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An Empirical Analysis of Transparency-Related Characteristics of European and US Sovereign Bond Markets

Peter Dunne
Queen's University Belfast*

Michael J. Moore
Queen's University Belfast

Richard Portes
London Business School and CEPR

Central Bank and Financial Services Authority of Ireland
P.O. Box 559, Dame Street
Dublin 2
Ireland
http://www.centralbank.ie

*Corresponding author, E-mail address: p.g.dunne@Queens-Belfast.AC.UK. Most of the exploratory empirical work presented below was carried out while Peter Dunne was visiting the Central Bank of Ireland and later the School of Banking and Finance in the University of New South Wales. The general findings in this work also form part of a wider study that was carried out by the Centre for Economic Policy Research on behalf of the major 'buy-side' and 'sell-side' participants of the European Sovereign Bond Markets and the Corporation of London. We would like to express our gratitude to Kx Systems, Palo Alto, and their European partner, First Derivatives, for providing their database software Kdb. The views expressed in this paper are not to be attributed to the Central Bank of Ireland.

Abstract

We examine transparency-related characteristics of European and US sovereign bond markets and relate these to differences in primary issuance approaches and the design of the different trading platforms. We highlight the existence of a winner's curse problem in the interaction between B2C and B2B segments of the market, and we provide evidence to analyze its prevalence. We examine the problems that can arise as the result of increasing the transparency of the B2B segment of the market and use the experience of the eSpeed platform in the US to obtain insights into these effects. Our analysis is directly relevant to the policy debate about whether to apply MiFID transparency requirements to the EU sovereign bond markets: our results suggest great caution in creating an extremely homogenous and transparent trading environment for sovereign bonds.

Introduction

The EU Markets in Financial Instruments Directive (MiFID) requires greater transparency in equity markets and stipulates that the European Commission examine whether to implement similar measures in bond markets. We investigate here the causes and effect of cross-country (as well as cross-trading platform) differences in the level of transparency in sovereign bond markets. Few studies have tried to assess empirically the possible consequences for sovereign bond markets of the level of transparency, the effects of primary dealer obligations and the issuance techniques chosen by sovereign issuers. We find that the primary issuance techniques used in the Euro-denominated sovereign bond market explains much of the cross country differences in transparency, trading costs, depth and other market quality measures.

We also find evidence to suggest that the current market structure suffers from a winner's curse problem arising from the increasingly electronic nature of dealer-to-customer (B2C) and inter-dealer (B2B) trading environments. This arises because customers are increasingly able to request quotes from a relatively large number of dealers simultaneously. This affects the risks faced by dealers in their attempts to hedge positions in the inter-dealer market once they have acquired positions following their dealings with buy-side customers.

Finally, from an analysis of increased transparency of the eSpeed platform in the US Treasury market, we find that there is a potential price to be paid for excessive transparency of the inter-dealer limit order book and post-trade information. This arises because customers are likely to reduce communication with dealers regarding their potential demands if they can already see inter-dealer prices and limit-orders. Dealers therefore are likely to reduce the provision of limit prices and their limit orders are likely to be less informed on average.

Most theoretical and empirical work on the effects of transparency has been on equity markets and corporate/municipal bond markets (e.g., Edwards et al. 2004). These markets differ in many ways from the sovereign bond market. Gravelle (2000) and Martinez-Rezano (2005) identify some of the most obvious differences. For example,

equity markets operate in the context of significant asymmetry in information regarding the actual cash flows arising from operations. This is not true of sovereign bond markets. Another major difference is the fact that bonds have a finite life and are more likely to be held for the long run. The size of sovereign issues also marks them out as different and the consequent risk positions taken by dealers providing liquidity are usually greater than in equity markets.

Both the theoretical and the empirical literature to date have mixed conclusions on the benefits or otherwise of transparency. The main theme is that infrequent large traders would prefer (or would obtain better execution quality on) opaque settings and more standard sized trades would obtain better service from markets arranged around transparent limit-order books. The degree of asymmetry in information regarding the actual cash flows of asset being traded significantly favours more transparency. Transparency can also raise the risks borne by dealers in markets where large, infrequent trades are the norm and where noise trades are not present in enough numbers. But less transparent 'competitive dealership markets' may benefit participants of any type when there is significant competition for order flow (Naik, et al., 1999).

Recently, Swan and Westerholm (2004) and Aitken et al. (2006) both consider the execution quality of different international equity markets in a multivariate regression approach. The latter authors used a matched pair methodology and consider a small number of exchanges but have more comprehensive coverage of thinly traded stocks, with more diverse explanatory variables. In particular they use various market attributes, including transparency within the B2B segment of the market and between the B2B and the B2C, as explanatory variables. They find that full transparency of the limit-order book within the B2B space reduces effective spreads, but transparency beyond this, to include the B2C segment, or to all investors, is associated with larger effective spreads. This is an interesting finding considering that our empirical work (below) also finds that a transparency increase to all investors in the eSpeed case leads to higher spreads (at least for a significant period of time).

Other studies that consider the effect of market design differences on execution costs with special consideration for thinly traded stocks are by Muscarella and Piwowar

(2001) and Nimalendran and Petrella (2003). The first paper finds that the liquidity of infrequently traded stocks suffers from a move from periodic call to continuous trading. Lai (2004) also found that execution costs rose for stocks on the LSE Mid-250 when there was a change from a pure dealer market to a hybrid arrangement involving a limit-order book and specialist. This might reflect effects similar to those we discuss in our analysis such as the winner's curse that arises because of the interaction between B2C and B2B markets.

There is a significant difference between equity and sovereign bond markets that is not addressed by Gravelle (and not reflected in the equity market research more generally) and is particularly relevant to the European sovereign bond market. It arises due to the relationship between the primary issuers and the primary dealers, who provide most of the liquidity in the secondary market (as well as distribution services in the primary market). Sovereign bond issuers are effectively monopsonistic demanders of liquidity services due to their very large issues and the frequency with which they roll-over debt. Sovereign issuers depend on primary dealers to take up large risky positions in primary auctions and require them to maintain a strong presence in a secondary market which is often illiquid. The theoretical analysis of this market structure (see Dunne et al 2006) implies that issuers use their monopsonistic power to increase liquidity in the secondary market for their issues while at the same time increasing the transparency of the market (since dealer obligations apply to transparent markets where dealer activity can be monitored).

This provides benefits for the issuers because their bonds are more attractive for buy-side participants and they obtain a premium for this at the issuance stage. By imposing primary market obligations on dealers a further improvement can be obtained by the issuer at the issuance stage (primary dealers are frequently required to participate in a significant way in primary auctions). The dealers' secondary market obligations are quite diffuse, sometimes across hundreds of bonds with very similar characteristics. Moreover, spreads in the secondary market are sufficiently tight that it is not very profitable, if at all. It is plausible to conclude that this activity is a loss leader for Primary dealers. They accept a poor return on their primary (and perhaps even their secondary market activity) in the expectation that they will obtain privileges such as access to recently issued stock at preferential prices, lead

managership in syndications and even preferential status in the award of privatisation mandates.

In this study we focus on the differences across issuers according to their management of issuance. Our empirical analysis relies on statistical comparisons across existing sovereign bond markets where differences in transparency, issuance techniques and other factors are well known. Our analysis covers most of the markets of the MTS inter-dealer space. We also rely on comparisons across maturities by benchmark status, and we compare the European experience with that of the US Treasury market, where recent developments have led to the co-existence of three major competing trading platforms. To ensure the relevance of our analysis in a constantly changing environment, we have selected high quality data that is of very recent vintage for our cross-market, cross-sector and cross-benchmark-status analysis.

We have supplemented this analysis with an examination of developments over recent years and also with the examination of a 'transparency event' that took place in the US Treasury market in June 2003. We discuss the possible effects of the proposed increase of pre-trade transparency of orderbooks in the MiFID directive to include the best three prices on either side of the book. We use the experience of the eSpeed transparency change in the US Treasury market to show that even small changes in the distribution of pre-trade information can have noticeable effects. We argue that this change could result in a reduction in pre-trade requests for quotes and therefore affect the information that dealers obtain from the B2C segment of the market. This leads us to suggest that implementation of MiFID in the sovereign bond markets, while increasing the recycling of information between the B2B and B2C segments, could reduce the equilibrium amount of trading and limit-order provision in the market. In this case liquidity may decline and available best execution also. The alternative outcome is also possible, assuming transparency is not already at its optimal level. Regulators should therefore be very cautious about intervention.

The paper proceeds with a discussion of the well-known differences within and across MTS and US markets/platforms. We relate these to the various issuance techniques and the obligations that are often imposed on primary dealers. We follow this with a discussion of the datasets we use. We then outline the empirical approaches we use to

obtain interesting and robust measures of the effects of transparency, issuance techniques and primary dealer obligations.

II. Differences within and across MTS and US markets/platforms

In general terms, all of the markets we analyze below have become increasingly transparent in recent years, due to the increasing use of electronic trading platforms for B2B business and, to a lesser extent, the automation of request-for-quote trading in the B2C space. In the euro-denominated sovereign bond market the MTS platform has improved the availability of pre- and post-trade information and this information, is made available outside of the B2B space in real-time. MTS provides real-time quotes and the last transaction price in all of the benchmark bonds on the platform via Bloomberg and Reuters. In November 2004 the entire range of MTS data was made available in real-time through Traderforce©.[1] Although these data are comprehensive and widely available at low incremental cost for professional investors, their availability does not imply that all parts of the euro-denominated markets are perfectly (or similarly) pre- and post-trade transparent.

The increasing transparency of the MTS market may have come at some cost. For many countries it has been necessary to encourage primary dealers to participate fully in this transparent market place. Encouragement has been in the form of payoffs from primary issuance business. This has distorted yields at primary auctions. Where secondary obligations are not imposed on primary dealers we expect to find less activity on the transparent market. We show that there is a lot of variability across countries with regard to the amount of activity that takes place on MTS. Most of it, if not all, can be explained with reference to the issuance techniques of the various issuers and their reliance on primary dealer obligations that extend to the secondary market.

Without secondary market obligations, our priors tell us that activity would drift to opaque trading venues. This is usually viewed negatively, because it fragments the market place, reduces the liquidity available in any one venue and of course reduces

[1] See the press release at http://www.mtsgroup.org/newcontent/news/d_new/2004_11_02.shtml

the transparency of the market for those not directly involved. It does have the advantage, however, that it allows for the build-up of trust between trading partners in their regular and repeated dealings. This reduces information asymmetry as well as the winner's curse problem that is a feature of anonymous request-for-quote B2C arrangements.

To be more specific about our priors, we now outline how the countries on MTS differ with respect to their issuance techniques and the secondary market obligations they impose. We regard Italy, Portugal, Austria, Belgium and Finland as extreme in their use of either syndicated issuance and/or the imposition of secondary market obligations on primary dealers. We regard France and Germany as outliers on the other end of the issuance style spectrum. Germany is the most extreme as it never issues by syndication and imposes no obligations on primary dealers. Spain and Greece are special cases, because they do not impose secondary market obligations that are specific to the MTS platforms. The Dutch market is somewhere between the two ends of the issuance style spectrum, since they do not often provide large benefits to primary dealers by way of syndicated issuance and do not impose secondary market obligations. In the Dutch case the lead runner in syndicated issues is often the debt management office itself (this has been referred to as Dutch Direct Auctions).

These facts appear to explain many of our empirical findings for the European case. Additional insights come from an analysis of the US Treasury market. Here issuance is by auction, and while there is a primary dealer system, this does not extend to the imposition of secondary market obligations. In this sense it is much more like the German bond market although it is far greater in size. Especially interesting in the US Treasury market is how the various alternative trading platforms compare and whether the comparisons can be related to differential transparency.

The US Treasury market has already responded to transparency initiatives. The response has affected only the already very liquid part of that market, the on-the-run segment. The initial response to SEC and Treasury calls for more transparency in the late 1980s and early 1990s led to the GovPX initiative. Up until its steady decline, which began in 2000, this transparency initiative provided consolidated best bid and offer prices and quantity as well as latest transaction quantity, price and type from

both OTC and individual inter-dealer broker trading platforms. All but one of the inter-dealer brokers took part at its inception. But more recently the number of contributing brokers declined until ICAP acquired the system in mid-2004 and became the sole contributor.

Electronic trading was not a feature of the GovPX system, so it became largely redundant as an indicator for the on-the-run market over recent years, as eSpeed and BrokerTec have dominated the on-the-run space. It is difficult to gauge how much the GovPX initiative improved transparency because there is little information available regarding how well disseminated the information was across participants (or how timely was its distribution). We doubt that it ever achieved the level of transparency of either of the more recently developed platforms or MTS. We therefore expect to find transparency - related effects, such as a tendency for larger trades to be conducted on GovPX.

We regard the eSpeed platform as the most transparent of the three US Treasury trading platforms. Its data are much more readily available to market participants and are in a much more user-friendly form than data from the other platforms. In September 2002, Cantor Market Data began to distribute a real-time data product that featured views of limit orders, trading stacks and last traded price for each of the five on-the-run UST Benchmarks. It also revealed whether bids and offers were made up from multiple buyers and sellers, single or multiple substantial orders or multiple small orders. Although this information was initially supplied only to Cantor customers, the coverage was extended in June 2003 to Reuters and in August of the following year to Bloomberg. The quality of presentation of the data has improved over time, and it is now combined with easy-to-interpret visual effects and related information from the futures markets.

As discussed below, eSpeed provides good quality execution for standard sized trades, and this has attracted a lot of buy-side participation via program-algorithmic trading. Although this market is very transparent, there is high level of activity. It could therefore be argued that this provides a 'natural-veil' effect that would counteract the liquidity reducing effects of transparency. An alternative view is that sophisticated participants now have the computing power and means to process the

larger amounts of high quality information emitted from this busy platform on a real-time basis and that the transparency of the market is fully utilized. We expect that participants respond to the high level of transparency of this market by reducing trade size and increasing its frequency and randomness.

The BrokerTec platform is not as transparent as eSpeed, but it has other qualities that attract activity. Its main advantage lies in providing trading integration with the relevant futures markets. It also allows for some negotiation regarding trade quantity (the 'work-ups'). This means that larger trades can be done at potentially better prices and quicker than on eSpeed. The orderbook information is not as user friendly or as widely available as the eSpeed book information. We expect that the relative opacity of the BrokerTec platform will affect characteristics of the market such as the incidence of front-running relating to limit orderbook changes in the seconds before buyer or seller initiated trades. BrokerTec and eSpeed provide markets for the on-the-run segment. The off-the-run segment is still largely OTC and quite opaque by most accounts, and we expect this to be reflected in the analysis of GovPX spreads and other execution quality characteristics.

Given the size of issuance and the concentration of activity, we do not expect to find that the on-the-run US Treasury market suffers from as many of the transparency-related distortions as are evident in the MTS case. Although transparency has been increasing and the ability of market participants to analyze real-time data has increased, we do not expect to find major effects in response to the transparency event that we study. This market is so active and deep that the risk of obtaining bad execution is naturally low. In fact, however, we do find some evidence to suggest that execution quality can be threatened by the interaction between the B2B and the B2C markets. This is where the winner's curse problem is evident, and it applies as much to MTS as it does to the US Treasury market.

Since the two US platforms for on-the-run issues differ in terms of their transparency we expect better execution quality for larger trades on the less transparent market (BrokerTec). GovPX should also be capable of providing opacity to larger trades in the on-the-run market. In off-the-run segment, GovPX has the advantage of both liquidity and opacity and it should therefore provide better execution for larger trades

there (the trading on this platform can still be regarded as being of the OTC/hybrid variety). However, since the 'effective opacity' of the US Treasury market could be due to network externalities (or the natural veil effect), we are open to the possibility that execution quality will be damaged by the lack of such externalities arising from the smaller amount of activity taking place in the off-the-run segment.

III. Datasets used in the analysis

The datasets that we have employed in this study are very large, and in some cases they possess very complex structures. We are fortunate to have access to detailed data for the limit orderbook and transactions from the MTS trading platforms covering a number of years (we use selected months from 2003, 2004 and 2005) and almost all sectors of the euro-denominated sovereign bond market. The ICMA Centre at Reading have been instrumental in compiling a very clean reconstruction of the time-stamped best three limit-order prices and quantities on an event change basis (except when this exceeds reasonable frequency and storage capacity in which case recording defaults to a second-by-second basis). Regardless of the dataset under consideration, we look only at the state of the orderbook immediately before each recorded transaction. Where we consider the pre-trade changes in the orderbook, these changes are usually in the few seconds before the trade. The transactions part of the MTS data provides time-stamped transactions records including price, quantity and a transaction initiation flag indicating whether the trade was aggressive on the buy or sell side of the market.

The other datasets that we employ are from the US Treasury markets. The data we have obtained from Cantor Market Data contain only records relating to 'on-the-run' Treasuries. These eSpeed data come in two different forms. One form provides time-stamped records of transactions and covers an extended period starting in the late 1990s (we focus on the years from 2002 onwards). This also includes quantity traded and the identity of the aggressive side of each trade. We use this to provide an insight into trading costs, size of trade and volume over time.

The second dataset from Cantor Market Data is an event-by-event dataset that contains the best six prices and quantities on each side of the eSpeed limit-orderbook

at the times of all/any changes in market information. This is a more detailed dataset and is available only for selected months in the year starting October 2004. We use the first three prices and quantities on each side of the orderbook to compare with MTS and other data. We also use the period of overlap between the two Cantor datasets to check our conclusions based on the analysis of the transactions database alone (i.e., in the periods when the full orderbook data were unavailable).

The next dataset that we employ from the US Treasury market relates to the BrokerTec electronic platform for on-the-run US Treasuries. Only a small amount of these data was provided to us by the inter-dealer broking firm, ICAP. Specifically, we have event-by-event data from July 2003 and July 2004. We have used these data to reconstruct the state of the limit orderbook immediately prior to about 60% of all trades that occurred on the platform in these two months. Once again we focus on the best three prices and quantities on each side of the limit orderbook at each of the transaction times. We have been able to assess the overall incidence of trading and statistics on trade size, etc., based on all of the recorded transactions.

We also acquired data from the GovPX trading information database that covers a significant proportion of inter-dealer trading activity in the 'off-the-run' category of the US Treasury market. As mentioned earlier, this dataset was developed in response to calls for increased transparency in the Treasury market in the early 1990s and has been in existence since mid-1992. A detailed description of this dataset as it was in the late 1990s and the first part of the year 2000 is provided by Fleming (2003). Until recently the GovPX dataset consolidated data from all of the main inter-dealer brokers except Cantor. Since mid-2004 it contains only information on ICAP quotes and trades, and this does not include ICAP's BrokerTec business.

As described by Fleming (2003), this dataset is not entirely reliable. The main problem is that it does not isolate different kinds of market events from each other in a clear enough manner (transactions, work-ups, changes to quotes, indicative prices and quantities and other events, some not shown on the database, all cause up-dating of the dataset, and this gives rise to an identification problem). Despite the presence of repetitions of records, we are confident that the measures we extract from the database are meaningful. What is most interesting from our point of view that this dataset

reveals interesting information about the off-the-run and opaque parts of the US Treasury market. We employ this dataset only to obtain information about trading costs, transaction size and liquidity at the best bid and ask quotes (it does not give information about the limit orderbook away from best prices). For these measures, the problem of the repetition of records is not serious, so long as such repetitions are evenly distributed. When we compare these measures with those of the other US Treasury markets they appear entirely plausible.

IV. Empirical Analysis

In our empirical analysis we have opted to concentrate on simple (mainly non-parametric) descriptive statistics. As often as possible we present summary statistics in the form of Median, 1st and 3rd Quartiles. This ensures that our statistics are free from undue influence from extreme outliers and from the effects of obvious non-symmetry in the distributions of measures such as bid-ask spreads and the frequency or amounts of trade. We also use an analysis of the proportions of the joint occurrences of outlying observations/characteristics. This turns out to be particularly revealing in the analysis of 'best-execution'. It is also useful in shedding light on the issue of 'front-running' as well as on the prevalence of a 'winner's curse' problem in the B2B market, which we suggest may be worsening due to the increasing automation and transparency of B2C request-for-quote platforms. Similar results occur repeatedly across the different market characteristics, across the different ways we examine the issues, across the different countries, different market segments and different time periods that we analyse. We believe that the pattern of results carries more weight than any of the most significant individual results. We find a reassuring correspondence in our results with our priors and on what we have learnt from extensive interviews with market participants.

Our empirical evidence is presented and discussed below within five main categories. These are (1) an analysis of turnover relative to amounts issued, (2) an analysis of liquidity provision, (3) an analysis of execution quality, (4) an analysis of winner's curse and/or front running and (5) an analysis of the transparency event on the eSpeed platform. The tables/figures associated with these categories are numbered from 1 to 5. In our discussions we provide an explanation of the empirical techniques used and an explanation of what they are designed to reveal. We also interpret the results and provide our conclusions.

IV (1) Turnover on MTS relative to outstanding issues

The amounts outstanding of specific benchmark bonds by country together with the associated volume traded on MTS are presented in Tables 1.2 to 1.12. The amounts

outstanding are taken from the MTS Handbook[2]. Quite apart from the relative share of activity that takes place on electronic venues, transparency is likely to be a much more important factor when the overall size of the outstanding stock in active portfolios is small. In this respect Table 1.1 and the tables that follow also reveal that there is a very significant difference between the largest three issuers and all of the others in the euro-denominated sovereign market. It is also the case that the largest of the euro-denominated sovereign markets is much smaller than the US Treasury market in terms of both outstanding issues and turnover. We estimate that the monthly turnover of the 10 year US Treasury is about 18 times as great as the turnover in Italian Benchmark Bonds at the same maturity. In terms of trading frequency the difference is even greater since US Treasury transaction sizes are on average much smaller (regardless of venue) than those on the MTS platform. In this respect we conclude that activity and the inventory positions of dealers are much easier to track in the European sovereign market. We expect that the thinner 'natural veil' provided by the less crowded and less complex market place increases the sensitivity to transparency in the European context.

Monthly volume traded on MTS for specific issues was derived from a summing up of all the relevant transactions recorded on the MTS database for the same month as the outstanding amounts were recorded. There is a wide variation in the percentage turnover on MTS, with the largest percentages occurring for Italy, Portugal, Belgium and Finland. The MTS turnover percentage is low for France and Germany, and the other countries are in the middle range. Greece is a special case since it has its own dedicated platform, HDAT, on which much of the remaining turnover occurs. Spanish volume is also divided between the MTS and Senaf platforms. Italy's percentage is high. This is not surprising given that the MTS system originated from the efforts of the Italian Treasury to increase the liquidity of the Italian market. It is still the case that secondary market obligations of primary dealers in the Italian bond market are specific to the MTS platform and exceed most of those imposed elsewhere in Europe. The effects of the primary dealer obligations combine with the network externalities that stem from the large overall issuance of Italian sovereign bonds to produce what is measurably the most liquid of the European sovereign bond markets.

[2] MTS Group (2005), The European Government Bond Market: A Single Market with Unique Segments, Edition II.

Given its significant presence on the MTS system we regard the Italian market as a close substitute for a natural experiment capable of revealing the effects of the MiFID proposals if OTC trading were forced onto transparent settings. Since Italian activity is generally concentrated on the MTS platform, it provides a special case from which to view this possibility. A post-MiFID environment would, in many respects, be comparable to what currently exists in the Italian MTS.[3] Consolidation might improve liquidity by way of a network externality. To assess whether this is a likely outcome from MiFID transparency requirements, we consider comparisons of the Italian turnover with that of the French and Portuguese.

The outstanding amounts issued of individual Italian BTPs are roughly equal to the outstanding amounts issued of individual French BTANs and OATs. We estimate that MTS Trading volume in BTANs and OATs is roughly half the total trading volume associated with these issues. But even doubling the MTS trading volumes for any of the French issues given in Table 1.5 would still leave them much lower than trading volumes shown for Italian issues of similar size. This is tentative evidence implying that the 'natural-veil' effect raises liquidity in the Italian market more than proportionately. It should be stressed, however, that most of the MTS markets (excluding Germany, France and Spain) have individual issue sizes that are roughly half those of individual Italian issues, so they may never acquire significant network externalities.

The Portuguese case is also interesting from this perspective. The secondary market obligations in Portugal are not very different from those in Italy but Portuguese issues are much smaller than the Italian. Despite the small issue size the Portuguese turnover percentage is often much higher than the Italian (Table 1.11. shows this is true in two cases at the short maturity). It would be difficult to make a network externality argument that could explain this, and this therefore casts doubt on the

[3] The Portuguese market is similar to the Italian in terms of the considerable obligations placed on the Primary Dealer to provide liquidity at both primary and secondary level but it is much smaller in terms of issuance. In our empirical analysis, we use the characteristics of this market to gain additional insights.

conclusion in favour of the network externality drawn from the comparison between the French and Italian turnovers.

The broad message that one can take from even a cursory view of the turnover percentages presented in Tables 1.1 to 1.12 is that these can be explained by the differential reliance on the imposition of secondary market obligations by certain issuers. Countries that rely more on syndicate issuance and the placing of secondary market obligations on primary dealers have higher turnover percentages on MTS.

The variation in MTS turnover percentages cannot be explained by variation in the overall turnover percentages. We focus on just one example where the data are readily available and can be verified immediately. This is the case of France where the daily average turnover reported to AFT in the 5 most liquid OATs and the 4 most liquid BTANs was roughly 20 billion euro each (or 40 billion daily on average for liquid BTANs and OATs taken together).[4] Table 1.5 shows the MTS trading volume for the month of June 2004 for the 3 most liquid OATs and the 2 most liquid BTANs. Assuming 20 trading days in the month, this implies an average daily turnover on MTS of about 4 billion euro. Although this is only a subset of the bonds for which total turnover is reported to AFT, it is still a very small fraction of that turnover. From this we tentatively assert that MTS turnover is likely to be less than half the total turnover in French sovereigns. This leaves substantial opacity in the market and reduces the representativeness of the MTS prices and quotes relative to those available more generally in the market place. It also reduces available liquidity on MTS, as we suggest below.

Our theoretical model leads us to expect differences in market characteristics across euro-denominated sovereign markets in relation to the extent to which smaller issuers rely on syndications of their issues and the degree to which they depend on primary dealers for provision of secondary market liquidity. While the Italian market has high turnover on MTS, other interesting cases in terms of MTS turnover are the Portuguese, Belgian and Finnish markets. Their main common feature is their high dependence on syndicated issuance (Portugal 40%, Belgium 40% and Finland no less

[4] See the monthly bulletin of the Agence France Trésor at http://www.aft.gouv.fr/IMG/pdf/169en.pdf

than 90%)[5]. With relatively small issue sizes, these markets manage to attract a large proportion of total trading activity to the transparent MTS market, but much of this is related to the obligations placed upon primary dealers who are keen to participate in primary issuance. In the Portuguese case primary dealers must also be involved in at least 2% of the secondary market turnover in specific benchmark issues. Similarly, Finnish and Belgian issuers rely on a primary dealer system to ensure secondary market liquidity. Participation in the secondary market is a factor used in selection of lead distributors.

In the case of Germany, there is no reliance on a primary dealer system and also no syndicated issues. As expected, .this affects the willingness of dealers to participate in the transparent secondary market. This is reflected in the relatively small proportion of trade in German issues occurring on the MTS trading platform (Table 1.6). This is tentative evidence that Germany relies on an opaque secondary market to ensure that primary dealers are prepared to provide liquidity at auctions. It is plausible that MiFID transparency proposals if implemented would drive German issuance policy towards the type of approach taken by many of the smaller issuers. The same conclusion can be drawn for France, where there is very little syndication and where primary dealers are not required to participate in the secondary market. Here again, activity on MTS is very low (see Table 1.5). For markets in which syndication and secondary market obligation are prevalent, it appears that more transparency can be obtained only by distorting other market characteristics. The obligations placed on primary dealers act as a disciplining device that effectively substitutes for the benefits that primary dealers would normally obtain under less transparent settings (or in markets where sufficient activity provides 'natural-veil' type network externalities).

The analysis of the share of turnover on MTS makes it clear that it relates directly to secondary market obligations or to the reliance of the relevant issuer on the syndication approach to issuance. When these factors are absent, as in the German case, MTS is not the chosen venue for activity, and the issuer has not opted to

[5] Source, Presentation by Lars Boman, Nov 2003, Swedish National Debt Office; http://www.oecd.org/dataoecd/59/4/29172097.pdf This presentation also highlights some of the disadvantages of the syndicated issuance approach.

encourage a move of activity to the transparent venue. The benefits that accrue to the German issuer from allowing its bonds to be traded in a more opaque setting are obtained by way of a less distorted primary auction system. Although opacity may be associated with less liquidity and a liquidity premium this does not appear to have affected German sovereigns greatly. Much the same conclusion applies to the French case. These conclusions are broadly supported by the analysis of other market-quality related analysis to which we now turn.

IV (2) An analysis of liquidity

Tables 2.1 to 2.4 provide results from the analysis of five liquidity-related variables for the MTS and US trading platforms by maturity and benchmark status. The variables calculated are the effective spread, the steepness of the orderbook, the trade size, the liquidity available at the best bid and ask quotes and the liquidity available in the best three quotes. Details of exactly how these measures are derived are provided in the notes accompanying the tables. In each case the median is provided along with the 1st and 3rd quartiles. Another liquidity measure that is not calculated here is the speed with which limit order quantities are replenished. In the case of the MTS platform this is usually instantaneous because of the use of hidden 'block-quantities' that feed automatically into the visible 'drip-quantity' as soon as existing limit order is hit or taken. A slow speed of replenishment would be expected to show up in various ways in the other liquidity measures that we present, however, so we do not specifically consider this attribute separately.

The effective spreads rise with term to maturity. Effective spreads are not necessarily higher for the non-benchmark issues at each maturity, as one might expect. This can be explained by the fact that off-the-run issues will have moved closer to their redemption date and will therefore have shorter terms to maturity than those that have been recently issued. This is particularly relevant at the short maturity where the off-the-runs are quite close to redemption. For this reason, comparisons between benchmarks and their non-benchmark counterparts are not always valid. It is also advisable not to read too much into small differences in effective spreads even within benchmark categories as this could be explained by differences in term to maturity.

Notwithstanding these reservations, there are some quite large differences that are unlikely to be explained by maturity differences.

Table 2.1. Panel A: Consider the results for the short maturity benchmarks presented in this table. It is interesting that all of the MTS country-related effective spreads are zero at the first quartile. For the Italian and Spanish markets there is a zero effective cost of trading for up to 50% of all trades at this maturity. The Netherlands, France and Germany all have slightly higher median effective spreads than other countries. This is broadly supportive of the view that these countries have less reliance on the MTS system and that best execution is regularly found on alternative trading venues. This view is further supported by the relatively small effective spread and plentiful liquidity found for the Finnish market in which issue size is seldom much greater than the minimum required. This can therefore be explained by the high dependence of Finland on the syndicated issuance approach and how this affects primary dealer participation on the transparent MTS.

There is little doubt that median effective spreads in the US Treasury market are significantly below those available on MTS. But there are interesting differences between the three US platforms. The most transparent and most liquid platform (eSpeed) has low effective spreads at the median and 1st quartile but not at the 3rd quartile. This is consistent with the view that a transparent setting will not provide small effective spreads for larger than usual trade size. By contrast, the BrokerTec platform provides a very stable effective spread which is roughly three quarters of a basis point for at least 75% of trades. Surprisingly, the GovPX effective spread is only marginally different from that which is available on the other two platforms (despite its minor share of the on-the-run market).

At the short maturity the comparison of orderbook steepness in conjunction with the liquidity variables reveals some interesting facts. The Netherlands appears to have a book with lower than average median steepness but also less overall available liquidity. Steepness on the MTS compares very well with that on the very liquid eSpeed system in the US. But this should be viewed in the knowledge that the available liquidity in the slightly steeper eSpeed orderbook is usually more than twice as great as that on any individual MTS market. BrokerTec also provides a market in

which the orderbook is less steep than on eSpeed but it also has about one-fifth the available liquidity. Smaller trades (5 Million euro/US dollar) are more likely on the Italian market as well as on all of the US Treasury platforms. This is consistent with the increased splitting-up of large orders in more transparent and consolidated markets and also the use of algorithmic automated trade execution in the case of the US Treasury market. GovPX and eSpeed both have larger than average 3rd quartile trade size but we note that the 3rd quartile effective spread is much greater on eSpeed than on GovPX or BrokerTec. It must be the case that eSpeed is the sometimes the choice of venue for large trades when the impact of such trades is visible (i.e., the trader knows in advance how far up the orderbook the trade will go and this is likely to be when there is more visible depth and when there is uncertainty as to what price impact will occur on other venues). In the case of GovPX, the incidence of large trade size at the 3rd quartile can be explained by the frequency with which traders negotiate 'work-ups' and the fact that these work-ups are afforded a significant degree of opacity. It may be the case that this is occurring when visible depth is lower than average on eSpeed, but this is something we have not explored.

Liquidity at the best quotes and the liquidity available in the best three quotes provide a broadly similar picture of the cross-country MTS landscape. Specifically, German, French and Dutch liquidity provision is lower than elsewhere and, at least in the cases of France and Germany, this reflects the lack of primary dealer obligations relating to secondary market participation on MTS. Liquidity on US treasury markets is characterised by a significantly deeper situation on the eSpeed platform than on BrokerTec.

Panel B of Table 2.1. contains similar measures for the non-benchmark segment of the short maturity market. These measures provide a picture similar to that just discussed for the benchmark segment. The most significant points of interest include (i) a relatively small trade size in the market for Italian issues (only 2.5 million euro for the entire interquartile range), (ii) the Spanish MTS market has a large effective spread that might indicate that the Senaf is where best execution occurs, and (iii) the GovPX effective spread is significantly smaller than the equivalent spread in the benchmark segment of the same market. The smaller GovPX spread in the non-benchmark segment of the US Treasury market is unlikely to be due to term-to-

maturity differences. It is also clear from the liquidity characteristics that the non-benchmark Treasury market is less liquid than the benchmark segment, so this is also not an explanation for the effective spread difference. The only plausible explanation is the relatively opaque nature of the GovPX market.

The results just discussed for the short maturity are largely repeated for the other maturities. It is nevertheless worth mentioning the main findings from these maturities. The medium maturity benchmark case is given in Table 2.2., Panel A. We note that the effective spreads do not vary much across the MTS markets. The effective spreads available in the US Treasury market at this maturity are much lower than in the MTS market. The German and Dutch total liquidity provision is lower than elsewhere. The Finnish market once again has a surprisingly low effective spread and unusually good liquidity for a small issuer. In the medium non-benchmark case shown in Table 2.2., Panel B the effective spread and steepness of the orderbook are relatively high for Germany and France and total liquidity is relatively low. Trade size is relatively small for Italy and for the US markets.

The long maturity results in Table 2.3. give rise to a similar set of conclusions, but in this case the US-European comparison is of particular interest. For the long benchmarks in Panel A we observe a large median French effective spread and total liquidity is reliably smaller for both the French and German cases when compared with other European countries. The Finnish and Italian markets have low effective spreads and liquidity is unusually large for the Finnish case given its issuance size. On the US Treasury market BrokerTec provides better effective spreads than the other two platforms and smaller median and 3rd quartile effective spreads than available on MTS. The eSpeed platform is surprisingly poor at this maturity and is generally not as high quality as the various MTS markets. The MTS platform also looks good in terms of orderbook steepness. The MTS country-specific orderbooks are flatter than both the eSpeed and BrokerTec orderbooks. Total liquidity provision is also better on MTS, but trade size might explain the need for this. Trade size is much smaller in the US Treasury market, which is likely to be related either to algorithmic trading or to the practice of breaking up large trades so as to hide positions in an excessively transparent market. The long maturity non-benchmark results are not comprehensive enough in their country coverage to permit definitive conclusions. It is worth

mentioning however that Italian and US trade size are again smaller than elsewhere which is what would be expected in transparent markets.

The results for the very long maturity benchmarks in Panel A of Table 2.4 once again show that German and Dutch effective spreads are high. In this maturity bracket there is not as much support for earlier findings, but this is probably due to the overall illiquidity of this segment. Total liquidity provision is much smaller for all countries at this maturity. Trade size is generally smaller for the MTS platforms than at other maturities, but it is relatively high in terms of the liquidity available at best quotes. While the US Treasury market is just as illiquid as the MTS platforms at this maturity, the effective spreads are much lower there. The non-benchmark measures presented in Panel B of the same table show relatively small effective spreads in the Italian market and otherwise provide no clear-cut conclusions.

In summary, the analysis of effective spreads, trade size and liquidity provision above is broadly what would have been expected give in the light of theory and the facts about issuance approaches and primary dealer obligations. We can summarise the findings as follows. Where transparency is very high, trade size tends to fall. We found this for Italy and the two electronic trading spaces in the US Treasury market. Where primary dealer obligations are greatest or where syndicated issuance is used heavily, we see better participation/liquidity provision on MTS and artificially small effective spreads. We found this for Finland and Italy. We found that MTS was not very liquid, however, for the Netherlands, Germany and France where issuance is seldom or never by syndication and where no obligations are imposed on primary dealers to participate in MTS. In the US effective spreads are generally smaller than on MTS but the long benchmark case shows a surprisingly competitive MTS.

IV (3) Execution quality

In Tables 3.1 to 3.3 we present an analysis of execution quality just for the benchmark issues at the short, medium and long maturities (primary dealer obligations usually apply to the benchmarks). This is an extended analysis of the liquidity conditions in the market surrounding trades that had poor execution quality as measured by the effective spread. We analyze how trade size interacts with execution quality. We

also examine what proportion of poorly executed trades coincide with low liquidity at the best quotes and with a steep orderbook. These proportions vary quite a lot across the different countries and trading platforms. Cross-market comparisons give insights into the effects of issuance technique, primary dealer obligations and other transparency considerations and confirm much of the evidence already discernible from the liquidity measures themselves.

At the short maturity shown in Table 3.1., we note that poor execution quality is not always strongly associated with large trade size when these attributes are defined in relation to their own country/platform distributions. To interpret the statistics presented in this table, it is necessary to recall the size of the 3rd quartiles for the effective spread associated with each country/platform and for the other attribute that is being considered. For example, the GovPX market has a very high proportion of trades that are defined as both poorly executed and large in size. But, the effective spread at the 3rd quartile for this market was quite low and was the same as the median and 1st quartile (Table 2.1 shows it to be 0.79), so this result is not that surprising. In other words, what is defined as poor execution quality for this market may not be very different from the execution quality obtained at the median or even the 1st quartile.

Although this makes cross-country comparisons difficult, it is usually possible to compare each result with at least one other country or platform for which the liquidity conditions are similar. For example, the BrokerTec effective spread at the 3rd quartile is roughly equal to that of GovPX, yet it has far fewer large trades that obtain poor execution quality. Once again, however, caution is required, since the trade size quartiles are not equal. Table 2.1. shows that the 3rd quartile trade size on GovPX is twice as large as that on BrokerTec. Trades defined as large on GovPX are therefore much larger than those defined as large on BrokerTec. If size and poor execution quality are related then the much larger trades on GovPX will naturally have a greater likelihood of obtaining poor execution quality and this would explain the high proportion of trades being classified in the poor-execution/high-size category for this platform relative to what is found on BrokerTec. This result is interesting because it implies that there are traders willing to accept poor execution quality for a significant proportion of their large trades on the GovPX platform despite the existence of

alternative platforms in competition. This must imply that those alternative venues are deliberately not chosen for such trades. This is consistent with the view that these large trades are conducted on GovPX because of its opacity.

Fortunately for most of the countries on MTS the size, steepness and liquidity profiles are sufficiently similar that the analysis of the proportions of trades combining poor execution quality with either large size, low liquidity or high steepness are quite valid, so long as a little caution is exercised. As shown in Table 2.1. Panel A, the MTS markets all have reasonably similar 3rd quartile effective spreads (just below 2 basis points). Apart from Italy they also all have similar trade size attributes (10 million at both median and 3rd quartile). In Table 3.1., however, the proportion of trades combining large size and poor execution quality differs a lot across countries. Poor execution quality seems to be most severe for large trades in the cases of the smallest issuers (Finland and Austria). The Italian proportion is also quite high, given that large trade size is defined as trades greater than only 5 million euro (thus a relatively large proportion of quite small trades experience bad execution quality in the case of the Italian market). Thus despite the appearance of small effective spreads and plenty of liquidity, these markets do not provide good quality service for larger trade size. Another interpretation is that larger trades cannot easily be done elsewhere for these countries.

In the second column of Table 3.1., we analyse the coincidence of poor execution quality and low liquidity at the best quotes. The most common proportion of trades with both poor quality execution and low liquidity is roughly between 7 and 9 percent. The outliers are therefore Finland and Italy where the proportions are much lower. This is consistent with the argument that primary dealer obligations are binding on these markets. Dealers are quoting reasonable size, but the effective spread is not always matching the appearance of high liquidity. In the final column of the table the proportion of poor quality execution when the orderbook is steep is large for all of the usual suspects (Austria, Finland, Greece and Italy) and smallest for Germany, France and the Netherlands where primary dealer obligations are least binding and larger trades can be done by less transparent means. On the US Treasury market the eSpeed platform appears to have a very low proportion of trades combining low quality execution with low liquidity on the orderbook. This is

probably because the orderbook is so transparent on eSpeed. As mentioned earlier, this is to be expected where the liquidity available is visible. Traders will usually go to the less transparent venue to conduct larger trades when liquidity is visibly low on the transparent venue. This comment also applies to visible steepness. BrokerTec has no trades of low quality associated with the very steepest orderbook conditions. This probably just reflects the fact that traders can move to other platforms when conditions are bad for trading on BrokerTec.

Similar conclusions can be obtained from the results for the other maturities. At the medium maturity shown in Table 3.2., we note that poor execution quality for large trade size occurs more frequently in the Finnish, Spanish and Belgian markets. Although the Italian proportion is not as large as might have been expected, the French proportion is very low, and this is what one would have expected given earlier arguments. The GovPX result is very similar to what occurred in the short maturity results, and this is already interpreted in the discussion of those results. The results on the joint occurrence of low execution quality and low liquidity at best do not give any clear-cut conclusions for this maturity. But the results for poor execution quality and high steepness generally confirm earlier results (apart from the German results, which are not what one would have expected). Specifically, there is a high proportion of trades experiencing low execution quality when the orderbook is unusually steep for Austria, Greece and Italy.

The long maturity results are also a bit inconclusive, but we take some comfort from the fact that the largest outlier in column 1 of Table 3.3., is for Spain while the smallest proportion occurs for Germany. In the case of poor execution quality with low liquidity at best quotes (column two of Table 3.3.), Austria, Finland and Portugal are all outliers with small proportions of trades in this category. Italy is also a severe outlier in the last column where poor execution quality and high steepness of the orderbook coincide for 16% of trades. We doubt whether such trades would have been conducted on this transparent venue if there had been less transparent venues available. The next largest proportions in the last column are for Finland and Greece respectively while France, Germany and the Netherlands are all on the other end of the scale. Although, there are some exceptions, the body of evidence compiled here gives a quite a consistent and convincing picture of how market characteristics are

distributed across markets. This distribution seems related to the size of the issuer, the issuance techniques and the obligations that are imposed on primary dealers. The US Treasury market results can be explained by the differential design of the three platforms. Opacity is sometimes chosen for the larger trades.

IV (4) Front-running and the winner's curse.

Tables 4.1 to 4.6 show the relationship between seller- or buyer-initiated trading and the changes in the available liquidity on the limit orderbook immediately prior to the trades. It is important to note that what is being examined here is the change in quantity available at the best quotes assuming no quote-price change in the few seconds before trades (not the liquidity change in the entire period since the last trade). We believe this activity has something to do with 'front-running' and a 'winner's curse' problem that arises when the inter-dealer participants are aware of large imminent or recent transactions in the B2C market. Specifically, when a number of dealers are involved in providing quotes to buy-side participants through a request-for-quote system, the winner is immediately at a disadvantage because he knows that he gave the best quote, other dealers were not prepared to give such good quotes, and other dealers now know that some dealer has acquired a position that they will want to share in the inter-dealer market.

If a dealer wants to pre-empt the effects of B2C activity he may lodge a limit-order as soon as a request for quote is received on the B2C platform. This would be a good strategy whether or not he expects to win the B2B business. If he does win the buy-side business then he has already begun a strategy to off-set the effects of the trade on his newly acquired inventory position. If he does not get the trade, then he is effectively front-running the trade that may occur as a result of the B2C activity. Alternatively, a dealer may regard a limit order quantity change as indicative of a desire to trade resulting from B2C activity and on the basis of this place a market order for immediate execution so as to front-run the limit order. If a dealer were providing a quote to a customer who was regarded as well-informed and if the dealer did not win the trade, he may want to place a market order to reflect the limit-order information. There are probably a dozen other ways to describe the possible responses of traders in the B2B space, relating to activity they observe in the B2C

space and all of these scenarios involve some pre-emptive action or immediate reaction in the B2B platform. It is this pre-emptive action and almost instant reaction that we are interested in discovering and analyzing in Tables 4.

Each table has two panels. Panel A refers to seller initiated trades while Panel B refers to buyer-initiated trades. We only consider benchmark issues at the short, medium and long maturities. We consider the imbalance in the proportions of rises in liquidity at the best quotes on each side of the market just prior to trades of different type. The second and third columns show the proportion of trades for which there are increases in quantity available at the best bid and offer. If front-running is occurring we would expect to find more rises on the ask side than on the bid (and the opposite for buyer-initiated trades). For seller-initiated trades, the last two columns consider the possibility that increases in the ask quantity predict the return that follows (where returns are defined as transaction-to-transaction returns using mid-quote price changes). The same two columns for the buyer-initiated trades consider whether a rise in bid quantity is reflected in returns. We would expect to see more positive than negative returns following rises in bid quantity and the opposite for rises in ask quantity if limit-orders are informative. Broadly speaking, we find evidence that that some limit orders are informative. We also find evidence that there is a winner's curse arising, and that this is reflected in the case of some countries more than others.

Consider the short maturity benchmark case for seller-initiated trades which is depicted in Table 4.1., Panel A. We begin with the last two columns and note that in the majority of cases, rises in ask-size (preceding a seller-initiated trade) precede negative returns more often than they precede positive returns. This implies the presence of information in the limit orders (and also information in the seller initiated trades that followed these limit-order changes). Although this conclusion is based on a small percentage of trades in total, it is nevertheless consistent with priors and we find no instances where there is an imbalance in the other direction. Furthermore, some countries have a large imbalance, but given the number of observations involved we are unable to find many examples where the cross-country differences are statistically significant.

The evidence of front-running or of a winner's curse is provided in the second and third columns. We expected seller-initiated trades to have been preceded more often by a rise in the ask size than a rise in the bid size and this occurs in most cases (8 out of 12 cases). In Panel B. the same analysis for buyer-initiated trades shows again that for the vast majority of cases positive returns are more likely after a rise in bid quantity. We expect a rise in bid size to be more prevalent before buyer-initiated trades, and this is also shown to be the case (9 out of 12 cases and 6 that are statistically significant).

Table 4.2 to a large extent confirms these results for the medium maturity benchmarks. In most cases (8 out of 11) rises in ask size are followed by negative returns more often than by positive returns. Ask size is much more likely to rise than bid size before seller initiated trades (8 out of 11). Bid size, rather than ask size, is more likely to rise before buyer-initiated trades (7 out of 11). At the long maturity, Table 4.3.shows very little evidence of informed trading. Here the percentage of trades preceding return changes is very low, and there is very slight imbalance between the occurrences of returns of different sign. For seller-initiated trades we also do not find much evidence of a winner's curse or front-running. For buyer - initiated trades, there is some more evidence that a rise in bid size is more prevalent before a buy transaction (7 out of 11 with 4 statistically significant differences).

We therefore find some evidence of a winner's curse problem in the sovereign bond markets in both Europe and the US. This is not at all surprising since the B2C market has been becoming more transparent over time and internalization of order flow has probably been declining. We do not have strong evidence to show that these problems are more apparent in some markets than others but we would suspect that they are more prevalent in markets that are more transparent and less fragmented. Inevitably, the winner's curse problem would be expected to worsen over time if the B2B and B2C markets become more transparent and if trading is increasingly centralised on a single platform.

IV (5) A Transparency Event

The transparency event that we now consider occurred on 13 June 2003 in the context of the US Treasury market. Detailed limit-orderbook information from Cantor Market Data became visible on Reuters to a much wider audience than previously at or soon after this date[6]. Although this can be considered an increase in pre-trade transparency, it is an event that affected only the buy-side participants directly and may have had indirect effects on how dealers priced in the B2C segment. We believe that this transparency change is similar to one of the MiFID proposals regarding the visibility of the orderbook, and since it took place on a sovereign bond market it is likely to give insights into what could happen on European sovereign markets if the MiFID transparency initiative were to be applied there. Unfortunately we do not have the full limit-orderbook database covering this period (it is only supplied in a historical database covering a period starting in October 2004). We do however have detailed transactions data for this period, and we are able to calculate effective spreads, the incidence of transactions being conducted, and the sizes of these transactions. From this we can infer some of the effects of the transparency event.

If orderbook data had been available it would have been possible to examine a number of important issues: whether transparency affects liquidity available at best, whether there is an increase in willingness to exceed trade size that remains equal to or below available best size, whether there is a reduction in execution risk, whether there is a rise in the cost of doing larger than average sized trades, and whether the quoted spread changes at the best prices.

Since we do not possess the data to assess this we refer the reader to recent findings for a similar event that took place in the Sydney Futures Exchange. This has been studied by Bortoli, Frino, Jarnecic and Johnstone (2006). The change that occurred there was a move from disclosure of liquidity available at the best quote prices to disclosure of depth at the best three quote prices on each side of the book. These authors provide a theoretical model based on execution risk to motivate their empirical approach, and they find that the transparency initiative caused a decline in

[6] The details of this event are available at http://www.espeed.com/articles/cmd20030613.html

liquidity at the best quotes, no significant change in the effective spread and a rise in the proportion of market orders exceeding depth at the best quotes. This amounted to a fall in execution risk because more liquidity was observable and its price was calculable pre-trade. However, the reduced execution risk was achieved at a cost. This arose because liquidity at best declined.

The Bortoli et al. approach is more appropriate to a situation where transparency within the interdealer segment itself changes, and therefore it is not entirely applicable to the transparency event considered here. In the case of the eSpeed initiative the interdealer part of the market was already pre-trade transparent for the participants of that segment of the market. To analyze the effects of an increase in transparency that disseminates inter-dealer information to buy-side participants we must consider changes in behaviour on the buy-side of the market that will have some knock-on effect in the inter-dealer space. The main effect of this nature that is most likely to occur following an increase in transparency of inter-dealer limit order prices is that buy-side participants would request quotes from fewer dealers when preparing to trade than they did before the increase in transparency. This is simply because they possess more information about what the quotes should look like and can make trading decisions without actually requesting as much pre-trade information as before. This of course affects the amount of information available to dealers about possible buy-side trading wishes, and it also affects the ability to front-run such information. Indeed it could reduce the winner's curse problem. A reduction in the winner's curse problem will likely lead to a greater preparedness by dealers to quote narrower spreads. Conversely, a reduction in the ability to make profits from buy-side orderflow information would be expected to raise risks for dealers and also their trading profits and therefore also the bid-ask spreads that they are willing to quote (this of course depends on competition within the inter-dealer market).

Despite the lack of detailed information about the orderbook and spreads we attempt an analysis of the eSpeed transparency event using transactions data alone. We estimate an effective spread based on the difference in prices obtained for buyer initiated transactions and seller - initiated transactions that were in close proximity by time (specifically, we use the closest trades of either type so long as they are no more than one minute apart – most of these are fleeting moments apart). We examine the

time profile of the third quartile of this effective spread measure. We also examined trade size, trading volume and frequency, but we did not find significant effects surrounding the event, and therefore we do not present any analysis of these variables in what follows.

Figures 1.1 and 1.2. show the time profile of daily 3rd quartile effective spreads for the 5 and 10 year maturities for a period which starts in April 2002 and runs through to August 2005. Only the months of April, June and August are available for each year. The transparency initiative took place in June 2003, but most buy-side participants would have needed some lead time to make proper use of the newly available data. We therefore do not expect the effects to be visible immediately. What we do observe is an increase in the 3rd quartile effective spread just following the transparency event (in August of 2003). This rise in spreads is not observable in the next observation which is for April 2004. What is interesting in the case of the 5- year benchmark is that another period of somewhat larger spread can be observed for an interval in August 2002. This coincides with the initial launch of the data product among Cantor customers. The increase in the effective spread at the 3rd quartile is only one crude measure of the effects of a fairly mild transparency event. We find it to be a surprising effect given how liquid these markets are.

MTS data are currently available through Reuters and Traderforce, but to our knowledge they are not as detailed, as widely distributed, as widely used or as user friendly as the data product produced and distributed by Cantor. In one important respect the MTS data are not quite as useful for buy-side participants as are Cantor's, because they are not from as liquid a market. Their distribution may be expected to have less impact on buy-side requests for quotes, and this in turn would lead to fewer knock-on effects for inter-dealer activity. If all limit-orders in the European context were to be consolidated and distributed in real-time to buy-side participants, then this might have more decisive effects. In essence, what buy-side participants gain from inter-dealer market information has much to do with the information that they themselves supply to dealers. If they receive more information, and this affects what they supply, then there is a circularity in this effect that could lead to very inefficient outcomes. Ultimately some degree of opacity is needed if dealers are to be encouraged to supply both liquidity services and pre-trade information.

V Conclusion

We investigate the effects of cross-country differences and changes over time in the level of transparency in sovereign bond markets. We take account of the specific microstructure characteristics of these markets, in particular the obligations on primary dealers and the issuance techniques chosen by sovereign issuers. We use data from the MTS markets for euro-denominated bonds and from the US Treasury market. There are significant differences across the euro-area countries in issuance techniques and the secondary market obligations that issuers impose on dealers. The US treasury market is closest to the German market although far larger. There our data permit comparisons across alternative trading platforms with differing degrees of transparency.

Our empirical analysis uses simple (mainly non-parametric) descriptive statistics. We find a consistent and convincing pattern of results that correspond largely to our priors, which are based on both theory and extensive interviews with market participants.

- Across the MTS markets, countries that rely more on syndicate issuance and the placing of secondary market obligations on primary dealers have higher percentages of turnover on the (transparent) MTS.
- Where there is little or no reliance on the primary dealer system nor on syndicated issuance, there is little activity in the transparent secondary market (MTS).
- Examination of five liquidity-related variables is also revealing. Where transparency is high, trade size tends to be low. Where primary dealer obligations are greatest or where syndication is used heavily, we see better liquidity provision on MTS and low spreads. Effective spreads in the US are generally smaller than on MTS, except for the long benchmark.
- A detailed study of execution quality again shows it is closely related to the size of the issuer, the issuance techniques, and the obligations imposed on primary dealers.

- We find evidence of a winner's curse problem in both Europe and the US. These appear to be more prevalent in markets that are more transparent and less fragmented.
- We examine a 'transparency event' that occurred in June 2003 on the US Treasury market. The data suggest that a discrete increase in transparency on eSpeed brought an increase in effective spreads.

We conclude dealers prefer to operate on more opaque markets. While they respond to the obligations imposed by issuers by trading on the monitored platform this requires some distortion of the primary issuance process. The benefits of this system however are greater liquidity and market quality for the smaller countries' bonds and this seems to benefit all of the major participants. Greater transparency is associated with lower trade size and possibly with higher spreads. The structure of the market as it becomes more electronic could pose problems for liquidity in the near future if it accentuates the winner's curse or reduces the flow of information being communicated to dealers. Some degree of opacity seems necessary to induce dealers to supply both liquidity and pre-trade information.

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Table 1.1 Outstanding Debt/Ratings (12/31/03)

Issuer	Outstanding	Long-Term Ratings		
	(€,bln)	Moodys	S&P	Fitch
Austria	146.4	Aaa	AAA	AAA
Belgium	263.0	Aa1	AA+	AA
Finland	63.3	Aaa	AAA	AAA
France	787.7	Aaa	AAA	AAA
Germany	773.8	Aaa	AAA	AAA
Greece	148.3	A1	A+	A+
Ireland	28.1	Aaa	AAA	AAA
Italy	1157.1	Aa2	AA	AA
Netherlands	180.5	Aaa	AAA	AAA
Portugal	78.4	Aa2	AA	AA
Spain	309.0	Aaa	AA+	AAA

Note: This table is reproduced from the MTS Handbook 2005 and it supplies input for the benchmark/non-benchmark breakdown that is contained in the country specific tables that follow..

Table 1.2 Austria, 8-Apr-05(€, millions)

			Security ISIN	Outstanding	MTS Volume	Turnover %
RAGB	15/07/06	5.875%	AT0000383518	6,404.1	208.98	3.26
RAGB	20/10/07	5.50%	AT0000384953	8,749.5	470.83	5.38
RAGB	15/01/08	5.00%	AT0000384227	8,140.1	138.08	1.7
RAGB	15/07/09	4.00%	AT0000384821	8,725.8	638.82	7.32
RAGB	15/01/10	5.50%	AT0000384938	8,810.0	824.68	9.36
RAGB	04/01/11	5.25%	AT0000385067	8,267.2	231.79	2.8
RAGB	20/10/13	3.80%	AT0000385992	9,482.3	328.88	3.47
RAGB	15/07/14	4.30%	AT0000386073	8,002.1	209.51	2.62
RAGB	15/01/18	4.65%	AT0000385745	9,771.4	145.22	1.49
RAGB	15/07/20	3.90%	AT0000386115	5,650.0	274.18	4.85
RAGB	15/07/27	6.25%	AT0000383864	6,581.1	123.18	1.87
Benchmark				88,583.60	3594.15	4.06
Non-Bench				57,816.40	469.48	0.81
Total				146,400.00	4063.63	2.78

Note: This table, and all of the country-specific tables, is derived from the MTS Handbook and from the month's volume that we calculated from MTS data on transactions. In the cases of the individual bonds we calculated the volume traded for the month for which the amount outstanding was given and this produced the turnover percentage as well as providing a total that we regarded as a benchmark total. The individual bond turnover percentage should be very accurate. For both the amount outstanding and the volume traded we compiled a benchmark total and turnover percentage. For amount outstanding, we also arrive at a non-benchmark total by subtracting the benchmark amount from the total given in table 1.1 (this total is also repeated at the bottom of the country-specific tables in millions of euro). The same was done for the volume traded where we extracted total volume traded from the MTS data, took the benchmark amount from this to produce the non-benchmark total and turnover. Although the benchmark/non-benchmark division is not necessarily consistent by country, the turnover percentage is accurate.

Table 1.3 Belgium, 30-June-04 (€, millions)

	Security ISIN	Outstanding	MTS Volume	Turnover %
5-yr:OLO323.75%	BE0000292012	16,463	760.96	4.62
10-yr:OLO434.25%	BE0000303124	7,224	1,987.8	27.52
15-yr:OLO405.50%	BE0000300096	7,627	3,033.64	39.78
Benchmark		36,314	5,782.4	15.92
Non-Benchmark		226,686	15,873.04	7
Total		263,000	21655.44	8.23

Note: The note on table 1.2 applies here too.

Table 1.4 Finland, 31-Dec-04 (€ millions)

		Security ISIN	Outstanding	MTS Volume	Turnover %
RFGB 2.75%	04-Jul-06	FI0001005514	7,110	998.57	14.04
RFGB 5%	04-Jul-07	FI0001005332	6,221	1888.86	30.36
RFGB 3%	May-08	F10001005522	5,999	-	-
RFGB 5%	25-Apr-09	FI0001004822	5,653	934.05	16.52
RFGB 5.75%	23-Feb-11	FI0001005167	5,673	2097.4	36.97
RFGB 5.375%	4-Jul-13	FI0001005407	6,000	1319.15	21.99
RFGB 4.25%	4-Jul-15	FI0001005704	5,000	1582.31	31.65
Benchmark			41,656	8820.34	21.17
Non-Benchmark			21644	1197.73	15.83
Total			63,300	10018.07	5.53

Note: The note on table 1.2 applies here too.

Table 1.5 France, 15-Jun-04 (€, millions)

			Security ISIN	Outstanding	MTS Volume	Turnover %
BTAN	12/01/06	5.00%	FR0102626779	17,599	259.19	1.47
BTAN	12/07/08	3.00%	FR0105760112	17,336	466.93	2.69
OAT	25/10/13	4.00%	FR0010011130	17,422	379.59	2.18
OAT	25/04/19	4.25%	FR0000189151	11,833	323.66	2.74
OAT	25/10/32	5.75%	FR0000187635	18,738	108.24	0.58
Benchmark				82,928	1537.61	1.85
Non-Benchmark				704,772	17991.66	2.55
Total				787,700	19529.27	2.48

Note: The note on table 1.2 applies here too.

Table 1.6 Germany, December 2004 (€, millions)

		Security ISIN	Outstanding	MTS Volume	Turnover %
2yr:BKO 2.25%	15/12/06	DE0001137081	14,000	159.55	1.14
5yr:OBL 3.50%	09/10/06	DE0001141455	18,000	141.03	0.78
10yr:DBR 3.75%	04/01/15	DE0001135267	16,000	601.85	3.76
30yr:DBR 4.75%	04/07/34	DE0001135226	20,000	480.88	2.4
Benchmark			68000	1383.31	2.03
Non-Benchmark			705800	27798.64	3.94
Total			773,800	29181.95	3.77

Note: The note on table 1.2 applies here too.

Table 1.7 Greece, 31-Dec-04 (€, millions)

	Security ISIN	Outstanding	MTS Volume	Turnover %
5Y5.95% 24-Mar-05	GR0114008338	6,785	181.65	2.68
3Y4.65% 21-Jun-05	GR0110013159	6,375	80.99	1.27
7Y6.00% 19-Feb-06	GR0118007559	6,996	297	4.25
3Y2.75% 21-Jun-06	GR0110014165	7,391	313	4.23
5Y4.65% 19-Apr-07	GR0114012371	7,500	141.45	1.89
3Y3.25% 21-Jun-07	GR0110015170	8,363	1407.27	16.83
5Y3.50% 18-Apr-08	GR0114015408	9,050	511.23	5.65
10Y6.30% 29-Jan-09	GR0124006405	6,787	592.85	8.74
5Y3.50% 20-Apr-09	GR0114017420	9,307	681.11	7.32
10Y6.00% 19-May-10	GR0124011454	8,486	843.54	9.94
10Y5.35% 18-May-11	GR0124015497	6,670	450.94	6.76
10Y5.25% 18-May-12	GR0124018525	8,060	935.62	11.61
10Y4.60% 20-May-13	GR0124021552	8,526	1105.31	12.96
15Y6.50% 11-Jan-14	GR0128002590	4,602	678.55	14.74
10Y4.50% 20-May-14	GR0124024580	8,523	1464.04	17.18
20Y6.50% 22-Oct-19	GR0133001140	8,222	291.47	3.55
20Y5.90% 22-Oct-22	GR0133002155	8,541	463.08	5.42
Benchmark		130,184	10439.1	8.02

Non-Benchmark		18,116	535.23	2.95
Total		148,300	10974.33	7.40

Note: The note on table 1.2 applies here too.

Table 1.8 Ireland, 30-Dec-2004 (€ millions)

			Security ISIN	Outstanding	MTS Volume	Turnover %
4.25%	Bond	2007	IE00031256211	6,086	-	
3.25%	Bond	2009	IE00032584868	5,043	-	
5.00%	Bond	2013	IE00031256328	6,106	-	
4.60%	Bond	2016	IE0006857530	5,791	156.03	2.69
4.50%	Bond	2020	IE0034074488	5,729	149.61	2.61
Benchmark				28,755	305.64	1.06
Non-Benchmark				655	1434.04	218.94
Total				28,100	1739.68	6.19

Note: The note on table 1.2 applies here too.

Table 1.9 Italy, 31-Dec-2003 (€, millions)

		Security ISIN	Outstanding	MTS Volume	Turnover %
3-yrBTP:	1-Sep-06	IT0003522254	13,775	5488.75	39.85
3-yrBTP:	15-May-06	IT0003477111	15,100	4074.08	26.98
3-yrBTP:	1-Feb-06	IT0003424485	16,060	4228.43	26.33
5-yrBTP:	15-Sep-08	IT0003532097	7,700	2018.09	26.21
5-yrBTP:	15-Jan-08	IT0003413892	15,970	1759.5	11.02
5-yrBTP:	15-Oct-07	IT0003271019	16,351	1516.07	9.27
10-yrBTP:	1-Aug-13	IT0003472336	18,410	6327.53	34.37
10-yrBTP:	1-Feb-13	IT0003357982	17,943	3832.5	21.36
10-yrBTP:	1-Feb-12	IT0003190912	23,468	2861.78	12.19
15-yearBTP:	1-Feb-19	IT0003493258	13,940	595.28	4.27
15-yearBTP:	1-Aug-17	IT0003242747	14,517	319.79	2.20
30-yearBTP:	1-Aug-34	IT0003535157	7,000	719.52	10.28
30-yearBTP:	1-Feb-33	IT0003256820	15,454	333.13	2.16
30-yearBTP:	1-Nov-29	IT0001278511	22,478	183.26	0.82
Benchmark			218,166	34257.71	15.70
Non-Benchmark			938,934	98,648	10.51
Total			1,157,100	132905.6	11.49

Note: The note on table 1.2 applies here too.

Table 1.10 Netherlands, 31-Jan-05 (€, millions)

		Security ISIN	Outstanding	MTS Volume	Turnover %
DSL 3.00%	15-Jul-07	NL0000102119	12,216	772.24	6.32
DSL 2.50%	15-Jan-08	NL0000102150	2,645	435.84	16.48
DSL 2.75%	15-Jan-09	NL0000102101	10,366	74.75	0.72
DSL 3.00%	15-Jan-10	NL0000102309	6,327	309.79	4.90
DSL 4.25%	15-Jul-13	NL0000102689	14,223	264.5	1.86
DSL 3.75%	15-Jul-14	NL0000102325	11,710	318.49	2.72
DSL 5.50%	15-Jan-28	NL0000102317	8,887	33.23	0.37
Benchmark			66,374	2208.84	3.33
Non-Benchmark			114,126	8,132	7.13
Total			180,500	10340.65	5.73

Note: The note on table 1.2 applies here too.

Table 1.11 Portugal, 31-Dec-04 (€, millions)

		Security ISIN	Outstanding	MTS Volume	Turnover %
2-yr:OT 3.00%	Jul 2006	PTOTEWOE0009	5,072	2787.57	54.96
3-yr:OT 4.875%	Aug 2007	PTOTEXOE0016	5,117	2501.1	48.88
4-yr:OT 3.25%	July 2008	PTOTE2OE0000	4,200	630.04	15.00
5-yr:OT 3.95%	July 2009	PTOTECOE0011	5,000	458.63	9.17

6-yr:OT 5.85%	May 2010	PTOTEHOE0008	5,147	969.64	18.84
7-yr:OT 5.15%	June 2011	PTOTEJOE0006	5,258	1194.29	22.71
8-yr:OT 5.00%	June 2012	PTOTEKOE0003	5,036	359.45	7.14
9-yr:OT 5.45%	Sep 2013	PTOTEGOE0009	5,043	904.34	17.93
10-yr:OT 4.375%	Jun 2014	PTOTE1OE0019	5,000	767.23	15.34
Benchmark			44,873	10572.29	23.56
Non-Benchmark (inc bills)			33,527	1,876	5.60
Total			78,400	12448.22	15.88

Note: The note on table 1.2 applies here too.

Table 1.12 Spain, 31 Dec 2004 (€, millions)

		Security ISIN	Outstanding	MTS Volume	Turnover %
Bono 3.25	01/31/05	ES0000012254	8,553.15	30.05	0.35
Bono 4.95	07/30/05	ES0000012379	11,967.94	284.68	2.38
Bono 3.20	01/31/06	ES0000012841	11,314.37	358.64	3.17
Bono 4.80	10/31/06	ES0000012445	11,307.16	370.41	3.28
Bono 3.00	07/30/07	ES0000012908	7,765.18	1127.57	14.52
Bono 4.25	10/31/07	ES0000012825	12,560.36	1214.41	9.67
Bono 3.60	01/31/09	ES0000012882	11,446.80	955.72	8.35
Obligaciones 6.00	01/31/08	ES0000011652	17,089.06	634.51	3.71
Obligaciones 5.15	07/30/09	ES0000012064	12,572.29	229.47	1.83
Obligaciones 4.00	01/31/10	ES0000012239	12,494.60	645.02	5.16
Obligaciones 5.40	07/30/11	ES0000012387	13,195.10	635.68	4.82
Obligaciones 5.35	10/31/11	ES0000012452	12,612.08	426.84	3.38
Obligaciones 5.00	07/30/12	ES0000012791	12,873.20	574.98	4.47
Obligaciones 6.15	01/31/13	ES0000011660	11,964.02	680.29	5.69
Obligaciones 4.20	07/30/13	ES0000012866	10,241.79	346.27	3.38
Obligaciones 4.75	07/30/14	ES0000012098	11,185.99	965.19	8.63
Obligaciones 4.40	01/31/15	ES0000012916	9,184.50	1483.83	16.16
Obligaciones 5.50	07/30/17	ES0000012783	13,793.87	847.56	6.14
Obligaciones 6.00	01/31/29	ES0000011868	12,193.27	70.24	0.58
Obligaciones 5.75	07/30/32	ES0000012411	11,600.09	254.87	2.20
Benchmark			272,902.62	12136.23	4.45
Non-Benchmark			36,097.38	3,207.19	8.88
Total			309,000	15343.42	4.97

Note: The note on table 1.2 applies here too.

Table 2.1. Short Maturity. Panels A & B.

Panel A - Benchmark Issues

Country	**Effective Spread**			Steepness			**Trade Size**			Best Liquidity			**Total Liquidity**		
	Median	**Q1**	**Q3**	Median	Q1	Q3	**Median**	**Q1**	**Q3**	Median	Q1	Q3	**Median**	**Q1**	**Q3**
AT	**1.87**	**0**	**1.95**	1.94	1.85	1.95	**10**	**10**	**10**	40	20	60	**260**	**120**	**300**
BE	**1.83**	**0**	**1.9**	1.9	1.81	1.92	**10**	**10**	**10**	50	30	70	**280**	**60**	**290**
DE	**1.91**	**0**	**1.99**	1.98		1.98	**10**	**5**	**10**	30	20	65	**150**	**140**	**140**
ES	**0**	**0**	**1.96**	1.96	1.89	1.97	**10**	**10**	**10**	60	30	90	**310**	**60**	**320**
FI	**1.87**	**0**	**1.99**	1.98	1.86	1.99	**10**	**10**	**10**	50	30	80	**300**	**60**	**310**
FR	**1.92**	**0**	**2.01**	1.95	0	2.01	**10**	**5**	**10**	30	20	45	**190**	**60**	**305**
GR	**1.88**	**0**	**1.98**	1.9	1.87	1.91	**10**	**5**	**10**	40	30	60	**250**	**120**	**275**
IT	**0**	**0**	**1.99**	1.99	0.98	1.99	**5**	**5**	**5**	35	20	62.5	**280**	**52.5**	**330**
NL	**1.96**	**0**	**1.99**	0.99	0.98	1	**10**	**10**	**10**	20	20	30	**120**	**90**	**160**
PT	**1.89**	**0**	**1.98**	1.98	1.87	1.98	**10**	**10**	**10**	50	25	75	**260**	**80**	**260**
US-BrokerTec	**0.78**	**0.78**	**0.78**	1.56	1.56	1.56	**5**	**2**	**10**	33	18	59	**104**	**71**	**150**
US-eSpeed	**0**	**0**	**2**	2	1	2	**5**	**2**	**16**	123	62	192	**549**	**371**	**693**
US-GovPX	**0.79**	**0**	**0.79**	N/A	N/A	N/A	**5**	**5**	**20**	30	12	52	**N/A**	**N/A**	**N/A**
Panel B – Non-Benchmark Issues															
BE	**1.7**	**0**	**1.83**	1.83	1.69	1.83	**5**	**5**	**10**	30	15	45	**160**	**55**	**170**
DE	**1.89**	**1.81**	**2**	1.89	1.81	1.91	**10**	**5**	**10**	30	20	50	**175**	**50**	**190**
ES	**2.06**	**1.92**	**3.84**	1.93	1.92	1.92	**10**	**5**	**20**	40	20	55	**180**	**160**	**160**
FR	**1.83**	**0**	**1.86**	1.86	1.82	1.92	**10**	**5**	**10**	25	15	30	**155**	**50**	**190**
GR	**1.97**	**0**	**1.98**	1.98	1.98	1.98	**5**	**5**	**10**	35	20	60	**230**	**170**	**255**
IT	**0**	**0**	**1.91**	1.78	0	1.98	**2.5**	**2.5**	**2.5**	20	7.5	37.5	**117.5**	**27.5**	**170**
NL	**1.85**	**0**	**1.88**	0.92	0	0.94	**10**	**10**	**10**	20	20	30	**105**	**60**	**115**
Freddie-Mac	**1.91**	**0**	**1.91**	1.91	1.9	1.91	**10**	**10**	**10**	50	30	80	**340**	**160**	**360**
US-GovPX	**0.39**	**0**	**0.39**	N/A	N/A	N/A	**5**	**5**	**20**	10	10	15	**N/A**	**N/A**	**N/A**

Notes for Table 2.1: The various measures given are for April and May 2004 in the case of the MTS data, for July 2004 in the case of BrokerTec data, for April 2005 in the case of eSpeed data and for April 2004 in the case of GovPX data. The effective spread is measured as twice the difference between the transaction price and the mid-quote immediately preceding the transaction expressed as a percentage of the mid-quote

(we multiply this by 100 to show it in basis points terms). The steepness is the average of steepness on each side of the orderbook. We measure steepness on each side as the difference between the 3rd worst bid/offer and the best bid/offer expressed as a percentage of the mid-point between these (we multiply this by 100 to show it in basis points terms). Trade size is based on the nominal volume being traded where transaction volume is based on a consolidated volume if trades are recorded at precisely the same time. Best liquidity is based on the average of the quoted size at the best bid and offer where we only consider the quotes immediately preceding the transactions. Total liquidity is based on the average of the total amount offered and the total amount bid in the best three quotes where we only include the quotes immediately preceding the trades.

Table 2.2. Medium Maturity. Panels A & B. The notes for Table 2.1., also apply to this table.

Panel A - Benchmark Issues

Country	**Effective Spread**			Steepness			**Trade Size**			Best Liquidity			**Total Liquidity**		
AT	**1.84**	**0**	**1.93**	1.87	1.81	1.94	**10**	**10**	**10**	30	20	50	**205**	**110**	**240**
BE	**2.02**	**2.01**	**2.02**	2.02	2	2.02	**10**	**10**	**10**	50	30	90	**310**	**80**	**350**
DE	**1.91**	**0**	**2**	2	1.91	2	**10**	**5**	**10**	25	20	50	**200**	**45**	**210**
ES	**1.92**	**0**	**1.95**	1.95	1.9	1.96	**10**	**10**	**10**	40	25	75	**280**	**60**	**310**
FI	**1.86**	**0**	**2.01**	1.87	1.86	2.01	**10**	**10**	**10**	40	20	50	**260**	**130**	**290**
FR	**1.97**	**0**	**1.99**	1.99	1.95	1.99	**10**	**10**	**10**	35	20	60	**250**	**60**	**305**
GR	**1.78**	**0**	**1.99**	1.97	1.77	1.98	**10**	**5**	**10**	30	20	55	**220**	**115**	**255**
IE	**2.01**	**1.92**	**3.98**	2.01	1.91	2.01	**10**	**10**	**10**	20	20	30	**115**	**60**	**115**
IT	**1.97**	**0**	**2.03**	1.99	1.97	2.04	**5**	**5**	**10**	35	20	60	**260**	**102.5**	**345**
NL	**2.05**	**2.04**	**2.05**	2.05	2.04	2.05	**10**	**10**	**10**	30	20	55	**200**	**70**	**200**
PT	**1.95**	**1.95**	**1.95**	1.95	1.95	1.95	**10**	**10**	**10**	35	20	50	**235**	**135**	**255**
US-BrokerTec	**0.78**	**0.77**	**0.79**	1.58	1.57	2.36	**2**	**1**	**5**	19	10	33	**73**	**52**	**101**
US-eSpeed	**0**	**0**	**2.01**	2.01	1.01	2.02	**3**	**1**	**8**	40	21	64	**246**	**147**	**316**
US-GovPX	**1.59**	**0.79**	**5.53**	N/A	N/A	N/A	**3**	**2**	**5**	8	3	10	**N/A**	**N/A**	**N/A**

Panel B – Non-Benchmark Issues

BE	**1.79**	**0**	**1.82**	1.8	1.71	1.82	**5**	**5**	**10**	30	20	45	**155**	**75**	**170**
DE	**2**	**1.84**	**3.99**	1.99	1.79	1.99	**10**	**10**	**10**	30	20	40	**180**	**50**	**200**
ES	**1.81**	**0**	**1.85**	1.81	1.79	1.81	**10**	**10**	**10**	20	10	40	**250**	**62.5**	**262.5**
FR	**3.7**	**1.81**	**5.52**	1.99	1.64	2.97	**5**	**5**	**10**	15	10	20	**65**	**30**	**90**
GR	**0**	**0**		2.51			**5**	**5**		20	20		**60**		
HU	**3.95**	**1.99**	**5.96**	2.95	1.99	2.99	**1**	**1**	**1**	3	2	5	**10**	**9**	**13**
IT	**1.87**	**0**	**1.98**	1.98	1.87	1.98	**2.5**	**2.5**	**2.5**	30	20	40	**127.5**	**62.5**	**147.5**
NL	**1.96**	**0**	**3.58**	1.98	1.79	1.98	**10**	**10**	**10**	30	20	40	**132.5**	**80**	**132.5**
PL	**3.98**	**1.99**	**5.96**	2.98	1.98	3.97	**1**	**1**	**1**	3	2	4	**10**	**8**	**12**
PT	**1.78**	**0**	**1.84**	1.79	1.76	1.79	**10**	**10**	**10**	40	30	70	**225**	**55**	**240**
Freddie-Mac	**1.98**	**1.96**	**3.92**	1.98	1.96	1.98	**10**	**10**	**10**	30	20	40	**270**	**180**	**330**
US-GovPX	**0.38**	**0**	**0.76**	N/A	N/A	N/A	**5**	**5**	**20**	10	10	10	**N/A**	**N/A**	**N/A**

Table 2.3. Long Maturity. Panels A & B. The notes for Table 2.1., also apply to this table.

Panel A - Benchmark Issues

Country	**Effective Spread**			Steepness			**Trade Size**			Best Liquidity			**Total Liquidity**		
AT	**1.85**	**0**	**2.05**	1.87	1.84	2.06	**10**	**5**	**10**	25	20	40	**140**	**85**	**150**
BE	**1.96**	**0**	**2.01**	1.99	1.87	2	**10**	**10**	**10**	30	20	45	**200**	**125**	**250**
DE	**1.93**	**0**	**3.73**	1.97	1.86	1.97	**10**	**5**	**10**	20	15	30	**140**	**40**	**140**
ES	**1.83**	**0**	**1.99**	1.87	1.81	1.92	**10**	**10**	**10**	30	20	50	**215**	**110**	**260**
FI	**1.8**	**0**	**1.83**	1.83	1.79	1.83	**10**	**10**	**10**	30	20	40	**180**	**110**	**210**
FR	**2.01**	**0**	**3.76**	2.02	1.84	2.02	**10**	**5**	**10**	25	20	40	**180**	**40**	**210**
GR	**1.84**	**0**	**1.98**	1.97	1.84	1.98	**5**	**5**	**10**	30	20	45	**170**	**110**	**190**
IE	**1.95**	**1.88**	**5.63**	2.82	1.85	2.82	**10**	**10**	**10**	20	15	40	**85**	**70**	**85**
IT	**1.9**	**0**	**2**	1.99	1.87	2.01	**5**	**5**	**10**	37.5	20	55	**260**	**170**	**305**
LU	**4.2**	**1.83**	**6.25**	2.09	1.81	2.71	**10**	**10**	**10**	30	20	50	**140**	**100**	**160**
NL	**1.98**	**0**	**3.73**	1.99	1.86	2.09	**10**	**5**	**10**	20	20	40	**150**	**70**	**190**
PT	**1.98**	**1.82**	**3.69**	1.87	1.8	1.98	**10**	**10**	**10**	30	20	50	**200**	**60**	**220**
US-BrokerTec	**1.53**	**1.52**	**1.54**	3.07	3.06	3.1	**2**	**1**	**4**	17	10	29	**76**	**56**	**103**
US-eSpeed	**2.08**	**2.07**	**2.08**	3.12	3.11	3.13	**3**	**1**	**8**	32	19	54	**181**	**106**	**265**
US-GovPX	**3.23**	**3.18**	**6.44**	N/A	N/A	N/A	**3**	**1**	**5**	4	2	15	**N/A**	**N/A**	**N/A**

Panel B – Non-Benchmark Issues

AT	**1.98**	**0**	**2**	1.99	1.98	2.95	**10**	**10**	**10**	30	20	35	**120**	**90**	**145**
BE	**1.56**	**1.5**	**4.51**	2.25	1.5	4.51	**5**	**5**	**5**	15	12.5	20	**70**	**30**	**90**
DE	**3.68**	**1.84**	**5.53**	1.89	1.81	2.05	**10**	**5**	**10**	20	20	35	**130**	**40**	**170**
ES	**5.19**	**0**	**9.24**	2.03	1.71	2.03	**10**	**10**	**10**	20	18	40	**175**	**47**	**185**
FR	**1.82**	**1.71**	**7.27**	1.81	1.69	1.9	**7.5**	**5**	**10**	20	10	30	**125**	**22.5**	**155**
HU	**5.97**	**3.92**	**9.74**	3.93	1.98	4.96	**1**	**1**	**1**	2	2	3	**8**	**6**	**9**
IT	**1.98**	**0**	**1.98**	1.98	1.96	1.98	**2.5**	**2.5**	**5**	30	20	40	**97.5**	**15**	**110**
LT	**7.87**	**1.97**	**9.89**	4.95	3.94	7.87	**1**	**1**	**1**	2	2	3	**8**	**7**	**9**
PL	**5.57**	**3.71**	**7.99**	3.01	2	4.02	**1**	**1**	**1**	2	2	2	**8**	**6**	**9**
Freddie-Mac	**3.99**	**3.87**	**6.01**	1.94	1.93	2	**10**	**10**	**10**	30	20	40	**200**	**100**	**220**
US-GovPX	**1.48**	**0.74**	**1.48**	N/A	N/A	N/A	**5**	**5**	**11**	10	10	10	**N/A**	**N/A**	**N/A**

Table 2.4. Very Long Maturity. Panels A & B. The notes for Table 2.1., also apply to this table.

Panel A - Benchmark Issues

Country	**Effective Spread**			Steepness			**Trade Size**			Best Liquidity			**Total Liquidity**		
AT	**5.89**	**1.96**	**8.25**	2.95	1.96	3.93	**5**	**5**	**5**	10	10	15	**40**	**35**	**50**
BE	**7.37**	**3.66**	**11.01**	3.7	2.75	7.33	**5**	**5**	**5**	10	10	15	**55**	**32.5**	**70**
DE	**8.11**	**6.09**	**12.17**	2.04	2	3.6	**2.5**	**2.5**	**5**	10	7.5	15	**50**	**32.5**	**60**
ES	**7.1**	**5.22**	**8.85**	2.66	1.77	2.67	**5**	**5**	**5**	10	10	15	**55**	**40**	**65**
FR	**4.08**	**2.07**	**8.14**	2.07	2.06	3.11	**5**	**5**	**5**	12.5	10	15	**70**	**47.5**	**95**
GR	**3.35**	**1.68**	**5.33**	2.69	1.68	3.57	**5**	**5**	**5**	10	10	15	**50**	**35**	**55**
IT	**4.01**	**2.03**	**5.39**	2.08	2.02	3.03	**2.5**	**2.5**	**5**	10	7.5	12.5	**42.5**	**32.5**	**60**
NL	**10.82**	**7.35**	**11.07**	2.74	1.81	3.68	**5**	**5**	**5**	10	10	20	**50**	**45**	**65**
US-BrokerTec	**1.55**	**1.53**	**3.1**	4.57	3.06	6.1	**2**	**1**	**3**	8	5	12	**27**	**21**	**34**
US-eSpeed	**1.83**	**1.82**	**3.65**	2.75	2.75	3.68	**1**	**1**	**2**	5	3	9	**38**	**23**	**53**

Panel B – Non-Benchmark Issues

DE	**11.31**	**9.76**	**13.98**	4.07	4	5.7	**2.5**	**2.5**	**5**	7.5	7.5	12.5	**30**	**22.5**	**32.5**
ES	**8.62**	**5.19**	**20.37**	5.18	5.1	5.18	**5**	**5**	**5**	10	10	20	**45**	**45**	**50**
FR	**8.53**	**2.76**	**17.48**	8.23	2.06	10.8	**2.5**	**2.5**	**5**	7.5	5	10	**20**	**15**	**25**
IE	**2.04**	**0**	**6.11**	7.13	4.04	8.15	**5**	**5**	**10**	15	10	15	**40**	**40**	**65**
IT	**3.91**	**1.9**	**7.69**	2.61	1.74	3.3	**2.5**	**2.5**	**5**	7.5	5	10	**32.5**	**22.5**	**37.5**
NL	**5.94**	**0**	**8.9**	2.97	1.48	5.22	**5**	**5**	**5**	10	10	10	**40**	**35**	**50**

Table 3.1. Short Maturity (Benchmarks): Execution Quality Analysis.

Country-Platform	Trades	Low Execution Quality & Trade Size in Highest Quartile	Low Execution Quality & Size at Best in Lowest Quartile	Low Execution Quality & Steepness in Highest Quartile
AT	68	16%	9%	15%
BE	264	5%	7%	8%
DE	179	4%	9%	5%
ES	307	11%	9%	8%
FI	179	17%	3%	11%
FR	204	10%	6%	5%
GR	232	2%	8%	11%
IT	2343	10%	3%	12%
NL	100	1%	5%	4%
PT	270	2%	7%	5%
US-BrokerTec	9204	7%	7%	0%
US-eSpeed	860	4%	1%	3%
US-GovPX	805	22%	7%	6%

Notes for Table 3.1.: Low execution quality is defined as trades that occur at effective spreads that are in their highest quartile by size. Likewise, trade size is considered large if in the highest quartile. Size at best in lowest quartile represents a situation where the average size available at the best bid and ask quotes is relatively low and price impact for a large trade would be expected to be high. The steepness measure is described in the notes to table 2.1. When this is in its highest quartile we regard it as an unfavourable time to be executing large trades.

Table 3.2. Medium Maturity (Benchmarks): Execution Quality Analysis.

Country-Platform	Trades	Low Execution Quality & Trade Size in Highest Quartile	Low Execution Quality & Size at Best in Lowest Quartile	Low Execution Quality & Steepness in Highest Quartile
AT	96	4%	7%	10%
BE	128	9%	5%	8%
DE	71	7%	4%	10%
ES	279	12%	4%	6%
FI	122	10%	7%	8%
FR	110	1%	8%	7%
GR	346	5%	8%	12%
IT	1266	6%	7%	11%
NL	51	6%	2%	6%
PT	51	6%	4%	4%
US-BrokerTec	21012	6%	8%	1%
US-eSpeed	1771	5%	2%	5%
US-GovPX	151	32%	7%	14%

Table 3.1. notes also apply to this table.

Table 3.3. Long Maturity (Benchmarks): Execution Quality Analysis.

Country-Platform	Trades	Low Execution Quality & Trade Size in Highest Quartile	Low Execution Quality & Size at Best in Lowest Quartile	Low Execution Quality & Steepness in Highest Quartile
AT	70	7%	3%	4%
BE	377	8%	6%	7%
DE	108	4%	5%	5%
ES	323	11%	7%	5%
FI	86	8%	3%	9%
FR	203	7%	5%	3%
GR	675	8%	7%	9%
IT	2347	6%	7%	16%
NL	82	5%	6%	4%
PT	254	9%	2%	3%
US-BrokerTec	20211	7%	7%	1%
US-eSpeed	2428	3%	6%	8%
US-GovPX	78	31%	0%	4%

Table 3.1. notes also apply to this table.

Table 4.1 Short Maturity, Benchmark Issues. Analysis of Winner's Curse.

Panel A. Limit orderbook activity in advance of seller initiated transactions

Country	Sells	Rise in Bid Size	Rise in Ask Size	Rise in Ask Size & Negative Return	Rise in Ask Size & Positive Return
AT	21	-	10%	5%	5%
BE	102	1%	11%	8%	1%
DE	68	6%	15%	6%	1%
ES	123	16%	16%	7%	4%
FI	46	22%	28%	13%	7%
FR	60	3%	3%	2%	2%
GR	82	-	2%	2%	-
IT	1148	**9%**	**6%**	**2%**	**1%**
NL	15	-	13%	13%	-
PT	85	20%	19%	7%	4%
US-BrokerTec	1778	**23%**	**33%**	**10%**	**4%**
US-eSpeed	208	10%	13%	4%	-

Panel B. Limit orderbook activity in advance of buyer initiated transactions

	Buys	Rise in Bid Size	Rise in Ask Size	Rise in Bid Size & Positive Return	Rise in Bid Size & Negative Return
AT	23	4%	-	4%	-
BE	79	19%	4%	9%	8%
DE	57	30%	7%	14%	9%
ES	91	**26%**	**10%**	5%	12%
FI	88	**35%**	**19%**	13%	11%
FR	49	6%	8%	4%	2%
GR	87	-	1%	-	-
IT	1218	**13%**	**5%**	**5%**	**2%**
NL	29	7%	7%	7%	-
PT	114	**30%**	**17%**	**13%**	**5%**
US-BrokerTec	1773	**29%**	**24%**	**9%**	**3%**
US-eSpeed	201	**16%**	**9%**	6%	-

Notes for Table 4.1. The Proportion of trades for which there was a rise in bid or ask size, refers to the proportion of transaction where a change in quantity bid or offered occurred and no change in the quoted price occurred. The change in quoted size usually precedes the transaction by a matter of seconds. The number of buys and sells provided are the number of transaction that this refers to (other transaction may have occurred but will not have had a constant price over the preceding quotes). The last two columns display the proportions of these trades that are also followed by a positive/negative return where the return is based on mid-quote returns between the current transaction and the following transaction. We base our analysis on comparisons of the second and third columns and also of the fourth and fifth columns. For sells/buys we would expect ask/bid size to increase just before the transaction. If there is information in the limit orders we would expect a rise in ask/bid size to more often precede negative/positive returns. Differences that are statistically significant at a 90% level are shown in bold.

Table 4.2 Medium Maturity, Benchmark Issues, Analysis of Winner's Curse.

Panel A. Limit orderbook activity in advance of seller initiated transactions

Country	Sells	Rise in Bid Size	Rise in Ask Size	Rise in Ask Size & Negative Return	Rise in Ask Size & Positive Return
BE	28	4%	11%	7%	-
DE	28	4%	14%	7%	4%
ES	59	7%	29%	10%	10%
FI	34	6%	3%	3%	-
FR	41	12%	5%	2%	-
GR	118	-	-	-	-
IT	365	**10%**	**23%**	**10%**	**6%**
NL	6	-	17%	17%	-
PT	11	27%	45%	27%	-
US-BrokerTec	3332	**18%**	**29%**	**10%**	**4%**
US-eSpeed	493	**6%**	**17%**	7%	-

Panel B. Limit orderbook activity in advance of buyer initiated transactions

	Buys	Rise in Bid Size	Rise in Ask Size	Rise in Bid Size & Positive Return	Rise in Bid Size & Negative Return
BE	52	25%	2%	8%	13%
DE	32	13%	13%	-	6%
ES	108	12%	6%	6%	6%
FI	40	3%	5%	3%	-
FR	21	-	5%	-	-
GR	115	2%	1%	1%	1%
IT	523	**19%**	**12%**	**8%**	**4%**
LU	59	2%	2%	2%	-
NL	14	21%	-	14%	7%
PT	11	18%	36%	9%	-
US-BrokerTec	3297	**27%**	**19%**	**10%**	**3%**
US-eSpeed	454	**15%**	**4%**	6%	-

Notes for Table 4.1. also apply to this table.

Table 4.3 Long Maturity, Benchmark Issues, Analysis of Winner's Curse.

Panel A. Limit orderbook activity in advance of seller initiated transactions

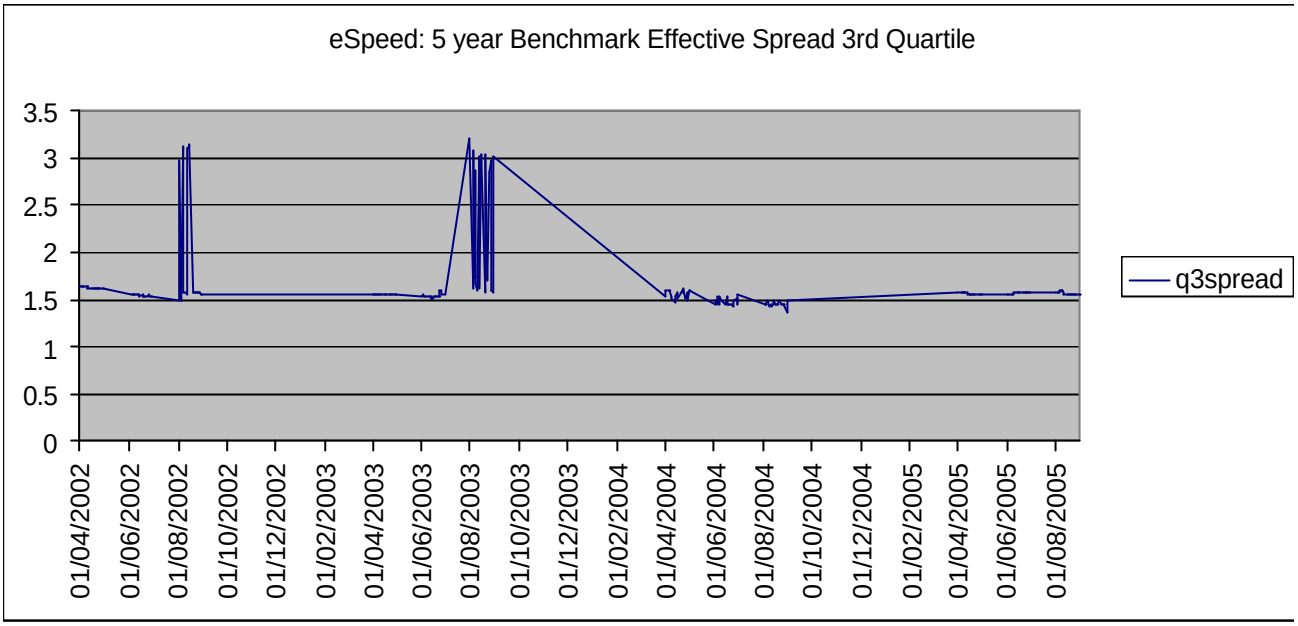
Country	Sells	Rise in Bid Size	Rise in Ask Size	Rise in Ask Size & Negative Return	Rise in Ask Size & Positive Return
BE	78	5%	4%	4%	-
DE	45	4%	2%	2%	-
ES	55	13%	9%	4%	4%
FI	24	8%	-	-	-
FR	36	17%	11%	8%	3%
GR	292	1%	4%	1%	2%
IT	945	**15%**	**25%**	**12%**	**6%**
NL	12	-	-	-	-
PT	39	8%	15%	3%	13%
US-BrokerTec	3344	**18%**	**31%**	**12%**	**4%**
US-eSpeed	621	**7%**	**14%**	**6%**	**1%**

Panel B. Limit orderbook activity in advance of buyer initiated transactions

	Buys	Rise in Bid Size	Rise in Ask Size	Rise in Bid Size & Positive Return	Rise in Bid Size & Negative Return
BE	155	2%	3%	2%	-
DE	22	-	-	-	-
ES	139	**12%**	**5%**	5%	4%
FI	39	13%	8%	5%	5%
FR	54	19%	4%	11%	4%
GR	281	1%	2%	-	1%
IT	1171	**24%**	**18%**	**13%**	**6%**
NL	18	6%	-	-	-
PT	93	14%	19%	4%	9%
US-BrokerTec	3281	**32%**	**21%**	**12%**	**4%**
US-eSpeed	761	**14%**	**9%**	4%	-

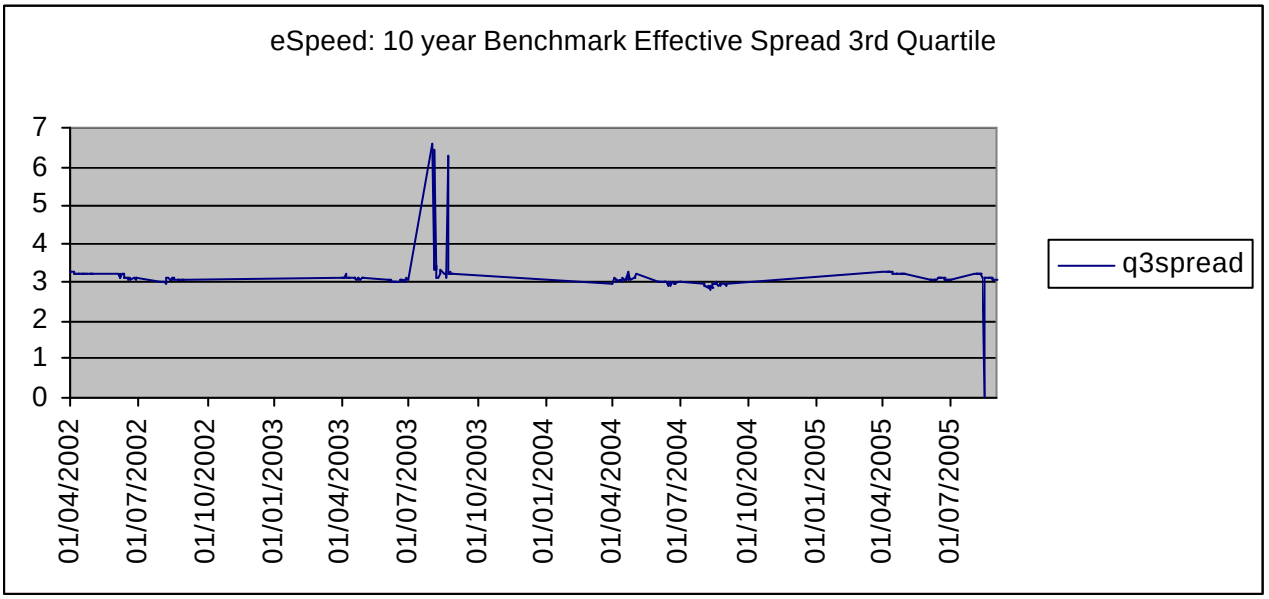
Notes for Table 4.1. also apply to this table.

Figure 1.1.



Notes for Figure 5.1. The 3rd quartile effective spread is based on transactions that are no-more than one minute apart and usually only a few seconds apart. Pre-transaction quotes were not available so the last seller- and buyer-initiated transactions in each minute were used to estimate the effective spread. The daily 3rd quartile of this is plotted for each EST day between 9.00am and 5.30pm. All trading days for 2003 are included but for years 2002, 2004 and 2005 we only show the daily 3rd quartile within the months of April, June and August. The event of interest occurred on 13 June 2003 and it is noticeable that this is soon followed by a larger 3rd quartile spread.

Figure 1.2.



The notes for figure 5.1. also apply to this table.