Determinants of the Bid-Ask Spread and the Role of Designated Sponsors: Evidence for Xetra

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Abstract

In order to enhance liquidity, Deutsche Börse AG postulates that non-actively traded stocks in the electronic trading platform Xetra trade with one or more designated sponsors who function similar to NYSE specialists. This paper provides a cross-sectional assessment of whether or not designated sponsors are found to increase liquidity as measured by their ability to decrease quoted and effective spreads. A trade-indicator model is applied in order to determine which theoretic component of the spread is particularly influenced. Overall, results indicate that while spreads narrow when trading with more than one designated sponsor, further increases in the number of specialists do not necessarily pay out in terms of higher liquidity. We hypothesise that benefits might be linked to the market segment under scrutiny. Finally, we provide some evidence that designated sponsors decrease the transitory spread component but cannot reject the null hypothesis of no influence on the adverse selection component.

JEL Classification: G12, G14, G19.

Keywords: Bid-Ask Spread, Trade Indicator Models, Designated Sponsors, Specialists, Xetra.

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1 Introduction

> "You can't hear them, you can't see them - but they are almost always around: Designated Sponsors."[1]

Almost 40 years after the seminal work of Demsetz (1968), research on determinants of liquidity on financial markets and on the efficiency of different market designs has lost none of its actuality. It is well known that real-world markets do not operate without costs and frictions as it is assumed by many theoretic models. The co-existence of distinct prices for buying and selling assets (i.e. the existence of a bid-ask spread) has long been established as an equilibrium phenomenon. Furthermore, it is widely accepted today that the choice of trading mechanisms might affect order decisions and, hence, asset prices. Within the last years, both theoretical and empirical research in the area of market microstructure has found an ideal playground in the rapid change of exchange systems and especially in the proliferation of electronic exchange platforms. Our work wants to add further evidence to the empirical side and focuses on the bid-ask spread as one of the most important indicators of the costs of trading (and, hence, of liquidity) in financial markets.[2] In particular, we are interested in the influence of liquidity providers in the German electronic exchange system Xetra on the spread as the market "price of immediacy":[3] So called *designated sponsors* have been introduced into the electronic trading system at the end of the 1990s as mandatory market makers for non-actively traded stocks with "insufficient" liquidity. By posting binding bid and ask quotes as well as participating in auctions, the existence of designated sponsors optimally assures that assets can be traded at their "fair" price at any point in time and thus increases incentives for investing in these securities. The sponsors' functions are very close to those of NYSE specialists or *animateurs* of the Paris Stock Exchange. However, there are interesting differences across

[1] http://boerse-frankfurt.com/, Deutsche Börse's official webside.

[2] The spread might reflect order handling costs, non-competitive pricing, inventory risk, an option value to trade or asymmetric information costs (compare e.g. Stoll (2003)).

[3] This expression dates back to Demsetz (1968) and captures the idea that the spread measures the price concession it takes to induce "waiting" agents in the market to transact immediatly instead of waiting until prices change in their favour.

exchanges: For instance, stocks in the Paris or Italian exchange deliberately opt for trading with a designated market maker while in Xetra, certain requirements have to be fulfilled in order to be eligible for trading without a sponsor. Additionally, it is not evident that the implementation of specialists has the same consequences for floor and electronic exchanges. We are particularly interested in a third point: Unlike other exchanges, Deutsche Börse's trading platform Xetra provides the possibility of (and sometimes requires) trading with more than one designated sponsor. Stocks in our data sample trade with up to seven designated sponsors and since the maximum mandatory number is two, it is not clear to us a priori whether one would always prefer to trade with more sponsors or whether, alternatively, there exists an optimal number of designated sponsors.[4] Companies seem to disagree on this issue as well: In line with a new market segmentation in 2003, rules were changed and the minimum of sponsors was reduced to 1 for all shares. Prior to the segmentation, Deutsche Börse AG conducted a survey and asked listed companies whether they were planning to follow the offical advice and continue trading with more than one designated sponsor in the future.[5] 29% of respondents stated "Yes" while 54% disapproved of this possibility, indicating that there might be some benefits in trading with more than one sponsor.[6]

Our paper contributes to the existing literature as follows: To our best knowledge, we are the first to examine the role of designated sponsors for the German electronic trading platform Xetra.[7] We can shed some light on the question of whether and how the bid-ask spread decreases in the number of designated sponsors and on whether possible

[4]The analysis solely focuses on liquidity. It would be interesting to conduct a cost-benefit analysis for firms since they often compensate sponsors for their services. However, data on related costs is not available and hence we limit our research to the question of liquidity enhancement.

[5]http: //deutsche-boerse.com/dbag/dispatch/de/binary/gdb_content_pool/imported_files/public_files/10_downloads /33_going_being_public/10_products/020_designated_sponsors/special_befragung_ds_15_8_03.pdf/.

[6]Unfortunately, we have no disaggregate information on the companies and thus cannot link the responses to characteristics of the firms.

[7]However, quite extensive research on the role of NYSE specialists or designated market makers in other systems already exists. Compare e.g. Venkataraman and Waisburd (2006) for the Paris Bourse, citing relevant theoretical literature as well as many relevant empirical studies particularly for the New York Stock Exchange.

benefits are related to the specific market segment. Finally, there are very few studies like ours focusing on determinants of the spread for "thinly-traded" shares.[8] In addressing our questions of interest, we proceed as follows: Section 2 contains the institutional background, introducing the concept of designated sponsors, the market structure and the data set. Sections 3 and 4 present the empirical analysis: Section 3 introduces several spread measures and employs a cross-sectional framework in order to gain first insights into the influence of designated sponsors on liquidity. Section 4 develops a trade-indicator model and uses obtained results in order to assess which parts of the spread are particularly influenced by the sponsors. Section 5 concludes.

2 Institutional Background

2.1 Designated Sponsors

Designated sponsors are specialists acting on the German electronic trading platform Xetra. Their main obligation is to provide liquidity and thus to enhance market quality in times of temporary imbalances on the stock market. Designated sponsors are obligatory for companies with insufficient liquidity (like stocks from the small cap market segment). Apparently, these stocks are often susceptible to high fluctuations of market prices. In order to smooth prices and to bridge temporary imbalances in order flow, designated sponsors were introduced on the market. In 2002, issuers on the Neuer Markt or stocks of the selection index SMAX were obliged to denominate at least two/one designated sponsor(s).[9]

Designated sponsors assure higher liquidity by quoting binding bid and ask prices. They have to participate in auctions and volatility interruptions. Shortly after the call phase has been initiated, they are obliged to enter a quote into the order book. Until prices have been determined, they must perpetuate the quote. In addition to that, designated

[8] Nimalendran and Petrella (2002) are an exception.

[9] The rule for a 'Designated Sponsor Requirement' of Deutsche Börse changed in 2003, but this change has no impact on our current study since our data refer to the year 2002.

sponsors have to immediately state effective quotes upon request. If a designated sponsor receives an electronic request, he must reply within a specified time period by placing a quote. Entering the request, the Xetra member can announce the number of equities he is willing to buy or sell. The market then will be informed about the quote request.
By giving binding bid and ask prices, designated sponsors provide a continuous pricing of demand and supply. Placed orders are more likely to be executed and investors can buy and sell at fair prices. This is obviously in the interest of investors. Designated sponsors are thus expected to be particularly beneficial for less liquid shares which do not enjoy a great market popularity. Since their main objective is to provide liquidity and thereby to prevent imbalances of order flow, trading partners for less liquid stocks can be found more easily. Designated sponsors benefit from certain privileges like reduced exchange fees. Moreover, they alone have access to some additional information given in a quote request (the identity of a quote requesting trader) which might be quite beneficial.
In general, all credit institutions, brokers or securities trading houses accepted for trading in Xetra, can apply for admission as designated sponsor. Designated sponsors are mainly financial service providers or credit institutions. Due to the fact that they continuously watch the market, designated sponsors gain expertise. They might use this information to offer services to their clients besides their function as liquidity suppliers. They could support or advice the company in areas like 'research', 'sales', 'market reports',' publicity' or 'investor relations'. One could expect the shareholder value of the respective company to increase. In the same way, designated sponsors might raise market transparency by gathering information on the respective company.

2.2 Market Structure

Xetra is a fully electronic trading system for the cash market of Deutsche Börse AG. Xetra was introduced in November 1997 at Frankfurter Wertpapierbörse FWB (Frankfurt Stock Exchange) replacing the former IBIS-system (Integriertes Börsenhandels- und Informa-

tionssystem). Advantages of electronic trading systems such as low transaction costs, more transparency, market-driven prices or the anonymity of trading partners should be realised by the introduction of Xetra. More than 90 percent of equity trading on German stock exchanges are conducted on the trading platform Xetra.

Equities on the order-driven platform Xetra can be traded in only auctions or continuously. Continuous trading is initiated with an opening auction and closes with an end-of-day auction or a closing auction. It can be interrupted by intra-day auctions. During the time of the call auction, the order book is partially closed. Trading on Xetra takes place from 9.00 a.m. till 8.00 p.m. The opening auction starts at 8.50 a.m. while the closing auction begins at 8.00 p.m.[10] The platform enables trading independently of the traders' current location. Buy and sell orders are matched in one fully electronic order book. As soon as an appropriate offer has been made, orders are executed during times of continuous trading.[11]

2.3 Data

We use Xetra data of bid, ask and transaction prices from 05/2002 to 07/2002 to compute spreads from the data.[12] Bid, ask and transaction prices occur time-ordered. The sample consists of stocks listed in MDAX, NEMAX, SMAX or the Regulated Market. We deleted all stocks trading less than 50 times within the sample period and for the subsequent trade-indicator model, we deleted all stocks containing less than 250 observations in order to assure having enough observations for model estimation. We also excluded penny stocks and stocks with a value of less than 2 Euro. After deleting the stocks, our sample consists of 183 stocks for the first estimation and of 119 stocks for the remaining analysis. Prices determined during intra-day call auctions, opening and closing auctions were omitted. An indication whether the trade was buyer- or seller-initiated was not included in the data.

[10] Note that trading hours were changed in 2003.
[11] Information is obtained from Deutsche Börse's official website http://www.deutsche-boerse.com.
[12] The data was supplied by Deutsche Börse AG.

We therefore used the trade classification algorithm of Lee and Ready (1991).[13] We also pooled trades which occurred within the same second to account for volume related effects and then calculated volume weighted transaction prices.

3 Methodology and Results I: Spread Measures

Literature in the field of market microstructure has proposed a variety of methods to estimate the spread and to decompose it into its components. Our empirical strategy is three-fold: In a first stage, we estimate quoted and effective half spreads by means of a cross-sectional regression in order to provide evidence on whether or not the existence of designated sponsors c.p. enhances liquidity for stocks traded in Xetra.[14] In a second stage, we use a trade-indicator model as proposed by Glosten and Harris (1988) to further decompose the spread. In a third stage, we employ empirical estimates of the spread components to assess whether the existence of designated sponsors rather decreases the transaction cost component or the adverse selection cost component of the spread.

3.1 Quoted and Effective Spreads

The quoted spread is the difference between the best quoted ask and the best quoted bid price. This measure can be interpreted as the costs of trading a round-trip. Since we want to measure the costs of trading per trade, we calculate quoted half spreads. The definition of the quoted half spread is given by

$$S_t^{quoted} = \frac{a_t - b_t}{2}, \tag{1}$$

[13]The trade classification algorithm by Lee and Ready identifies transactions as buy and sell orders by comparing the transaction price to the quoted bid and ask prices. A transaction is then buyer-initiated if it is closer to the ask price of the prevailing quote and vice versa. If the transaction occurs exactly at the midpoint of the quote, a "tick test" is implemented. In case the last price change prior to the transaction is positive (negative), the transaction is categorised as buyer-/seller-initiated.

[14]For empirical cross-sectional evidence on determinants of the spread, cf. related literature of e.g. Stoll (2000), Corwin (1999), Cao, Choe and Hatheway (1997) or Madhavan (2000).

Table 1: Descriptive Statistics: Average Quoted Half Spreads

	Quoted Half Spread	In Percent	Smallest	Largest	Observations
MDAX	0.1323	0.5461	0.0221	0.4982	66
NEMAX	0.0711	0.7473	0.0143	0.2902	40
SMAX	0.2242	1.7174	0.0515	0.7345	41
OTHERS	0.1474	3.3703	0.0337	0.4934	37

Explanations: OTHERS: Stocks trading on the Regulated Market.

where a_t is the best quoted ask price and b_t is the best quoted bid price. Table 1 reports the average quoted half spreads for a sample of 183 stocks taken from the Regulated Market and from different German indices (MDAX, SMAX, NEMAX).

Expectedly indices containing less liquid stocks or rather small caps such as the SMAX or the Regulated Market report a high average half spread. The SMAX has a relatively high half percentage spread (1.7174) compared to the one of the selection index MDAX (0.5461).[15] The average quoted spread ranges from 0.0711 cents for more liquid stocks to 0.2242 for small caps.

The effective half spread measures the difference between the trade price and the time-of-trade quotation midpoint. It is also called the liquidity premium. The effective half spread is defined as follows:

$$S_t^{effective} = |P_t - M_t|, \tag{2}$$

where P_t is the transaction price at time t and $M_t = \frac{a_t - b_t}{2}$ is the time-of-trade transaction midpoint. The effective half spread is measured only at times when transactions take place, contrary to the quoted spread. The effective spread and the quoted spread are equal for trades in case all purchases occur at the quoted bid price and all sales occur at the quoted ask price. Due to the fact that trades rather occur when spreads are relatively

[15] Tests for mean equality are rejected at the 1% level of significance.

Table 2: Descriptive Statistics: Average Effective Half Spreads

	Effective Half Spread	In Percent	Smallest	Largest	Observations
MDAX	0.0882	0.3728	0.0110	0.3045	66
NEMAX	0.0556	0.5954	0.0103	0.2052	40
SMAX	0.1710	1.3357	0.375	0.4734	41
OTHERS	0.1091	2.4455	0.2610	0.3739	37

Explanations: OTHERS: Stocks trading on the Regulated Market.

tight, the effective spread might be smaller than the quoted spread.[16] The results for the average effective half spreads are summarized in Table 2.[17]

The intuition behind the results of the effective half spread is in the same manner as for the quoted spread. Indices containing less liquid stocks report a relatively high average effective half spread in contrast to indices with more liquid stocks. For all stocks, the average effective half spread is smaller than the average quoted half spread. This is because the effective spread allows for price improvements. On average the effective half spread can be obtained by multiplying the quoted half spread with 0.7379.

3.2 Cross-sectional Regression Results

Before we determine and analyse the spreads' single components, we use a simple cross-sectional regression framework to test which factors might influence the bid-ask spread. Factors that can be expected to influence the spread from the literature are the market capitalisation of a firm, the standard deviation of returns and variables that signal to which index the stock belongs to. Since our study turns special attention to the role of designated sponsors in Xetra, we construct binary variables standing for certain numbers of sponsors a stock holds. Our intention is to test whether the existence of designated

[16]The effective spread can be smaller than the quoted spread for another reason which is not applicable to Xetra since all orders are matched in Xetra at quoted bid and ask prices: If price improvements can be arranged by trading inside the quotes, the effective spread is smaller than the quoted. The opposite case should be taken into consideration as well. If large orders trade at prices outside the spread, the effective exceeds the quoted spread. Huang and Stoll (1996) argue that the effective spread is consequently a better measure of execution costs than the quoted spread. Quoted prices are rather "starting points for negotiation" than prices at which transactions actually take place.

[17]As in the case for quoted spread, tests for mean equality of percentage spreads are rejected at the 1% level of significance.

sponsors enhances liquidity and thus decreases the bid-ask spread. We then estimate:

$$S_t^{quoted} = \alpha_0 + \alpha_1 SD + \alpha_2 \mathbf{1}_{ds2-3} + \alpha_3 \mathbf{1}_{ds4-7} + \alpha_4 LOGMARKETCAP$$

$$+\alpha_5 SDAX + \alpha_6 NEMAX + \alpha_7 MDAX, \tag{3}$$

$$S_t^{effective} = \beta_0 + \beta_1 SD + \beta_2 \mathbf{1}_{ds2-3} + \beta_3 \mathbf{1}_{ds4-7} + \beta_4 LOGMARKETCAP$$

$$+\beta_5 SDAX + \beta_6 NEMAX + \beta_7 MDAX, \tag{4}$$

where

SD=Average daily return standard deviation for three-month-period prior to May 1, 2002;

$\mathbf{1}_{ds2-3}$=Dummy variable that takes on a value of one if the stock holds two or three designated sponsors and zero otherwise;

$\mathbf{1}_{ds4-7}$=Dummy variable that takes on a value of one if the stock holds four, five, six or seven designated sponsors and zero otherwise;

$LOGMARKETCAP$=Logarithmised market capitalisation;

$SMAX$=Dummy variable that takes on a value of one if the stock belongs to the selection index SMAX and zero otherwise;

$NEMAX$=Dummy variable that takes on a value of one if the stock belongs to the selection index NEMAX and zero otherwise;

$MDAX$=Dummy variable that takes on a value of one if the stock belongs to the selection index MDAX and zero otherwise.

The regression results for the quoted and the effective half spread are contained in Tables 3 and 4. The coefficients of both dummy variables (indicating the number of designated sponsors a stock has) are negative and significant. This finding provides evidence that designated sponsors are liquidity enhancing and thus decrease the bid-ask spread. Sur-

prisingly, the existence of fewer (two or three) designated sponsors has a higher impact on the spread than a larger number (four, five, six or seven). As expected the relation between the quoted half spread/effective half spread and the logarithmised market capitalisation is negative. We supposed the selection index variables to have a lower impact on the spread if the stock refers to an index containing less liquid stocks and vice versa. The dummy variables of NEMAX, SMAX and MDAX are all significant and negative. Our assumptions concerning these variables were approved. The coefficient of the NEMAX dummy variable has a higher absolute value than the one of the SMAX dummy. Contrary to expectations, the coefficient for the remaining variable, the average daily return standard deviation, is insignificant.

[Insert Tables 3 and 4 about here]

For the quoted and effective half spread regressions we applied the Heteroskedasticity Consistent Covariance Estimator of White (1980).

[Insert Table 5 about here]

So far we tested which factors might influence the bid-ask spread. The analysis of both the effective and quoted half spread provides evidence that designated sponsors enhance market liquidity. We also measured the impact of the different selection index variables on the spread. We are now interested in testing whether the designated sponsors' impact on the spread varies with its index membership. We hypothesise:

> *The more liquid the stocks of the designated sponsors' associated index are, the lower will be the designated sponsors' impact on the bid-ask spread and vice versa.*[18]

We construct the following regression estimations for the quoted and effective half spread:

[18]The spread is assumed to decrease in both cases.

$$S_t^{quoted} = \gamma_0 + \gamma_1 MIN.DS * SMAX + \gamma_2 MIN.DS * NEMAX$$

$$+\gamma_3 MIN.DS * MDAX + \gamma_4 SMAX + \gamma_5 NEMAX + \gamma_6 MDAX, \quad (5)$$

$$S_t^{effective} = \lambda_0 + \lambda_1 MIN.DS * SMAX + \lambda_2 MIN.DS * NEMAX$$

$$+\lambda_3 MIN.DS * MDAX + \lambda_4 SMAX + \lambda_5 NEMAX + \lambda_6 MDAX, \quad (6)$$

where $MIN.DS$ is a dummy variable that takes on a value of one if the stock holds more designated sponsors than its index is obliged to denominate and zero otherwise. Table 6 and 7 report the results of our estimation.

[Insert Tables 6 and 7 about here]

The regression results corroborate our hypothesis. The coefficients for MIN.DS*SMAX and MIN.DS*NEMAX have negative signs and are statistically significant for both spread measures. Thus there is a negative relation between these two variables and the spread. The result shows that the designated sponsors' impact on the spread varies with its index membership.[19] Being a designated sponsor for the SMAX implies a higher influence on the bid-ask spread than comparatively being a designated sponsor for the NEMAX. The coefficient for MIN.DS*MDAX is insignificant and positive and provides no additional explanatory information for the spread.[20] The interpretation of the results for the selection index variables remains the same. The selection index variables have a lower impact on the spread if the stock refers to an index containing less liquid stocks and vice versa.

[19] We also used the Heteroskedasticity Consistent Coefficient Covariance Estimator of White (1980) to correct the corresponding standard errors.

[20] In order to test for robustness of results, we re-estimate the equation including the significant variable $LOGMARKETCAP$ from the former regressions. Results remain qualitatively unchanged.

4 Methodology and Results II: Trade-Indicator Model

Having observed that the existence of designated sponsors decreases both quoted and effective half spreads for the shares in our sample, we now proceed to analyse which particular component of the spread they influence by means of a trade indicator model. As the name suggests, trade indicator models employ binary variables indicating the direction of a trade to decompose the spread into its components and to model short-run price dynamics. Trade indicator models have been proposed by e.g. Glosten and Harris (1988), Huang and Stoll (1997) and Madhavan, Richardson and Roomans (1997) and typically divide the spread into an order processing component, an inventory component and/or an adverse selection component.[21] Like Cao, Choe and Hatheway (1997) or Theissen and Grammig (2005), we opt for the Glosten-Harris approach which enables us to incorporate trade size as an explanatory variable and singles out the adverse selection component which we regard as particularly interesting.[22]

In particular, let Q_t be a trade indicator variable where $Q_t = 1$ if the transaction at time t is buyer-initiated and $Q_t = -1$ if it is seller-initiated. Furthermore, let μ_t stand for the post-trade expectation of the "true" value of the stock conditional on public information and on the information revealed by the trade initiation variable. The innovation in beliefs between $t-1$ and t due to semination of public information is denoted by ϵ_t. We assume

[21] The different components relate to theoretic literature on determinants of the spread. Literature starting with Roll (1984) has shown that the existence of order-processing costs such as labour or telecommunication costs induces a bid-ask bounce since those costs are either added to or subtracted from the underlying value of the asset for each buy or sell order. Literature dealing with the inventory component as e.g. Garman (1976), Stoll (1978) or Ho and Stoll (1981) has identified the possibility of a spread arising when risk-averse dealers have to be compensated for taking the (diversifiable) risk of bearing an unwanted inventory position. With respect to the adverse selection component, literature as Bagehot (1971), Copeland and Galai (1983) or Glosten and Milgrom (1985) focuses on the adverse selection exposure of market makers who are posting quotes in the presence of informed as well as uninformed traders. It can be shown that even in markets without explicit transaction costs, with perfect competition and risk-neutral dealers, a spread emerges to compensate the market makers for losses to informed traders.

[22] Alternatively, we could use the concept of realized spreads which is independent of model choice in order to determine whether or not designated sponsors decrease adverse selection costs in shares they trade in.

that μ_t evolves according to

$$\mu_t = \mu_{t-1} + Z_t Q_t + \epsilon_t, \tag{7}$$

where Z_t is the adverse selection component of the spread and measures the sensitivity of the post-trade expected value to the information revealed by the trade direction.[23] Furthermore, we assume that the price generating process is determined from the unobserved process above by adjusting for the costs C_t of providing liquidity services (i.e. order processing and inventory costs):

$$p_t = \mu_t + C_t Q_t + e_t = \mu_{t-1} + Z_t Q_t + C_t Q_t + \epsilon_t + e_t, \tag{8}$$

viz the sum of the asymmetric information and the transitory component, is simply the half spread. e_t is white noise and captures possible rounding errors. The bid and ask prices p_t^a and p_t^b quoted by the market maker at time t are conditional on the direction of the trade:

$$\begin{aligned} p_t^a &= \mu_t + C_t + e_t \quad \text{if } Q_t = 1, \\ p_t^b &= \mu_t - C_t + e_t \quad \text{if } Q_t = -1. \end{aligned}$$

Consequently, a market participant buys at the ask price and sells at the bid price. First-differencing equation (8), the price change is given by:

$$\begin{aligned} \Delta p_t &= \Delta\mu_t + C_t Q_t - C_{t-1} Q_{t-1} + e_t - e_{t-1}, \\ &= Z_t Q_t + C_t Q_t - C_{t-1} Q_{t-1} + \nu_t, \end{aligned} \tag{9}$$

$$\text{where } \nu_t = \epsilon_t + e_t - e_{t-1}.$$

[23] We subsequently employ the terms adverse selection component, asymmetric information component and permanent component identically.

4.1 Application of Glosten-Harris Model

We now proceed to estimate equation (9) from the data. For several reasons we want to include volume as an explanatory variable into our regressions. Apart from the saying "*it takes volume to move prices*", one can imagine that the transitory component of the spread might decrease in volume due to economies of scale or the like. Furthermore, with regard to the asymmetric information component, one may argue that informed traders will rather trade large volumes in order to exploit their informational advantages.[24] Thus, we include trading volume and postulate a linear form of both the adverse selection component and the transitory component in trading volume Vol_t:[25]

$$Z_t = z_0 + z_1 \cdot Vol_t,$$

$$C_t = c_0 + c_1 \cdot Vol_t.$$

Inserting these specifications into equation (9), we obtain:

$$\begin{aligned} \Delta p_t &= (z_0 + z_1 \cdot Vol_t)Q_t + (c_0 + c_1 \cdot Vol_t)Q_t - (c_0 + c_1 \cdot Vol_{t-1})Q_{t-1} + \nu_t, \\ &= c_0 \Delta Q_t + c_1 \Delta(Q_t Vol_t) + z_0 Q_t + z_1 Q_t Vol_t + \nu_t, \qquad (10) \\ &\text{where } \Delta X_t = X_t - X_{t-1}. \end{aligned}$$

When applying equation (10) to the data, we would expect to observe a positive sign for c_0 since some of the order-processing costs can be assumed to arise independently of trade size. If we allow for the existence of economies of scale, transaction costs will decrease in volume. Inventory costs, however, increase in trading volume such that the sign for c_1 depends on the relative magnitude of each factor. With respect to the adverse-selection component, we clearly expect related costs to increase in trade size, implying a positive z_1. Finally, the constant z_0 should rather be positive in sign since otherwise the possibility

[24] However, literature as Easley and O'Hara (1987) shows that it might be worth wile for them to transact small volumes as well.

[25] One might as well employ the logarithm or the square root of trading volume. However, both measures seem as ad hoc as a linear specification and suffer from the problem of inducing high multi-collinearity between the regressors.

of "adverse-selection benefits" would arise for low trading volumes.

When estimating the Glosten-Harris model, one has to be cautious with respect to the error term ν_t. By construction, it is serially correlated and hence, standard OLS t-statistics are not reliable. We employ Newey-West HAC standard errors to account for this problem.[26] Another issue with respect to the regressors arises since our data does not indicate whether a particular transaction has been triggered by a buy or a sell order. Fortunately, we can apply the widely-used algorithm as proposed by Lee and Ready (1991) which has been explained above in order to infer the trade direction from the data. However, as has been noted, applying the Lee/Ready algorithm imposes the danger of misspecifying the trade direction which in turn might deteriorate the quality of obtained results.

An overview of results from estimating equation (10) is provided in Tables 8 and 9. Overall, the results confirm our expectations. For the vast majority of stocks, coefficients show the expected signs and are statistically significant: As expected, we find that there exists some part of the transitory spread component $\hat{c}_0$ being independent of trade size. From the negative sign of $\hat{c}_1$ we infer that there exist economies of scale in transacting shares which outweigh possible volume-related effects stemming from inventory management. With respect to the permanent component, it appears that there are parts of asymmetric information costs $\hat{z}_0$ which are not influenced by the trading volume, while other parts ($\hat{z}_1$) clearly increase in trading volume as is predicted by the theory. Table 8 shows exemplary estimation results for seven shares of each market segment.[27] It can be observed that estimates fluctuate across stocks, however, in nearly all cases the numerical magnitude of $\hat{c}_0$ is the highest, followed by $\hat{z}_0$ and the volume-related components. As can be further seen, the model fits particularly well for the more liquid stocks from the NEMAX and MDAX market segment where significance levels often exceed 1%. For shares listed in the small cap market segment and the regulated market, the model has difficulties in

[26] Alternatively, one might estimate the model via Generalized Method of Moments. Results are very similar and thus not reported here.

[27] We choose firms in alphabetical order.

finding a significant influence of trading volume, especially with regard to the asymmetric information component. We attribute these findings at least partly to the low number of observations for these shares and the low variation in trading volume. Regarding Table 9, we observe that signs are as expected in almost all cases. Overall, we suggest that the advantages of the Glosten-Harris model of incorporating trading volume rather pay out for stocks not traded too infrequently.

[Insert Tables 8 and 9 about here]

Additionally, since we only allow stocks to the estimation for which we have at least 250 observations available in our 3-months sample period, we lose about 3/4 of the observations in the SMAX segment and markedly more for the shares not listed in either of the indices. Thus, if we want to determine whether designated sponsors exert an influence on the adverse selection component of the spread for a larger percentage of shares, further research might use the concept of realized spreads in order to answer this question as well for the least actively traded stocks.

Like Glosten and Harris (1988), Cao, Choe and Hatheway (1997) and Theissen and Grammig (2005), we find that the transitory component of the spread is markedly larger than the permanent component which indicates that this property might not be related to the specific structure of the exchange under examination. Finally, if evaluated at average volume, we find that the estimated spread $\hat{c}_0 + \hat{c}_1 \cdot \overline{Vol} + \hat{z}_0 + \hat{z}_1 \cdot \overline{Vol}$ underestimates the percentage effective half spread as computed from the data by about one third. However, the correlation between both measures lies at 97.4%, hence we have some reason to believe that estimates are not systematically biased and proceed to use them for the further analysis without worrying.

4.2 Decomposition of the Influence of Designated Sponsors

Having applied the Glosten-Harris model to the data, we can now employ the obtained estimates in order to assess whether designated sponsors are found to influence the transitory part of the spread (being unrelated to the underlying value), the adverse selection component, or both parts. The empirical strategy is similar to the first cross-sectional approach undertaken: We regress the Glosten-Harris estimates of the spread (evaluated at average volume) on a number of cross-sectional regressors which should influence the respective component and on the number of designated sponsors. Since our sample contains very few shares that trade without a designated sponsor, we again employ three binary variables indicating the number of sponsors for each share and use them for the regressions instead of creating one single indicator for the existence of designated sponsors. We provide some intuition of why we expect shares trading with a designated sponsors to c.p. exhibit lower spreads than other shares when discussing the distinct equations below and let the data decide on whether or not the influence is significant.

In our approach, we proceed similar to Glosten and Harris (1988) and specify a multivariate system when testing for effects since we want to allow for possible endogeneity of trading volume and the magnitude of the spread. Overall, we estimate three equations: the first equation regresses the transitory component estimate on standard cross-sectional regressors as well as on the number of designated sponsors. The second equation performs the analogous exercise for the asymmetric information component. The third equation captures possible endogeneity and regresses daily trading volume among other variables on the magnitude of the spread. Next to the main question of interest, results might serve as a check for the quality of estimated components from the Glosten-Harris model: If theoretical predictions for the transitory or the permanent spread component are clearly rejected by the application, one should call results (or theory) into question.

As was noted before, the transitory component encomprises order processing and inventory costs. Thus, when specifying determinants of the transitory components, we identify

variables that can be linked to those concepts. Inventory-theoretic literature as Stoll (1978) and Ho and Stoll (1981) introduces risk-averse market makers who must be compensated for bearing the risk of unwanted inventory positions by means of the spread. The higher the security risk and the lower the liquidity of the assets, the higher the transitory component should be.[28] Additionally, since we suggested that order processing costs might decrease in trading volume, we employ the log of average daily trading volume as a measure of liquidity including both trade frequency (employed by Glosten and Harris) and average trading volume per transaction. We test for an influence of designated sponsors by including binary dummy variables for having 2 or 3, or 4 to 7 sponsors trading in the respective asset.[29] With respect to the sign of these variables, at least two mechanisms suggest that the existence of designated market makers decreases transaction costs: First, since these market makers receive cost reductions when trading, the transitory component might decrease if this advantage is passed on to other market participants. Second, the implementation of sponsors increases competition which might force prices closer to the underlying value and thus narrow the spread. The first equation for our system is given by:

$$s^{Trans}/P = \alpha_0 + \alpha_1 \cdot SD + \alpha_2 \cdot volume^d + \alpha_3 \cdot \mathbf{1}_{ds2-3} + \alpha_4 \cdot \mathbf{1}_{ds4-7} + u, \qquad (11)$$

where s^{Trans} denotes the estimated transitory component of the Glosten-Harris model, evaluated at average trade size. Since we are interested in the magnitude of the spread components in relative terms, we divide the regressand by the average price level P. SD denotes the daily standard deviation, measured as an average over the three months prior to the estimation period. $volume^d$ denotes the natural logarithm of average daily trading volume, computed as the average number of shares transacted times the average number of transactions per day.[30]

For the second equation of the percentage adverse selection component of the spread,

[28] Compare Glosten and Harris (1988), pp. 137.

[29] Hence, results can be interpeted relatively to the case of a share trading with 0 or 1 designate sponsors.

[30] Checking pairwise correlations, we do not find a multicollinearity problem by employing the average trading volume both in the regressand and one explanatory variable.

s^{Adv}/P, we refer to literature as Copeland and Galai (1983), Glosten and Milgrom (1985) or Easley and O'Hara (1987) assuming that both informed and liquidity investors trade in the market. Since we assume that a higher share of informed traders in the market increases adverse selection problems for the rest of the market, we want to include a proxy for informed trading activity. Like Glosten and Harris, we employ the measure of "insider ownership concentration" ratio IC, defined as the proportion of shares owned by either members of the management or supervisory board, their families or holdings where one of the mentioned persons is a board member.[31] Similarly, the adverse selection component should be a function of liquidity trade frequency. As it seems reasonable that firms with a large market capitalization (resp. a large number of shares outstanding) possess c.p. more liquidity traders than smaller firms (since the probability that a trade is liquidity-initiated increases), we include the ratio of log market capitalization of the firm over the average price level, $marketcap/P$, as a proxy. Additionally, we employ the estimate of the transitory component of the spread as a regressor in order to capture the idea that with high transaction costs, the probability of informed trades relative to liquidity trades increases. Finally, we employ the daily standard deviation of returns since the adverse selection cost is essentially a cost arising from ongoing revisions in the expected value of a share. Consequently, for shares with very stable prices (and thus low volatility), we would expect lower adverse selection costs relative to shares with a high standard deviation. Indicator variables for designated sponsors are added as above. Since the designated sponsor gains expertise on the share during his activities (e.g. by learning the identity of an investor requesting a quote or by engaging in research or advisory for the firm), the existence of one or more designated sponsors might as well decrease the adverse selection component of the spread. Additionally, as pointed out in Glosten and Milgrom (1985), relating to the "lemons" problem, designated sponsors might hold the market when it would otherwise break down because of asymmetric information. The

[31] Compare Glosten and Harris (1988), p. 138.

second equation is given by:

$$s^{Adv}/P = \beta_0 + \beta_1 \cdot IC + \beta_2 \cdot marketcap/P + \beta_3 \cdot s^{Trans}/P + \beta_4 \cdot SD + \beta_5 \cdot \mathbf{1}_{ds2-3} + \beta_6 \cdot \mathbf{1}_{ds4-7} + v. \quad (12)$$

The third equation relates the logarithm of average number of trades per day to the estimated percentage spread, evaluated at the average trading volume: $spread = (\hat{c}_0 + \hat{c}_1 \cdot \overline{Vol} + \hat{z}_0 + \hat{z}_1 \cdot \overline{Vol})/P$. If the coefficient is significant and positive, we have reason to believe that the average number of trades per day is influenced by the spread and not only vice versa. Additionally, we include the liquidity measure introduced above, $marketcap/P$ since it is natural to assume that a higher market capitalization (resp. a higher number of shares outstanding) should increase the number of shares traded:

$$volume^d = \gamma_0 + \gamma_1 \cdot spread + \gamma_2 \cdot marketcap/P + w. \quad (13)$$

In order to estimate this system, we cannot use OLS since we would otherwise obtain inefficient estimates. Thus we have to apply a different approach and choose the Three Stage Least Squares procedure as proposed by Zellner and Theil (1962), circumventing problems related to heteroskedasticity or contemporaneously related error terms. However, with respect to the small sample size of 119 observations, we rather opt for a qualitative interpretation of results and mainly focus on obtained signs of the estimates.

Results are depicted in Table 10: In spite of the small sample size, we are rather satisfied with the results. Each coefficient bears the expected sign, suggesting that the components of the spread as identified by the Glosten-Harris model are indeed influenced by the theoretically proposed determinants. With respect to the equation for the transitory component, we find highly significant estimates at a level of 1% for both standard deviation and daily trading volume. As expected, higher risk in form of a higher standard deviation of returns induces higher transitory costs. Similarly, the transitory component of

the spread in percentage terms is seen to decrease in trading volume which is in line with former predictions. Considering binary variables for the existence of designated sponsors, we find that trading with more than 1 designated sponsor reduces the order processing and inventory cost component of the spread. However, only having more than 3 designated sponsors significantly reduces the spread estimate at a level of 7%. We interpret our findings as an indication that the existence of sponsors can serve to decrease transaction costs and thus improve liquidity for stocks traded in Xetra.

With respect to the second equation for the adverse selection component, the variance of the dependent variable can highly significantly be explained by the variance of the transitory component of the spread. Considering pairwise correlations of over 80% for both components, this result does not come as a surprise. None of the other variables is able to add any explanatory power to the equation due to the relative power of the first regressor. However, signs are as expected: A higher number of insiders decreases the adverse selection spread whereas higher liquidity decreases the spread. Signs for the number of designated sponsors are negative as well, but we cannot reject the null hypothesis of no influence on the asymmetric information component.

Considering the last equation, a larger estimated spread significantly reduces the number of shares transacted within a trading day at a level of 9%. This finding suggests that it is indeed useful to estimate the system with a multi-stage routine like 3SLS since it indicates endogeneity of trading volume and the spread. Finally, trading volume increases in liquidity of the firm (approximated by the log of market capitalization over the average price level and thus by a measure similar to the number of shares outstanding) at a level of 1% which is very intuitive.

[Insert Table 10 about here]

Overall, while we acknowledge that it is certainly wise to estimate the system with a larger number of observations and while we avoid a numerical interpretation of results,

it seems that the Glosten-Harris model fits our sample rather well. With regard to our main question of interest, namely the influence of designated sponsors on the transitory or asymmetric information component of the spread, we conclude that there is evidence suggesting an influence on the transitory component, but we cannot reject the null hypothesis of no influence on asymmetric information costs.

5 Conclusions

In our previous analysis we applied a three-step procedure to determine the single components and influence variables of the bid ask spread. Since our study turns special attention to the role of designated sponsors in Xetra we tested if designated sponsors are liquidity enhancing and thus decrease the bid-ask spread. We first presented two simple regressions to test for factors influencing the spread. We analysed the average quoted as well as the average effective half spread. The impact of designated sponsors (concerning their number and existence per stock) and of additional variables on the spread were measured. In a second regression, we particularly tested whether the designated sponsors' impact on the spread varies with its index membership. We found out that the existence of designated sponsors decreases the spread. We further showed that the designated sponsors' influence on the spread will be comparatively higher if the stocks of the Designated Sponsors' associated index are less liquid. We also found evidence to the contrarian case. In a next step we employed a trade indicator model in order to decompose the spread into its single components. The spread was divided into the adverse selection and the transitory component. We opted for the Glosten and Harris (1988) approach which incorporates trade size as an explanatory variable. It turned out that the advantage of the Glosten-Harris model - incorporating trading volume - rather pays out for more liquid stocks. In a final step, we discussed the estimated spread components assessing whether, besides other explanatory variables, the designated sponsors significantly influence the transitory

or adverse selection spread component. We found evidence suggesting an influence of designated sponsors on the transitory component, but that there is no evidence in favor of a decrease of asymmetric information costs.

In summary, it turned out that designated sponsors are liquidity enhancing and particularly advantageous for less liquid stocks. For these stocks, the trade indicator model had difficulties to find a significant influence of trading volume especially for the asymmetric information spread component. Thus, the model could not provide an appropriate measure of the designated sponsors' influence on the asymmetric selection component. For future research, it might be interesting to employ the concept of realized spreads to answer the question. Furthermore, other variables such as the Designated Sponsors' performance rating might be included into the analysis to determine more precisely the designated sponsors' impact on the bid-ask spread.

A Tables and Figures

Table 3: Regression results of the quoted half spread in percent

Variable	Coefficient	Std. Error	t-Statistic
Constant	9.5694	1.7666	5.4169 (0.0000)
SD	3.0111	6.6096	0.4556 (0.6493)
DS23	-0.7575	0.3710	-2.0418 (0.0427)
DS4567	-0.6697	0.2916	-2.2968 (0.0228)
LOG M.C.	-0.3414	0.0732	-4.6652 (0.0000)
SMAX	-1.4358	0.5042	-2.8475 (0.0049)
MDAX	-1.4434	0.3509	-4.1139 (0.0001)
NEMAX	-1.6852	0.2859	-5.8942 (0.0000)
Adjusted $R^2 = 0.5203$			

Explanations: The probability values for the test statistics are parenthesised.

Table 4: Regression results of the effective half spread in percent

Variable	Coefficient	Std. Error	t-Statistic
Constant	6.9461	1.3981	4.9684 (0.0000)
SD	1.2174	5.3388	0.2280 (0.8199)
DS23	-0.4485	0.2804	-1.5995 (0.1115)
DS4567	-0.3721	0.2126	-1.7504 (0.0818)
LOG M.C.	-0.2493	0.0578	-4.3081 (0.0000)
SMAX	-0.9358	0.4004	-2.3374 (0.0206)
NEMAX	-1.2078	0.2069	-5.8365 (0.0000)
MDAX	-1.1222	0.2729	-4.1124 (0.0001)
Adjusted $R^2 = 0.4811$			

Explanations: The probability values for the test statistics are parenthesised.

Table 5: White's Heteroskedasticity test results

	Quoted half spread	Effective half spread
White Heteroskedasticity Test	15.7222 (0.0729)	12.8274 (0.1706)

Explanations: The probability values for the test statistics are parenthesised. We used White's Heteroskedasticity Test (no cross terms) implemented in Eviews.

Table 6: Regression results of the quoted half spread in percent

Variable	Coefficient	Std. Error	t-Statistic
Constant	3.4184	0.4057	8.4250 (0.0000)
MIN.DS*SMAX	-0.7972	0.2811	-2.8356 (0.0051)
MIN.DS*NEMAX	-0.2634	0.1324	-1.9894 (0.0482)
MIN.DS*MDAX	0.0662	0.1966	0.3367 (0.7367)
NEMAX	-2.4145	0.4234	-5.7026 (0.0000)
SMAX	-1.4482	0.4846	0.0032 (0.0000)
MDAX	-2.9354	0.4487	-6.5418 (0.0000)
Adjusted $R^2 = 0.4293$			

Explanations: The probability values for the test statistics are parenthesised.

Table 7: Regression results of the effective half spread in percent

Variable	Coefficient	Std. Error	t-Statistic
Constant	2.4786	0.2970	8.3466 (0.0000)
MIN.DS*SMAX	-0.5685	0.2425	-2.3441 (0.0202)
MIN.DS*NEMAX	-0.2125	0.1369	-1.5519 (0.1225)
MIN.DS*MDAX	0.0377	0.1256	0.3004 (0.7643)
NEMAX	-1.6756	0.3240	-5.1718 (0.0000)
SMAX	-0.9626	0.3758	-2.5615 (0.0113)
MDAX	-2.1418	0.3210	-6.6715 (0.0000)
Adjusted $R^2 = 0.4092$			

Explanations: The probability values for the test statistics are parenthesised.

Table 8: Estimates of Glosten-Harris model for stocks traded in Xetra

Stock	$\hat{c}_0$	t	$\hat{c}_1$	t	$\hat{z}_0$	t	$\hat{z}_1$	t	Obs	$\overline{R}^2$
NEMAX										
ADV	0.010***	20.8	-5.0E-07**	-2.1	0.003***	9.6	5.2E-07**	2.2	3,636	0.36
AIX	0.017***	48.8	-1.1E-06***	-4.2	0.005***	16.2	2.0E-06***	6.9	21,555	0.38
AUS	0.030***	17.4	-7.9E-06***	-4.6	0.007***	5.4	1.1E-05***	3.8	2,260	0.36
BAD	0.023***	14.1	-3.7E-06**	-2.5	0.005***	4.6	2.7E-06	1.3	2,001	0.30
BBZ	0.086***	32.2	-3.7E-05***	-8.3	0.022***	11.1	1.5E-05**	2.2	8,448	0.39
CEW	0.012***	26.4	-1.3E-06***	-4.7	0.004***	13.7	7.4E-07***	2.9	7,183	0.36
COM	0.015***	37.1	-9.8E-07***	-4.6	0.005***	11.7	1.1E-06**	2.2	8,703	0.44
MDAX										
ALT	0.029***	29.2	-5.7E-06***	-4.1	0.009***	9.9	4.0E-06***	2.9	26,608	0.25
AMD	0.014***	12.6	-8.0E-05***	-4.2	0.050***	6.68	1.3E-05	0.6	3,878	0.19
AWD	0.050***	13.1	-9.3E-06***	-3.5	0.025***	9.3	2.9E-06	1.6	2,298	0.28
BBX	0.012***	26.4	-3.7E-07***	-3.0	0.003***	8.8	1.9E-07	1.1	8,005	0.34
USE	0.040***	8.4	-7.8E-06	-1.2	0.013***	2.9	6.2E-07	1.0	482	0.39
BEI	0.073***	25.1	-2.4E-05***	-4.2	0.025***	10.9	2.1E-05***	2.6	11,692	0.24
BZL	0.092***	10.0	-6.5E-05***	-4.0	0.033***	4.6	2.0E-05	0.9	1,198	0.24
SMAX										
BWB	0.031***	5.6	-9.6E-06***	-2.8	0.011**	2.5	1.1E-05**	2.3	281	0.34
CWC	0.035***	3.7	1.8E-05	0.9	0.050***	4.9	-4.2E-05**	-2.0	278	0.25
CAG	0.071***	7.0	-1.8E-05	-1.3	0.036***	4.5	1.1E-05	0.8	451	0.42
EDS	0.170***	8.9	-9.2E-05***	-3.7	0.032***	2.6	3.2E-05	0.8	344	0.34
HAW	0.111***	7.0	-5.1E-05***	-2.6	0.066***	3.6	2.6E-07	1.0	482	0.39
MAV	0.271***	8.0	-2.0E-04***	-3.0	0.116***	2.7	-5.6E-05	-1.0	297	0.39
MED	0.014***	5.8	-1.0E-06	-1.4	0.011***	4.7	3.70E-07	0.5	518	0.28
Regulated Trading										
RSB	0.033***	16.0	-2.6E-06*	-1.7	0.011***	4.9	3.8E-06	1.1	2,457	0.34
ADJ	0.013***	7.0	-2.5E-07	-1.4	0.008***	5.8	-3.6E-07	-1.1	649	0.31
CMD	0.045***	5.9	-1.6E-05***	-3.5	0.012*	1.8	1.4E-05**	2.2	268	0.33
COC	0.043***	6.7	-2.0E-05***	-5.7	0.006	0.8	2.1E-05***	4.2	333	0.35
CQJ	0.057***	8.7	-1.0E-05***	-4.6	0.010*	1.9	6.1E-06	1.3	338	0.48
EKT	0.034***	13.7	-3.3E-06***	-5.3	0.004*	1.7	5.2E-06*	1.9	719	0.45
GIR	0.052***	9.4	-7.7E-06*	-1.7	0.009***	3.7	-2.3E-06	-0.4	638	0.34

Remark: ***, ** and * denote significance at the 1%, 5%, and 10% level, respectively. T-statistics are computed using Newey-West standard errors and denoted by t.

Table 9: Signs of Estimates of Glosten-Harris Model: Part I

Stock	$\hat{c}_0$	$\hat{c}_1$	$\hat{z}_0$	$\hat{z}_1$	Obs.	Segment
ADVA	+	-	+	+	3,636	NEMAX
AIXTRON	+	-	+	+	21,555	NEMAX
AT+S AUSTRIA	+	-	+	+	2,260	NEMAX
BALDA	+	-	+	+	2,001	NEMAX
BB BIOTECH	+	-	+	+	8,448	NEMAX
CE CONSUMERS	+	-	+	+	7,183	NEMAX
COMDIRECT BANK	+	-	+	+	8,703	NEMAX
CONSORS	+	-	+	+	5,256	NEMAX
D. LOGISTICS	+	-	+	+	6,222	NEMAX
DAB BANK	+	-	+	+	5,079	NEMAX
DIALOG SEMICOND.	+	-	+	+	3,999	NEMAX
EVOTEC	+	-	+	+	4,624	NEMAX
FJH	+	-	+	+	2,563	NEMAX
FUNKWERK	+	-	+	+	2,383	NEMAX
GERICOM	+	-	+	-	85,129	NEMAX
GPC BIOTECH	+	-	+	+	3,713	NEMAX
IDS SCHEER	+	-	+	+	2,521	NEMAX
IM INTERNATIONALMED.	+	-	+	+	5,534	NEMAX
INTERSHOP COMM.	+	-	+	+	3,814	NEMAX
IXOS SOFTWARE	+	-	+	+	3,027	NEMAX
LAMBDA PHYSIK	+	-	+	+	2,410	NEMAX
LEONI	+	-	+	+	1,568	NEMAX
LION BIOSCIENCE	+	-	+	+	5,499	NEMAX
MEDIGENE	+	-	+	+	4,695	NEMAX
MEDION	+	-	+	-	10,999	NEMAX
MOBILCOM	+	-	+	+	23,279	NEMAX
MORPHOSYS	+	-	+	+	5,117	NEMAX
NORDEX	+	-	+	+	4,834	NEMAX
PANDATEL	+	-	+	+	2,056	NEMAX
PFEIFFER VACUUM	+	-	+	+	3,358	NEMAX
PIXELPARK	+	-	+	+	1,578	NEMAX
PLAMBECK N.ENERG.	+	-	+	+	1,978	NEMAX
SAP SYSTEMS INTEGR.	+	-	+	+	6,498	NEMAX
SCM MICROSYSTEMS	+	-	+	+	2,591	NEMAX
SENATOR ENTERTAINM.	+	-	+	+	2,718	NEMAX
SINGULUS TECHNOL.	+	-	+	+	14,728	NEMAX
STEAG HAMATECH	+	-	+	+	2,204	NEMAX
SUESS MICROTEC	+	-	+	+	6,712	NEMAX
T-ONLINE INTERN.	+	-	+	+	19,771	NEMAX
TELEPLAN INT.	+	-	+	+	6,859	NEMAX
THIEL LOGISTIK	+	-	+	+	43,625	NEMAX
UMWELTKONTOR	+	-	+	-	1,984	NEMAX
UTD.INTERNET	+	-	+	+	3,927	NEMAX

Table 9: Signs of Estimates of Glosten-Harris Model: Part II

Stock	$\hat{c}_0$	$\hat{c}_1$	$\hat{z}_0$	$\hat{z}_1$	Obs.	Segment
ALTANA	+	-	+	+	26,608	MDAX
AMB GENERALI	+	-	+	+	3,878	MDAX
AWD HOLDING	+	-	+	+	2,298	MDAX
BABCOCK BORSING	+	-	+	+	8,005	MDAX
BEATE UHSE	+	-	+	+	482	MDAX
BEIERSDORF	+	-	+	+	11,692	MDAX
BERU	+	-	+	+	1,198	MDAX
BHW HOLDING	+	-	+	+	1,371	MDAX
BILFINGER+BERGER	+	-	+	+	3,519	MDAX
BUDERUS	+	-	+	+	4,953	MDAX
CARGOLIFTER	+	-	+	+	6,010	MDAX
CELANESE	+	-	+	+	4,444	MDAX
CELESIO	+	-	+	+	9,604	MDAX
CONTINENTAL	+	-	+	+	18,400	MDAX
DEUTSCHE BOERSE	+	-	+	+	12,941	MDAX
DIS DTE.IND.SERV.	+	-	+	+	600	MDAX
DOUGLAS HOLDING	+	-	+	+	5,335	MDAX
DRAEGERWERK	+	-	+	+	1,058	MDAX
DUERR	+	-	+	+	223	MDAX
DYCKERHOFF	+	-	+	+	1,391	MDAX
ESCADA	+	-	+	+	352	MDAX
FIELMANN	+	-	+	+	638	MDAX
FRAPORT	+	-	+	+	4,071	MDAX
FRESENIUS	+	-	+	+	8,113	MDAX
GERRY WEBER	+	-	+	+	1,446	MDAX
GFK	+	-	+	+	1,110	MDAX
GILDEMEISTER	+	-	+	+	1,977	MDAX
HANN. RUECK.	+	-	+	+	4,447	MDAX
HEIDELB. DRUCK	+	-	+	+	4,867	MDAX
HEIDELB. ZEMENT	+	-	+	+	4,820	MDAX
HUGO BOSS	+	-	+	+	10,528	MDAX
IKB DTE. IND.BANK	+	-	+	+	1,300	MDAX
INDUS HOLDING	+	-	+	+	601	MDAX
IVG	+	-	+	+	2,179	MDAX
IWKA	+	-	+	+	1,576	MDAX
JENOPTIK	+	-	+	+	3,040	MDAX
JUNGHEINRICH	+	-	+	+	915	MDAX
KALI+SALZ	+	-	+	+	3,669	MDAX
KAMPS	+	-	+	+	3,562	MDAX
KARSTADT/QUELLE	+	-	+	+	18,027	MDAX
KOENIG+BAUER	+	-	+	+	1,070	MDAX
KOLBENSCHMIDT	+	-	+	+	445	MDAX
KRONES	+	-	+	+	1,155	MDAX
LOEWE	+	-	+	+	860	MDAX
MERCK	+	-	+	+	12,145	MDAX
MG TECHN.	+	-	+	+	7,359	MDAX
MUENCHENER RUECK.	+	-	+	+	111,059	MDAX

Table 9: Signs of Estimates of Glosten-Harris Model: Part III

Stock	$\hat{c}_0$	$\hat{c}_1$	$\hat{z}_0$	$\hat{z}_1$	Obs.	Segment
NORDDT. AFF.	+	-	+	+	1,078	MDAX
PHOENIX	+	-	+	+	237	MDAX
PRO SIEBEN/SAT 1	+	-	+	+	7,420	MDAX
PUMA	+	-	+	+	11,502	MDAX
RHOEN-KLINIKUM	+	-	+	+	1,894	MDAX
SALZGITTER	+	-	+	+	1,901	MDAX
SCHWARZ PHARMA	+	-	+	+	901	MDAX
SGL CARBON	+	-	+	+	5,052	MDAX
SIXT	+	-	+	+	938	MDAX
STADA	+	-	+	+	3,888	MDAX
STINNES	+	-	+	+	6,826	MDAX
SUEDZUCKER	+	-	+	+	3,391	MDAX
TECHEM	+	-	+	+	1,593	MDAX
TECIS	+	-	+	+	1,149	MDAX
VOSSLOH	+	-	+	+	893	MDAX
WCM BET.	+	-	+	+	14,962	MDAX
WEDECO	+	-	+	+	1,967	MDAX
WELLA	+	-	+	+	9,710	MDAX
ZAPF	+	-	+	+	1,376	MDAX
BAADER WPH.-BANK	+	-	+	+	281	SMAX
CEWE	+	+	+	-	278	SMAX
CONDOMI	+	-	+	+	451	SMAX
EDSCHA	+	-	+	+	421	SMAX
HAWESKO	+	-	+	+	344	SMAX
MANNHEIMER	+	-	+	-	297	SMAX
MEDICLIN	+	-	+	+	518	SMAX
RATIONAL	+	-	+	-	289	SMAX
SPUETZ	+	-	+	+	706	SMAX
TA TRIUMPH-ADLER	+	-	+	+	267	SMAX
TAG	+	-	+	+	253	SMAX
TAKKT	+	-	+	+	650	SMAX
TFG	+	-	+	+	486	SMAX
ABWICKLUNGSG. ROESCH	+	-	+	+	2,457	OTHERS
ADORI	+	-	+	-	649	OTHERS
COMPUTEC MEDIA	+	-	+	+	268	OTHERS
COR AG INSUR.TECHN.	+	-	+	+	333	OTHERS
CYBIO	+	-	+	+	338	OTHERS
ENERGIEKONTOR	+	-	+	+	719	OTHERS
GIRINDUS	+	-	+	-	638	OTHERS
IN-MOTION	+	-	+	+	371	OTHERS
INTERNOLIX	+	-	+	+	257	OTHERS
MEDIA NETCOM	+	-	+	+	329	OTHERS
MICROLOG LOGISTICS	+	-	+	-	562	OTHERS
NOVASOFT	+	-	+	+	379	OTHERS
SZ TESTSYSTEME	+	-	+	+	867	OTHERS

Remark: OTHERS denote shares not listed in any of the above indices which are admitted to continuous trading in the regulated market.

Table 10: Decomposition of the Glosten-Harris Estimates

Eq. number	Dependent variable	Endogenous variables: cons.	$volume^d$	s^{Trans}/P	*spread*	Exogenous variables: SD	IC	cap/P	$\mathbf{1}_{ds2-3}$	$\mathbf{1}_{ds4-7}$	Obs.	Adj. R^2
(11)	s^{Trans}/P	0.0113***	-0.0009***			0.0504***			-0.0003	-0.0013*	119	38.16%
		(0.0021)	(0.0002)			(0.0098)			(0.0006)	(0.0007)		
(12)	s^{Adv}/P	0.0015		0.5831***		0.0006	0.0002	-8.24E-05	-0.0003	-0.0002	119	73.24%
		(0.0020)		(0.1094)		(0.0065)	(0.0003)	(0.0001)	(0.0003)	(0.0004)		
(13)	$volume^d$	-3.5113*			-67.6611*			0.8363***			119	55.11%
		(1.9784)			(40.0724)			(0.1083)				

Remarks: ***, ** and * denote significance at the 1%, 5%, and 10% level, respectively. The endogenous variables are specified as follows: s^{Trans}/P and s^{Adv}/P stand for the estimated transitory resp. adverse selection component of the Glosten-Harris model, evaluated at the average trading volume. *spread* is the total estimated half spread, i.e. the sum of both transitory and adverse selection components. $volume^d$ denotes average daily trading volume per stock. With respect to the exogenous variables, SD is the average of daily standard deviations in returns for each share, computed over the period from February to April 2002. IC measures the percentage of shares held by either members of the management board, supervisory board or their families directly or in form of holdings in which they as well participate in one of the boards. cap/P denotes the log of market capitalization for the firm calculated as the average over the sample period divided by the average price level for the share in the sample period from May 2002 to July 2002. Finally, $\mathbf{1}_{ds2-3}$ respectively $\mathbf{1}_{ds4-7}$ are binary variables indicating whether the firm had 2 or 3 designated sponsors (1) or not respectively 4 to 7 designated sponsors or not. The multivariate cross-sectional system is estimated using 3SLS. The sample contains all 119 variables for which the Glosten-Harris model could be estimated and for which values for the exogenous variables were available.

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