Forestalling Floor Closure: Evidence from a Natural Experiment on the German Stock Market

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For Peer Review

Forestalling Floor Closure: Evidence from a Natural Experiment on the German Stock Market

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Abstract

This paper contributes to the debate about the relative qualities of floor and electronic trading systems by analysing the effects of bringing forward the Xetra closing time from 8.00pm to 5.30pm in November 2003, while the Frankfurt floor remains open until 8.00pm. This natural experiment provides a 'cleaner' institutional setting than in Venkataraman (2001), as it enables us to investigate trading quality on *both* platforms for the *same* stocks in the *same* country before and after the event. The empirical evidence suggests that primarily institutional investors trading in large stocks transfer to the floor when Xetra closes earlier. It appears that investors remain with Xetra for informed trading though.

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Forestalling Floor Closure:
Evidence from a Natural Experiment
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Abstract

This paper contributes to the debate about the relative qualities of floor and electronic trading systems by analysing the effects of bringing forward the Xetra closing time from 8.00pm to 5.30pm in November 2003, while the Frankfurt floor remains open until 8.00pm. This natural experiment provides a 'cleaner' institutional setting than in Venkataraman (2001), as it enables us to investigate trading quality on *both* platforms for the *same* stocks in the *same* country before and after the event. The empirical evidence suggests that primarily institutional investors trading in large stocks transfer to the floor when Xetra closes earlier. It appears that investors remain with Xetra for informed trading though.

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1 Introduction

On 3 November 2003, the closing time of the German electronic trading platform Xetra was brought forward from 8.00pm to 5.30pm, while the Frankfurt floor remained open until 8.00pm. Deutsche Boerse announced this change in opening hours in a press release on 3 September 2003. This release claims that market participants prefer uniform trading hours across Europe as stock trading becomes increasingly international (Deutsche Boerse, 2003).

We analyse the effects of this event on the trading qualities on both platforms, thereby overcoming the limitations of Venkataraman (2001) as pointed out by Madhavan (2001). Venkataraman (2001) analyses the trade execution costs for the non-anonymous New York Stock Exchange (NYSE) compared with the anonymous Paris Bourse for large and liquid stocks. He finds trading costs in Paris to be higher than at the NYSE by 0.14 percent of the trading volume and concludes that human intermediation may increase liquidity on a stock exchange. In a critical discussion, Madhavan (2001) demonstrates several substantial difficulties with this analysis: Venkataraman (2001) examines two stock exchanges in different countries with different regulatory settings and different sets of stocks that are matched using various algorithms. Moreover, two auction markets are investigated which makes the interpretation of the spreads ambiguous. As we compare the *same* stocks traded simultaneously on *both* platforms in continuous trading at the *same* stock exchange, we are able to report more reliable results than Venkataraman (2001).

Moreover, our direct comparison of the electronic trading system with the floor provides further evidence regarding the Seppi (1990) hypothesis that broker-facilitated upstairs markets are preferred to electronic downstairs markets by those traders who can credibly convey that their trades are uninformed. Bessembinder and Venkataraman (2004) find empirical evidence supporting Seppi (1990) and report total execution costs, and their adverse selection component, to be lower in the upstairs market than downstairs. They argue that the presence of brokers drives down transaction costs in part because these brokers have information about unexpressed liquidity (Grossman, 1992), and in part because the information asymmetry is lower in a non-anonymous market. Bessembinder and Venkataraman (2004) conclude that an electronic exchange needs an upstairs market.

By presenting empirical evidence on the comparison of two trading systems in a clean institutional setting, we also contribute to the more general debate on whether anonymous electronic trading systems provide more or less favourable conditions for investors than the non-anonymous floor. While a few studies find evidence for the electronic system offering lower execution costs than the floor (Pirrong, 1996, Domowitz and Steil, 1999), the majority of authors argue that higher information asymmetries in computerised trading lead to higher transaction costs (Venkataraman,

2001, Theissen, 2002, Barclay *et al.*, 2003, Jain *et al.*, 2006). In fact, De Jong *et al.* (1996) find substantial permanent price effects of trading on the anonymous Paris Bourse, while the price impact of off-exchange transactions appears non-existent. These findings imply that the anonymous market tends to attract informed trading.

Previous studies either compare floor and electronic trading platforms at the same time (Venkataraman, 2001, Grammig *et al.*, 2001, Theissen, 2002), or they investigate how the market properties change over time when an electronic system is introduced instead of the existing trading floor (Gilbert and Rijken, 2006). In our study, this is reversed in that part of the trading time in the *electronic* system is abolished. This reversal is intriguing in itself as one might expect the traditional floor trading to be more prone to cuts in opening hours than highly automated electronic trading platforms. Moreover, this setting provides a natural experiment to study potential transfers of investors from Xetra to the floor as it enables us to examine continuous trading of the same stocks in two trading mechanisms at the same stock exchange.

Generally, the higher the information asymmetry is, the less liquid and less deep a market. While traders on the floor have better knowledge about the order flow and the identity of their trading counterparties, those who trade on a computerised system have easier access to fundamental information and prices on other markets (Pirrong, 1996). Pirrong compares theoretically and empirically the liquidity of German Bund Futures contracts traded simultaneously on the open-outcry platform LIFFE and electronically on Deutsche Terminboerse DTB. He finds that the computerised system offers lower spreads and is more liquid and deeper than the floor system.

Domowitz and Steil (1999) examine the total execution costs on various U.S. trading platforms and hypothesise that electronic trading systems compete for traders with floor-based ones. The degree of automation and the resulting lower running costs of a computerised platform should lead to lower overall execution costs in an electronic system than the floor can offer. In fact, they find that electronic markets provide more favourable conditions to investors than the floor for trading in over-the-counter stocks. As for trading listed issues, commissions for traditional brokers are so high that they over-compensate the lower implicit execution costs on the floor.

In contrast to these studies, there is evidence for the floor offering lower execution costs and hence more favourable conditions for investors than electronic trading systems. Theissen (2002) compares the transaction costs on the Frankfurt floor with those in the electronic system (then IBIS, now Xetra) and finds the electronic system to offer lower bid-ask spreads for actively traded stocks. The floor, however, offers more favourable conditions for less frequently traded stocks, with the market share of less liquid stocks being lower in the electronic system than on the floor. Theissen attributes the higher execution costs on the electronic platform to the adverse selection

component of the spread.

Several related studies investigate the influence of market makers on information asymmetry. Jain *et al.* (2006) examine the price impact for stocks traded parallel in the electronic system SETS and on the dealer market at the London Stock Exchange. They find empirical evidence for the computerised trading system to attract relatively more informed trades than the non-anonymous dealer market. Similarly, Barclay *et al.* (2003) conclude for Nasdaq stocks that informed traders prefer electronic systems over market makers. Benveniste *et al.* (1992) construct a theoretical model for the spread whose primary implication is that information asymmetries are lower in a non-anonymous market. However, Lehmann and Modest (1994) examine empirically the Tokyo Stock Exchange's success in providing liquidity without a specialist on the floor and the electronic system. They conclude that the Tokyo Stock Exchange is a well-functioning, liquid market despite the lack of market makers. Ding and Lau (2001) investigate how the Stock Exchange of Singapore - which includes a screen-based dealer system that has no specialist - performs relative to the NYSE and Nasdaq. They find, to a large extent, similarities between the Singapore Stock Exchange and the NYSE and Nasdaq.

Bringing forward the closing time of Xetra is not an endogenous variable (Deutsche Boerse, 2003) and therefore provides an ideal institutional setting to study the extent to which investors transfer from Xetra to the floor, and to ascertain the type of investors that accept trading on a non-anonymous system when the anonymous one closes earlier.¹ This should yield insights into the perceptions of traders regarding the relative market qualities of both trading platforms. As investors choose the platform through which to route their orders, the 'selection bias' is an integral part of this study and does not need to be corrected for or explicitly modelled empirically. Since information asymmetry impacts directly on market quality, we examine whether it is primarily uninformed investors that accept the floor as a substitute of the electronic system. Theissen (2002) finds differences in relative execution costs between large and small stocks. This is consistent with Dennis and Weston (2002), who suggest that institutional investors are generally better informed than individual ones, and Falkenstein (1996), who concludes that mutual funds prefer large stocks. We therefore conduct our analysis separately for large and for small stocks, which might give further indications regarding the type of investors that transfer to the floor. Finally, we draw conclusions regarding the design of a trading platform.

We expect trading volume to increase sharply on the floor in November 2003 after 5.30pm, driven by uninformed trades which can thereby be settled at a time when Xetra is closed. As informed

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¹While liquidity-motivated trades are likely to have a strong time preference and will thus readily transfer to the floor when Xetra closes earlier, we hypothesise that informed trades will remain with the anonymous Xetra and be settled in the daytime from November 2003 onwards.

traders prefer the anonymity of the electronic system (e.g. Barclay *et al.*, 2003, De Jong *et al.*, 1996), this might lead, under otherwise equal conditions, to a higher fraction of informed traders in Xetra, thereby increasing the adverse selection costs and hence making the computerised platform less favourable for investors. This might induce further transfers to the floor. Alternatively, it is possible that the fraction of informed traders increases on the floor if the transferring traders are a representative subset of all traders in Xetra. If primarily institutional (individual) investors move to the floor, we expect especially trading volume for large (small) stocks to increase there in November 2003. If mostly uninformed traders transfer to the floor, we conclude that a trading platform should be non-anonymous in order to avert informed trading. This latter finding might shed light on the justifiability of abolishing floor trading systems from the perspective of market microstructure.

In order to empirically analyse the relative market quality on both trading platforms over time, section 2 introduces the dataset and the methodology before section 3 describes the empirical results. Section 4 summarises our findings and concludes.

2 Data and Methodology

2.1 Data

Our dataset captures three months prior to, and after, the bringing forward of the Xetra closing time on 3 November 2003 from 8.00pm to 5.30pm. This results in 66 trading days from August 2003 to October 2003 and 60 trading days from November 2003 to January 2004. The data comprise transactions and quotes data for 136 shares traded contemporaneously on both Xetra and the floor. This portfolio captures roughly 90 percent of the equities market in Xetra (Deutsche Boerse, 2004). The transactions data include timestamp, price, and number of shares. They were obtained from the University of Karlsruhe database and the quotes data from Deutsche Boerse AG.

The 136 stocks were selected based on the instrument groups set up by Deutsche Boerse which contain predominantly German companies' shares. The DAX index comprises 30 blue-chip stocks, the MDAX contains 50 stocks whose size ranks immediately below that of the DAX ones, the TecDAX covers 30 medium-sized stocks in the technology sector, and the SDAX consists of 50 small-cap stocks. Out of these four indices, we choose those shares that were traded on both platforms throughout the six months under investigation.

Quotes are only available for Xetra as this platform has one orderbook from which we received the data. On the floor, by contrast, several market makers operate who are not obliged to publish their orderbooks. For this institutional reason, it is impossible to obtain a comprehensive set of

quotes for the floor. Quotes data for Xetra comprise bid and ask prices with timestamps and the respective number of shares. The relative spreads, which are reported multiplied with 100, are calculated as the difference between ask and bid prices divided by the spread midpoint.

We conduct common plausibility checks on the data (Madhavan *et al.*, 1997, Chung and Van Ness, 2001) and eliminate implausible observations with negative spreads or with negative or zero trading volume, as well as overnight returns. There were no entries with changes in absolute spreads, spread midpoints or returns larger than 50 percent. We only use data from continuous trading, i.e. we exclude auctions and observations outside the trading times. This results in a dataset containing 1,106,147 transactions for the floor, 10,376,549 transactions for Xetra, and 28,165,410 quotes.

Transactions that market makers settle in their own accounts should also be eliminated since they do not pay spreads to themselves. However, we cannot identify such transactions in the dataset, and their impact on overall trading volume should be negligible for large stocks in which institutional investors trade actively. Since our results are driven by large stocks, we do not pursue this further.

2.2 Methodology

In order to analyse the anonymous and the non-anonymous trading platforms over time, we apply descriptive methods from the market microstructure literature, and we decompose the bid-ask spreads following George *et al.* (1991). The methodology of Venkataraman (2001) cannot be applied here because quotes data are not available for both markets that we are comparing. For the descriptive analysis, we choose the turnover as a proxy for trading volume, transaction size as an indicator for the presence of institutional investors, and return volatility (standard deviation as in Madhavan *et al.*, 1997 or Ding and Lau, 2001) and the relative bid-ask spread (Glosten and Milgrom, 1985) to reflect information asymmetry. The trading time is split into 15-minute intervals, and within each interval the average is calculated per share on each trading day following Abhyankar *et al.* (1997). Rather than aggregating the shares into a portfolio, this method preserves the characteristics of each stock in each interval.

Turnover is calculated as the cumulative product of price and number of shares, transaction size gives the number of shares per trade, and return volatility is computed cumulatively across each interval with the return being $(p_t - p_{t-1})/p_{t-1}$.² The volatility and the spreads are reported in percent in Table 1. We employ t-tests to determine whether the means in the indicators have changed significantly over time. Statistically, this is identical to estimating dummy regressions and t-testing the estimated coefficients.

²For the descriptive analysis, we follow Roll (1984) and do not take the logarithm of the prices.

As there are no quotes data available for the floor, we estimate the spread following Roll (1984) for the descriptive analysis of the total spread.³ Alternatively, transaction costs could be approximated as in Lesmond *et al.* (1999). Their results are strongly correlated with those of Roll (1984) so that the choice of model will have very little impact on the interpretation of the estimates in our setting. The basis of the spread estimation in Roll (1984) is the autocovariance γ_T of the returns:

$$Spread_T = \sqrt{(-4)\gamma_T} , \quad (1)$$

where T is the last period for which a return observation is available. $Spread_T$ can be interpreted as the average relative spread since the returns that feed into the estimation are relative. In case of $\gamma_T > 0$ it is not defined.

George *et al.* (1991) propose two methods for decomposing the spread into its order processing and adverse selection cost components. Under the first approach, the realised return of an individual stock $R_{i,t} = \ln(p_{i,t}/p_{i,t-1})$ over each 15-minute interval needs to be purged of its time-varying expected return component that is approximated by the return of an equal-weighted size-based portfolio R_p to which stock i belongs. We use the four portfolios DAX, MDAX, TecDAX, and SDAX described in section 2.1. The regression

$$R_{i,t} = \alpha_0 + \alpha_1 R_{p,t} + u_{i,t} \quad (2)$$

is used to extract the expected return of stock i . $u_{i,t}$ are the residuals, whose autocovariance across 2-hour intervals form the basis of the synthetic spread $Spread_{calc,i,t}$ which is otherwise calculated as in equation (1). In order to decompose the observed spread into its order processing and adverse selection cost components, we estimate the regression

$$Spread_{calc,i,t} = \beta_0 + \beta_1 Spread_{obs,i,t} + \epsilon_{i,t} \quad (3)$$

where $Spread_{obs,i,t}$ is the average observed spread across each 2-hour interval. β_1 measures the order processing costs and $(1 - \beta_1)$ are the adverse selection costs. While the constant has to be included in the model specification (George *et al.*, 1991), it is not needed to determine the estimated components of the spread. When $\hat{\beta}_1 < 0$, the adverse selection costs are set to 1. As there are no observed spread data $Spread_{obs,i,t}$ available for the floor, we can only decompose the spreads from Xetra.

The starting point of the second method proposed by George *et al.* (1991) is the difference

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³Kara and Denning (1998) also follow the Roll (1984) approach to estimate the transaction costs of insider trades and argue that this is a valid method in a market with information asymmetries.

between R_i and the logarithm of the bid price return to compute a synthetic spread $Spread_{calc}$. Roll's (1984) spread measure as given in equation (1) can only be used as $Spread_{calc}$ if the expected return of a security is constant over time, and if the adverse selection costs in the market equal zero.

George *et al.* (1991) test their models with daily and weekly data of stocks traded on the NYSE and on Nasdaq from 1983 to 1987. Their major result is that adverse selection costs are smaller than previously reported in the literature and account for 8 to 13 percent of the observed spread. George *et al.* (1991) conclude that order processing costs are the predominant component of the quoted spread.

If the aim of this paper was to directly compare spreads between the two trading platforms, we would need to report the Roll (1984) measure for Xetra as well. However, we observe spreads before and after bringing forward the Xetra closing time for each trading system separately, so that it is not meaningful to analyse an inferior proxy spread measure (i.e. Roll, 1984) for Xetra when observed spreads are available. Likewise, the asymmetric information spread model proposed by Glosten and Harris (1988) or the models introduced by De Jong *et al.* (1996) could be estimated for both the floor and Xetra. For Xetra, however, we have observed spread data available, so that interpreting or decomposing any spread estimate would be unnecessarily unreliable. Moreover, in order to follow Glosten and Harris (1988) or De Jong *et al.* (1996), the trade direction would need to be inferred from previous price changes. A number of studies show that these estimates are inaccurate (e.g. Aitken and Frino, 1996, Ellis *et al.*, 2000), and Odders-White (2000) reports spread components to be biased as a result.

3 Empirical Results

We expected a sharp increase in trading volume on the floor in November 2003 after 5.30pm. In fact, turnover almost doubles there in the evening. As can be seen from Panel A in Table 1, it increases slightly in the daytime but grows from approximately 15,400 Euros in the evening in October to 29,700 Euros at the same time in November. This increase coincides with bringing forward the closing time in Xetra on 3 November 2003, which we view as empirical evidence for investors transferring to the floor rather than remaining with the electronic trading platform and trading in the daytime instead.

Insert Table 1 about here

The results of the cross-sectional analysis, which are not reported here in detail but are available on request, suggest that the sharp growth in trading volume on the floor is driven by large stocks,

while daytime turnover in Xetra for small stocks increases. This is an indication that primarily institutional investors transfer to the floor in the evening, while individual investors trading in small stocks remain with the electronic trading platform and adjust their trading time (see Falkenstein (1996) for the relationship between the size of stocks and investor type). Since Xetra has a larger market share in large stocks than in small stocks (Theissen, 2002), it is not surprising that large stocks are especially affected by the earlier closing time of Xetra.

In Xetra, the trading volume increases steadily from August 2003 to November 2003, drops in December 2003 and grows strongly in January 2004. This time series behaviour, along with the fact that only a small fraction of pre-event evening trading volume in Xetra is visible on the floor post-event, suggests that other factors play a part in Xetra in addition to bringing forward its closing time.

Since transactions in Xetra tend to be larger than those settled on the floor, an increase in transaction size on the floor could be interpreted as further evidence for investors transferring to the floor when Xetra is closed. As Panel B of Table 1 shows, the average number of shares traded per transaction on the floor increases significantly from about 394 to 535 in November 2003 after 5.30pm. On average, transactions in the evening are then larger than during the daytime. Thus, the substantial increase in trading volume on the floor is driven by the growth in transaction size, and is interpreted as further evidence for the increased trading volume originating from Xetra. Similarly to turnover, transactions in Xetra grow steadily from August 2003 to October 2003, drop in size in November 2003 and resume growing thereafter.

The transaction size on the floor increases substantially for large stocks in November 2003 after 5.30pm, while the transaction size in Xetra grows slowly across the six months under investigation. We conclude that investors trading in large stocks transfer to the floor when Xetra closes earlier. As a larger fraction of market participants in Xetra are informed traders than on the floor (Barclay *et al.*, 2003), and since those traders that appear to have transferred tend to be well informed, we expect this movement of investors to increase information asymmetry on the floor in November 2003. We investigate this by analysing return volatility and the bid-ask spread.

However, the volatility decreased on both trading systems, with the floor showing a significant reduction in the daytime and in the evening (Panel C, Table 1). Following Barclay and Hendershott (2003), we interpret this as a reduction in asymmetric information on the floor. It therefore appears that the transfer of investors from Xetra to the floor does not result in higher information asymmetries on the floor. This can be explained in two ways: Either those investors that are prepared to transfer to the floor are not informed, or they are informed but the trades they choose to settle on the floor are not information-based. Either way, this transfer should increase information

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3 asymmetry in Xetra under otherwise equal conditions. Since we are investigating a dynamic market
4 across six months, holding everything else equal is too restrictive an assumption. Therefore, we
5 also observe an overall reduction in volatility in Xetra which could be attributed to a growth in
6 liquidity shown in Panels A and D of Table 1.
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10 The bid-ask spread is another measure of information asymmetry as it contains a component
11 that compensates the market maker for losses incurred when trading against informed investors.
12 The overall spread decreases in both trading systems, with the reduction being particularly sharp
13 on the floor in the evening in November 2003 (Panel D, Table 1). For actively traded stocks, the
14 decrease in the spread is so large that the usual pattern of lower spreads in the daytime than in
15 the evening reverses. Thus, for large stocks, the daytime spread is larger than that in the evening
16 from November 2003 onwards. The reduction in spreads in Xetra could be driven by the increase
17 in liquidity or other factors beyond the transfer of trades to the floor.
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24 Overall, return volatility is higher on the floor than in Xetra, implying a larger degree of
25 information asymmetry on the floor compared with the electronic system. At the same time,
26 the total spreads on the floor are lower relative to Xetra. Since the spreads are also a proxy for
27 asymmetric information, these empirical results are, at first sight, surprising. However, since the
28 non-anonymous floor is likely to have a larger share of uninformed trades than Xetra (Barclay *et*
29 *al.*, 2003), stock prices on the floor might be noisier than in Xetra. As the primary goal of this
30 paper is the change in either trading platform over time, rather than a comparison of the two
31 trading systems, we do not investigate this in greater depth.
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38 As explained in section 2.2, the adverse selection component of the spread can be analysed
39 for Xetra only. Table 2 shows the mean adverse selection costs for the first version of the spread
40 decomposition according to George *et al.* (1991). For DAX and MDAX shares, the adverse selection
41 costs before November 2003 are smaller in the evening than in the daytime. Thus, the trades that
42 are affected by bringing forward the closing time of Xetra are informed to a smaller extent than
43 the trades in the daytime. We therefore expect transfers inside Xetra from the evening to the
44 daytime to lower adverse selection costs under otherwise equal conditions. Indeed, we observe
45 minor, though statistically significant reductions in adverse selection costs for large and medium-
46 size stocks, with the changes for small stocks being insignificant. This is plausible since small shares
47 are not actively traded in Xetra in the evening, which implies that they are not much affected by
48 shortening the Xetra trading time. While the changes are very small, their statistical significance
49 gives an indication of the direction in which adverse selection costs have changed over time.
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59 In light of the results of the descriptive analysis, one might expect an increase in adverse
60 selection costs in November 2003, since primarily informed investors appear to remain with Xetra,

while uninformed ones prefer the floor. However, liquidity in Xetra increased over time, which reduces spreads and adverse selection costs. While the adverse selection costs for the TecDAX stocks decrease over the six months under investigation, there is no significant effect at the time when Xetra begins to close earlier.

The level of the adverse selection costs across all four portfolios is surprisingly high. George *et al.* (1991) report that only about 10 percent of the spread compensate the market maker for adverse selection costs, and their results change substantially when varying interval lengths. However, our results are robust against the choice of interval length and the decomposition approach as we also followed Roll (1984) and the second method presented by George *et al.* (1991). This discrepancy between our results and those of George *et al.* (1991) could be attributed to technical innovations in the past 20 years lowering order processing costs, thereby increasing the fraction of the spread that is driven by information asymmetries.

Insert Table 2 about here

It should be noted that the German stock market is fragmented from 9.00am to 5.30pm into floor and Xetra trading platforms. After 5.30pm, only the floor exists, which enables market makers to observe the entire market more easily than in the daytime. They can therefore learn faster, so that information is incorporated more promptly into quotes. This will also make floor trading in the evening more attractive than before November 2003 and might thus account for some of the observed transfers.

For turnover, transaction size, return volatility and spread, large stocks drive the empirical results. There are at least two possible explanations for this finding. First, Xetra has a much larger market share in large stocks than in smaller ones. It is therefore plausible that primarily large stocks are affected by bringing forward the Xetra closing time, which is what we see reflected in the data. Second, consistent with this interpretation is Falkenstein's (1996) result that institutional investors prefer large stocks over small ones. Therefore it is likely that primarily institutional investors transferred to the floor in November 2003, but continued to settle informed trades on the anonymous electronic platform. Consistently with De Jong *et al.* (1996), it can be concluded that non-anonymous trading platforms offer favourable conditions to uninformed traders, while the anonymity of a computerised platform is preferred for settling informed trades.

As a robustness check, we conducted our analysis of turnover, transaction size, volatility, spread and the spread decomposition for each of the six months from August 2003 to January 2004 separately for either trading platform. The results are not reported in detail but are available from the authors on request. The prominent changes in all these time series occurred in November 2003, which we regard as support for our attributing those changes to the earlier closing time in Xetra.

4 Summary and Conclusions

The aim of this paper is to contribute to the debate about the relative qualities of floor and electronic trading systems. This issue is investigated in a natural experiment on the German stock market: The trading hours on the anonymous electronic trading system Xetra are reduced, while the non-anonymous floor remains open from 9.00am to 8.00pm. Previous studies either compare both trading platforms operating parallel, or they examine how the market properties change over time when a computerised system is introduced to replace the trading floor. Our setting enables us to observe potential transfers of investors from Xetra to the floor, and it overcomes the limitations of Venkataraman (2001) as pointed out by Madhavan (2001).

We find empirical evidence for primarily investors trading in liquid shares transferring to the floor after 5.30pm when Xetra closes early. The transactions they settle on the floor are, on average, not informed. Our insights are consistent with Barclay *et al.* (2003), Jain *et al.* (2006), Benveniste *et al.* (1992), De Jong *et al.* (1996), and Venkataraman (2001) who find that informed traders prefer the anonymity of the electronic trading system. Uninformed investors should choose non-anonymous trading systems, and they should settle their transactions before 5.30pm. The lack of fragmentation in the German stock market after 5.30pm from November 2003 onwards further contributes to lower transaction costs as market makers learn faster when the entire market can be observed more easily.

Likewise, if information-based trading is to be reduced, the trading platform should not be anonymous. This implies the recommendation to stock exchanges to refrain from closing floor trading even if highly automated electronic systems have lower running costs than the floor. However, there are exchanges that have completely abolished floor trading, e.g. Italy. Like Bessembinder and Venkataraman (2004), we argue that an electronic exchange benefits from a broker-facilitated upstairs market, especially if the floor has already been closed.

There are various alleys for methodological extensions of this paper. Firstly, a model as in Easley *et al.* (1996) could be estimated. However, this approach is based on the assumption that information events occur only *outside* the trading hours, and the market maker learns the information throughout the trading day. As a result, splitting the trading time into 9.00am to 5.30pm and 5.31pm to 8.00pm is not meaningful. In light of our empirical results, which underscore the sharp differences on the floor between daytime and evening, we would not be able to interpret the probabilities of informed trading with respect to the research questions in this paper.

Secondly, the price impact of a trade could be estimated as in Hasbrouck (1991). The core of this method is to model the interactions between trades and quotes. As quotes data are not available for the floor, this can only be estimated for Xetra. Like with the spread decomposition

performed above, this means that results cannot be compared between the floor and the electronic trading platforms. Thirdly, the effective spread could be used for the descriptive analysis and for the spread decomposition separately to the quoted spreads. This spread measure allows for trade executions within the quoted spread (Venkataraman, 2001). Once again, this would only be possible for Xetra. Finally, depth is another indicator of market quality and could also be examined in the context of this paper. However, Lee *et al.* (1993) find that spreads are negatively correlated with depth so that qualitative results regarding the latter can be inferred from our analysis of spreads.

More generally, further empirical research should take into account the explicit trading costs as well. Fees and commissions that investors face for transactions they settle on the floor might outweigh the relative benefits of the non-anonymous trading platform (Domowitz and Steil, 1999). Since institutional investors tend to have their own dealers on the floor, they might be able to save on those fees. This could be another reason why we observe primarily institutional investors transferring to the floor.

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Panel A: Turnover

		Floor			Xetra		
		H_0 : equal means			H_0 : equal means		
		mean	t -test	P -value	mean	t -test	P -value
Aug03-Oct03	daytime	34,135.45	2.57	0.01	915,752.10	9.87	<0.0001
Nov03-Jan04	daytime	34,989.55			1,000,625.36		
Aug03-Oct03	evening	16,417.06	19.47	<0.0001	198,846.24		
Nov03-Jan04	evening	28,527.03			not applicable		
Oct03	evening	15,444.56	12.74	<0.0001	947,214.42	2.86	0.004
Nov03	evening	29,712.98			990,182.64		

Panel B: Transaction Size

		Floor			Xetra		
		H_0 : equal means			H_0 : equal means		
		mean	t -test	P -value	mean	t -test	P -value
Aug03-Oct03	daytime	493.85	-4.00	<0.0001	768.33	-0.72	0.47
Nov03-Jan04	daytime	478.49			765.25		
Aug03-Oct03	evening	420.31	8.59	<0.0001	629.00		
Nov03-Jan04	evening	512.23			not applicable		
Oct03	evening	394.23	7.13	<0.0001	782.88	-4.57	<0.0001
Nov03	evening	534.66			756.32		

Table 1: Descriptive Statistics

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Panel C: Return Volatility									
		Floor				Xetra			
		H_0 : equal means				H_0 : equal means			
		mean	t -test	P -value		mean	t -test	P -value	
Aug03-Oct03	daytime	0.286	-26.45	<0.0001		0.187	-20.04	<0.0001	
Nov03-Jan04	daytime	0.245				0.168			
Aug03-Oct03	evening	0.274	-18.49	<0.0001		0.232			
Nov03-Jan04	evening	0.199				not applicable			
Oct03	evening	0.249	-6.63	<0.0001	daytime	0.173	0.76	0.45	
Nov03	evening	0.205			daytime	0.174			
Panel D: Bid-Ask Spread									
		Floor				Xetra			
		H_0 : equal means				H_0 : equal means			
		mean	t -test	P -value		mean	t -test	P -value	
Aug03-Oct03	daytime	0.356	-21.12	<0.0001		0.636	-36.54	<0.0001	
Nov03-Jan04	daytime	0.307				0.553			
Aug03-Oct03	evening	0.350	-16.46	<0.0001		0.778			
Nov03-Jan04	evening	0.252				not applicable			
Oct03	evening	0.322	-6.21	<0.0001	daytime	0.618	-12.26	<0.0001	
Nov03	evening	0.262			daytime	0.571			

Table 1: Descriptive Statistics, Continued

	DAX			MDAX			TecDAX			SDAX		
		mean	t -test	H_0 : equal means P -value		mean	t -test	H_0 : equal means P -value		mean	t -test	H_0 : equal means P -value
Aug03-Oct03	daytime	0.9945	-2.7407	0.0062	0.9935	-3.6298	0.0003	0.9864	-4.1547	0.9949	0.4796	0.6315
Nov03-Jan04	daytime	0.9942			0.9924			0.9826		0.9953		
Aug03-Oct03	evening	0.9924			0.9932			0.9871		0.9948		
Oct03	daytime	0.9948	-10.8685	<0.0001	0.9949	-187.8081	<0.0001	0.9821	0.3150	0.9943	-0.2416	0.8091
Nov03	daytime	0.9924			0.9009			0.9864		0.9940		

Table 2: Relative Adverse Selection Costs (George *et al.*, 1991) for equal-weighted size-based portfolios in Xetra