dealers will widen their spreads. This, in turn, reduces the competitive pressure faced by the better informed dealers, who also widen their spreads. Such wide spreads generate rents for the dealers.[3]

In this framework we can compare opaque and transparent markets. We show that the winner's curse effect is lower in the transparent market, where dealers, observing previous transactions, obtain information about the value of the asset. In turn, this leads to more aggressive competition between dealers and tighter spreads. Consequently, in the post-trade transparent market, potential informational rents are lower. Dealers therefore acquire less information in equilibrium. The extent to which information is eventually revealed to the market at large reflects the combined effects of information acquisition and disclosure. Thus depending on parameter values, the opaque market can give rise to more or less information revelation than the transparent market.

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[3] Our analysis is in line with Bloomfield and O'Hara (2000), who also analyze theoretically how better informed dealers earn rents. The origin of private information differs in their model and ours. While we assume dealers acquire information, they assume dealers face better informed traders. They show that in a non-transparent market, dealers initially post tight quotes to attract (potentially informed) orders and thus acquire information. In later stages, as in our model, this private information gives the dealers market power. They earn rents and spreads are large.

The next section presents the model. Section 3.3 presents our theoretical results. Section 3.4 concludes and discusses policy implications of our theoretical analysis. Formal proofs of the propositions are available from the authors on request.

3.2 The model

3.2.1 Asset and agents

The final value of the risky asset can be u or d, with equal probability. The unconditional expectation of this final value is: μ. For simplicity we consider a symmetric setting: $u = \mu + 2\epsilon$ and $d = \mu - 2\epsilon$. Also for simplicity, transaction prices are assumed to be on a discrete grid: $\mu + 2\epsilon, \mu + \epsilon, \mu, \mu - \epsilon$ and $\mu - 2\epsilon$.

There are four market makers, two trading periods and two liquidity traders. The latter have varied initial positions in the risky asset, as described below. The market makers are rational, strategic and risk neutral.

In contrast with the standard approach in market microstructure (e.g., Kyle, 1985; or Glosten and Milgrom, 1985), we do not assume that the market makers face traders with superior information. The risk neutral market makers face uninformed liquidity traders, and incur no handling costs. Thus, we assume away the three standard ingredients giving rise to bid-ask spreads: asymmetric information between market makers and their customers, order handling costs and inventory risk bearing costs (see Biais et al., 2005, for a survey of these standard models).

On the other hand, as explained below, we assume that the market makers can acquire private information about the fundamental value of the asset. This will generate winner's curse effects among market makers and thus give rise to a bid-ask spread. This is similar to Calcagno and Lovo (2006), who study dynamic competition between an informed market maker and an uninformed one. Their analysis differs from ours, however: (1) they analyze a general dynamic game with N market makers and T periods, while we consider a simple two-dealer two-period model; (2) they consider a transparent market, while we compare the opaque and transparent cases; and (3) they consider the case where one of the market makers is known to be informed while the other is known to be uninformed, while we consider the case where each of the two market makers can, with some probability, have observed a private signal.

3.2.2 Extensive form of the game

The timing of the game is the following:

- At time 0, each market maker ($i = 1,2,3,4$) decides how much information (α_i) to acquire. The cost of this information is $c(\alpha_i) = \frac{k\alpha_i^2}{2}$. Then they privately observe the corresponding information signals. With probability α_i, market maker i observes the true value of the asset. With the complementary probability he does not observe anything.

- At time 1, with probability λ, the first liquidity trader enters the market. She holds either a long position and desires to sell or a short position and seeks to buy. The liquidity trader places a market order for one unit. Two of the four market makers are randomly drawn and receive this request for quotes. They simultaneously and independently post quotes. The market order is executed against the best quote. If there is a tie, one of the two market makers is randomly drawn.
- At time 2, with probability λ, the second liquidity trader enters the market. She places a market buy or sell order for one unit. The two market makers who did not participate in the first trade receive this market order. They simultaneously and independently post quotes. The market order is executed against the best quote. If there is a tie, one of the two market makers is randomly drawn.
- At time 3, the final value of the asset is realized and consumption takes place.

3.2.3 Transparency and opaqueness

There is no pre-trade transparency. In the opaque market, there is no post-trade transparency during the two trading periods. Customers and dealers cannot observe the trades conducted by others. After the two trading periods, however, we assume that the last transaction price is observed. Even in the opaque market, therefore, there is some information revelation, benefiting the general public. In the transparent market, there is post-trade transparency. After each trade, the transaction price is observed by all.

3.2.4 Symmetric information benchmark

When the dealers do not acquire private information, they compete à la Bertrand. Equilibrium is competitive and dealers earn no rents. The ask price and the bid price are equal to μ.

3.3 Analysis

3.3.1 Equilibrium in the opaque market

Quoting strategies for a given level of information

Proceeding by backward induction, we start by analysing quotes and trades, taking information acquisition as given. Then we compute how much information the dealers choose to acquire, rationally anticipating the next stages in the game. In the opaque market, in our simple model, there is no link between the two trading rounds. Quoting strategies are the same in the two periods. In this case, the trading strategies arising in the perfect Bayesian equilibrium are given in the following proposition:

Proposition 1: *In the opaque market, if $\alpha <.5$, the equilibrium strategies of the dealers are the following:* If dealer i is informed and observes that $v = u$, then his ask quote is u, while his bid quote is μ. If dealer i is informed and observes that $v = d$, then his ask quote is μ, while his bid quote is d. If the dealer is uninformed, then his ask quote is $\mu + \epsilon$, while his bid quote is $\mu - \epsilon$.

Uninformed market makers realize they face a winner's curse, since their quotes tend to be filled more often when their competitor is informed and realizes the trade is unprofitable. To cope with this problem, the uninformed market maker posts unagressive quotes, with a positive bid-ask spread (equal to 2ϵ). Facing such quotes, informed market makers can choose to undercut their uninformed competitors (when the liquidity trader places a buy order and the value is low) or to post wide spreads, at which they do not trade (when trading would be unprofitable).

Hence, as in Calcagno and Lovo (2006), the informed market maker earns larger expected profits than the uninformed one. But, unlike in Calcagno and Lovo (2006) both the informed and the uninformed market makers earn strictly positive expected profits. Overall, in this market, asymmetric information and quote opacity generate rents for market makers.

Information acquisition

We now turn to the determination of the equilibrium level of information acquisition. Using the strategies given in Proposition 1, we first compute the market makers profits, when they are informed and when they are not. Then, relying on these profits, we study the information acquisition choice of the market makers. As before, we focus on the ask side – the bid side is symmetric.

When market maker i is informed, with probability $1/2$ he learns that the value is $v = u$, in that case, he does not earn any profit on the ask side of the market. With probability 1/2 he learns the value is $v = d$. In that case, as shown in Proposition 1, he quotes $A = \mu$, and his expected profit is:

$$\alpha_j \frac{\mu - d}{2} + (1 - \alpha_j)(\mu - d).$$

The first term corresponds to the case where the other market maker is also informed, so that i and j share the trade. The second term corresponds to the case where the other market maker is uninformed, so that i undercuts him and serves the liquidity trader's order. Overall, the expected profit of the informed market maker is:

$$\frac{\epsilon}{2}[2 - \alpha_j]$$

When market maker i is uninformed, he quotes $A = \mu + \epsilon$ and his expected profit is:

$$\alpha_j \frac{1}{2}(\mu + \epsilon - u) + (1 - \alpha_j)\frac{(\mu + \epsilon) - \mu}{2}.$$

The first term corresponds to the case where the other market maker (j) is informed and i is exposed to the winner's curse. The second term corresponds to the case where the other market maker is uninformed and i and j share the trade. The expected profit of the uninformed market maker simplifies to:

$$\frac{\epsilon}{2}[1 - 2\alpha_j].$$

Adding the expected profits of the informed and uninformed market makers (weighted by the corresponding probabilities) and subtracting the cost of information, we obtain the overall expected profit of market maker i, taking as given the strategy of j :

$$\lambda[\alpha_i \frac{\epsilon}{2}(2 - \alpha_j) + (1 - \alpha_i)\frac{\epsilon}{2}(1 - 2\alpha_j)] - c(\alpha_i).$$

Substituting $c(\alpha_i) = \frac{k}{2}\alpha_i^2$ and simplifying, the expected profit of the market maker is:

$$\lambda[\alpha_i \frac{\epsilon}{2}(1 + \alpha_j)] - \frac{k}{2}\alpha_i^2 + \frac{\lambda\epsilon}{2}(1 - 2\alpha_j).$$

Taking the first order condition, and noting that the second order condition holds, we obtain the next proposition.

Proposition 2: *In the opaque market, the optimal information acquisition of dealer* i *is:*

$$\alpha_i = \frac{\lambda}{k}\frac{\epsilon}{2}(1 + \alpha_j).$$

If the dealer anticipates a large customer flow (λ), or if the cost of information (k) is low, then he chooses to acquire a lot of information. Note also that the amount of information acquired by the dealer is increasing in the amount acquired by his competitor. Thus information acquisitions are strategic complements. This is because, as the quality of the information of dealer j rises, the winner's curse problem faced by i when he is not informed also rises. Thus, the better the information of j , the more valuable it is for i to acquire information.

Relying on the above stated optimal information acquisition choice, we obtain the Nash equilibrium level of information acquisition by each dealer:

Proposition 3: *If* $\frac{k}{\lambda} \geq \frac{3}{2}\epsilon$ *, the Nash equilibrium level of information acquired by each dealer in the opaque market is:*

$$\alpha_o^* = \frac{\epsilon}{\frac{2k}{\lambda} - \epsilon}.$$

Proposition 3 shows that the equilibrium level of information acquisition is decreasing in the cost of information (k) and increasing in the volume of trade expected by the dealers (λ).

Information revelation

Relying on Propositions 1,2 and 3, we can study how much information is revealed in the opaque market. Recall that in this market the two rounds are i.i.d.

In the opaque market, only the last transaction price is publicly disseminated. With probability ${\alpha_o^*}^2$, it fully reveals the true value of the asset, u or d. With probability $1-(1-\alpha_o^*)^2$, the transaction price is μ, which, if one does not observe the direction of the trade, conveys no information. With probability $\lambda\frac{1-\alpha_o^*}{2}$, the transaction price can be $\mu+\epsilon$, which reveals that the value of the asset is u with probability $\frac{1+\alpha_o^*}{2}$. With the same probability, the first period price can be $\mu-\epsilon$, which reveals that the value of the asset is d with probability $\frac{1+\alpha_o^*}{2}$.

3.3.2 Equilibrium in the transparent market

Now consider the case where there is post-trade transparency. In that case, when there is a trade, the transaction price is revealed to all.

Quoting strategies for a given level of information

Because we assumed each dealer participates only in one round of trade, strategies at the first round are the same in the opaque and the transparent market. At the end of the first round, in the transparent market, the transaction price is publicly disseminated. This can affect the strategies of the dealers. In particular, with probability α^2, it fully reveals the true value of the asset, u or d. In that case, Bertrand competition drives the quotes of the dealers to this value, and they earn zero profits. Analysing the strategies of the dealers along similar lines as in the previous subsection, we obtain the following proposition:

Proposition 4: *If $\alpha \leq 2-\sqrt{3}$, the equilibrium strategies of the dealers are the same in the transparent market as in the opaque market, except when the transaction price at the first round fully revealed the true value of the asset. In that case, Bertrand competition prevails at the second trading round, and both the bid and the ask are equal to the true value of the asset.*

The intuition is the following. If α is not too large, then except when there is full information revelation at the first round, the information content of the early trades is limited. Hence quoting strategies are unaffected. If α were greater, then information revealed in the first round would affect more the strategies of the dealers. This would lead to a starker contrast between the transparent and the opaque market.

Information acquisition

We can now turn to the determination of the equilibrium level of information acquisition in the transparent market.

Proposition 5: *If dealer i anticipates that the other dealers acquire information with probability α_j, then her information acquisition choice is:*

$$\alpha_i = \frac{\lambda}{k}\frac{\epsilon}{2}(1+\alpha_j)(1-\frac{\lambda\alpha_j^2}{4}).$$

Comparing Proposition 5 to Proposition 2, we see that, for a given level of information acquisition by the others (α_j), dealer i acquires less information in the transparent market than in the opaque market. The intuition is the following. The expected profits of the dealers are the same in the transparent and the opaque market, except at the second round when full information revelation occurred previously. When that event occurs, all dealers earn zero profits, and the wedge between informed and uninformed dealers disappears. The greater the probability of this event ($\frac{\lambda\alpha^2}{2}$), the less attractive it is to acquire information.

Building on the previous results, we can now compare the equilibrium level of information acquisition in the transparent market to its opaque market counterpart.

Proposition 6: *The equilibrium level of information acquisition in the transparent market (α_T^*) is lower than its opaque market counterpart:*

$$\alpha_T^* \leq \alpha_o^*.$$

3.4 Discussion and implications

We have set out a simple theoretical model of the information acquisition and trading process in dealer markets, such as the corporate bond market. Liquidity traders send request for quotes. Dealers independently and separately respond by proposing bid or ask prices. The market order is executed against the best quote. Our model offers a theoretical analysis of the competition between dealers.

This competition is affected by the information sets of the dealers. We assume that, initially, dealers choose how much information to acquire. The information they acquire is neither perfect nor homogeneous. Hence information acquisition leads to information asymmetries between dealers. Correspondingly, when responding to the request for quotes placed by customers, they will post different prices. In line with this aspect of our theoretical analysis, we were told, during extensive interviews of buy- and sell-side participants in the European corporate bond markets (see Section 6), that dealers will typically offer somewhat different prices for the same bond. We were also told that dealers are reluctant to have their best bid and ask offers disclosed to their competitors. Our theoretical model analyses how informational asymmetries influence the dealers' bidding strategies. We show that there are winner's curse effects, which mute down competition between dealers, and thus increase spreads.

Our theoretical analysis also shows that post-trade transparency reduces information asymmetries between dealers. Hence, it enhances competition and thus reduces spreads. Ex post, each dealer would prefer to observe the quotes of his or her competitors. But ex ante, dealers prefer the market to be opaque, since this increases their expected rents.

Our theoretical result that post-trade transparency should reduce spreads can be viewed as consistent with that documented for the US corporate bond market by Edwards et al. (2005) and Goldstein et al. (2005).

Regarding information revelation, our theoretical analysis delivers ambiguous predictions. Transparency reduces information acquisition. But greater information acquisition in the opaque market does not necessarily lead to greater eventual information disclosure. The information revealed in the marketplace reflects the combined effect of the acquisition of information and the disclosure of prices. In our model, for some parameter values the information eventually revealed by the trading process is greater in the transparent market, for others it is greater in the opaque market.

In the theoretical model presented above, the only cost incurred by dealers is the information acquisition cost. To make the model more realistic, it would be reasonable to add a fixed cost, incurred by the dealer, to maintain a presence in the market. This would include the fixed component of the wage of the traders as well as the cost of the technological infrastructure. Dealers are willing to incur these costs only if they are outweighed by their expected profits from trading. Since transparency reduces the profits of competing dealers, it can possibly drive expected trading profits below fixed costs. In this case, transparency would induce dealers to exit the market. If this effect were strong, transparency could end up increasing spreads, rather than reducing them. This is unlikely to be the case for rather actively traded securities, where the volume of activity is sufficiently large that the dealers can cover their costs, even if the market is transparent. But for infrequently traded securities, the ability to recoup fixed costs can be a real issue. For such markets, it is possible that too much transparency could be detrimental to liquidity.

Our model is highly stylized, so its implications should be viewed with caution. That being said, our theoretical analysis suggests that, for relatively actively traded bonds, some extent of post-trade transparency should be expected to reduce bid-ask spreads. To the extent that transparency reduces the rents of the dealers, our analysis also suggests that one should not expect sell-side financial intermediaries themselves to demand or develop post-trade transparency.

4. The microstructure of the European corporate bond market

4.1 Differences with equities

There are several important differences between the microstructure of the bond market and that of the stock market.

First, the characteristics of bonds' payoffs (redemption date, relative safety) attract a specific type of investors: Pension funds and insurance companies are among the largest investors in bonds. These investors, especially insurance companies, tend to follow buy-and-hold strategies. This limits the level of activity in the secondary market. Indeed, certain issues are entirely purchased by a single buy-and-hold investor, so that the bond issue is in practice like obtaining a bank loan. All this severely reduces the liquidity of the market, although some aspects (e.g., the extreme buy-and-hold case) may simply represent efficient contracting.

Second, at least in Europe, it is difficult and costly to short sell bonds. This further reduces the liquidity of the bond market. When an issue is entirely, or in large part, in the hands of a buy-and-hold investor, it is practically impossible to sell it.[4]

Third, while stocks are very specific and differ from one another, differences among bonds are less marked. Often an investor will desire to trade a certain category of bond (say a utility, 10 years to maturity, A-rated) rather than a given bond. In that case, when contacting potential counterparties investors will not only ask for a quote, they will also enquire which bond is for trade at the moment. Note that this way of arranging trades to some extent mitigates the inefficiencies brought about by the difficulty of short sales.

Fourth, stock market activity is concentrated in a relatively small number of securities which trade very frequently each day, while the others trade only infrequently. For example, 2,800 companies are quoted on the NYSE. On this market, the 100 most active stocks account for a little less than half the total trading volume! In contrast, the bond market is much less concentrated. Each issuer has typically several bonds outstanding. Capitalization and trading are spread across thousands of securities. This difference in concentration induces differences in the ease with which counterparties can be located. In the stock market, most large operators have an interest in the most active securities which constitute the bulk of the market. In the bond market, large operators will typically have an interest only in a subset of securities. Hence in the bond market it will be much more difficult to identify a counterparty than in the stock market.

[4] This is likely to be one of the reasons underlying the remarkable development of the Credit Derivative Swaps market. Sellers of such swaps receive the yield spread as long as the issuer of the bond services its debt. They pay the buyers of the swap when the firm defaults. While insurance companies, pension funds or UCITs generally cannottrade CDS, dealers can. This facilitates their ability to establish positions equivalent to short sales, and thus increases their risk management ability.

4.2 Dealership

The European corporate bond market, like its US counterpart, is an over-the-counter market, revolving around dealers and brokers. Suppose an institutional investor desires to trade a given bond. He or she will contact one or several dealers, telling them which bond he or she wants to trade, the desired quantity, and whether he or she wants to sell. The dealers will then make price offers for the whole trade. Eventually, the customer will trade with the best offer, or decide not to trade. After trading with customers, the dealer often unwinds at least part of his inventory on the interdealer market.

Alternatively, the investor can contact a broker, who will direct him to interested counterparties. Also, the sequencing of the game can sometimes be reversed: brokers or dealers can contact investors, informing them of trading opportunities, in given bonds, at given prices, and asking them if they would be interested in trading under those conditions.

Dealers are not rewarded by commissions. Their bid and ask prices are net prices. Of course, they implicitly factor in the compensation of their dealership services. Hence they will reflect the costs of market making and also possibly the rents of the dealers. In contrast with the convention used in several other markets, brokers in the European corporate bond market are not explicitly rewarded by commissions. In the trades they arrange, they receive the bid-ask spread between the price paid by the buyer and the price received by the seller.

Because of their permanent presence on the market and thanks to the order flow and contacts they are exposed to, dealers and brokers are in a good position to cope with the informational problems arising in the bond market. They have good private information about which bonds are relatively easier to trade at a given point in time and about who is interested in trading them.

4.3 Telephones and screens

Traditionally, interaction in the bond market has taken place on the telephone. Institutional investors would call dealers on the phone, negotiate on the price, and then have the option to call another dealer.[5] Or the customer would call a phone broker, who would simultaneously call several dealers. Of course, this technology limits the number of dealers the customer can contact. This increases the search costs incurred by the customer when searching for the right counterparty or the right bond. This limits the ability of the customer to let dealers compete with one another. This increases the rents of the dealers, particularly when they have private information about which bonds are currently traded and who trades them.

Electronic communication now complements the telephone. Investors, dealers and brokers communicate through Bloomberg screens and messaging systems. Investors can purchase access to real time information from Bloomberg. Dealers' quotes are disseminated on screens. These quotes are indicative but close to the prices at which trades can occur. Bonds, however, differ markedly in terms of activity, and this affects the availability of quotes. Bonds with headline news, or which have been recently

[5] Retail investors or small institutional investors do not contact dealers directly. They trade through the intermediation of their bank or of brokers.

issued, are actively traded. For such bonds numerous quotes are posted on Bloomberg screens. Dealers and brokers also frequently send messages to large institutional investors, via the Bloomberg system. Such messages provide indications of trading interest, with prices, size and direction. Other bonds are inactively traded. For such bonds, it is difficult – and sometimes impossible – to find recent or significant quotes on Bloomberg screens.

4.4 Electronic trading platforms

Recently, electronic trading platforms have developed. They can be put in place by a single dealer, offering its customer pricing information. They can also involve several dealers. One of the most successful platforms in the European corporate bond market is MarketAxess. This platform relies on 20 dealers and has attracted 360 clients. These customers are large institutional investors (in this market €200,000 would be a small size, and €1,000,000 a typical size). MarketAxess facilitates trading in approximately 5000 bonds in Europe. There are about 250 trades a day on this platform.

MarketAxess was developed as a computerized equivalent to the traditional telephone based system. Just like the telephone system, it involves customers announcing their desired size and direction and asking dealers for quotes. Clients can request quotes from up to six dealers. As on the telephone, the identity of the customer is revealed to the dealers. Consistent with models of repeated interaction, different customers might well get different prices for the same trade. The dealers contacted by the customer have three minutes to post prices, which remain firm for a small amount of time. The customer can take one of these offers by clicking on it. Thus, bond trading on MarketAxess works as a sequence of computerized first price auctions. This system enhances the efficiency of the market for the investors in two ways: First, it displays information on which dealers are interested in trading which bonds. This simplifies greatly the search problem of the investor. Second, by running an auction for the customers, MarketAxess enhances their ability to let dealers compete with one another. This may in turn reduce the variance of prices across dealers.

Thus electronic communication and trading platforms have broadly enhanced transparency and efficiency in the markets. Over time, we may expect further growth of electronic trading systems with beneficial effects on competition and transparency.

4.5 Regulation

Since it is a dealer market, the European bond market is decentralized. This market is self-regulated by the International Capital Market Association (ICMA).[6] While some dealers are based in continental Europe, most operate from London. The FSA plays a key role in the regulation of the European bond market. Other regulators concerned with this market include the AMF in France and the London Stock Exchange.

All the London based members of ICMA (i.e., the great majority of the dealers in the European corporate bond market) and all members of the Council of Reporting Dealers,

[6] ICMA defines itself as "the self-regulatory organisation and trade association representing the investment banks and securities firms issuing, trading and dealing in the international capital markets worldwide." (See its website http://www.icma-group.org.)

irrespective of their location, have to report their trades to this self-regulatory organisation, through a system known as TRAX. The system captures most of the professional business in continental Europe and the UK. Retail trading conducted between European banks and small clients is usually not reported to TRAX. The TRAX information goes to national regulators, such as the FSA in London, the National Bank of Belgium and, previously, the AMF in Paris, which can use it for monitoring and surveillance.

4.6 Transparency

Currently, there is no systematic post-trade transparency in the European corporate bond market. For large investors, there is a significant amount of pre-trade transparency. As discussed above, institutions can obtain competing firm quotes from dealers through electronic trading platforms or brokers. In addition, information on quotes is disseminated by data vendors and via Bloomberg messaging. For retail investors and small institutions, in contrast, it is likely that there is little transparency in the bond market, be it pre- or post-trade.

An interesting and important example of electronic quote dissemination in the bond market is offered by the International Index Company (IIC), which computes and disseminates iBoxx indices. In this paper, we focus only on the corporate bond market segment of their acitivity. iBoxx indices are computed for hundreds of euro-denominated bonds and hundreds of sterling bonds. Ten dealers (ABN Amro, Barclays Capital, BNP Paribas, Deutsche Bank, Dresdner Kleinwort Wasserstein, HSBC, JP Morgan, Morgan Stanley, Royal Bank of Scotland and UBS Investment Bank) transmit indicative bid and ask quotes to the Deutsche Börse every minute for every bond in the iBoxx universe. Once IIC receives these data, it conducts quality controls.[7] Then average ask prices and bid prices are computed for each bond. IIC sells the data in real time through vendors such as Bloomberg, Telerate, Telekurs, Reuters, etc. In addition, daily closing prices can be freely observed on the IIC website.

While the dealers' prices used by IIC are only quotes, not tradeable prices or transactions prices, it has been confirmed to us by market participants that they are quite representative of actual market pricing, at least for institutional size trades. Dealers have little incentives to manipulate their quote reports, in particular because their reports are averaged with those of the others; outliers are excluded by IIC from the computation of the average price; and IIC does not disseminate individual, non-anonymous quotes. Because the IIC bond prices are reliable, they can be used by investors as a benchmark when negotiating trades with dealers, or to value their portfolios.

To ensure that the bonds in the index are roughly comparable, iBoxx includes only plain vanilla bonds, excluding sinking funds and callable bonds. Furthermore, to ensure that there will be a minimum amount of liquidity, bonds can be included in the iBoxx universe only if their amount outstanding is at least €500 million. Finally, the bonds included in the iBoxx index are investment grade, i.e., their ratings range from AAA to BBB.

[7] IIC first checks whether the quotes are non negative, whether the bid is lower than the ask quote, and whether the spread is blow 500 bp. To be included in the average, the quotes must pass these tests. Second, IIC checks if the difference between the maximum bid quote and the minimum bid quote is below a threshold. If it is not quotes are inspected further and outliers are eliminated. The same filter is applied on the ask side.

4.7 Pricing conventions

Market practitioners use several alternative conventions to express bond valuations. Sometimes, they express those values in terms of prices, for a nominal of €100. Alternatively they express the value of the bonds in terms of yield to maturity, or in terms of the difference between the yield of the bond and a benchmark yield, on a government bond. Of course, there is a one-to-one mapping between prices and yields. Platform organizers (such as MarketAxess) or data vendors (such as Bloomberg) provide conversion engines. Denote the bond value at time t by V_t, and its maturity by T. Denote the sequence of cash flows it promises by F_τ. The yield to maturity is y_t such that:

$$V_t = \Sigma_{\tau=t+1}^{T} \exp[-y_t(\tau-t)]\, F_\tau = V(y_t).$$

In an imperfect market, the fundamental value is not directly observed, only ask and bid and transactions prices are observed. Assuming the bid and ask prices (A_t and B_t) are symmetric around the value of the bond, and denoting by S_t the proportional spread we have:

$$A_t = V_t(1+S_t/2), \quad B_t = V_t(1-S_t/2), \qquad (1)$$

while the absolute spread is: $A_t-B_t = V_t\, S_t$ and the midquote is: $(A_t+B_t)/2= V_t$. Similarly, denote the ask and bid yields by: $y_t-s_t/2$ and $y_t+s_t/2$. We have:

$$A_t = V(y_t-s_t/2)= V(y_t)- s_t/2\, V'(y_t)+o(s_t)$$
$$B_t = V(y_t+s_t/2)= V(y_t)+ s_t/2\, V'(y_t)+o(s_t)$$
$$(A_t-B_t)= (- V'(y_t))\, s_t + o(s_t) \qquad (2)$$

Together (1) and (2) imply that the bid ask spread in terms of yields is approximately equal to the price spread divided by the duration (D_t):

$$S_t / D_t= s_t + o(s_t) \qquad (3)$$

4.8 The retail market for corporate bonds in Europe

4.8.1 Holdings

Direct holdings of fixed income securities by households vary a lot across countries in Europe (see Figures 2 and 3). While in Italy they can be as high as 20% of total financial holdings or even higher, in Germany they are between 10% and 15%, and in other countries they will typically be lower than 5%. While during the internet bubble, these percentages had declined, they rebounded after 2000. In euros, these percentages translate as follows: In 2004, the average Italian household held more than €12,000 in fixed income securities, the average German household held €5,800, and the average British, Spanish and French held around €1000. To some extent, these differences reflect differences in tax treatment (e.g., the historically disadvantageous treatment of corporate bonds in France). In Belgium, Germany and Italy, household direct holdings of fixed income securities are significant. In other European countries such investments take place primarily through funds.

Figure 2: Fraction of households' financial holdings directly invested in fixed income securities (Source: IEM Finance)

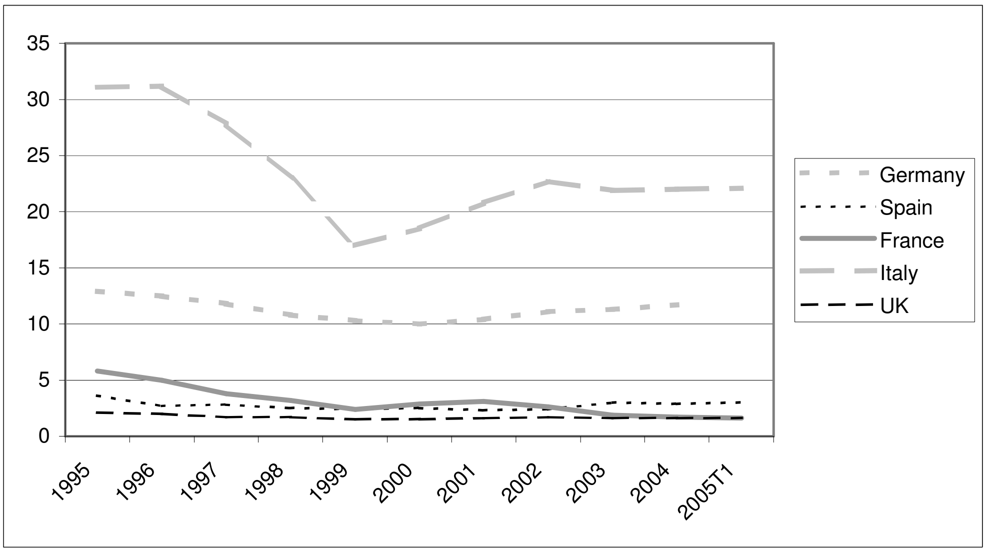
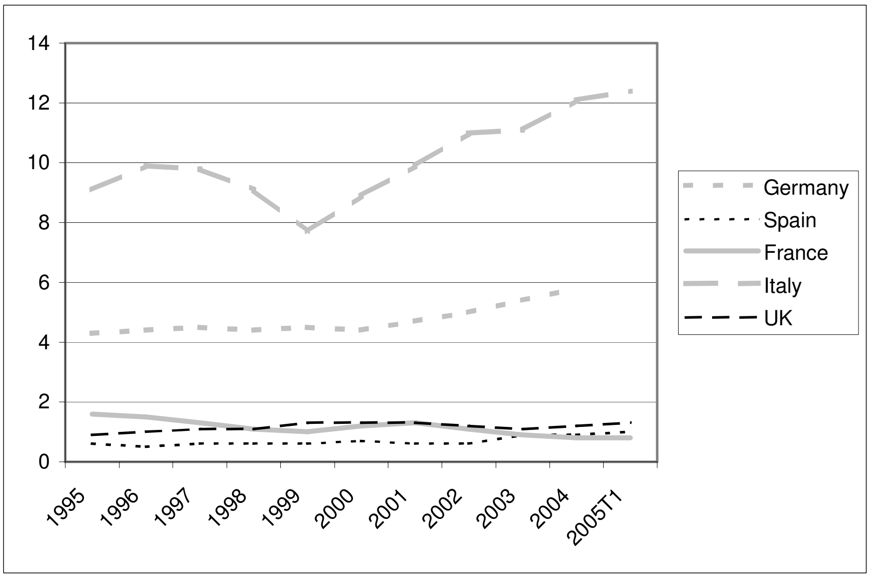


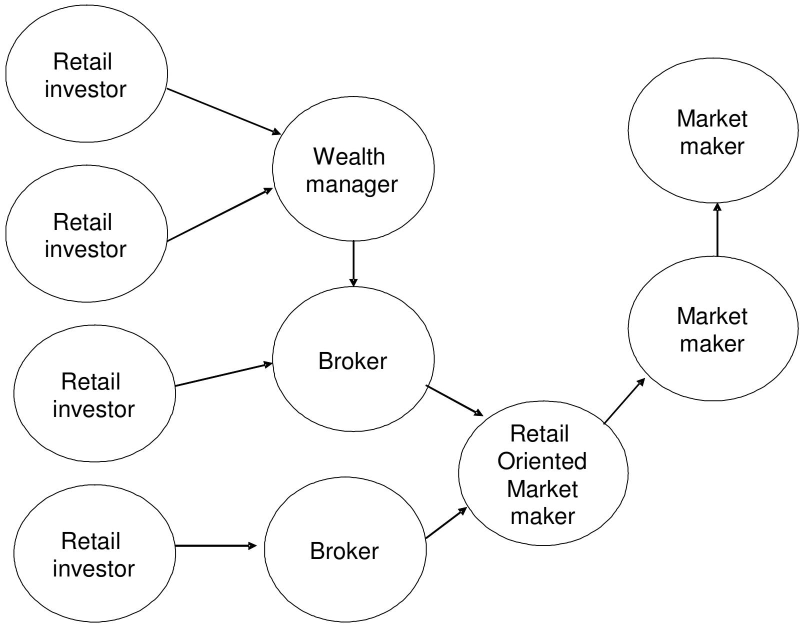
Figure 3: Direct holdings of fixed income securities by households, in €1000 (Source: IEM Finance)



4.8.2 Access

Retail investors access the bond market via several layers of intermediation, as illustrated in Figure 4. (This is about direct investment, not investment through funds.) A typical case could be the following: Madame Dupont inherited bonds, she wants to sell them. She contacts her bank or her broker. The latter arranges the trade with a dealer.

Figure 4: Retail access to direct bonds investments



Some market makers specialize in supplying liquidity at the retail end of the spectrum, typically below £30,000 or €40,000. They provide price and depth, not advice. They supply liquidity to the brokers, who act on behalf of the investors. They try to keep a balanced position. If they accumulate a large position in a bond, once it has reached a standard market size they unwind it with market makers.

At the retail bank level, bond trades are infrequent. They are conducted manually by the bankers. To cover the costs of this non automated and labour intensive task the bank charges a relatively large fee (e.g., 1%) to the retail investor.

There exist several screen-based quote facilities designed for retail trades. One of the most prominent of these systems is Bondscape. It was set up at 2001 by a joint venture involving HSBC and Barclays. It is accessible to brokers and wealth managers, not directly to retail investors. The market makers sponsoring this system post two-way quotes, for over 350 bonds, including gilts as well as other sterling- and euro-denominated bonds. The minimum trade size is the minimum deliverable amount of the issue. In addition to Bondscape, there exist other screen-based quoting systems for retail size. Among the most prominent are the systems which have been created by Royal Bank of Canada and Deutsche Bank. The bank sponsoring the system displays electronic two-way quotes for hundreds of bonds. Typically, quotes are firm up to $500,000. The agent in charge of conducting the trade for the retail investor (broker or retail banker) can inspect the quotes posted on these systems and request execution by clicking on the price. The dealer has a few seconds to back out, and if he does not the deal is done. The delay protects market makers from opportunistic quote lifting when the market moves rapidly. Funds may use electronic sources (e.g., MarketAxess, Bondscape, Bloomberg) to search, then conduct transactions on the voice market.

Spreads quoted on these electronic platforms can be quite tight: 10 centimes. One of the reasons why banks are willing to post such tight spreads is that they want to attract volume. This provides them with information about what types of bond are in demand, and that information can then be valuable, for example, in the primary market. In addition, in small retail size, orders are unlikely to be motivated by private information about the fundamentals. Hence, spreads need not include an adverse selection component. This is not unlike market skimming strategies followed by some platforms in the equity market in the US.

4.8.3 The Prospectus and Transparency Directives

The primary market is regulated by the Prospectus Directive, together with its close counterpart the Transparency Directive, (both of which came into use in 2005), as well as national rules. This directive was designed to protect investors, by enhancing transparency. Firms marketing their bonds to the investor public must issue very complete prospectuses and comply with European accounting standards. This can have some perverse effects: retail investors actually do not read long and complex prospectuses, yet those are very costly to produce. Furthermore, for non European issuers, it can be a great burden to comply with European accounting standards. Some issuers reacted by taking measures that limit their bond sales to retail investors, to avoid the regulation. Thus they set the minimum bond size above € 50,000. This reduces the universe of bonds to which retail investors have access, and it can also be costly for smaller funds.

4.8.4 Secondary market regulation

The secondary market has hitherto been subject to the conduct of business regulation imposed by the Investment Services Directive (ISD), plus additional local regulation. This will be replaced by the Markets in Financial Instruments Directive (MiFID) from 1 November 2007.

Conduct of business regulation faces two ways: firm-client and firm-market. It applies to firms providing investment services in financial markets, instruments and products, principally securities and derivatives, with some limited exceptions.

Under the ISD, a single passport may be used by firms to operate in other EU countries, but firms have to comply with local conduct of business rules governing firm-client relationships. The ISD sets minimum standards for regulation and transparency of ‘regulated markets’. It permits member states to use a ‘concentration rule’ for regulated markets, requiring equity trades to be directed to the local stock exchange for execution. Such a rule is applied in a number of European countries. Investment advice is a ‘non-core’ service, so regulation of investment advice is optional in each member state. Although the UK introduced a regime to regulate investment advice in 1987, this remains the exception. UK retail distribution is diffuse and relies upon a range of models, but includes the use of small independent financial advisers, all of whom are regulated. By contrast, distribution of financial instruments and products in many other European countries is heavily concentrated through retail banks.

MiFID seeks to introduce more competition, to extend the range of investment services and products which are regulated, and to harmonise regulations at a much greater level of detail than previously. It covers secondary market activities only. In contrast to the ISD, investment advice becomes a core service: every member state will now have to introduce regulation. A passport will be available to firms based on compliance with the 'home state' conduct-of-business rules. The concentration rule is discarded, in exchange for more transparency pre and post-trade (for shares only) and post-trade regulatory reporting (for all MiFID instruments admitted to trading on a regulated market). This means that brokers will in future have to search for best execution in more than one venue. A specific best execution rule imposes the requirement to deliver the 'best outcome' to retail and professional clients across all MiFID asset classes. Three further requirements are imposed in relation to certain activities, all going beyond ISD requirements: (1) Firms providing investment advice or portfolio management must assess 'suitability' of services for each client. (2) Firms providing any other investment service (e.g., receipt and transmission of orders) must assess the 'appropriateness' of the service for each client. (3) Products that are deemed to be 'non-complex', however, may be sold on an execution-only basis, i.e., without assessment of appropriateness or suitability. Corporate bonds fall into this category, unless they embed a derivative. So MiFID permits retail investors to access the corporate bond markets without taking advice.

4.9 Credit default swaps

The credit default swap market has grown tremendously over the recent period. The British Banker Association estimates that its total notional amount was $180 billion in 1997, $2 trillion in 2002 and $5 trillion in 2004.

4.9.1 Definition

Credit default swaps (CDS) are essentially insurance contracts against default risk for bondholders. The party buying insurance (or "protection") pays the seller a fixed premium each period until either default occurs or the contract matures. The company that has issued the bond is called the "reference entity." The bond itself is called the "reference obligation." If the issuer defaults, the seller of protection must pay the buyer of protection. The CDS contract defines the occurrence of default. It is referred to as a "credit event." Types of credit events include: bankruptcy, obligation acceleration, obligation default, failure to pay, repudiation/moratorium, and restructuring.

To fix ideas, consider the following example (borrowed from Longstaff et al, 2003.) On January 2002, a protection buyer wishes to buy five years of prtotection against the default of the Worldcom 7.75 percent bond maturing April 1, 2007. The buyer owns 10,000 of these bonds, each having a face amount of $1,000. Thus the notional value of the buyer's position is $10,000,000. The buyer contracts to buy full protection via a single name CDS with a 169 basis points premium. If there is a default, the buyer delivers the 10,000 bonds and receives $10 million.

While, in that example, there is physical delivery, some CDS contracts are based on cash settlement. In that case, if there is a credit event, the seller of protection pays to the buyer the difference between the nominal and the market value of the distressed bond. The BBA survey shows that the vast majority of the contracts involve physical settlement.

4.9.2 Trading

CDS are traded over the counter, mostly by bank dealers. In contrast with Exchange traded derivatives, for which there are margin calls and clearing houses, CDS are OTC contracts, involving counterparty risk. Most participants in the CDS market are large institutions with good credit rating.

The majority of trades in the CDS market are conducted over the telephone. Interdealer brokers (IDBs), who match buying and selling dealers, play a major role in this market. The ISDA's Operations Benchmarking Survey (2004) estimates that 34% of the CDS trades are arranged by IDBs. Interdealer brokerage involves some voice-based systems, and some electronic platforms. An example of the latter is the platform set up by CreditTrade. There, dealers can post or hit quotes directly, without voice-intermediation. CreditTrade charges lower commissions on its electronic platform than for voice-brokered trades.

4.9.3 Advantages

Lack of liquidity in the corporate bond market can arise because i) it is difficult and costly to short bonds, and ii) for each issuer, liquidity can be spread across a large number of bonds. These problems are overcome in the case of the CDS market. Because these are derivative contracts, they enable traders to take short or long position relative to the default risk of an issuer. Also, even if the issuing firm has issued several bonds, a single standardized CDS contract can be used to manage the corresponding default risk. Trading this contract can become a focal equilibrium. Such concentration of trading can increase liquidity and reduce trading costs. Longstaff et al. (2003) offer very interesting empirical evidence on this point. Controlling for credit risk by comparing CDS and underlying bonds, they find that yield spreads are greater in the cash market than in the CDS market. They show that this difference reflects (in part) the greater liquidity of the CDS market.

Because this OTC market involves counterparty risk, it is accessible only to big names, with good credit standing. In fact, in our extensive interviews of investment managers, all interviewees (except one) said they did not use the CDS market or used it very little. Thus, only bank dealers actually operate directly in this market. Yet the existence of the CDS market can be beneficial for traders and investors who can only access the underlying cash market.

Because of its advantages, discussed above, the CDS market is used extensively by bank dealers to hedge their risk exposure. Hence, it facilitates risk sharing for dealers. This reduces their inventory costs and, in turn, leads to tighter spreads for the underlying bonds (for a model of the link between risk exposure and spreads see, e.g., Biais et al, 2005.).

Another advantage of CDS is that they can foster price discovery in the credit risk market. As discussed above, the CDS market is quite liquid and active. Observing the prices set in that market thus gives useful information about default risk and its valuation. Such information is useful to discover the prices of the underlying bonds.

Acharya and Johnson (2005) shed interesting light on the contribution of CDS for price discovery. Using data from CreditTrade, they show that trading in CDS has a statistically significant impact on stock prices for firms with higher credit risk. This means that, for these firms, information flows from the CDS market to the equity market. For all firms on average, this ínformation flow is insignificant.

In the European market, institutional investors with access to CDS quotes via Bloomberg screens can use this information to discover the price of corporate bonds.

4.9.4 Potential problems

The growth of the CDS market has been such that in many cases, the notional amount is much larger than the underlying cash amount. This precludes physical settlement in case of credit events. This can be a problem, since most CDS contracts mention cash settlement. This problem arose recently, in the case of Delphi. The notional amount was vastly greater than the underlying. The market handled this problem rather efficiently. An auction was run, to set the reference price of the underlying bond. CDS were settled in cash, relative to this reference price. That the market was able to handle the problem rather well may reflect the relatively small number of non-anonymous participants, and the importance of relationships and reputations between dealers.

Another potential problem which could arise in this market is related to contractual incompleteness. CDS contracts are sometimes not entirely precise and exhaustive. In case of default, ambiguities could lead to litigation.

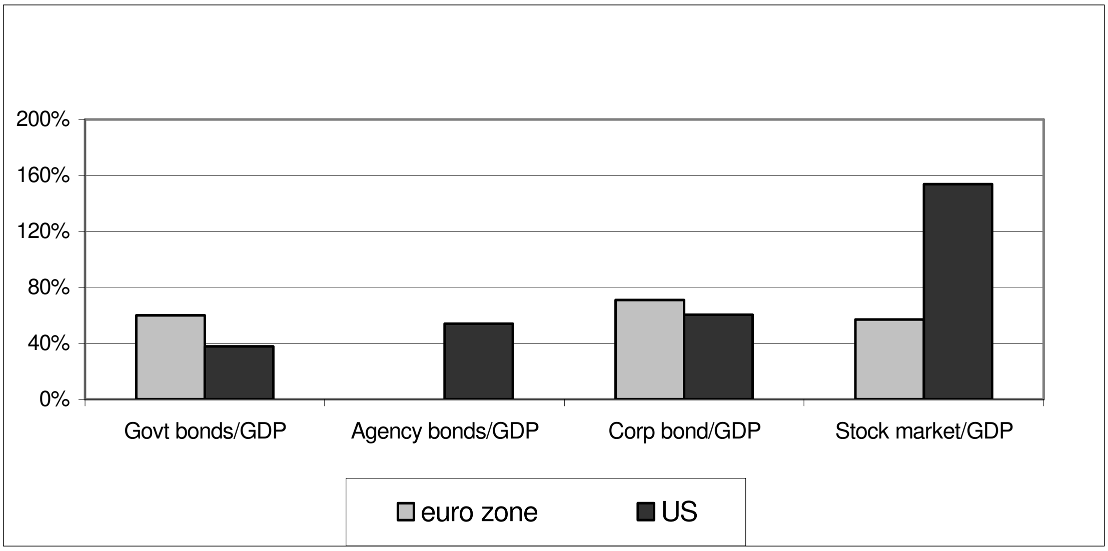
For the most actively traded CDS, there is now a trend towards greater standardization and the possibility of exchange trading, with margin calls and clearing. Such trading arrangements would solve the potential problems mentioned above.

5. An empirical study of liquidity and price discovery in the European corporate bond market

5.1 Introduction

Bonds play a very important role in the financing of our economies. The market capitalization data in Figure 5 show that in the US, the bond market is roughly the same size as the stock market. In Europe, it is even larger than the equity market. As we have seen, however, the relative weights of different types of bonds differ across countries. In Europe, government bonds and those issued by financial firms amount to a much larger fraction of the market than in the US.

Figure 5: Capitalization of stock & bonds relative to GDP, 2004 (Source ECB, FED)



Our goal is to understand the workings of this market and investigate its efficiency. Is the supply of liquidity competitive? Does it result in satisfactory liquidity? Does the market convey adequate information to economic agents? These are important issues, as the liquidity and informational efficiency of the bond market directly affect the cost of funds for issuing firms and the investment opportunities of households.[8]

In contrast with the US bond market, we have very little evidence on the microstructure and liquidity of the European bond market. The research reported here is, to our knowledge, the first substantial empirical work on these issues. First, it should provide a useful out of sample robustness check of the results obtained for the US market. Are the rather surprising features of that market also observed in Europe: Do we see relatively large spreads? Are effective spreads increasing in trade size? Second, the European corporate bond market is not post-trade transparent, as it has not undergone a

[8] While in Italy and Germany, households often directly hold bonds, in other European countries this is less frequent. The bond market still matters for households, however, who indirectly hold bonds, through mutual funds, pension funds, and insurance policies.

regulatory reform comparable to TRACE. Hence comparing liquidity and transactions costs in the corporate bond market on both sides of the Atlantic can help one understand better the consequences of post-trade transparency. Does greater opacity in the European market lead to larger spreads than in the US market? Do other factors drive the relative size of spreads on both sides of the Atlantic?

An additional interesting feature of the European market is that it includes two different segments: the euro zone, which is composed of several countries and attracts many investors and liquidity suppliers, and the sterling zone, for which the potential number of participants is smaller. International investors tend to operate in euro-denominated bonds rather than in sterling bonds. Most investors in sterling are UK institutions: insurance companies, pension funds or UCITs. The investors in this relatively small pool of participants tend to follow buy-and-hold strategies. This situation is likely to generate relatively low liquidity. Does this affect bid-ask spreads, trading activity, dealer participation?

To conduct our analysis we rely on a new quotes and trades dataset, provided to us by the International Index Company (IIC) and the International Capital Market Association (ICMA). The data include trades and quotes for 627 euro-denominated bonds in 2003, 765 in 2004 and 812 in 2005. For sterling-denominated bonds, the number of bonds in our dataset is 539 in 2003, 653 in 2004 and 647 in 2005. This sample is quite representative of the universe of investment grade corporate bonds in Europe. For these bonds, over the three years, our dataset includes a complete report of 1,952,244 time-stamped trades, with the transaction's price, the volume, and the characteristics of the bond. This unique dataset enables us to propose the first high-frequency data analysis of the microstructure of the European corporate bond market.

Our main results can be summarized as follows:

- *Trading activity* ***:*** The average number of trades per bond and per day is slightly above 3 for euro-denominated bonds and 2 for sterling-denominated bonds. For euro-denominated bonds the average transaction size is around one million euros. For sterling-denominated bonds it is around £800,000. Trading activity is relatively stable throughout our sample years.
- *Maturity, ratings and transaction size* ***:*** In line with theoretical models, spreads increase with maturity and default risk. This was also found for the US bond market, which suggests the economics of the secondary markets for bonds are not radically different in Europe and in the US. They also decrease with trade size, which is similar to the results obtained by previous studies for the US market (Edwards, Harris and Piwowar (2004) and Goldstein, Hotchkiss and Sirri (2005).) Note that such a decrease was also observed in dealer operated equity markets such as Nasdaq (see Christie and Schultz, 1994) and the London Stock Exchange (see Reiss and Werner). Hence, it is likely to be a structural feature of dealer market. We also find that spreads were much higher in 2003 than in 2004 and 2005. This is because, in 2003, the market perceived default risk to be quite high, and large risk leads to wide spreads.
- *Euro- versus sterling-denominated bonds* ***:*** For euro-denominated bonds, we find that spreads are rather tight. In 2005, for a bond valued at €100, the ask price would be on average at €100.05 and the bid at €99.95. In 2003, the corresponding figures are 100.07 for the ask and 99.93 for the bid. For sterling

bonds, the spread is less tight. For a bond valued at £100, in 2005, the ask price would typically be at €100.10 and the bid at €99.90. As discussed above, relatively few investors are active in the sterling market. This leads to low natural liquidity, which, in turn, attracts only a limited number of market makers. Consistently with this interpretation, we find that the sterling market has both larger spreads and more concentration of dealership activities than the euro denominated market. In the former, the market share of the three most active dealers in a given bond is typically above 50%. In the latter, it is below 40%.

- *Spreads in the euro zone and in the US*: Our estimates of the effective spreads for euro-denominated bonds are lower than their US counterparts. In their sample of 90 BBB bonds, Goldstein et al. (20005) find that, for transaction sizes, above one million, the half-spread is 0.22% before dissemination and 0.135% after.[9] In our sample, for the same period (2003), the effective half spread for trades above one million euros is 0.049%. For BBB bonds, in 2003, we find an average effective spread of 0.095%. Hence, controlling for sample period and credit risk, we find that effective spreads in euro-denominated bonds are lower than their post-trade transparent US counterparts.
  Since the advent of the euro, the European bond market is quite integrated. Investors from all European countries trade in the same market. This large pool of buyers attracts sell-side intermediation. And banks from one country of the euro zone can easily deal with investors from another country of that zone. Our results suggest that, as a result, the supply of liquidity in the euro-denominated bond market is rather competitive, which drives spreads down.
- *Information content of trades*: In line with asymmetric information theories, trades are found to have significant informational content, especially for low rating bonds. It takes more than one day, however, for the information content of a trade to be fully impounded in market pricing. Such a delay likely stems from the lack of post-trade transparency.

The next section presents our dataset. Then we present our empirical results. Finally we offer a conclusion and discuss policy implications of this empirical analysis.

5.2 Data

Quote data

The International Index Company (IIC) gave us the history of daily, end of day, bid and ask quotes for the euro- and sterling-denominated bonds in its iBoxx index. These bonds represent the vast majority of the European investment grade, plain vanilla bond market. For 2003 and 2004, we consider the subset of these bonds which were already issued and which did not mature before 2005. We discarded from this subset the bonds for which quotes were missing for more than 15% of the days (missing data were mostly concentrated in 2003.) We also discarded two sterling-denominated bonds with erratic behaviour. As reported in Table 2, this leaves us, for euro-denominated bonds, with 627

[9] These are bid-ask spreads expressed as a function of the bond price. Hence, they correspond, for a bond priced at $100, to an ask price of $100.22 or 100.135. Spreads in the corporate bond market are often expressed in terms of yields rather than prices. As explained in the next section, there exists an easy formula to go from one formulation to the other.

bonds in 2003, 765 in 2004 and 812 in 2005. For sterling-denominated bonds, the number of bonds in our dataset is 539 in 2003, 653 in 2004 and 647 in 2005.

The bid and ask quotes are expressed with the convention of a nominal bond price of €100 or £100, except in the case of zero-coupons. Thus, except for zero-coupons, the bond prices in our data are typically between 90 and 110. The IIC data gives separately the bond bid and ask quotes and the accrued interest. The latter is a deterministic, pre-specified function of time, independent from the pricing behaviour of the dealers. This function exhibits discontinuities around coupon payment days. Thus, to work with smooth times-series, reflecting the behaviour of the traders in the marketplace, we focus on prices net of accrued interest.

Table 2: Number of bonds in our sample

	Number of € denominated bonds with		Number of £-denominated bonds with	
	quotes data	quotes & trades data	quotes data	trades data
2003	627	310	539	336
2004	765	594	653	511
2005	812	637	647	543

Transactions data

ICMA provided us with transactions data from TRAX. To be able to use jointly the IIC quote data and the transactions data from TRAX, we asked ICMA to give us data for bonds included in the IIC sample. ICMA gave us a complete record of all trades from January 2003 to September 2005.

As reported in Table 2, for euro-denominated bonds we have transactions data for 637 bonds in 2005, 594 in 2004 and 310 in 2003. For sterling-denominated bonds, the corresponding figures are 543 bonds in 2005, 511 in 2004 and 336 in 2003. Overall, we have 1180 bonds in 2005, 1105 in 2004, and 646 in 2003. While this is a large number of securities, this is much lower than in the samples analysed by Edwards, Harris and Piwowar (2005) and Goldstein, Hotchkiss and Sirri (2005), which included 16,746 and 5,503 bonds, respectively.

For these securities, we have a complete time stamped record of the transactions reports, with characteristics of the bonds (such as its ISIN number, its date of issuance, its maturity, and the name of the issuing company) and the trades (such as the price, the quantity, whether the dealer reporting the trade was selling or buying, and an anonymized dealer code, which enabled us to compute market shares, reported in the next section).

To eliminate outliers and erratic observations we discarded the trades that were reported between 11:00 p.m. and 6:00 a.m., the trades with value traded below 100 (€ or £), and the trades with value traded above 20 millions (€ or £). We also eliminated observations for which the change in price since the last trade was outside the +10%, -10% range. After these eliminations, we have a dataset of 1,952,244 transactions. This includes the inter-dealer trades, but excludes double counting. When two dealers trade and each report the trade to ICMA, this shows up in our data as a single transaction.

One major difference between our dataset and those used by Edwards, Harris and Piwowar (2005) and Goldstein, Hotchkiss and Sirri (2005) relates to trade size. In the US studies, in terms of number of trades, the majority of the observations are retail trades. In our data, there are practically no retail size trades, since those are generally not reported to ICMA. Another major difference relates to the time period. Edwards et al. (2005) and Goldstein et al. (2005) studied the immediate aftermath of TRACE. For example, Goldstein et al. (2005) analyze data from July 2002 to February 2004. In contrast, we study data from 2003, 2004 and 2005.

Issue size

As mentioned above, our sample includes only plain vanilla bonds – excluding sinking funds and callable bonds – with amount outstanding greater than or equal to €500 million. This differs somewhat from the sample analyzed by Goldstein, Hotchkiss and Sirri (2005) who consider bonds with issue size between $10 million and $1 billion. In terms of issue size our sample also differs from that analyzed by Edwards, Harris and Piwowar (2005). Half the bonds in their sample fall in what they call the medium ($100 million - $5000 million) issue size category. Our current dataset does not include information on issue sizes. We are currently working on collecting that information.

Industry

The industry structure of our sample of bonds with trades and quotes is given in Table 3. For both currencies the most frequent industry is financials, and the weight of these bonds in our sample is very stable across years (ranging between 45% and 46% for € and between 56% and 60% for £). This is in line with the stylized fact that the fraction of corporate bonds issued by financial firms is quite large in Europe. It is similar to the US sample of BBB bonds studied by Goldstein, Hotchkiss and Sirri (2005) where financials account for 44% of the bonds. Also in both currencies, utilities represent a sizeable and stable fraction of the sample (ranging from 10% to 13% for €, and from 11% to 13% for £.) In comparison, in the US sample studied by Goldstein, Hotchkiss and Sirri (2005) around 20% of the bonds are issued by utilities. Another sizable fraction of the sample, for euro or sterling denominated bonds, is consumer services or goods. Also, for €, telecommunications range between 9% and 13% of the sample – a legacy from the bubble period. This differs from the sample of sterling-denominated bonds or the US sample.

Table 3: Industry structure of our sample of bonds with quotes & trades data

Panel A: Euro denominated bonds						
	2003		**2004**		**2005**	
Basic Materials	9	3%	22	4%	22	3%
Consumer Goods	41	13%	75	13%	76	12%
Consumer Services	15	5%	30	5%	31	5%
Financials	141	45%	267	45%	293	46%
Health Care	2	1%	5	1%	5	1%
Industrials	21	7%	44	7%	47	7%
Oil & Gas	8	3%	20	3%	22	3%
Technology	2	1%	2	0%	3	0%
Telecommunications	39	13%	52	9%	59	9%
Utilities	32	10%	77	13%	79	12%
	310		594		637	

Panel B: Sterling denominated bonds						
	2003		**2004**		**2005**	
Basic Materials	6	2%	7	1%	7	1%
Consumer Goods	20	6%	41	8%	42	8%
Consumer Services	38	11%	50	10%	50	9%
Financials	188	56%	300	59%	326	60%
Health Care	2	1%	2	0%	2	0%
Industrials	20	6%	24	5%	24	4%
Oil & Gas	5	1%	13	3%	14	3%
Technology	1	0%	1	0%	1	0%
Telecommunications	13	4%	18	4%	19	3%
Utilities	43	13%	55	11%	58	11%
	336		511		543	

Maturity and rating

The structure of our samples in terms of maturity and rating is depicted in Figure 6. For both currencies, A-rated bonds are by far the most frequent, and this is quite stable across years in our sample. The next is BBB, again for both currencies and across sample years. AA bonds come next. The least frequent bonds are AAA. Their frequency is slightly higher in the £ sample than in the € sample. This differs by construction from the sample of BBB US bonds analysed by Goldstein, Hotchkiss and Sirri (2005). It also differs from the sample of bonds analysed by Edwards, Harris and Piwowar (2005), in which AAA bonds included 9% of the population, and speculative grade bonds (with ratings lower than BBB) included 23% of the population.

Figure 6: Number of bonds in our sample with trades and quotes data, by rating

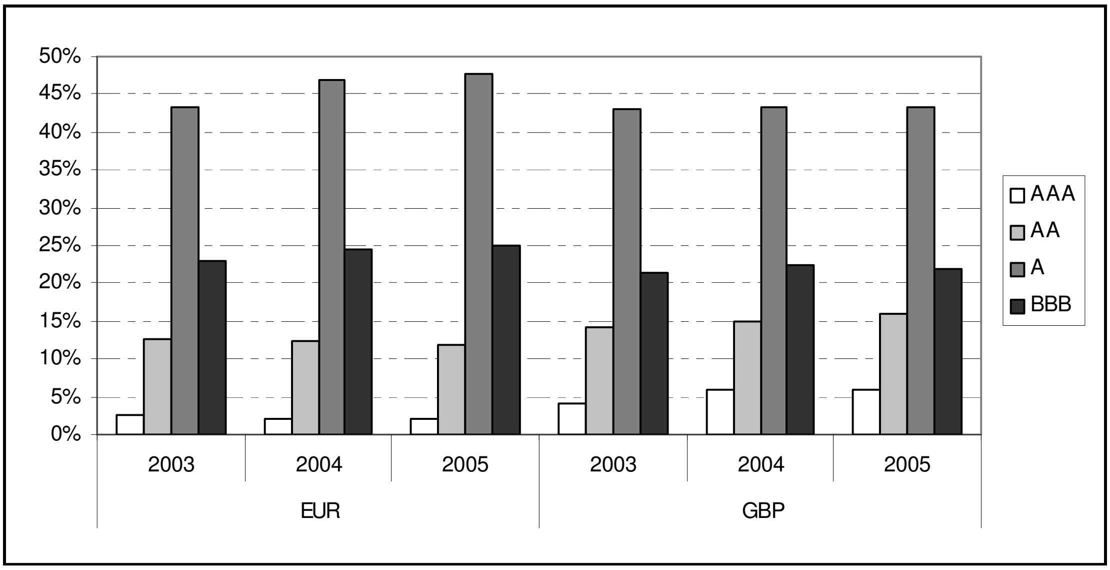


Table 4 offers additional information on the maturity structure of the bonds in our sample. For euro-denominated bonds, the most frequent maturities are 2, 3, 4, 5 and 6 years, as well as ten years. Ignoring the 11 bonds with maturity longer than 20 years, the average maturity for euro-denominated bonds in the IIC sample is 6 years. For sterling-denominated bonds, the most frequent maturities are 10 years, 15 years and 20 years. Thus, the sterling-denominated bonds tend to have longer maturities than the euro-denominated bonds. Ignoring the 59 bonds with maturity longer than 20 years, the average maturity for sterling-denominated bonds in the IIC sample is 9 years. These maturities are comparable to those of the US corporate bonds studied by Goldstein, Hotchkiss and Sirri (2005), which have an average maturity of 7.8 years.

Conclusion

Overall, these statistics suggest that our sample is relatively broad and quite representative of European investment grade bonds. Also, the maturity, industry and rating structure of our sample is fairly stable across years. While our sample includes a smaller number of bonds, it is not markedly different in terms of maturities and industries from the US samples studied by Goldstein, Hotchkiss and Sirri (2005) and Edwards, Harris and Piwowar (2005). In terms of ratings it does differ somewhat from the US samples, since that studied by Goldstein, Hotchkiss and Sirri (2005) includes only BBB bonds, while that studied by Edwards, Harris and Piwowar (2005) includes relatively more AAA and speculative grade bonds than ours. Also, our sample only includes plain vanilla bonds, like the sample of Goldstein, Hotchkiss and Sirri (2005), while that of Edwards, Harris and Piwowar (2005) includes bonds with complex features (callable, convertible, sinking, etc.).

Table 4: Structure by maturity & rating of our sample of bonds with quotes & trades data, in 2005[10]

Panel A: Euro denominated Bonds

	AAA	*AA*	*A*	*BBB*	*AAA/AA*	*AA/A*	*A/AA*	*A/BBB*	*BBB/A*	*TOTAL*
1	2 (1)	6 (3)	18 (6)	17 (8)	0	0	1	0	0	44 (18)
2	5 (4	12 (11)	36 (25)	32 (27)	1	0	0	0	4	90 (72)
3	6 (4)	13 (10)	34 (23)	22 (16)	0	0	2	1	6	84 (59)
4	2 (1)	20 (16)	46 (45)	25 (24)	1	0	0	0	4	98 (88)
5	4 (3)	15 (13)	45 (37)	21 (19)	0	0	1	1	4	91 (77)
6	0 (0)	13 (10)	40 (35)	27 (21)	1	0	2	1	4	88 (71)
7	1 (1)	8 (2)	43 (32)	21 (15)	1	0	0	1	4	79 (53)
8	0 (0)	8 (6)	24 (21)	4 (4)	0	0	0	1	1	38 (32)
9	1 (0)	10 (9)	33 (32)	15 (14)	1	0	1	0	1	62 (59)
10	1 (1)	12 (7)	60 (45)	16 (12)	0	0	0	0	2	91 (67)
15	0 (0)	3 (3)	14 (13)	6 (5)	0	1	0	0	1	25 (22)
20	0 (0)	4 (1)	8 (7)	2 (1)	0	0	0	0	0	14 (9)
Longer	0 (0)	2 (1)	3 (3)	4 (3)	0	0	0	0	2	11 (9)
TOTAL	**22 (16)**	**126 (92)**	**404 (324)**	**212 (169)**	**5**	**1**	**7**	**5**	**33**	**815 (636)**

Panel B: Sterling denominated bonds

	AAA	*AA*	*A*	*BBB*	*AAA/AA*	*AA/A*	*A/AA*	*A/BBB*	*BBB/A*	*TOTAL*
1	0 (0)	4 (3)	7 (5)	3 (2)	0	0	0	0	0	14 (10)
2	3 (3)	17 (16)	19 (17)	16 (13)	0	1	0	0	0	56 (50)
3	5 (5)	9 (7)	18 (15)	11 (10)	0	0	0	1	1	45 (39)
4	2 (2)	17 (15)	15 (15)	11 (9)	2	0	0	1	0	48 (44)
5	3 (3)	11 (9)	23 (19)	10 (10)	1	0	1	0	0	49 (43)
6	2 (2)	9 (6)	19 (17)	9 (6)	0	1	2	0	2	44 (33)
7	1 (1)	8 (6)	7 (6)	9 (9)	1	0	0	0	0	26 (23)
8	0 (0)	4 (3)	11 (10)	10 (7)	1	0	0	0	1	27 (22)
9	1 (1)	8 (5)	5 (5)	13 (13)	0	0	0	0	0	27 (24)
10	2 (2)	6 (6)	40 (33)	23 (17)	1	0	0	2	0	74 (61)
15	5 (5)	13 (12)	50 (44)	31 (21)	2	0	1	2	3	107 (88)
20	3 (3)	9 (6)	45 (40)	16 (15)	0	1	0	0	0	74 (65)
Longer	10 (7)	10 (5)	29 (22)	7 (6)	0	1	0	0	2	59 (43)
TOTAL	**37 (34)**	**125 (99)**	**288 (248)**	**169 (138)**	**8**	**4**	**4**	**6**	**9**	**650 (545)**

[10] The first four columns (AAA, AA, A and B) refer to bonds which kept the same rating from January to September 2005. In each cell, the first figure is the number of bonds in the IIC sample, while the second figure (in parentheses) is the number of bonds in the TRAX sample.
The next four columns (AA to A, A to AA, A to BBB, and BBB to A) refer to bonds in the IIC sample which changed rating during the sample period. In the last row and the last column, the first figure gives the number of bonds in the IIC sample, while the second figure (in parentheses) gives the number of bonds in the TRAX sample.

5.3 Empirical Results

5.3.1 Trading activity

In this subsection we report findings on the number of trades and the size of trades, from the TRAX dataset, in 2004 and 2005.

Daily number of trades

For each bond in the TRAX sample, using data from 2004 and 2005, we computed the average number of trades per day. The median, across the euro-denominated bonds, of these daily averages is 3.37 in 2003, 3.56 in 2004 and 3.07 in 2005. Across the 545 sterling-denominated bonds, the median average daily number of trades is 2.07 in 2003, 2.51 in 2004, and 2.23 in 2005. The minimum (across bonds) of the average daily number of trades is slightly larger than one for both currencies. The maximum average daily number of trades is above 50 for euro-denominated bonds and varies between 10 and 33 for sterling bonds.

Figure 7: Median number of trades per day

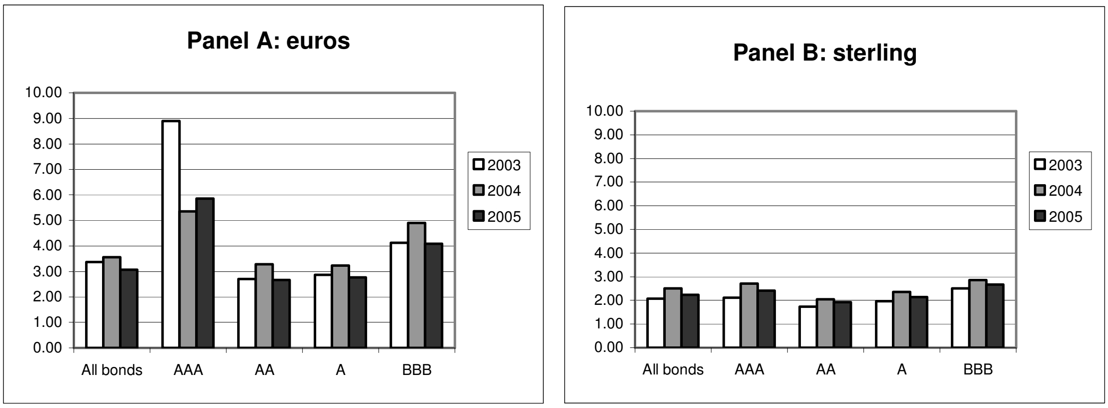


Figure 7 depicts the average daily number of trades for bonds with different ratings. The relation between the average daily number of trades and the rating of the bond is U-shaped, for both currencies. AAA rated bonds and BBB rated bonds are the most frequently traded, while AA and A are somewhat less frequently traded. This could reflect the interaction of two countervailing effects. On the one hand, high rating can increase liquidity by reducing adverse selection. On the other hand, news affecting the values of higher risk bonds is relatively more frequent, thus generating relatively greater activity. Finally note that for both currencies and all ratings, there are no clear differences across years in terms of average number of bonds traded.

As mentioned above, the euro-denominated bonds market attracts many investors, from the euro zone and from other regions. In contrast, most investors in sterling bonds are UK institutions (insurance companies, pension funds or UCITs) which tend to follow buy-and-hold strategies. Our empirical results show that, correspondingly, trading is more active in the euro-denominated market than in the sterling-denominated market.

The European bonds in our sample are more frequently traded than the US corporate bonds analysed by Goldstein, Hotchkiss and Sirri (2005) and Edwards, Harris and

Piwowar (2005). Goldstein, Hotchkiss and Sirri (2005), focusing on BBB bonds, find an average number of trades per day equal to 1.1, which is lower than the medians in our sample for BBB bonds in 2003: 4.12 for euros and 2.51 for sterling. Edwards, Harris and Piwowar (2005), study bonds spanning several ratings, and find an average number of trades per day equal to 1.9, again lower than what we find. This is all the more striking since our dataset, in contrast with theirs, does not include the small trades. The latter, although small in terms of total dollar trading volume, account for more than half the number of trades in the TRACE-based studies.

Table 5: Average daily number of trades by maturity.

		EUR			GBP	
	2003	2004	2005	2003	2004	2005
1	18,11	31,87	10,75		6,30	2,42
2		6,44	5,22		4,72	2,58
3	9,58	7,57	8,76	1,90	4,12	2,73
4	5,95	4,13	4,00	2,17	2,66	2,26
5	7,68	7,36	5,73	3,02	3,67	2,99
6	3,87	4,47	3,56	3,20	3,76	4,32
7	4,81	5,28	4,28	2,96	3,32	3,35
8	3,33	3,00	2,76	2,04	2,19	2,33
9	4,70	3,62	3,33	2,57	3,53	2,97
10	6,84	6,91	5,06	2,33	3,49	3,61
15	3,44	4,84	4,43	2,23	3,86	2,63
20		9,71	6,03	1,96	2,91	2,31
25	12,46	12,63	14,32	2,47	2,82	3,00

Table 5 shows how the average daily number of trades varies with maturity. For euro-denominated bonds, the relationship between trading activity and maturity tends to be U-shaped. Bonds with only short maturity as well as long term bonds are most actively traded. Bonds with intermediate maturities are less actively traded. For sterling-denominated bonds, there is no strong pattern, although bonds with 5 or 10 years to maturity tend to be more active. The link between maturity and activity may reflect some clientele effects. Some market participants are constrained to hold bonds with a given maturity, such as ten years for example. Other participants choose to hold bonds with a given maturity because of the structure of their own balance sheet. For example, life insurance companies may find it optimal to tilt their portfolios towards long bonds. These biases in the term structure of portfolios will affect the maturity structure of the trading activity in the bond market. It is possible that different clientele effects lead to different patterns of trading activity for euro- and sterling-denominated bonds.

Table 6: Average trade size in the TRAX sample

Panel B: Sterling denominated bonds. Trade size in sterling.

	Mean across bonds of average trade size	Minimum across bonds	Median across bonds	Max across bonds
2003				
All bonds	743,184	72,749	733,244	1,682,080
AAA	1,016,285	365,282	987,700	1,623,061
AA	730,820	219,333	661,935	1,581,384
A	766,714	72,749	791,641	1,682,080
BBB	662,568	162,207	644,441	1,412,339
2004				
All bonds	867,867	48,961	818,905	2,411,575
AAA	767,750	191,849	524,490	2,411,575
AA	779,747	115,201	680,751	1,867,004
A	948,428	48,961	940,260	2,317,812
BBB	775,764	171,989	778,019	2,378,477
2005				
All bonds	872,151	49,901	813,509	3,692,000
AAA	749,951	96,941	578,458	1,861,564
AA	689,775	86,547	521,710	3,692,000
A	965,488	49,901	902,643	2,558,591
BBB	846,782	131,469	765,174	3,110,000

Panel A: Euro denominated bonds. Trade size in euros.

	Mean across bonds of average trade size	Minimum across bonds	Median across bonds	Max across bonds
2003				
All bonds	955,620	132,169	880,454	4,300,000
AAA	409,836	203,786	296,557	904,872
AA	791,010	172,424	576,209	2,300,000
A	1,017,366	296,302	932,036	2,656,500
BBB	933,737	132,169	866,147	3,207,456
2004				
All bonds	1,020,534	101,658	941,119	3,560,778
AAA	464,536	106,047	331,948	1,498,957
AA	891,382	131,019	646,501	3,026,689
A	1,068,225	122,988	967,422	3,560,778
BBB	1,041,011	101,658	978,335	2,650,368
2005				
All bonds	949,388	117,961	893,355	2,830,033
AAA	383,170	117,961	382,158	1,124,852
AA	771,348	131,643	564,211	2,359,688
A	1,006,750	122,814	947,353	2,830,033
BBB	998,751	190,680	914,511	2,361,513

Trade size

For each bond in our TRAX sample, we computed the average of all trade sizes. Then we studied the distribution of this average across bonds. The results are in Table 6. Average trade sizes are quite large, typically around €1,000,000 or £800,000. This is larger than their counterparts in the TRACE-based US studies. This reflects the fact that our TRAX dataset does not include the small trades, as mentioned above. Average trade sizes are somewhat larger in the sterling-denominated bond market than in the euro-denominated one. Also, trade sizes tend to increase with default risk. This suggests that more difficult trades, in riskier bonds, tend to be lumpier.

Average total trading volume per bond

While trading frequency is greater for euro-denominated bonds, the size of individual trades is lower. Which of the two effects dominates when it comes to total trading volume? To answer this question we computed the average total trading volume per day for euro-denominated bonds and also for sterling-denominated bonds. Then we divided each of these averages by the number of bonds in our sample for each of the two currencies. The results are in Table 7. We find that, for euro-denominated bonds, the average trading volume per day and per bond is typically between €3,500,000 and 4,200,00. The corresponding figures for sterling-denominated bonds are around: £700,000 and 1,000,000. Converted at the exchange rate that prevailed on November 13, 2005 (1.4857), this corresponds to an average daily trading volume per sterling-denominated bond ranging between €1,000,000 and 1,500,000. We checked that the ranking of the two currencies in terms of volume per bond is the same for all ratings and all maturities. Thus, overall trading activity is lower in the sterling-denominated market.

Table 7: Total trading volume per day and average trading volume per day per bond in our sample

	€ denominated bonds in €	£-denominated bonds in £	£-denominated bonds in €
2003			
Total volume	1 290 290 150	252 726 486	375 475 741
Volume per bond	4 148 843	696 216	1 034 368
2004			
Total volume	2 129 395 545	536 046 873	796 404 839
Volume per bond	3 590 886	1 049 015	1 558 522
2005			
Total volume	2 154 136 645	523 466 377	777 713 996
Volume per bond	3 387 007	964 026	1 432 254

5.3.2 Quoted spreads

In this subsection we report findings on the quoted spread, from the IIC dataset. Denote the (end of day) ask and bid prices for bond *i* on day *t* by $A_{i,t}$ and $B_{i,t}$, respectively. The (end of day) midquote for that bond and that day is:

$$M_{i,t} = (A_{i,t} + B_{i,t})/2, \quad (4)$$

and the (proportional) quoted spread is:

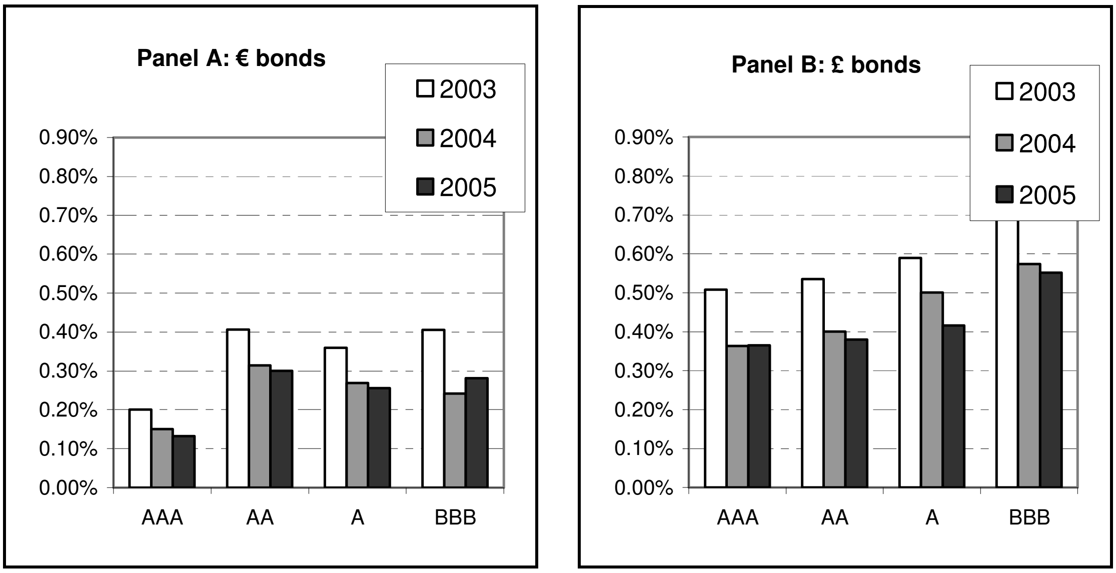
$$S_{i,t} = (A_{i,t} - B_{i,t})/M_{i,t}. \quad (5)$$

Relying on the IIC dataset, we first computed, for each bond, and each day, the end of day closing (proportional) spread. Then for each bond in our IIC sample, we computed the average quoted spread. Then we studied the distribution of this average across bonds.

Findings

Figure 8 presents the average quoted spread, in each currency, by rating. For both currencies, average quoted spreads decrease from 2003 to 2004. Most of the decline occurs between 2003 and 2004.

Figure 8: Average quoted spread, by rating



The figure shows that quoted spreads are much tighter for euro-denominated bonds than for sterling ones. This holds for all ratings and all sample years. The difference can be economically very significant. For example, in 2005, for AAA bonds, the average quoted spread is .13% for euro-denominated and .36% for sterling-denominated bonds.

For sterling-denominated bonds, average quoted spreads increase monotonically as ratings decline. This is not the case for euro-denominated. For these bonds, while spreads are very tight for AAA ratings, they are roughly the same for AA, A and BBB ratings.

Figure 9: Average quoted spread, by maturity

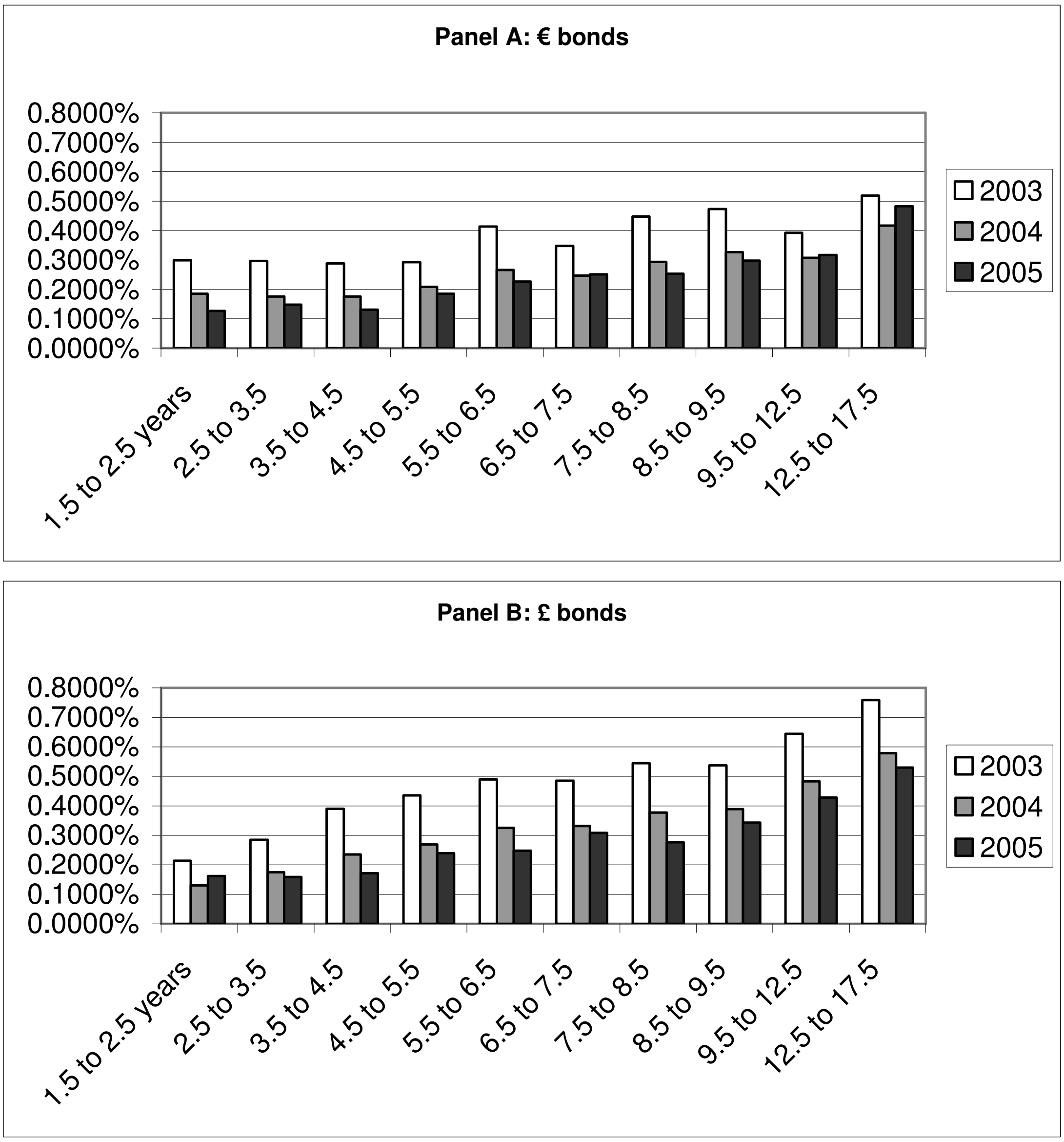


Figure 9 presents the average quoted spread, in each currency, by maturity, measured as the number of years from the sample date to the redemption of the bond. For both currencies, and all sample years, average quoted spreads tend to increase with maturity, but this is more pronounced for sterling- than for euro-denominated bonds. The latter have smaller average quoted spreads than sterling-denominated bonds, for all maturities between 3.5 and 17.5 years, and this ranking is stable across sample years. For the shortest maturities (below 3.5 years) however, the ranking between the two currencies is unclear.

Discussion

Determinants of spreads: The results in Figure 8 and Figure 9 suggest that spreads in the European corporate bond market vary with economic forces, as suggested by theoretical reasoning. Market microstructure models of dealer markets imply that spreads should increase with the inventory bearing costs of the dealers (see e.g., Ho and Stoll, 1983, Biais, 1993, or the survey by Biais, Glosten and Spatt, 2005). Inventory costs increase with the risk that the value of the security will vary a lot. In the case of bonds, this risk increases with the duration of the bond (which can be proxied by its maturity) and its credit risk (which can be proxied by its rating). Consistently with these implications of the theory, we find that bid-ask spreads in the European corporate bond market increase with maturity and decrease with credit quality.

This finding suggests that the bid and ask quotes supplied by IIC are meaningful prices, and also that market pricing varies in line with costs, and thus is not completely dominated by market power. This contrasts, for example, with the findings of Chen and Ritter (2000) for underwriter spreads in the equity IPO market. There, spreads were found to be constant, independent of variations in economic variables determining intermediation costs. This was interpreted as suggesting that spreads reflected collusion rather than marginal costs.

Comparison between the euro and sterling markets: Except for the shortest maturities, average quoted spreads are tighter for euro-denominated bonds than for sterling-denominated bonds. That this result obtains for most maturities and all ratings implies that the overall difference between € and £ spreads is not driven by differences between the two subsamples in terms of maturity or rating. This finding (based on our IIC quote data) is in line with the previous one (based on our TRAX transactions data) that trading activity is greater for euro-denominated bonds. Both reflect that the euro-denominated market is larger and more liquid than its sterling counterpart. There are more potential investors in the former than the latter. This increases trading frequency and correspondingly trading business. This attracts dealership services. It also enhances the ability of dealers to turn around their positions. Both phenomena reduce spreads.

5.3.3 Effective spreads

In this subsection we report findings on effective spreads, based on the merged quote dataset (IIC) and trades dataset (TRAX).

Method

Consider bond i on day t. Focus on the cases where there is at least one trade during the day. Consider the n^{th} transaction reported for bond i on day t in the TRAX dataset. Denote the transaction price by: $P_{i,n,t}$, the trade size by $X_{i,n,t}$ and the direction of the trade by: $Z_{i,n,t}$ (the latter takes the value one if the customer purchases from the dealer and minus one if the customer sells to the dealer.) Finally, denote the fundamental value of bond i by v_i. This is the risk adjusted expected discounted value of the cash flows to be distributed by the bond. Just before the n_{th} trade in bond i on day t, the expectation by the market of the fundamental value of the bond is:

$$V_{i,n,t} = E[v_i \,|H_{i,n,t}^{-}],$$

where $H_{i,n,t}^{-}$ is the information set of the market just before the trade. The effective half-spread for this transaction is:

$$Z_{i,n,t}\,(P_{i,n\,t} - V_{i,n,t}). \quad (6)$$

This is difficult to measure, however, since the fundamental value is not observable. To cope with this problem, we use the midquote as a proxy for the value. Specifically, we assume that:

$$M_{i,t-1} = \mathrm{E}[v_i\,|\mathrm{H}_{t-1}] = \mathrm{E}(V_{i,n,t}|H_{t-1}), \quad (7)$$

where H_{t-1} is the information set of the market at the end of day $t-1$. Hence,

$$V_{i,n,t} = M_{i,t-1} + \varepsilon_{i,n,t},$$

where $\varepsilon_{i,n,t}$ is the informational innovation from the end of day $t-1$ to the time of the n[th] trade on day t ($\mathrm{E}(\varepsilon_{i,n,t}\,|H_{t-1})=0$.) Hence, the effective half-spread can be written as follows:

$$Z_{i,n,t}\,(P_{i,n\,t} - M_{i,t-1}) + Z_{i,n,t}\ \varepsilon_{i,n,t}.$$

Note that:

$$\mathrm{E}[Z_{i,n,t}\,(P_{i,n\,t} - V_{i,n,t})] = \mathrm{E}[\mathrm{E}\{Z_{i,n,t}\,(P_{i,n\,t} - V_{i,n,t})\ |H_{t-1}\}] = \mathrm{E}[\mathrm{E}\{\ Z_{i,n,t}\,(P_{i,n\,t} - M_{i,t-1}) + Z_{i,n,t}\ \varepsilon_{i,n,t}\,|H_{t-1}\}]$$
$$= \mathrm{E}[\mathrm{E}\{\ Z_{i,n,t}\,(P_{i,n\,t} - M_{i,t-1})|H_{t-1}\}] = \ \mathrm{E}[Z_{i,n,t}\,(P_{i,n\,t} - M_{i,t-1})].$$

Thus, denoting by EA the empirical average, we have that:

$$\mathrm{EA}[Z_{i,n,t}\,(P_{i,n\,t} - M_{i,t-1})] \quad (8)$$

is an unbiased estimator of the effective half-spread. Note that, to compute this estimate we use both data from TRAX ($Z_{i,n,t}$ and $P_{i,n\,t}$) and data from IIC (to compute $M_{i,t-1}$.)

Some bonds in our data have different price levels than others. For example, while most prices in our data are around 100 (corresponding to a nominal of 100), we have some zero-coupons, with prices much below 100. To ensure comparability of the results across bonds with potentially different price levels, we normalize the variables by the previous day midquote.

Table 8: Effective half-spread by rating[11]

	Euro denominated bonds					
	2003		*2004*		*2005*	
	Spread	*Std*	Spread	*Std*	Spread	*Std*
All	0,0739%	*0,000760*	0,0365%	*0,000329*	0,0512%	*0,000635*
AAA	0,04999%	*0,000326*	0,02930%	*0,000161*	0,01325%	*0,000070*
AA	0,07489%	*0,000706*	0,03964%	*0,000437*	0,05658%	*0,000912*
A	0,06896%	*0,000578*	0,03621%	*0,000293*	0,04496%	*0,000394*
BBB	0,09469%	*0,001059*	0,03859%	*0,000346*	0,06690%	*0,000853*
	Sterling denominated bonds					
	2003		*2004*		*2005*	
	Spread	*Std*	Spread	*Std*	Spread	*Std*
All	0,1942%	*0,001874*	0,1076%	*0,001263*	0,1039%	*0,001153*
AAA	0,24843%	*0,002161*	0,05305%	*0,001595*	0,08970%	*0,000905*
AA	0,10510%	*0,001139*	0,08556%	*0,000938*	0,08011%	*0,000890*
A	0,17154%	*0,001436*	0,09916%	*0,000767*	0,09079%	*0,000880*
BBB	0,27233%	*0,002494*	0,14461%	*0,001779*	0,13780%	*0,001641*

Table 9: Effective half spread, by maturity[12]

Euro denominated bonds			
Years to maturity	*2003*	*2004*	*2005*
3	0,0720%	0,0277%	0,0582%
4	0,0602%	0,0267%	0,0349%
5	0,0886%	0,0323%	0,0388%
6	0,0767%	0,0361%	0,0403%
7	0,0758%	0,0367%	0,0523%
8	0,0893%	0,0429%	0,0582%
9	0,0654%	0,0422%	0,0686%
10	0,0699%	0,0400%	0,0533%
15	0,0120%	0,0404%	0,0659%
20		0,0762%	0,1169%
Longer	0,1352%	0,0601%	0,1133%

Sterling denominated bonds			
Years to maturity	*2003*	*2004*	*2005*
3	0,0754%	0,0358%	0,0508%
4	0,1433%	0,0693%	0,0608%
5	0,2044%	0,0793%	0,0626%
6	0,1117%	0,0854%	0,1105%
7	0,1590%	0,0898%	0,0799%
8	0,1489%	0,0975%	0,1097%
9	0,1228%	0,1300%	0,0768%
10	0,1693%	0,1143%	0,1184%
15	0,2281%	0,1128%	0,1025%
20	0,2205%	0,1365%	0,1423%
Longer	0,3058%	0,1686%	0,1690%

[11] For each bond i in our sample, we compute the empirical average over trades (n) and days (t) of: [$Z_{i,n,t}$ ($P_{i,n\ t}$ - $M_{i,t-1}$)/ $M_{i,t-1}$], where $Z_{i,n,t}$ is the indicator variable taking the value +1 for customer purchases and -1 for sales, $M_{i,t-1}$ is the midquote at the end of day *t-1* and $P_{i,n\ t}$ is the transaction price. The table reports the mean and standard deviation across bonds of these averages.

[12] For each bond we compute the empirical average over trades & days of: $Z_{i,n,t}$ ($P_{i,n\ t}$ - $M_{i,t-1}$)/ $M_{i,t-1}$], where $Z_{i,n,t}$ takes the value +1 for customer purchases & -1 for sales, $M_{i,t-1}$ is the closing midquote & $P_{i,n\ t}$ the trade price. The table reports the mean across bonds.

Table 10: Effective half spread by transaction size[13]

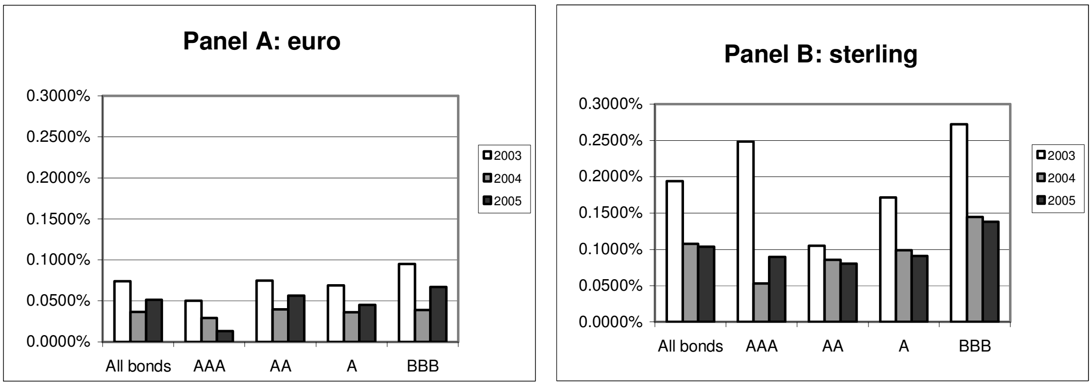
	Euro denominated bonds					
	2003		*2004*		*2005*	
Trade size in €	Spread	*Std*	Spread	*Std*	Spread	*Std*
[0. 10.000]	0,0840%	*0,001521*	0,0496%	*0,001414*	0,0595%	*0,001253*
(10.000. 25.000]	0,1033%	*0,001397*	0,0462%	*0,000759*	0,0625%	*0,001239*
(25.000. 50.000]	0,0907%	*0,001275*	0,0471%	*0,000782*	0,0555%	*0,000916*
(50.000. 100.000]	0,0960%	*0,001174*	0,0376%	*0,000558*	0,0538%	*0,001021*
(100.000. 200.000]	0,0719%	*0,001309*	0,0364%	*0,000577*	0,0611%	*0,001267*
(200.000. 500.000]	0,0579%	*0,001158*	0,0302%	*0,000476*	0,0555%	*0,001115*
(500.000. 1.000.000]	0,0531%	*0,000907*	0,0256%	*0,000560*	0,0385%	*0,000934*
Above 1.000.000	0,0499%	*0,000890*	0,0327%	*0,000407*	0,0430%	*0,000605*
	Sterling denominated bonds					
	2003		2004		2005	
Trade size in £	Spread	*Std*	Spread	*Std*	Spread	*Std*
[0. 10.000]	0,2671%	*0,004440*	0,1867%	*0,003085*	0,1456%	0,003198
(10.000. 25.000]	0,2486%	*0,004174*	0,1377%	*0,002532*	0,1235%	0,003383
(25.000. 50.000]	0,1887%	*0,006006*	0,1206%	*0,002128*	0,1068%	0,002031
(50.000. 100.000]	0,1914%	*0,003962*	0,1051%	*0,001898*	0,1042%	0,001923
(100.000. 200.000]	0,1871%	*0,003843*	0,0981%	*0,001915*	0,1017%	0,002195
(200.000. 500.000]	0,1751%	*0,002679*	0,0810%	*0,001325*	0,0921%	0,001512
(500.000. 1.000.000]	0,1820%	*0,002572*	0,0797%	*0,001923*	0,0690%	0,002109
Above 1.000.000	0,1649%	*0,001973*	0,0888%	*0,001247*	0,0919%	0,001435

Results

Estimates of the effective half spread are given in Table 8, Table 9 and Table 10. Qualitatively, the results are in large part consistent with those obtained for quoted spreads. Effective spreads are tighter for euro-denominated bonds than for sterling ones. As can be seen in Figure 10, effective spreads increase with credit risk (measured by ratings), in line with the prediction of theoretical models. Table 10 reports our estimates of the effective spread for different transactions sizes. In line with the analyses conducted by Goldstein, Hotchkiss and Sirri (2005) and Edwards, Harris and Piwowar (2005) for the US bond market, we find that spreads decrease with trade size.

[13] For each bond in our sample, and for the different trade sizes, we compute the empirical average over trades (n) and days (t) of: [$Z_{i,n,t}$ ($P_{i,n\,t}$ - $M_{i,t-1}$)/ $M_{i,t-1}$], where $Z_{i,n,t}$ is the indicator variable taking the value +1 for customer purchases and -1 for sales, $M_{i,t-1}$ is the midquote at the end of day *t-1* and $P_{i,n\,t}$ is the transaction price. The table reports the mean and standard deviation across bonds of these averages.

Figure 10: Effective half spread



Our estimates of effective spreads in the euro-denominated corporate bond market are remarkably tight. In 2005, for euro-denominated bonds, the effective half spread is such that, on average, for a bond valued at €100, the ask price would be at €100.05 and the bid at €99.95. In 2003, the corresponding figures are 100.07 for the ask and 99.93 for the bid. For sterling bonds, the spread is less tight. For a bond valued at £100, in 2005, the ask price would typically be at €100.10 and the bid at €99.90. In both currencies, the order of magnitude of the effective is equal to half the order of magnitude of the quoted spread.

That our measure of effective spreads is tighter than our measure of quoted spreads is not entirely surprising. Consider the case of an investor who wants to buy a bond. Suppose the 10 best dealers in the market are those who post quotes on IIC. Assume the customer runs an auction between these 10 dealers. Suppose the dealers' offers to the customer are equal to their IIC quotes. Then the customer will choose to trade at the best ask, which is the minimum of these ten quotes. This minimum will by construction be lower than the average of the ten ask quotes. The effective spread is computed on the basis of this minimum ask quote, while the quoted spread is computed based on the average ask quote.

Comparison between the European and US markets

Our findings on the relationship between spreads and maturity are consistent with those of Goldstein, Hotchkiss and Sirri (2005) and Edwards, Harris and Piwowar (2005). Our results are also consistent with the latter's result that spreads decrease as credit risk decreases. This suggests that the economics of the secondary markets for bonds are not fundamentally different in Europe and in the US.

On the other hand, the effective spreads we estimate for euro-denominated bonds are lower than their US counterparts. Consider the findings of Goldstein et al. (2005) for their treatment sample of 90 bonds. For a small institutional size of $250,000 to $1,000,000, Goldstein et al. (2005) find that the half-spread is around 0.33% prior to TRACE dissemination and 0.18% after dissemination. For larger transaction sizes, above one million, the half-spread is 0.22% before dissemination and 0.135% after.

In our sample of euro-denominated bonds, for the same period (2003), the effective half spread for trades between €500,000 and €1,000,000 size is: 0.053%. For trades above one million euros, the effective half spread for euro-denominated bonds in our sample is 0.049%. And, for BBB bonds, in 2003, we find an average effective spread of 0.095%. Thus, controlling for sample period (2003) and ratings (BBB), effective spreads in euro-denominated bonds compare favourably to their post-trade transparent US counterparts.

To improve our understanding of the European corporate bond market, we conducted extensive interviews with buy-side and sell-side participants in this market. They mentioned to us that the supply of liquidity is much more competitive in the euro zone than in the UK or the US. In the US, five or six very large financial institutions dominate the market. In the UK also, the number of financial institutions actively offering dealership services is limited. In contrast, in the euro zone, there is a large number of significant players in the market. Each of the large countries has about three banks actively dealing in corporate bonds. For the smaller countries the number may range between one and three. Thanks to the euro, the market is well integrated. A Dutch bank can quote prices on German bonds to a French institution. Hence tight effective spreads for euro-denominated bonds are likely to stem from competition between dealers to supply liquidity.

5.3.4 Information content of trades

In this subsection we report findings on the information content of trades, based on the merged quotes dataset (IIC) and trades dataset (TRAX).

Method

From a theoretical standpoint trades in the corporate market might well reflect private information. Bonds are by construction less sensitive than stocks to the performance of the firm.[14] Yet, as long as there is default risk, changes in the performance of the firm should impact the value of the bond. Thus, traders with superior information about the performance of the issuing firm should use the bond market, as well as the stock market, as a vehicle for their trades. This is especially true for bonds with low ratings. As far as we know, however, the hypothesis that trades in the corporate bond market can reflect private information has not been tested so far.

The information content of the n[th] trade in bond i on day t can be expressed as:

$$E[Z_{i,n,t} (E[v_i | H_{i,n,t}^{+}] - E[v_i | H_{i,n,t}^{-}])] \qquad (9)$$

where $H_{i,n,t}^{+}$ is the information set of the market just after the trade. In words, the information content of the trade is the product between the change in assessment of the value of the bond and the direction of the trade. If purchases (resp. sales) convey positive (resp. negative) signals about the value of the bonds, then, when $Z_{i,n,t} = +1$ (resp. -1), there will be an increase (resp. decrease) in the market expectation of the value of the bond and $E[v_i | H_{i,n,t}^{+}]$ will be above (resp. below) $E[v_i | H_{i,n,t}^{-}]$). Hence the product in (9) will be positive on average, and the expectation bounded above 0. In contrast, if the direction of trades conveys no systematic information to the market, and

[14] This is the economic intuition underlying the theoretical corporate finance literature showing that debt contracts optimally mitigate adverse selection problems, see, e.g., Myers and Majluf (1984), DeMarzo and Duffie (1999) and Biais and Mariotti (2005).

thus are independent from changes in assessments of the value of the bond, the expectation in (9) will be equal to 0.

The conditional expectations $E[v_i \,|H_{i,n,t}^{+}]$ and $E[v_i \,|H_{i,n,t}^{-}]$ are not directly observable for the econometrician. However, as mentioned above, assuming that: $M_{i,t-1} = E(v_i \,|H_{t-1})$, we have:

$$E[v_i \,|H_{i,n,t}^{-}]= M_{i,t-1} + \varepsilon_{i,n,t},$$

where $\varepsilon_{i,n,t}$ is the informational innovation from the end of day $t-1$ to the time of the n[th] trade on day t ($E(\varepsilon_{i,n,t} \,|H_{t-1})=0$.) Similarly, $M_{i,t} = E(v_i|H_t)$ yields:

$$M_{i,t} = E[v_i \,|H_{i,n,t}^{+}] + \eta_{i,n,t},$$

where $\eta_{i,n,t}$ is the informational innovation from just after the trade until the end of day t. ($E(\eta_{i,n,t} \,|\, H_{i,n,t}^{+})=0$.) Hence, the informational content of the trade rewrites as:

$$E[Z_{i,n,t}\,((M_{i,t} - M_{i,t-1}) - (\eta_{i,n,t} + \varepsilon_{i,n,t}))].$$

By construction, $\eta_{i,n,t}$ is unpredictable conditionally on $H_{i,n,t}^{+}$. Hence:

$$E[Z_{i,n,t}\,\eta_{i,n,t}]=0.$$

If trades direction is unpredictable, as in Kyle (1985), we also have that:

$$E[Z_{i,n,t}\,\varepsilon_{i,n,t}))]=0.$$

Hence, denoting by EA the empirical average, we have that:

$$EA[Z_{i,n,t}\,(M_{i,t} - M_{i,t-1})].$$

is an unbiased estimator of the information content of trades.

As in the analysis of effective spreads, to ensure comparability of the results across bonds with potentially different price levels, we normalize the variables by the previous day midquote.

Findings

Our results on the information content of trades are in Table 11 and 12 and Figure 11. For each bond in our sample, we computed the average information content of trades. Then we computed the mean and standard deviation of these averages across bonds. The overall results, for all the bonds in our sample, are in Table 11. The information content of trades is significantly positive for both currencies. It is greater for sterling-denominated bonds than for euro-denominated bonds. This could reflect that for the latter, there is more publicly available information, for example more research or more analysts following. Correspondingly there should be less information asymmetry.

Table 11: Information content of trades, by rating[15]

	2003		2004		2005	
	$(M_{i,t} - M_{i,t-1})/M_{i,t-1}$	$(M_{i,t+1} - M_{i,t-1})/M_{i,t-1}$	$(M_{i,t} - M_{i,t-1})/M_{i,t-1}$	$(M_{i,t+1} - M_{i,t-1})/M_{i,t-1}$	$(M_{i,t} - M_{i,t-1})/M_{i,t-1}$	$(M_{i,t+1} - M_{i,t-1})/M_{i,t-1}$
Euro denominated bonds						
All	-0,00235%	0,0085% ***	0,00236% **	0,00844% ***	0.0050 % *** (0.000411)	0.0104% *** (0.000536)
AAA	0,00082%	0,00078%	0,00569%	0,01563%	-0.0001 % (0.000071)	0.0001% (0.000110)
AA	0,01021%	0,02170% **	0,00290%	0,00797%	0.0043 % (0.000214)	0.0068% (0.000326)
A	-0,00640% *	0,00294%	0,00160%	0,00852% ***	0.0031 % ** (0.000249)	0.0080% *** (0.000368)
BBB	-0,00127%	0,01332% **	0,00442% **	0,01119% ***	0.0082 % (0.000681)	0.0165% *** (0.000839)
Sterling denominated bonds						
All	-0,00350%	0,0015%	0,01000% ***	0,01938% ***	0.0098 % *** (0.000628)	0.023% *** (0.000898)
AAA	-0,01634%	-0,04932%	0,00569%	0,01563%	0.0164 % (0.000531)	0.0156% (0.000763)
AA	-0,01947%	-0,01784%	0,00290%	0,00797%	0.00669 % (0.000391)	0.0157% *** (0.000469)
A	-0,00802%	-0,00892%	0,00160% ***	0,00852% ***	0.00723 % (0.000575)	0.0222% *** (0.000742)
BBB	-0,00793%	0,01831%	0,00442% ***	0,01119% ***	0.0091 % (0.000839)	0.0238% ** (0.001322)

[15] For each bond i in our sample, we compute the empirical average over trades (n) and days (t) of: $[Z_{i,n,t} (M_{i,t} - M_{i,t-1})/ M_{i,t-1}]$ or $[Z_{i,n,t} (M_{i,t+1} - M_{i,t-1})/ M_{i,t-1}]$ where $Z_{i,n,t}$ is the indicator variable taking the value +1 for customer purchases and -1 for sales, and $M_{i,t}$ is the midquote at the end of day *t*. The table reports the mean across stocks of these average (and in parentheses their standard deviation.)

Table 12: Information content of trades, by transaction size[16]

	Information content	Std
Trade size in €		
[0. 10.000]	0.0031%	0.000773
(10.000. 25.000]	0.0106%	0.000865
(25.000. 50.000]	0.0058%	0.000693
(50.000. 100.000]	0.0000%	0.000685
(100.000. 200.000]	0.0080%	0.000694
(200.000. 500.000]	0.0053%	0.000755
(500.000. 1.000.000]	0.0009%	0.000765
Above 1.000.000	0.0111%	0.000469
Trade size in £		
[0. 10.000]	0.0019%	0.001826
(10.000. 25.000]	0.0049%	0.001496
(25.000. 50.000]	0.0055%	0.001361
(50.000. 100.000]	0.0060%	0.001229
(100.000. 200.000]	0.0094%	0.001026
(200.000. 500.000]	0.0156%	0.000879
(500.000. 1.000.000]	0.0093%	0.001030
Above 1.000.000	0.0098%	0.000721

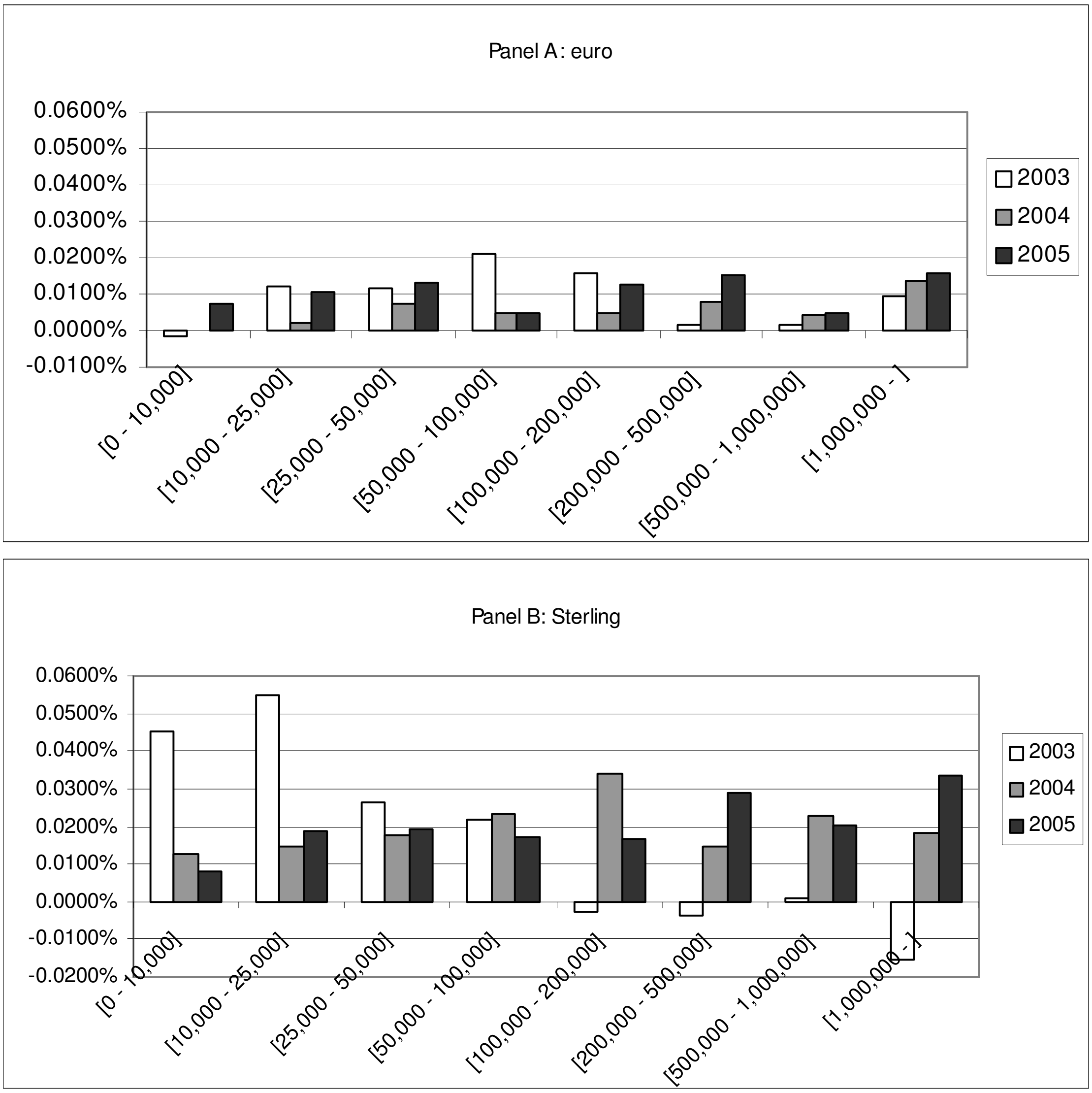
We computed two measures of the information content of a trade on day t. The first measure compares the midquote at the end of day t to the previous day closing midquote. The second measure compares the midquote at the end of day t+1 to the midquote at the end of day t-1. As can be seen in Table 11, the information content of trades is larger and more significant when measured with the latter method. This means that *it takes more than a day for the information content of a trade to be reflected in market prices*. Such slow incorporation of trading information into prices is likely to stem from the lack of post-trade transparency.

It is sometimes difficult to disentangle empirically the adverse selection component of the spread and the inventory cost component. Both adverse selection and inventory costs imply that quotes should move down after the dealer bought and up after the dealer sold. Our data offers an interesting natural laboratory to disentangle the effects of adverse selection and inventory costs. The latter should fall as time since the trade increases. Indeed, during this time interval, the dealer can manage his inventory and unwind the trade. And this is expected even if the market is opaque. In contrast, as explained above, in opaque markets the information content of the trade should be revealed in public quotes only after some delay. Thus, in this context, the inventory cost and adverse selection theories generate two opposite implications. Our results are consistent with the implications of the adverse selection theory, not with those of the inventory costs theory.

[16] For each bond in our sample in 2005, and for each trade size category, we compute the empirical average over trades and days of: [$Z_{i,n,t}$ ($M_{i,t}$ - $M_{i,t-1}$)/ $M_{i,t-1}$] or [$Z_{i,n,t}$ ($M_{i,t+1}$ - $M_{i,t-1}$)/ $M_{i,t-1}$] where $Z_{i,n,t}$ is the indicator variable taking the value +1 for customer purchases and -1 for sales, and $M_{i,t}$ is the midquote at the end of day *t*. We then compute the mean and standard deviation across bonds of these averages.

Table 11 also shows that the information content of trades increases with the default risk of the bonds. This is in line with theory. On the other hand, as shown in Figure 11, there is no clear link between the size of the trade and its information content.

Figure 11: Information content of trades by transaction size



5.3.5 Competition to supply liquidity

As discussed above, there are relatively few investors in the sterling-denominated market, and they tend to follow buy-and-hold strategies. This is likely to attract relatively few dealers. Correspondingly, it is likely that there is only limited competition to supply liquidity in the sterling-denominated bond market. To investigate this point, we computed, for each bond:

i) the number of different dealers with at least one trade;
ii) the market shares of the most active dealer;
iii) the market share of the three most active dealers.

The results are depicted in Figures 12, 13 and 14. In line with our expectations, the average number of active dealers is greater for euro-denominated bonds (around 25) than for sterling-denominated bonds (around 18); the market share of the most active dealer is lower for euro-denominated bonds (below 20%) than for sterling-denominated bonds (above 25%); and the market share of the three most active dealers is lower for euro-denominated bonds (below 40%) than for sterling ones (above 50%). Note that these results are quite stable across sample years. These findings reinforce the view that the supply of liquidity is likely to be more competitive in the euro-denominated bond market than in the sterling market.

Figure 12: Number of market makers with at least one trade

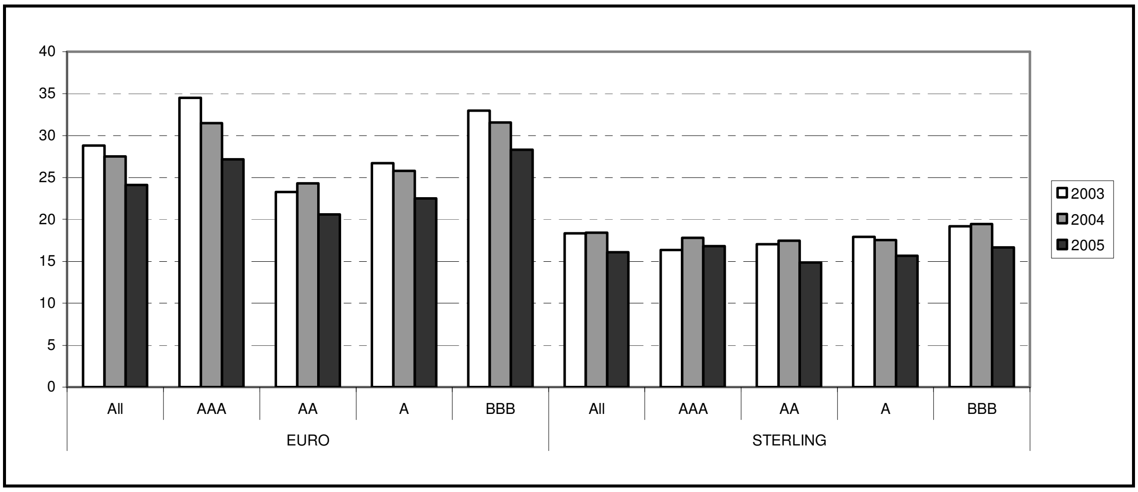


Figure 13: Market share (%) of the most active dealer

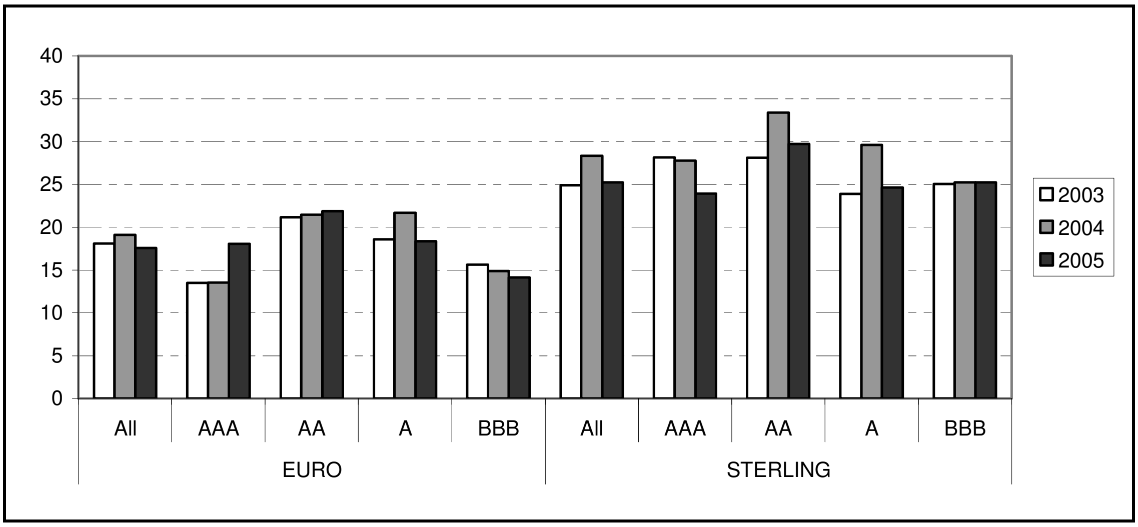
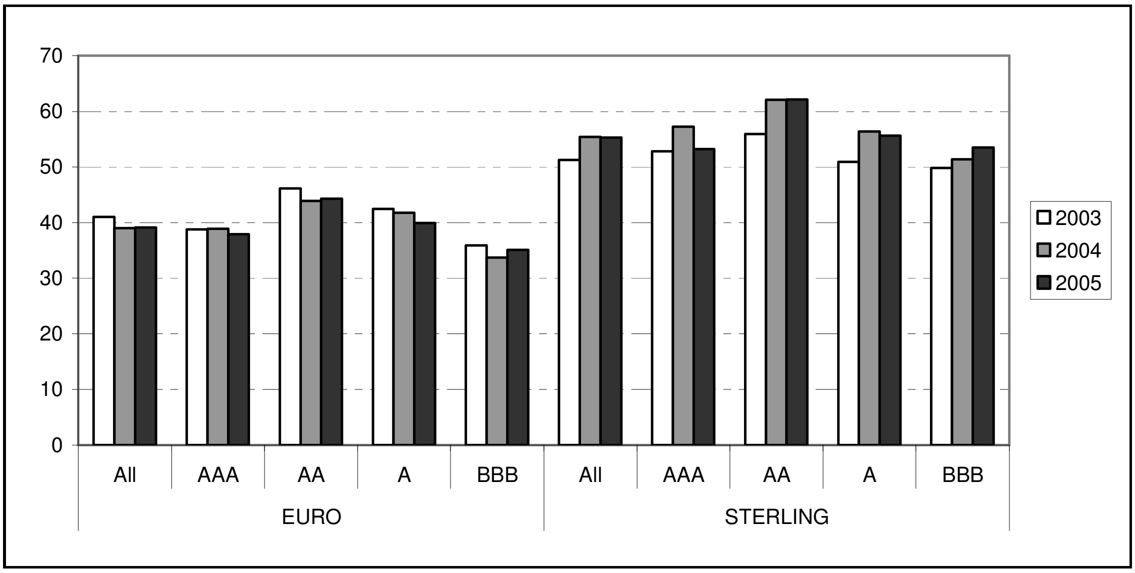


Figure 14: Market share (%) of three most active dealers



5.4 Conclusion

This research is, to our knowledge, the first high-frequency data study documenting bid-ask spreads, trading activity, and the information content of trades in the European corporate bond markets. We find that bid-ask spreads in the European corporate bond market vary with inventory-bearing costs, as predicted by theory, and similarly to their US counterparts. Spreads are tighter for euro-denominated bonds than for sterling ones. Correspondingly, the supply of liquidity by dealers is more competitive for euro-denominated bonds than for sterling bonds. Spreads seem to be tighter in Europe than in the US, even after transparency was enhanced by TRACE. Trades in the corporate bond market have significant information content. It takes more than one day for this content to be fully impounded in market pricing. This could reflect limited post-trade transparency.

To us, the most striking finding is that spreads are tighter for euro-denominated bonds than for sterling-denominated bonds (which have the same transparency regime) and also than for US dollar-denominated bonds (which, since TRACE, are more transparent). This suggests that transparency is not the only key determinant of transactions costs in bond markets. We think that the major difference between the euro-denominated bond market and its sterling and dollar counterparts is related to openness and competition. Our results suggest that the advent of the euro has led to a well-integrated market for European corporate bonds. A large number of investors from many countries intervene in this market. And a large number of banks offer dealership services. Interviews with market participants suggested that, in the US for dollar-denominated bonds or in the UK for sterling ones, the number of active dealers is typically around five or six, while for euro-denominated bonds it is much larger. Our empirical findings are consistent with this observation.

Thus our findings suggest that public policy should focus on openness and competition. Barriers to entry should be minimized, both for sell-side and for buy-side participants. In that respect, the various EU directives, aiming at creating an integrated market, seem to have contributed to the liquidity of the European bond market. Our results also suggest that, as far as the bond market is concerned, UK investors and corporations would benefit from greater participation in the euro-denominated market. Regarding transparency, the implications from our study are not clear-cut. One the one hand, transparency could increase competition, as we show theoretically in Section 3 above, and this would reduce spreads. On the other hand, transparency could possibly reduce competition, and thus market liquidity, if it forced a significant number of active dealers to exit the market. As we have seen, it is unlikely that limited post-trade transparency would have this effect in relatively actively traded bonds. For less actively traded bonds, however, this could be a real issue.

6. Summary and analysis of interviews

We conducted 33 interviews, in London, Paris and Frankfurt. 31 were face to face and two on the phone. On the buy-side, we interviewed 12 fund managers or wealth managers and 1 proprietary trader (working within a bank). On the sell-side, we interviewed 5 brokers/broker dealers, 2 primary market bankers, and 11 dealers. We also interviewed 1 index provider and 1 issuer and 1 electronic platform organizer. Table 1 lists all the interviews.

One of the goals of the interviews was to better understand the way the market worked: how transactions took place, how prices and counterparties were discovered, what information market participants used, etc… We relied on that information to design and interpret our empirical study and our theoretical study.

Another goal of the interview was to elicit the preferences, evaluations and attitudes of the market participants: Did they think the market was performing satisfactorily? Did they think that it would be a good thing or a bad thing to have post-trade transparency?

To summarize these evaluations, we tried to quantify the data. We sorted the firms between buy-side and sell-side. We also sorted them between small, medium and large size. Regarding the overall performance of the market we sorted their answers in three categories: “I do not think the market is doing its job satisfactorily” (coded -1), “Neutral” and “I think the market is doing its job satisfactorily” (coded +1). Regarding transparency, we sorted their answers in 5 categories: “Definitely against post-trade transparency” (coded -2), “Not favourable to post-trade transparency” (coded -1), “Neutral” (coded 0), “Favourable to post-trade transparency” (coded 1), “Very favourable to post-trade transparency” (coded 2).

We have these quantifications for 31 firms. Based on these data, we obtain fairly consistent results. Of course, given the small number of data points, and the imprecision with which evaluations are measured, these results are only suggestive, and should not be interpreted as hard evidence.

Overall, the responses suggest that, except in a few cases, the firms tend to think the market works satisfactorily. The mean evaluation of market performance was 0.88 (on the [-1, +1] scale). There is a slight difference between buy and sell-side firms, as the latter tend to be somewhat more satisfied with the workings of the market than the latter. Also, overall, firms do not have very strong views on post-trade transparency. The average evaluation is moderately positive (0.37 on the [-2,+2] scale). Some sell-side firms strongly oppose to it, while some buy-side firms are enthusiastic about it. The general view seems to be that post-trade transparency is unavoidable and will not radically alter or improve the market.

Interestingly, large firms tend to favour post-trade transparency less than small firms, and this both for the sell-side and the buy-side. An interpretation is that large firms have already access to more information than small firms. Hence they stand to gain less and possibly lose more from post-trade transparency.

7. Conclusions

This report offers an in-depth analysis of the European corporate bond market. It is based on economic theory, a wide-ranging investigation of the market structure, and an empirical study. After reviewing the empirical and theoretical literature, we designed a theoretical microstructure model to analyze the consequences of transparency in dealer markets. We conducted extensive interviews of many participants: buy-side, sell-side, platform organizers, issuing firms, and others. We also drew several major conclusions from a unique high-frequency dataset of trades and quotes for euro- and sterling-denominated bonds (2003 to 2005).

The goal of our research was to shed light on the following issues: What is special about the bond market? How are prices formed and trades arranged in the European corporate bond market? How liquid is this market? What are the determinants and magnitudes of bid-ask spreads? What information is conveyed by prices in this market? What is the origin and what are the consequences of the current microstructure of this market? Is it efficient? In particular, should it be more transparent? And should that be regulated or should market forces be expected to generate optimal outcomes spontaneously?

We have come to the following conclusions on the facts:

- Some liquidity problems are specific to the bond market: Institutions (in particular insurance companies) sometimes buy a large fraction of an issue and hold it until maturity, thereby reducing the liquidity of that issue; there are often several different bonds per issuer, which spreads out the liquidity; short-selling is sometimes problematic in the European corporate bond market.
- The market revolves around dealers, whose intermediation services offer some answers to these problems. Electronic platforms, while important, represent only a small fraction of the total trading volume. Most communications and negotiations are on the telephone or Bloomberg screens. This market structure may be a response to the natural lack of liquidity of corporate bonds.
- The euro-denominated bonds segment is much more active and liquid than the sterling-denominated segment. The former involves many more investors and attracts greater liquidity supply. As a result, effective spreads are tighter for euro-denominated bonds than for sterling bonds. While the European corporate bond market is currently not post-trade transparent, the liquidity of euro-denominated bonds compares favourably to that of dollar-denominated bonds post-TRACE.

The majority of the persons we interviewed, on both the buy and the sell-sides, judged that the secondary market for European corporate bonds operates rather satisfactorily. The dealer market model seems to fit the needs of these participants. The majority of the persons we interviewed expect that electronic platforms will develop further, but they did not express the desire that regulation should introduce an order-driven system.

One characteristic of the current system is that retail investors are not active in the market. This is due primarily to cost and technology considerations. Retail orders are currently handled manually, often via bank networks. This generates high fixed costs and hence large overall transactions costs, making this business unattractive both for customers and financial intermediaries. One promising response to that situation is to pool all retail orders on a focal, electronic, order-driven exchange. By pooling all retail orders one could achieve some liquidity and possibly attract some professional liquidity suppliers. By managing orders electronically, one could reduce administrative handling costs. By executing trades on an exchange, one could facilitate compliance with best execution rules. This evolution would not require regulatory intervention.

It is not clear how pre-trade transparency could be implemented in a market where negotiations occur bilaterally on the telephone or via email. Pre-trade transparency would require significant changes in the microstructure of the market. Several persons we interviewed (both from the sell-side and the buy-side) expressed the concern that major regulatory changes could upset the current balance, at the risk of reducing the quality of the market. We conclude that it would be premature and risky to impose pre-trade transparency via regulation.

Our findings (both our theoretical model and our empirical comparison of euro-, sterling- and dollar-denominated bonds) suggest that competition is a key driver of liquidity. Hence public policy should focus on openness and competition. Barriers to entry should be minimized, both for sell-side and for buy-side participants. EU legislation to promote an integrated market seems to have enhanced the liquidity of the European bond market. Our results suggest that, as far as the bond market is concerned, UK investors and corporations would benefit from greater participation in the single European currency area.

Regarding post-trade transparency, our conclusions leave some ambiguity. On the one hand, transparency could increase competition, as we show in our theoretical analysis, and this (as suggested by our empirical work) would reduce spreads and enhance liquidity. But if it forced a significant number of active dealers to exit the market, transparency could reduce competition and thus market liquidity. It is unlikely that limited post-trade transparency would have this effect for relatively actively traded bonds. For less actively traded bonds, however, this could be a real issue. The majority of our interviewees were either positive or neutral about post-trade transparency. But a small fraction of the interviewees, all sell-side, expressed strong opposition to greater post-trade transparency. Their reaction is consistent with the results of our theoretical analysis: greater transparency would reduce dealer profits. It suggests that an increase in transparency may not emerge spontaneously from the initiative of financial intermediaries.

It might therefore be desirable to help the market move towards greater competition through limited, appropriate post-trade transparency that would not provoke a significant withdrawal of traders from the market. But there is always a danger that regulatory intervention, however well-intentioned and based on reliable analysis, may go too far, with unintended and harmful consequences.

Moreover, all the persons we interviewed stated that post-trade transparency, if it were implemented by regulation, should be moderate. This conforms to our concern over unforeseen consequences of any significant, imposed change in market microstructure. In any move towards greater post-trade transparency, the identities of the traders should not be disclosed. The exact transaction size should not be disseminated, in particular for large trades. For these trades, dissemination could be delayed. Given the reporting delay, price levels could vary between the transaction time and the reporting time; to adjust (in part) for such changes, yield-spreads relative to Treasuries should be disseminated rather than prices.

These remarks suggest the following policy proposal. It would not be optimal to regulate pre-trade transparency now. On the other hand, it would be reasonable to introduce some limited post-trade transparency. This could involve anonymous reporting of transaction yields, after a delay of one hour, for trades below one million, and anonymous reporting of transaction yields after a delay of one day for larger trades. In both cases, the trade size would not be exactly reported. Instead, it could be stated whether the trade was above or below one million.

These specific numbers are of course no more than illustrative. Ideally, the market itself could lead such changes, and the specifics could emerge from discussion involving buy-side and sell-side participants. It may be doubted, however, that existing incentives will lead to this outcome. If the information could be sold, that might provide an appropriate incentive.

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Appendix 1: Interviews

ABN Amro Bank (UK)
Artemis Fund Managers Ltd (UK)
Barclays Capital (UK)
British Petroleum, Issuer (UK)
Credit Lyonnais Asset Management (France)
Deka Bank, Asset management unit (Germany)
Deutsche Bank (Germany)
Dresdner Kleinwort Wasserstein (UK)
DWS (Germany)
DZ Bank (Germany)
ETC Pollak (France)
Fidelity Investments International (UK)
F & C Asset Management (UK)
Française des Placements (France)
Hermes Pensions Management Ltd (UK)
HSBC Bank (France)
International Index Co (IIC) (Germany)
IXIS (France)
JP Morgan Securities Limited (UK)
JP Morgan Asset Management (UK)
Kredit Bank Luxembourg (Luxembourg)
MarketAxess (UK)
Merrill Lynch Europe (UK)
Morgan Stanley International (UK)
New Star Investment Funds Ltd (UK)
Oddo Securities (France)
Rathbone Unit Trust Management Ltd (UK)
Royal London Asset Management (UK)
Royal Bank of Canada Europe (UK)
UBS Investment Bank (UK)
WestLB AG (UK)
Winterflood Securities (UK)

Appendix 2: Commissioning bodies

The **Association of British Insurers (ABI)** represents the UK insurance industry. Its members include large institutional investors controlling funds worth some €1,600 bn, including large holdings of corporate bonds.
Website: www.abi.org.uk

The **City of London Corporation** provides local government services for the City of London. The City Corporation is committed to maintaining and enhancing the status of the City as the world's leading international financial and business centre through its policies and services.
Website: www.cityoflondon.gov.uk

The **European High Yield Association (EHYA)** represents banks, investors, issuers, rating agencies, law firms, accounting firms, financial sponsors and other participants in the European high yield market. The EHYA is an affiliate of the Bond Market Association.
Website: www.ehya.com

The **International Capital Market Association (ICMA)** represents financial institutions active in the international capital markets, with over 400 member firms drawn from some 50 countries.
Website: www.icma-group.org

The **Investment Management Association (IMA)** represents the UK asset management industry. Its members include independent fund managers, the asset management arms of retail banks, life insurers, investment banks and occupational pension scheme managers.
Website: www.investmentuk.org

The **London Investment Banking Association (LIBA)** represents firms active in the investment banking and securities industry, including the major international investment banks which base their European operations in London.
Website: www.liba.org.uk

The research was commissioned from:

The **Centre for Economic Policy Research (CEPR)** is a network of Research Fellows who conduct research on issues affecting the European economy; the Centre's research includes open economy macroeconomics, international trade, financial economics, labour economics, industrial organization, public policy, and economic institutions.
Website: www.cepr.org

The City of London Corporation

The City of London is exceptional in many ways, not least in that it has a dedicated local authority committed to enhancing its status on the world stage. The smooth running of the City's business relies on the web of high quality services that the City of London Corporation provides.

Older than Parliament itself, the City of London Corporation has centuries of proven success in protecting the City's interests, whether it be policing and cleaning its streets or in identifying international opportunities for economic growth. It is also able to promote the City in a unique and powerful way through the Lord Mayor of London, a respected ambassador for financial services who takes the City's credentials to a remarkably wide and influential audience.

Alongside its promotion of the business community, the City of London Corporation has a host of responsibilities which extend far beyond the City boundaries. It runs the internationally renowned Barbican Arts Centre; it is the port health authority for the whole of the Thames estuary; it manages a portfolio of property throughout the capital, and it owns and protects 10,000 acres of open space in and around it.

The City of London Corporation, however, never loses sight of its primary role – the sustained and expert promotion of the 'City', a byword for strength and stability, innovation and flexibility – and it seeks to perpetuate the City's position as a global business leader into the new century.

DOMINE DIRIGE NOS

CITY OF LONDON