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 on the electronic limit order platform Xetra contract services of a *designated sponsor*. Interestingly, a lot of stocks opt for trading with more than one designated liquidity provider. In a first step, this paper provides a panel data assessment of whether or not designated sponsors increase liquidity as measured by their ability to decrease quoted and effective spreads. Results indicate that while spreads narrow when trading with one or two designated sponsors, further increases in the number of specialists do not necessarily pay out in terms of higher liquidity. Findings are shown to differ both across market segments and across different sponsor firms with brokers outperforming banks. In a second step, the variation in the number of liquidity providers is used to test predictions that link the number of market makers to theoretic components of the bid-ask spread. We provide evidence that the observed spread decline is related to inter-dealer competition and risk sharing, but not necessarily to a decrease in adverse selection costs.

EFM Classification: 360.

Keywords: Liquidity, 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. While theoretical work has highlighted advantages of electronic limit order systems over other exchange types (cf. e.g. Glosten (1994) and Biais, Foucault, and Salanié (1998)), our work wants to add further evidence to the empirical side. We focus on the bid-ask spread as the market ”price of immediacy”, one of the most important indicators of the costs of trading (and, hence, of liquidity) in financial markets.[2] In particular, we investigate the influence of liquidity providers on the German electronic exchange system Xetra, where *designated sponsors* have been introduced at the end of the 1990s as mandatory market makers for 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 reduction of liquidity risk is expected to be particularly beneficial for rather illiquid stocks with a low market capitalisation.[3] The sponsors’ functions are similar to those of NYSE specialists or *animateurs* at the Paris Stock Exchange. However, there are interesting differences across exchanges: For instance, small stocks traded on the Paris Bourse, the Italian Stock Exchange or the Stockholm Stock Exchange can deliberately opt for trading with a designated market maker. Contrarily, on Xetra certain requirements have to be fulfilled in order to be eligible for trading without a designated sponsor. Since requirements apply to a broad range of stocks, one motivation of our study is the question

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

[2]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 immediately instead of waiting until prices change in their favour.

[3]Compare e.g. Pastor and Stambaugh (2003) or Acharya and Pedersen (2005). Compare as well Amihud, Mendelson, and Pedersen (2005) for an extensive survey of theoretical and empirical literature on liquidity (risk) and asset pricing.

of whether benefits of designated sponsoring prevail for larger firms or whether results suggest that Deutsche Börse should re-think the current regulation. We are particularly interested in a second point: Unlike other exchanges, Deutsche Börse's trading platform Xetra provides the possibility of (and even used to require) trading with more than one specialist. Stocks in our data sample trade with up to six designated sponsors. While the average number of designated sponsors per firm in our sample decreased over the sample period after, in December 2006 still 36.3% of our sample firms traded with more than one designated sponsor. Since one specialist is sufficient to fulfill the spread requirements of Deutsche Börse AG, we ask whether hiring more than one designated sponsor significantly reduces spreads, especially so for rather liquid firms.[4] Equally interesting, we are able to perform the unique exercise to test predictions of theoretic models linking the number of designated market makers to components of the bid-ask spread. Our results from analysing the influence of the number of liquidity providers on magnitude and components of the bid-ask spread confirm that designated sponsors are an important source of liquidity even for rather actively traded stocks with benefits of hiring multiple market makers mainly stemming from inter-dealer competition and risk-sharing.

Our paper contributes to the existing literature as follows: First, to our best knowledge, we are the first to examine the role of designated sponsors for the German electronic limit order trading platform Xetra accounting for about over 90% of overall equity turnover on German stock exchanges.[5] We are able to show that the hybrid market element in form of quote provisions by designated sponsors constitutes a driving force of liquidity in our broad sample of mid cap (MDAX), technology (TecDAX), and small cap stocks (SDAX). Second, next to Menkveld (2006), we know of no other study being able to link the number of designated market makers to liquidity measures on electronic limit order markets. Our results show that while bid-ask spreads clearly decrease when hiring a designated sponsor, effects of contracting further sponsors depend on the market segment under scrutiny. Disposing of a control group of observations for more liquid firms trading without designated liquidity providers, we can draw some conclusions on whether Xetra regulation is reasonable in terms of liquidity. Our paper is the first to explore whether, apart from the number of designated sponsors hired, also the characteristics of sponsor firms themselves are found to play a role for bid-ask spreads in electronic limit order markets. We find that all else equal, brokers outperform commercial banks. A main novelty of

[4]Due to data restrictions, the present analysis solely focuses on liquidity. It would be interesting to conduct a cost-benefit analysis taking into account that firms often compensate sponsors for their services. Furthermore, there might be external effects to firms from establishing business connections with a bank providing sponsor services which we cannot account for.

[5]Deutsche Börse AG, Xetra's operator, is European number three after the London Stock Exchange and Euronext in terms of market capitalization of domestic equity. Compare e.g. statistics published by the Federation of European Security Exchanges such as the European Securities Exchange Statistics for July 2007.

our study linked to the multiplicity of designated sponsors are tests of predictions of theoretic models linking the number of market makers to components of the bid-ask spread. We proceed by applying two different methods to decompose the bid-ask spread into a transitory and a permanent component and find support for predictions of the first type of models. Finally, while all studies we are about to introduce analyse impacts for rather small firms, we focus on a broader sample of 110 (larger) firms from the German mid cap, technology and small cap segments which trade at rather high liquidity levels. Our data set allows us to separately investigate effects for differing market segments. Given that the value of designated sponsorship is considered to increase in illiquidity of stocks, our results may understate the actual importance of designated sponsors for inactively traded stocks. Conversely, it is not evident that we find any effects at all for the more liquid stocks that are affected by the regulation. This issue is strengthened by our choice of a rather long and recent sample period from April 2003 to December 2006. Since average spreads markedly decreased over this time horizon, our study can shed some light on the question of whether, even in an environment with low levels of trading frictions, there is still scope for significant benefits of designated liquidity providers.

In addressing our questions of interest, we proceed as follows: After a brief literature review in section 2, section 3 contains the institutional background, introducing the reader to the market structure, the concept of designated sponsors and the data set as well as to some summary statistics. Sections 4 and 5 present the empirical analysis: Section 4 introduces several spread measures as well as the data set and estimates the influence of designated sponsors on liquidity by means of a panel data approach. Section 5 develops a trade-indicator model and uses obtained results in order to assess which theoretic component of the spread is particularly influenced by the sponsors. Furthermore, results from a spread decomposition using realized spreads are presented. Section 6 concludes.

2 Related Literature

Apart from the vast literature on NYSE specialists, there exist a few studies on a more "European" type of liquidity provider on electronic limit order platforms, enjoying markedly lower privileges compared to the US-American counterpart.[6] As a general result, all studies analyzing liquidity changes following the introduction of designated market markers find an increase in market quality as measured by spreads, quoted depth or volatility levels. Often, the announcement of the introduction of liquidity providers is accompanied by positive abnormal stock returns. Specifically, Nimalendran and Petrella (2003) investi-

[6] With respect to general literature on market microstructure, compare e.g. O'Hara (1997) or the surveys by Madhavan (2000) and Biais, Glosten, and Spatt (2005). Relating to literature on the NYSE specialist, compare also Venkataraman and Waisburd (2007).

gate a regulatory change by the Italian Stock Exchange (ISE) to improve market quality of thinly traded stocks. In 1997, these stocks were given the option to trade either on a pure order driven market or on a hybrid system with specialist and limit order book. Using a combined event study approach, the authors isolate the specialist's effect for 20 stocks choosing the hybrid system. The authors differentiate their analysis with respect to stock liquidity and find that "very" illiquid shares (classified by market capitalisation) profit more from adoption a hybrid system compared to moderately illiquid shares. In a similar study, Anand, Tanggaard, and Weaver (2005) examine the 2002 decision by the Stockholm Stock Exchange to allow firms to contract liquidity providers to assure quality levels as maximum spread levels or minimum depth levels. The authors employ an event study framework to investigate changes in market quality for a sample of 50 firms and use cross-sectional regressions to study determinants of liquidity provider compensation and contract terms.[7] Venkataraman and Waisburd (2007) examine the value of designated market makers for non-liquid stocks on the Paris Bourse, also implementing an event study approach. In their sample of 75 firms choosing the market maker approach and 206 firms trading without, the authors find that younger, smaller and less volatile firms are more likely to opt for trading with an "animateur" who will induce more frequent trading as well as lower book imbalances. As a fundamental difference to the other studies, Venkataraman and Waisburd (2007) study stocks that trade in two daily call auctions and not continuously. The authors argue that positive announcement returns from the introduction of designated market makers show that purely endogenous liquidity provision might not be the optimal trading mechanism for smaller stocks. The closest study to us is Menkveld (2006), investigating the introduction of designated market makers (DMMs) on Euronext in the Netherlands in October 2001. Contrary to the three studies above, Menkveld (2006) uses a panel data approach comprising 20 months for 74 firms which started with at least one DMM at the introduction. To our knowledge, this paper is the only one next to us examining an electronic limit order market with active use of the possibility to hire *more than one* liquidity provider. Mainly focusing on the relation between bid-ask spreads, the number of DMMs, trading volume and firm size, the author sets up a standard inventory model predicting that a higher number of DMMs decreases both spreads and volatility due to inventory risk sharing. In the empirical application for a sample of small firms, disposing of daily data, the author finds evidence that spreads decrease in the number of designated liquidity providers. Before presenting the empirical approach, we now introduce the reader to the institutional background.

[7] The authors stress that liquidity providers in their analysis differ in "very fundamental ways" from NYSE specialists. Compare Anand, Tanggaard, and Weaver (2005), p. 3.

3 Institutional Background and Data

3.1 Market Structure

Xetra is the fully electronic order-driven trading system for cash market trading in equities and other instruments 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 Informationssystem). Today, More than 90% of equity trading on German stock exchanges are conducted on the trading platform Xetra, independently of the traders' current location. Equities can be traded in 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 5.30 p.m. The opening auction starts at 8.50 a.m. while the closing auction begins at 5.30 p.m.[8] Buy and sell orders are matched in the fully electronic order book. Orders are executed according to price and time priority. Trading is anonymous for all parties, trades are processed through a "central counterparty" (CCP).[9]

3.2 Designated Sponsors

Designated sponsors were introduced to Xetra at the end of the 1990s in order to provide liquidity to the market, to smooth prices and to bridge temporary imbalances in order flow. They assure higher liquidity by quoting binding bid and ask prices, by participating in auctions and in volatility interruptions. Depending on the equity's liquidity, requirements of Deutsche Börse AG must be fulfilled with respect to minimum quote quantity, minimum quoting time, maximum quoted bid-ask spreads and maximum response time to quote requests. The sponsor's performance is then measured and quarterly published by Deutsche Börse AG.[10] 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. Services are expected to be particularly beneficial for less liquid shares which do not enjoy a great market popularity, which have a narrow investor base and which are often susceptible to high price fluctuations. Sponsors are compensated for their service through several channels: In case of fulfilling their obligations, they benefit from privileges like a rebate of exchange fees. Given that designated brokerage is in general no profit-making activity, especially for volatile firms, sponsors are often compensated by a

[8]Note that the daily auction times for stocks listed in the MDAX and SDAX segment compared to DAX or TecDAX stocks slightly differ. Before November 2003, trading took place from 9.00 a.m. to 8.00 p.m. and was interrupted by two regular intra-day auctions.

[9]Information is obtained from Deutsche Börse's official website http://www.deutsche-boerse.com and in particular from the section on the Xetra Market Model.

[10]All sponsor firms in our sample obtain the highest rating AA.

fee from the respective company. A current survey reported an average annual fee of EUR 34,000 across firms.[11] Designated sponsors are mainly financial service providers, brokers or commercial banks. Due to the fact that they continuously watch the market, liquidity suppliers gain expertise. They often use this information to offer additional services to their clients in areas like research, sales or investor relations. Cross-selling aspects may be a dominant motivation to offer brokerage services. For the covered firm, these services might be attractive in that they provide access to a broader investor base and in that they increase investor awareness, transparency and possibly market valuation. Talking to several designated sponsors and covered firms, it seems that the importance of these "side services" has steadily increased over the last years.

As was stated, unlike on other electronic limit order exchanges, designated sponsorship is not voluntary for all stocks. Firms with low levels of liquidity that want to use the continuous trading model are obliged to contract a designated sponsor. Deutsche Börse AG recommends trading with two designated sponsors. The designated sponsor requirements changed in 2003 and are based on both the Xetra Liquidity Measure XLM and on turnover.[12] The XLM measure relies on the concept of market impact costs or implicit transaction costs. These costs can be computed as the difference between the average execution price and the theoretical fair value (average of best bid and best ask price) for a round-trip of a given order volume. The XLM measure is computed on a daily basis and denoted in base points. The smaller the difference, the smaller the XLM measure.[13] Continuously traded stocks on Xetra are divided into two liquidity categories. Stocks in category A do not require designated sponsor services, while stocks in category B do so.[14] Deutsche Börse AG ranks stocks once per quarter on the basis of the preceding four months period and publishes the liquidity categories, possibly implying changes in designated sponsor requirements. Depending on XLM size, minimal quoting criteria and maximum spreads are set.[15] Figure 1 in the appendix depicts the development of the average number of designated sponsors over time. Interestingly, the development differs across market segments. Information is obtained from Deutsche Börse AG.

[11] Compare *Going Public*, Volume 10/07, p. 56.

[12] Before, the mandatory number of designated sponsors was linked to the index segment. It amounted to a maximum of two (one) for stocks in the trading segment NEMAX (SMAX).

[13] As an example, a XLM of 20 base points at a volume of EUR 25,000 would correspond to market impact costs of EUR 50 for a hypothetical round-trip of that volume, since 20 base points equal 0.2%).

[14] Category A contains stocks with an XLM measure smaller or equal to 100 base points for a hypothetical order volume of EUR 25,000 points and an average daily turnover of EUR 2.5 million per day, where averages are computed over the last four months. Stocks not complying with both criteria are classified as category B and are divided into several sub-groups.

[15] For instance, for stocks with an XLM between 100 and 500 base points, the minimum quoting volume is equal to EUR 20,000 and the maximum spread is set to 4%. For further information, we refer the reader to Deutsche Börse's official website http://www.boerse.com.

3.3 Data

In order to construct our panel data set and to compute spread measures, we employ Xetra data of best bid, best ask and transaction prices from April 2003 to December 2006 which was supplied to us by Deutsche Börse AG. Bid, ask and transaction prices in our data set are time-stamped. Our originally constructed panel sample consists of 130 stocks listed in MDAX, TecDAX and SDAX on April 1st, 2003 and comprises 45 panel months. We exclude penny stocks and stocks with an average price below EUR 2 from the analysis. Doing the same for stocks for which less than 35 months observations are available due to de-listing, takeovers or the like, our cross-sectional sample size for the panel data analysis is further reduced to 110 stocks.[16] Prices determined during intraday call auctions, opening and closing auctions are omitted as are relative price jumps above 50% compared to the prior price. An indication whether the trade was buyer- or seller-initiated is not included in the data. We therefore use the trade classification algorithm proposed by Lee and Ready (1991).[17] We pool trades which occur within the same centisecond to account for volume related effects and calculate volume weighted transaction prices and midpoints. In a last step, we build monthly averages of computed spread measures. Summary statistics for our sample of 110 firms are presented in Table 2 in the appendix. They are disaggregated by trading segments. Monthly key figures for firms are obtained from DATASTREAM.

[Insert Table 2 about here]

4 Methodology and Results I

The existence of a bid-ask spread is typically explained by trading frictions associated with the existence of order processing costs, inventory costs or asymmetric information costs. 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 two-fold: In a first stage, we introduce quoted, effective and realized half spreads and use the first two measures in panel data estimations in order to provide evidence on whether or not the existence of designated sponsors c.p. enhances liquidity for stocks traded in Xetra. In a second stage, we want to assess which "theoretic" component is particularly influenced by designated sponsors using a trade-indicator model and realized spreads.

[16] Conducting estimations for the full sample or a sample of stocks with at least 25 months of observations does not change main results.

[17] 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.

4.1 Quoted, Effective and Realized Spreads

The following introduction to spread measures is in line with Huang and Stoll (1996). The *quoted spread* is the difference between the best quoted ask and the best quoted bid price and can be interpreted as the costs of trading a round-trip (i.e. of an instantaneous buy and sell transaction). Since we want to measure the costs per transaction, we employ quoted half spreads. The definition of the (percentage) quoted half spread is given by

$$S/2_t^{quoted} = (a_t - b_t)/2; \qquad S/2_t^{quoted} \text{ in } \% = 100(a_t - b_t)/2M_t,$$

where a_t is the best quoted ask price, b_t is the best quoted bid price and $M_t = \frac{a_t+b_t}{2}$ is the midpoint between the best quotes representing the "fair" value of the share. The upper panel of Table 1 reports the average quoted half spreads for our sample of 110 stocks disaggregated by market segments. Expectedly the MDAX containing the largest stocks reports the lowest spreads, with average percentage half spreads amounting to 0.19%, followed by TecDAX stocks with 0.36% and SDAX stocks with 0.60%.[18]

Table 1: Descriptive Statistics: Average Half Spreads

	Quoted Half Spread	Std. Dev.	Min.	Max.	Half Spread in %	Std. Dev.
MDAX	0.0604	0.0502	0.0080	0.3193	0.1890	0.1165
TecDAX	0.0490	0.0573	0.0054	0.9295	0.3550	0.9268
SDAX	0.1108	0.1242	0.0104	1.9260	0.5965	0.3127
	Effective Half Spread	Std. Dev.	Min.	Max.	Half Spread in %	Std. Dev.
MDAX	0.0375	0.0305	0.0068	0.2666	0.1221	0.0805
TecDAX	0.0361	0.0601	0.0053	1.0200	0.2973	1.1287
SDAX	0.0807	0.0857	0.0084	0.7304	0.4418	0.2383
	Realized Half Spread	Std. Dev.	Min.	Max.	Half Spread in %	Std. Dev.
MDAX	0.0096	0.0150	-0.0545	0.1614	0.0395	0.0503
TecDAX	0.0161	0.0472	-0.0145	0.9252	0.1602	0.9308
SDAX	0.0418	0.1279	-0.5434	4.1043	0.2317	0.3368

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 and is defined as follows:

$$S/2_t^{effective} = P_t - M_t; \qquad S/2_t^{effective} \text{ in } \% = 100(P_t - M_t)/M_t.$$

P_t is the transaction price at time t and M_t is defined as above. The effective half spread is measured only at times when transactions take place, contrary to the quoted spread. On Xetra, both measures are equal at transactions since market maker purchases (sales) occur at the quoted bid (ask) price. Due to the fact that trades rather occur when spreads

[18]Comparing spread magnitudes to those of other papers presented in section 2, we find that our sample stocks are markedly more liquid, which is partly due to the different time horizon and firm size chosen.

are relatively tight, the effective spread might be smaller than the quoted spread.[19] The results for the average effective half spreads are summarized in the middle panel of Table 1, intuition is in the same manner as for the quoted spread. For all trading segments, the average effective half spread is smaller than the average quoted half spread.[20]
The *realized spread* relates to asymmetric information costs arising since dealers want to protect themselves against losses to informed traders. Because of potential information possessed by some traders, prices tend to move against the market maker after a trade, meaning that they rise (fall) after a market maker's sale (purchase).[21] Hence, on average, the dealer does not earn the effective spread but his gross revenue rather equals the *realized spread*, i.e. the difference between the initial trade price and a subsequent trade price when the position is liquidated. As is common in the literature, we compare transaction prices to the quoted midpoint in place five minutes after the trade.[22] Then, conditional on a trade at the ask or bid price, the realized (percentage) half spread can be computed as:

$$S/2_t^{realized|a_t} = [P_t - M_{t+\tau}|P_t = a_t]; \qquad S/2_t^{realized|b_t} = [M_{t+\tau} - P_t|P_t = b_t].$$
$$S/2_t^{real.|a_t}\text{in } \% = 100[P_t - M_{t+\tau}|P_t = a_t]/M_t;\ S/2_t^{real.|b_t}\text{in } \% = 100[M_{t+\tau} - P_t|P_t = b_t]/M_t.$$

Sample averages for realized half spreads are depicted in the lower panel of Table 1: As expected, realized spreads are markedly smaller than effective spreads. Differences are largest for the most opaque SDAX firms. We will return to the concept of realized spreads at the end of section 5.

4.2 Panel Data Estimation Results

4.2.1 Empirical Approach

Before we determine and analyse the spread measures' single components, we employ a panel data framework to examine the influence of designated sponsors on the bid-ask spread. In order not to suffer from an omitted variable bias, we include factors into the equation that are known to influence the spread like firm size in form of market

[19]The effective spread can be smaller or larger than the quoted spread for another reason not applicable to Xetra: If price improvements can be arranged by trading inside the quotes, the effective spread is smaller than the quoted. If large orders trade at prices outside the spread in the book, 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.

[20]For all spread measures, tests for equality of means are rejected at the 1% significance level.

[21]Compare e.g. Huang and Stoll (1996), p. 326.

[22]Ideally, the realized spread is calculated by comparing the transaction price to the next differently signed transaction price after time τ has passed. The time span is to be set long enough such that new information has been impounded into prices, but short enough such that prices do not change due to other information. The time span should be set such that the probability of a purchase and a sale occurring is equal. Often τ is set equal to five minutes. Compare the discussion in Huang and Stoll (1996), pp. 326.

capitalisation, average trading volume, standard deviation of returns or average stock price.[23] A general panel data model then takes the following form:

$$y_{it} = x'_{it}\alpha + w'_{it}\beta + v_i + u_{it}, \quad i = 1, ..., N; \quad t = 1, ..., T. \tag{1}$$

w_{it} is a vector of potentially endogenous covariates, all of which might be correlated with v_i, the unobserved individual heterogeneity. w_{it} might include lagged values of the dependent variable y_{it}. x_{it} is a vector of strictly exogenous covariates, possibly including time constants. v_i denotes the unobserved individual heterogeneity, u_{it} the i.i.d. error term. When estimating model (1), one mainly faces two problems. The first is how to cope with the unobserved individual heterogeneity v_i, the second is how to account for possible endogeneity of regressors. With respect to the first problem, standard procedures like first differencing or the fixed effects (within) transformation can be used. If we are willing to assume that all regressors are exogenous in a statistical sense,[24] a natural estimation approach is fixed effects (within) estimation, delivered by averaging equation (1) over time and then subtracting averages from the original equation in order to remove v_i. We can then estimate the following equation by OLS:

$$y_{it} - \overline{y}_i = (x_{it} - \overline{x}_i)'\alpha + (w_{it} - \overline{w}_i)'\beta + u_{it} - \overline{u}_i, \quad i = 1, ..., N; \quad t = 1, ..., T, \tag{2}$$

where $\overline{a}_i = 1/T \sum_{t=1}^{T} a_{it}$. Unfortunately, this approach is inconsistent if an explanatory variable in some period is correlated with the error term. Regarding the literature, a contemporaneous relation between the average trade size and bid-ask spreads has been established. It is not clear whether this high frequency relation persists on a monthly basis, but it may be wise to introduce another approach besides fixed effects estimation. Regarding other potentially problematic regressors, it has been argued that firms with large spreads might c.p. have problems to attract investors which could influence firm size in the long run. However, given that we have monthly observations over a restricted time horizon, we believe that it is reasonable to consider firm size as exogenous for our estimations. Finally, it is important to regard our main variable of interest, the number of designated sponsors. Here, the question to ask is whether firms base their decision to alter their sponsor structure on (current) trading conditions.[25] Talking to several firms and sponsors, it appears that it typically takes at least a month to establish a contact to a sponsor and to set up a contract. Since contracts are typically specified for at least

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

[24]Compare e.g. Wooldridge (2002), pp. 252.

[25]From section 3.2, we know that the requirement to hire the first sponsor is a function of bid-ask spreads and trading volume lagged four to seven months. However, firms tend to have more sponsors than they need and we hardly observe reactions to changes in liquidity classes.

a year, firms cannot dismiss their sponsor quickly, ruling out contemporaneous relation between the number of sponsors and u_{it}. Most important, all firms and sponsors we talked to confirmed that they regard the choice of a sponsor as a long-term decision. They do not react quickly to changes in market conditions and would not engage a sponsor for a few months to smooth unfavorable trading conditions.[26] This implies that if past market conditions influence the number of designated sponsors, it is reasonable to assume a delay of at least a quarter. This facilitates the econometric analysis if, as a second approach, we remove individual heterogeneity by first differencing to obtain:

$$\Delta y_{it} = \Delta w_{it}'\alpha + \Delta x_{it}'\beta + \Delta u_{it}, \quad i = 1, ..., N; \quad t = 1, ..., T, \tag{3}$$

where $\Delta a_{it} = (a_{it} - a_{it-1})$. This approach has the advantage that lags of endogenous variables from time $t-2$ to time t_0 are uncorrelated with the error term Δu_{it}.[27] Hence, discussions imply that only average trade size has to be instrumented with its lags. Out of efficiency considerations, we opt for a GMM procedure that instruments the differenced variables that are not strictly exogenous with all available lags in levels.[28] Since the Arellano-Bond (1991) estimator has been designed for dynamic models, we will later on confirm that results are robust to a dynamic specification including y_{it-1} as a predetermined variable.[29] Applied to our model setting, the specification becomes:

$$\begin{aligned} \Delta S/2_{it} = {} & \alpha_1 \Delta DS_{it} + \alpha_2 \Delta LnMarketcap_{it} + \alpha_3 \Delta SD_{it} \\ & + \alpha_4 \Delta Price_{it} + \beta_1 \Delta Volume_{it} + \Delta u_{it}, \quad i = 1, ..., N; \quad t = 1, ..., T. \end{aligned} \tag{4}$$

The dependent variable S is either the quoted or effective half spread, denoted in percentage terms. DS stands for the influence of designated sponsors which we will test in several specifications. *Lnmarketcap* is the log market capitalisation, $Volume$ denotes

[26]In fact, it seems that in most cases firms decide whether to alter the number of sponsors towards the end of the contract period which typically does not coincide with the calender year. A change can as well be related to investment banking activities conducted with the help of a sponsor firm.

[27]Consider e.g. the simple case with $\Delta y_{it} = \alpha_1 \Delta x1_{it} + \beta_1 \Delta w1_{it} + \Delta u1_{it}$ and $\Delta w1_{it} = \gamma_1 \Delta y_{it} + \delta_1 \Delta w1_{it-1} + \Delta e_{it} = \gamma_1 \Delta(\alpha_1 \Delta x1_{it} + \beta_1 \Delta w1_{it} + \Delta u1_{it}) + \delta_1 \Delta w1_{it-1} + \Delta e_{it}$. Apparently, $\Delta w1_{it}$ is correlated with $\Delta u1_{it}$ as is $\Delta w1_{it-1}$, but there is no more correlation from $t-2$ onwards.

[28]Compare e.g. Holtz-Eakin, Newey, and Rosen (1988) and Arellano and Bond (1991) which implement the GMM estimator for dynamic models that may contain fixed effects and idiosyncratic errors that are heteroskedastic and correlated within but not across individuals. In our application, we reduce the number of instruments stepwise to keep the number of instruments not too large compared to the number of groups and to be able to rely on specification tests. While significance levels may change, results are unaffected. Presented results include lags 2 to 5 of potentially endogenous variables. Results from applying a standard instrumental variable routine using lags of potentially endogenous variables are similar.

[29]The discussion implies that in specification (3), only average trade size has to be instrumented. Correlations between differenced volume and its lags are significant at a level of 1%, the Hansen/Sargan statistic assures that instruments are not correlated with the error term. An earlier version of the paper conducted all estimations considering additionally both the number of designated sponsors and firm size as endogenous. Results are qualitatively similar and can be obtained from the authors upon request.

the average trading volume in EUR. *SD* stands for the average daily return standard deviation, *Price* for the average trading price.[30] All averages are monthly.
The following section presents estimation results of equations (2) and (3) with variables specified in (4). Again, the fixed effects estimation is only consistent if one is willing to assume strict exogeneity of all regressors.[31] For all estimations, we employ the robust Huber/White sandwich estimator of the variance-covariance matrix.

4.2.2 Results

Our sample includes 110 Xetra stocks for which at least 35 monthly observations are available, yielding 4,803 observations for the sample period April 2003 to December 2006. We estimate all specifications including year dummies as well as index dummies $MDAX$, $TecDAX$ and $SDAX$ denoting the mid cap, the technology and the small cap index segment of Xetra. STATA results for quoted and effective half spreads are reported in Tables 3 to 8 in the appendix.[32] In order to assess whether firms with designated sponsors have lower spreads compared to firms without sponsors, we start by estimating models (2) and (3) including an indicator variable $\mathbf{1}_{DS}$ which is 1 if the firm has hired one or more designated sponsors and 0 otherwise. The index "a" in all specifications denotes OLS fixed effects estimation while the index "b" stands for GMM estimation. Odd specification numbers denote quoted spreads, even numbers effective spreads. Our focus in on the GMM estimations since they control for potential endogeneity. Not surprisingly, the coefficient of $\mathbf{1}_{DS}$ is negative and significant at levels from 1% to 4% in all four specifications. Hence, controlling for other determinants of bid-ask spreads, the existence of one or more sponsors increases liquidity. Regarding control variables, we detect a significantly negative impact of log market capitalisation. The coefficients for trading volume are close to zero in magnitude indicating that only very large orders may move the spread. They are only significant in one specification, suggesting that on a monthly basis, the relation between average trading volume and spreads may not be as important as compared to the relation at higher frequency. The coefficient of *SD* is positive and significant in most cases, in line with the theory that compensation for risk-averse liquidity providers increases in security risk. Somewhat surprisingly, stocks with high price levels c.p. tend to have higher percentage spreads. Some specifications identify year effects for 2003 (2005) (relatively high (low) spreads) which is in line with the stock market environment at that

[30] Employing lagged values of the standard deviation does not change results.

[31] A Hausman test for model specification clearly indicates to choose fixed effects over random effects estimation.

[32] For more details on the xtabond2 estimation procedure in STATA, compare Roodman (2006). We choose the robust "difference" GMM one-step procedure. Results for the two-step procedure are similar. For the implementation of fixed effects estimation and on the question why a constant is included, compare http://www.stata.com/support/faqs/stat/xtreg2.html.

time. Specifications (1a) and (2a) find significant effects for MDAX and SDAX stocks.[33] Overall, results are in line with former literature, the correctness of signs is recomforting with respect to model specifications. Effects for quoted spreads are markedly larger than for effective spreads which is not surprising given their differing magnitudes.[34] Results imply that "forcing" firms to hire a sponsor increases liquidity compared to having none.

[Insert Table 3 about here]

As was said, one distinguishing feature of the current paper is that in our sample, the number of sponsors does not vary between 0 and 1, but rather between 0 and 6. Hence, we can check whether the existence of 2 or more designated sponsors leads to an improvement of spreads in that market makers undercut opponents' prices in Bertrand-style competition. Since any market participant can serve as a liquidity provider by posting limit orders, one would imagine that effects of price competition are higher for firms for which it is not attractive to post limit orders such as for very volatile technology shares or for small cap stocks. Since it appears reasonable to assume that effects of designated brokerage are not linearly increasing, we estimate specifications (3) and (4) including the number of sponsors and its square as regressors. Results are depicted in Table 4.

[Insert Table 4 about here]

Since results for the other variables do not change, we focus on the variables No_DS and No_DS^2. Expectedly, quoted bid-ask half spreads decrease in the number of designated sponsors with diminishing effects of adding further sponsors. Surprisingly, results for effective half spreads are not significant. Hence, average spreads at transaction times do not appear to decrease the way imposed above. Given that there seems to be an effect from the first estimations, we further explore the effects of hiring designated sponsors by including the number of sponsors as separate indicator variables. Since only about 11% of firms trade with more than two sponsors, we collapse these observations into one indicator $DS3456$. In the upper panel of Table 5, we do the same for firms trading with 1 and 2 sponsors ($DS12$), in the lower panel we show disaggregated results.

[Insert Tables 5 and 6 about here]

Regarding specifications (5) and (6) for quoted and effective spreads, both indicator variables $DS12$ and $DS3456$ have a negative coefficient and are significantly different from

[33] All three index segments appear as indicator variables since sample stocks that left one of the indices and either joined the DAX or no other index, were given a separate index entry.

[34] For the GMM estimations, these and all further specifications pass the Hansen test of overidentifying restrictions. However, with reasonable lags included as instruments, the number of instruments remains above the number of observations, significantly weakening the results of the Hansen test.

zero at a level of at least 5%. The Wald statistic for the OLS specifications rejects equality of coefficients, coefficient tests for the GMM specifications however do not find a significant difference. Disaggregating the number of sponsors further as is done in the lower panel, three out of four specifications detect statistical differences between trading with more than 2 as opposed to 2 or less sponsors. Since we have chosen a broad sample of rather large (MDAX), rather small (SDAX) and rather innovative and risky firms (TecDAX), we cannot resist to test whether liquidity effects differ across market segments (differing across market capitalisation, turnover or industries) by splitting up our sample into three subsamples. Estimation results for quoted spreads are presented as specifications (5d) to (5i) in Table 6.[35] Since especially the number of groups for TecDAX stocks is very small, results are to be taken with care. The estimates clearly suggest that benefits of designated sponsors vary across market segments. For the most liquid midcap stocks, having 1 or 2 sponsors is broadly related with the same benefits in terms of spread reduction, while it does not seem favorable to hire more than 2 sponsors. For stocks from the highly volatile technology segment, the magnitude of the influence of sponsors is pronouncedly highest and it appears good to have more than 2 designated sponsors. However, the GMM specification has problems to find statistical significance. For the least liquid SDAX segment, it also appears to pay out to contract more than 2 sponsors (see however the upper panel of specification (5i)). Interestingly, security risk as measured by the standard deviation of returns is most important for the least liquid stocks.

As a robustness check, in Table 7 we present results from dynamic AR(1) versions of specifications (1), (3) and (5) using the Arellano-Bond (1991) estimator. The lagged dependent variable is positively related to the dependent variable at a significance level of 1%. The relation between designated sponsors and quoted bid-ask spreads remains stable.

[Insert Table 7 about here]

4.2.3 The Choice of the Designated Sponsor Firm

Before we proceed to the decomposition of the bid-ask spread, we perform an additional exercise related to the fact that firms are free to choose their preferred designated sponsors among a variety of firms. The 130 firms of our original sample trade with 35 different designated sponsors, leading to the question whether, all else equal, the magnitude of spreads differs across designated sponsor firms.[36] Ideally, we would test the null hypothesis of equal spreads across sponsor firms with data revealing the identity of traders. Unfortunately, we only dispose of anonymous order flow data. However, we know the identities of

[35] Since the number of groups is markedly reduced to 45 groups for MDAX, 40 groups for SDAX and 25 groups for TecDAX stocks, the problem of a high number of instruments relative to groups may be rather severe. We again reduce the number of lags used as instruments to alleviate this problem.

[36] Compare also the work of Cao, Choe, and Hatheway (1997) on NYSE specialist firms.

sponsor firms in a given month for each of the sample firms. Hence, we can test whether c.p. identity or characteristics of a sponsor firm exert an influence on the bid-ask spread. The motivation for the following estimations comes primarily from conversations with several designated sponsors. All sponsors agree on the fact that there is a high degree of competition in the market. In good market conditions, it is common practice that sponsors try to attract business from their competitors by either offering lower costs or by providing higher services for the same costs. Furthermore, sponsors believe that there are qualitative differences in the market which can be quite pronounced with respect to additional services like investor relations services, but also in terms of market making.[37] This is particularly interesting given that all sponsor firms in our sample obtain the highest rating of Deusche Börse AG.[38] When we perform the same estimations as before but additionally include the identities of designated sponsors, we indeed find significant differences across sponsors and can reject the null hypothesis of no differences in spreads across sponsor firms, all else equal, at a level of 1%. In order to find out whether this result can be related to particular characteristics of sponsor firms, we have to consider the market for sponsoring services in some more detail. Over the last years, the market has been quite dynamic. After the year 2001, a lot of firms significantly reduced their activities as a reaction to the crash of new economy stocks and to markedly deteriorating outlooks for future revenue-generating services like seasoned equity offerings. With the recovery of the stock market, increased corporate access to the equity market, the new market segmentation and a change in the designated sponsor requirements, brokerage houses and banks have re-discovered this field of business. Characterizing individual sponsor firms on the Xetra stock market, coverage size varies significantly from 1 mandate to over 50 mandates. Hence, a first question to ask is whether a firm trading with a large designated sponsor firm has c.p. different spreads compared to a firm trading with a small sponsor. Since a large firm being active for several firms in our segment has developed more expertise compared to a small firm and is able to realized lower fixed costs per covered stock, we expect a negative relation between transaction costs and the size of a sponsor firm. Similar in flavor, we expect that firms which have extended their business over the last years and recognized the importance of sponsoring services might be inclined to post smaller spreads than their competitors in order to establish a good reputation and to tighten relations with the listed company. Finally, given that the designated sponsoring industry consists of both commercial banks and brokers (or banks having their origin in the brokerage business), we investigate possible differences across institutional groups in

[37]Apparently, it is rarely the case that firms set up contracts specifying lower spreads or higher quantities than officially demanded. Hence, differences across firms are in general not due to the fact that firms simply pay more to obtain lower spreads.

[38]Some designated sponsors might choose to only fulfil minimum "AA" requirements and exit the market in "difficult" times if their time bonus allows them to.

the market. On the one hand, one might expect that bid-ask spreads by brokerage firms are smaller since their core business and expertise is in market making. On the other hand, at least the banks with many mandates may have a similar expertise compared to brokers. Since they tend to have a higher interest in cross-selling activities, they will do their best not to dissatisfy their customers. While costs appear to be more or less homogenous among institutional groups, sponsor firms that have their origins in the brokerage business may charge lower fees compared to commercial banks, both with respect to market making and to additional services.[39] Overall, we expect an equal influence of brokers and banks on liquidity and test the following hypotheses:

H.A: The bid-ask spread is c.p. smaller for firms with a large designated sponsor.

H.B: The bid-ask spread is c.p. smaller for firms with a sponsor extending its business.

H.C: The choice to contract a broker or a bank does not impact the bid-ask spread.

The empirical approach consists of re-estimating the specifications above and to include proxies for the hypotheses *H.A* to *H.C*. Each of the constructed variables shows a similar dispersion across stock characteristics and market segments, mitigating concerns that results are linked to the fact that e.g. brokers may only cover high tech stocks or the like. With respect to hypothesis *H.A*, we create dummy variables being equal to 1 if the firm has (possibly among others) hired a sponsor covering at least 10 of our sample firms in the current month and 0 otherwise. Results reveal no significance whatsoever of the coverage size of the sponsor firm and are not reported here.[40] Regarding hypothesis *H.B*, we construct an indicator variable being equal to 1 if the firm has (possibly among others) hired a sponsor that has expanded its business from the beginning to the end of the sample period and covers at least five sample firms. We again find no significance for this and several similar specifications, inducing us to reject *H.B*. With respect to the third hypothesis *H.C*, results are depicted in table 8. Specifications (7a), (7b), (8a) and (8b) contain the indicator variables *Broker* and *Bank*. These variables are equal to 1 if the firm has hired at least one sponsor with origins in the brokerage business and the banking business, respectively, and 0 otherwise. Interestingly, the coefficient of *Broker* always bears a negative sign while the coefficient of *Bank* bears a positive sign or is not statistically significant. The difference between both variables is different from zero at a level of 1% in the OLS specifications. Hence, we find clear evidence that brokerage firms outperform banks with respect to market making, inducing us to reject *H.C* as well.

[Insert Table 8 about here]

[39] Typically, however, the range of additional services provided by brokers is limited compared to banks, the same yielding for the access to potential investor groups.

[40] Results are available from the authors upon request. Varying the size category by e.g. using an indicator for the 10 largest or 10 smallest sponsor firms using an average of mandates over time does not change the results.

Summing up, we find robust evidence that trading with designated sponsors increases liquidity by decreasing quoted and effective bid-ask spreads. While it pays out for all stocks to hire at least one sponsor, effects are not linear. Disaggregated to the trading segment, we find that for German midcap stocks having 1 or 2 sponsors seems optimal. For stocks from the technology segment and the small cap segment, having more than 2 sponsors is beneficial in terms of liquidity. Interestingly, the magnitude of the estimates is by far highest for the intermediate market segment in terms of firm size and liquidity. We attribute this finding to the fact that while the market for high technology shares constitutes an attractive trading segment for investors, high idiosyncratic risk deters other traders from providing liquidity. Correspondingly, potential gains of designated sponsors not exiting the market in volatile trading environments are relatively high. Finally, we present evidence that spreads of firms contracting brokers are significantly lower compared to those of firms only contracting banks, whereas the number of mandates of the sponsor firm does not seem to play a role. We again remind the reader that our analysis only focuses on the bid-ask spread and does not take other costs and benefits of hiring a designated sponsor into account. One further exercise comes at low cost: When performing similar estimations in order to see whether average trading volume is influenced by the existence of designated sponsors, our results clearly indicate "no".

5 Methodology and Results II

Having observed that designated sponsors decrease quoted and effective half spreads for the shares in our sample, we now proceed to analyse which particular component of the spread they influence. As was stated before, the different components relate to theoretic literature on determinants of the bid-ask spread.[41] Why would we expect that designated sponsors exert an influence on the transitory non-information spread component, i.e. on (transitory) inventory costs, order processing costs or costs related to non-competitive pricing? Standard inventory models in line with e.g. Ho and Stoll or, adapted to a market structure similar to Xetra, Menkveld (2006), argue that risk averse market makers have to be compensated for bearing the risk of building up inventory positions in order to accommodate public order flow.[42] Typically, this cost increases in security risk, in risk aversion of the liquidity providers and in trade size. An increase in the number of market

[41]Literature from Roll (1984) onwards has shown that the existence of order-processing costs such as labour or telecommunication costs induces a bid-ask bounce. For the inventory spread component, compare e.g. Garman (1976), Stoll (1978) or Ho and Stoll (1981). For models on the adverse selection spread component, compare e.g. Bagehot (1971), Copeland and Galai (1983) or Kyle (1985). Finally, if market makers possess some market power, the existence of a bid-ask spread may relate to the degree of non-competitiveness in the market.

[42]Compare also Biais, Glosten, and Spatt (2005), p. 221.

makers c.p. reduces the exposure risk each liquidity supplier has to bear, hence inventory risk sharing implies lower spreads. Note that in our setup, inventory costs are limited by the fact that designated sponsors do not have to bear large exposure risks since they can always choose to quote no more than the required minimum amount or even to stay out of the market for a limited time period. As an intuition why pure order processing costs may decrease in the number of designated sponsors, one could imagine that an increase in the overall number of market makers on the exchange leads to an increase in the average number of contracted firms per sponsor, implying economies of scope in processing costs. If we assume that an increase in the number of designated sponsors changes trading volumes transacted by the market maker, this factor might additionally influence costs. Finally, if market makers possess market power which they translate into bid-ask spreads, price competition should clearly decrease this component unless there is tacit collusion. Predictions are quite clear cut and we formulate the following hypothesis: *"The transitory spread component decreases in the number of designated sponsors."*

With respect to the asymmetric information component, the spread balances losses to informed traders with profits from uninformed traders, ensuring that market makers do not lose money on average. There are several possibilities how this component might be affected by an increase in the number of market makers: If market makers reduce opaqueness of the covered firm, this might reduce the relative information advantage of informed traders (e.g. in form of the private signal received or the signal-to-noise-ratio), reducing adverse selection costs. Conversely, since informed traders are more likely to track the stock and trade when mid-quotes are far from efficient prices, a more efficient price from increasing the number of market makers should reduce informed trades. However, a decrease in the private signal received by an informed agent could potentially increase the quantity transacted if a reduced price impact outweighs effects from a decreased marginal valuation by the informed trader reducing demanded volume. If the information structure of the market does not change after the introduction of designated sponsors, but the quantity supplied at a given price increases, the informed trader might decide to transact more compared to the situation before, rendering the problem more severe for the market. We test the following hypothesis: *"The adverse selection spread component decreases in the number of designated sponsors."* Since expected results for the adverse selection component are not as clear cut as those for transitory transaction costs, we will employ decomposition approaches that explicitly single out permanent adverse selection costs.

5.1 Trade Indicator Model

We are going to test our hypotheses by means of two different methodologies. We start with a trade indicator model, employing binary variables of the trade direction in order to model short-run price dynamics. In this class of models as proposed by e.g. Glosten and Harris (1988), Huang and Stoll (1997) and Madhavan, Richardson, and Roomans (1997), one assumes that information about the share is contained in signed order flow. 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. Alternatively and as a robustness check, we perform a similar exercise using the empirical concept of realized spreads. Since we expect inventory costs to be relatively small, we do not opt for a procedure explicitly singling out the inventory spread component like e.g. the three-way decomposition by Huang and Stoll (1997).[43]

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 that μ_t evolves according to

$$\mu_t = \mu_{t-1} + Z_t Q_t + \epsilon_t, \tag{5}$$

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.[44] 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 costs, baseline inventory costs or mark-ups from non-competitive pricing):

$$p_t = \mu_t + C_t Q_t + e_t = \mu_{t-1} + Z_t Q_t + C_t Q_t + \epsilon_t + e_t. \tag{6}$$

The sum of the asymmetric information and the transitory component is 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:

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

[43]Compare also e.g. Cao, Choe, and Hatheway (1997), p. 1619, referring to some empirical evidence with respect to the size of the inventory cost component. As was said, we clearly expect inventory risk to decrease in the number of designated sponsors. Note then that quote updates in the following model contain asymmetric information costs and the part of inventory costs that does not have a fixed cost character. Similarly, it might be that in the realized spread decomposition, the permanent component also contains inventory effects. However, the fact that inventory effects may be quite persistent may be alleviated by the fact that "expensive" inventory positions for volatile stocks in our setup can be avoided. It may also be the case that large parts of inventory costs are already priced into the transitory spread component since Deutsche Börse's requirements set the cap of mandatory risk exposure.

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

Consequently, a market participant buys at the ask price and sells at the bid price. First-differencing equation (6), the price change is given by:

$$\begin{aligned} \Delta p_t &= \Delta\mu_t + C_t Q_t - C_{t-1} Q_{t-1} + e_t - e_{t-1}, \\ &= Z_t Q_t + C_t Q_t - C_{t-1} Q_{t-1} + \nu_t, \\ \text{where } \ \nu_t &= \epsilon_t + e_t - e_{t-1}. \end{aligned} \tag{7}$$

5.2 Application of Glosten-Harris Model

We now proceed to estimate equation (7) from the data. Since we have reasons to believe that the spread is not constant, but might differ for different trade sizes, we include trading volume as an explanatory variable and postulate a linear relation of Vol_t and both the adverse selection component and the transitory component:[45]

$$\begin{aligned} Z_t &= z_0 + z_1 \cdot Vol_t, \\ C_t &= c_0 + c_1 \cdot Vol_t. \end{aligned}$$

Inserting these specifications into equation (7), we obtain:

$$\begin{aligned} \Delta p_t &= (z_0 + z_1 \cdot Vol_t) Q_t + (c_0 + c_1 \cdot Vol_t) Q_t - (c_0 + c_1 \cdot Vol_{t-1}) Q_{t-1} + \nu_t, \\ &= c_0 \Delta Q_t + c_1 \Delta(Q_t Vol_t) + z_0 Q_t + z_1 Q_t Vol_t + \nu_t, \\ \text{where } \ \Delta X_t &= X_t - X_{t-1}. \end{aligned} \tag{8}$$

When applying equation (8) to the data, we expect a positive sign for c_0 since some of the transitory 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, rendering c_1 negative. With respect to the adverse-selection component (including the part of inventory costs that is charged in form of quote revisions), we expect related costs to increase in trade size, implying a positive z_1. Finally, the constant z_0 should be positive since otherwise the possibility of "adverse-selection benefits" arises for small trade sizes. When estimating the Glosten-Harris model, one has to control for the fact that the error term ν_t is serially correlated by construction, rendering OLS errors unreliable. We employ Newey-West HAC standard errors to account for this problem.[46] Our data set does not dispose of a trade initiation variable, indicating whether a particular transaction has been triggered by a buy or a sell order. Fortunately, we can apply the widely-used Lee and Ready (1991) algorithm as introduced above in order to infer the trade direction from the

[45] 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.

[46] Alternatively, one can estimate the model by GMM. Results are virtually identical and not reported.

data, bearing a small risk of misspecifying the trade direction. Following the literature, we estimate the model for three-months-periods and exclude firms from our sample for which on average less than 250 observations are available. We consequently obtain a maximum of 15 different estimates for 106 firms.[47] An overview of typical results from estimating equation (8) is provided in Tables 9 and 10 for the time period from Januar to March 2005. 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. Furthermore, 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 9 shows exemplary estimation results for eight shares of each market segment.[48] 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 more liquid stocks from the TecDAX and MDAX market segment. For shares listed in the small cap market segment, the model sometimes fails to identify a significant influence of trading volume. We attribute these findings at least partly to the smaller number of observations for these shares and the lower variation in trading volume. Regarding Table 10, we observe that signs are as expected in almost all cases.[49]

[Insert Tables 9 and 10 about here]

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. 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 fourth. However, the correlation between both measures lies at 96%, hence we have some reason to believe that estimates are not systematically biased and proceed to use them for the further analysis without worrying.[50]

[47] By increasing sample size as opposed to estimating the model on a monthly basis, this approach should be especially valuable for firms from the small cap segment where trading intensity is lowest.

[48] We chose firms in alphabetical order. Results are not affected by the choice of the sample period.

[49] With respect to all estimates obtained, deviations from any of the expected signs occur in about 9% of all estimations, occurring in 0%, 5%, 1% and 3% of all cases for $c0$, $c1$, $z0$ and $z1$, respectively.

[50] This figure excludes one company, whose average correlation figure is negative. Estimations are robust to excluding this company.

5.3 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, the adverse selection, or both components of the bid-ask spread. The empirical strategy then consists of two-stage least squares panel data regressions of the estimates on a number of explanatory variables including the number of designated sponsors. Since it seems plausible to assume that related effects are not linear in the number of sponsors, we include the square of the number of designated sponsors.

With respect to the specification, we proceed similar to Glosten and Harris (1988) and propose a multivariate system when testing for effects. Since we use 3 months intervals in this section, we now allow for the possible endogeneity of trading volume, spread components and the number of designated sponsors. For the first stage regressions, we use the relations as depicted in the three equations below with values of the respective covariates lagged six months. Overall, we estimate three equations: the first equation regresses the transitory component estimate on potential determinants. The second equation performs the analogous exercise for the asymmetric information component. The third equation regresses the logarithm of daily trading volume among other variables on the magnitude of the spread.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 the estimation approach (or theory) into question.

Specifying determinants of the transitory components, from inventory-theoretic literature we infer that the higher the security risk and the lower the trade frequency, the higher the transitory component.[51] Hence, we include a measure of risk as well as the log of average daily trading volume as a measure both trade frequency and average trading volume per transaction into the estimation.[52] The first equation of our system is given by:

$$\begin{aligned} \hat{s}^{Trans}/P_{it} = {} & \gamma_0 + \gamma_1 SD_{it} + \gamma_2 Volume^d_{it} + \gamma_3 Size_{it} \\ & + \gamma_4 No\_DS_{it} + \gamma_5 No\_DS2_{it} + \zeta_{it}, \quad \zeta_{it} = w_i + s_{it}. \end{aligned} \tag{9}$$

$\hat{s}^{Trans}$ denotes the estimated transitory component of the Glosten-Harris model evaluated at average trade size and divided by the average price level P. SD denotes the daily standard deviation of returns, measured as an average over the estimation period.[53] $Volume^d$ denotes the natural logarithm of average daily trading volume, computed as the average

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

[52] Due to correlation levels of over 70%, we want to avoid putting both variables together into one specification.

[53] Employing lagged values of the standard deviation decreases significances, but does not change any of the main conclusions.

number of shares transacted times the average number of transactions per day. Given the fact that firm size was found to be highly significant in the first part of the empirical analysis, we further include $Size$ into the equation. To mitigate endogeneity issues, we employ the natural logarithm of total assets of a firm. Finally, we include the number of designated sponsors and its square, expecting a negative influence. The individual heterogeneity is denoted by w_i, s_{it} is the iid error.

For the second equation of the percentage adverse selection component of the spread, $\hat{s}^{Adv}/P$, we refer the reader to the literature assuming that both informed and liquidity investors trade in the market. Since a higher share of informed traders in the market should c.p. increase adverse selection problems for the rest of the market, we want to include a proxy for informed trading activity. Like Glosten and Harris, we use the "insider ownership concentration" ratio IC, defined as the proportion of shares owned by either members of the management board, their families or holdings where one of the mentioned persons is a board member.[54] Similarly, the adverse selection component should be a function of liquidity trade frequency. As it seems reasonable that "large" firms possess c.p. more liquidity traders than smaller firms (the probability that a trade is liquidity-initiated increases), we again include firm size measured as above 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 include 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. We are going to test whether designated sponsors decrease adverse selection costs by gaining expertise on the shares and by increasing efficiency of prices. The second equation is:

$$\begin{aligned}\hat{s}^{Adv}/P_{it} = \gamma_6 + \gamma_7 IC_{it} + \gamma_8 Size_{it} + \gamma_9 s^{Trans}/P_{it} + \gamma_{10} SD_{it} \\ + \gamma_{11} No\_DS_{it} + \gamma_{12} No\_DS2_{it} + \eta_{it}, \quad \eta_{it} = w_i + t_{it}.\end{aligned} \tag{10}$$

The third equation relates the logarithm of average daily trading volume in Euro to the estimated spread components, evaluated at average trading volume. One would assume that volume decreases in trading frictions and, hence, in both spread components. Additionally, we include firm size as it is reasonable to assume that more volume is turned over in larger firms. Furthermore, we include daily return standard deviations and the number of designated sponsors. Volatility and trading volume should be positively correlated and

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

one would rather expect that sponsors increase trading volume than decrease it.

$$Volume^d_{it} = \gamma_{13} + \gamma_{14}\hat{s}^{Trans}/P_{it} + \gamma_{15}\hat{s}^{Adv}/P_{it} + \gamma_{16}Size_{it} + \gamma_{17}SD_{it} + \gamma_{18}No\_DS_{it} + \gamma_{19}No\_DS2_{it} + \theta_{it}, \quad \theta_{it} = w_i + u_{it}. \tag{11}$$

All results of the two-stage fixed effects panel data routine prevail if we apply the ordinary robust fixed effects estimator. Results are depicted in Table 11.

[Insert Table 11about here]

Overall, we are satisfied with the results. Estimates bear the expected sign in most cases, suggesting that the components of the spread as identified by the Glosten-Harris model are indeed linked to 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 decreases in trading volume. Controlling for trading volume, firm size does not further influence the transitory spread component. Considering the influence of designated sponsors, a positive effect on the transitory spread component can be distinguished which is decreasing in the number of further designated sponsors. At significance levels of 7% and 1%, designated sponsors decrease the non-information share of transaction costs and thus improve liquidity for stocks traded in Xetra which is in line with theory and our first hypothesis.[55]

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 82% for both components, this result does not come as a surprise. None of the other variables except for return standard deviation is able to add any explanatory power to the equation due to the relative power of the first regressor. As expected, higher volatility is positively related to adverse selection costs as is a higher transitory spread component. This is in line with our hypothesis that given high transaction costs, the probability of liquidity trades decreases. However, signs for firm size and the importance of corporate insiders are contrary to expectations. In order to see whether results hinge on the use of the highly correlated contemporaneous spread variable, we re-estimate equation (10) and include the more exogenous 6 month lag of the transitory spread component. As can be seen in results for specification (10b), all coefficients are as expected. In line with the argument that the danger of trading with an informed agent is relatively small in larger firms, we

[55] A Wald test rejects the null hypothesis that the aggregate effect is zero at a level of 5%.

find a negative sign of the *Size* coefficient which is significant at a level of 8.5%. The sign for *IC* becomes positive with a significance level of 10.1%. Negative coefficients for the sponsor variables indicate that there might be a potentially beneficial effect with respect to adverse selection costs. However, the z-statistics are close to zero, hence we cannot infer that designated sponsors decrease adverse selection costs. Considering the last equation, both a larger estimated transitory and permanent spread component tendentially reduce the log Euro volume of shares transacted within a trading day, while only the effect for the adverse selection component is significant at a level of 2%. Finally, trading volume increases in firm size and is positively correlated to stock volatility. In line with former findings, there is no evidence that designated sponsors increase trading volume.

5.4 Decomposition with Realized Spreads

As our last exercise, we repeat the same analysis using the concept of realized spreads introduced in section 4. Remembering that the realized spread equals the market maker's gross revenue after information costs as measured by the difference between trading price at time t and the midpoint in $t + 5$ minutes have been subtracted, we can use the realized spread as the non-information related, transitory spread component and the difference between effective and realized spreads as the adverse selection component. The empirical analysis is then the same as before. Results are depicted in table 12 and are very similar to the results above. Apart from confirming an effect of designated sponsors on the non-information spread component at a level of 5%, estimations also identify an effect on the adverse selection component which is however only decreasing from having three designated sponsors onwards.

Overall, the decompositions into theoretical components both by means of the Glosten-Harris decomposition and the concept of realized spreads work quite well. At a significance level of 5%, we find that designated sponsors decrease the transitory spread component for both models, hence our first hypothesis is approved. Regarding the adverse selection component, results are not clear cut. Hence we conclude that the scope to decrease bid-ask spreads by increasing the number of designated sponsors mainly seems to stem from competition and risk-sharing among multiple liquidity providers and not so much from an reduction of asymmetric information in the market.

6 Conclusions

Deutsche Börse AG calls its Designated Sponsors the "Guardian Angels of Electronic Trading". In our study, we empirically tested the influence of Designated Sponsoring on magnitude and composition of bid-ask spreads in Xetra. We first presented an instrumental variables GMM framework and analysed impacts of designated sponsors on average quoted and effective half spreads. In a next step we employed a trade indicator model in order to decompose the spread into its single components. We opted for the Glosten and Harris (1988) and alternatively employed the concept of realized spreads. Estimates were then used to assess the impact of multiple liquidity providers on theoretic spread components. In summary, designated sponsors were found to be liquidity enhancing for a broad sample of stocks from the German stock market, implying that the current Xetra regulation which postulates trading with designated sponsors also for rather actively traded stocks makes sense. In terms of liquidity, it pays out for all firms to invest in one or two designated sponsors. Depending on firm characteristics, hiring additional sponsors may be useful, which is especially the case for the very volatile high tech stocks in the TecDAX index and for small stocks from the SDAX segment. We are the first to provide evidence that also the choice of a sponsor firm is a factor deserving attention for firms wanting to improve their liquidity on electronic limit order markets. It appears particularly worth wile to contract brokerage houses as opposed to commercial banks. However, commercial banks typically provide a more extensive range of services than brokerage houses, making a mixture between institutional forms appear to be a good choice. Decomposing the spread into its components, we find evidence that realized spreads earned by designated sponsors as well as the transitory spread component decrease in the number of designated sponsors, providing evidence that increased competition and risk-sharing increase liquidity as is predicted by theory (cf. e.g. Biais, Martimort, and Rochet (2000), Ho and Stoll (1981)). Evidence on the adverse selection component of the spread (cf. e.g. Bagehot (1971), Glosten and Milgrom (1985)) is less clear-cut. Three issues might be of interest for further research: First, it would be interesting to investigate cross-sectional determinants of the chosen number of designated sponsors and its variation over time. Second, given the conflicting evidence with respect to the asymmetric information component, one might think of further disentangling effects and to use decomposition methods allowing for serial correlation in trade flows in order to learn more about the nature of designated sponsor intervention. Third, given the known link from asset pricing to liquidity, the question of stock market reactions to changes in liquidity supply is a natural one. Overall, findings indicate that with respect to liquidity, other exchanges may want to consider the introduction of market makers also for more actively traded stocks as well as the option of increasing the number of designated liquidity providers beyond one.

A Tables and Figures

Table 2: Descriptive Statistics: Firm Characteristics

MDAX averages of	Mean	Std. Dev.	Min.	Max
Market cap. in million EUR	2,556.55	3,280.45	92.57	27,118.91
Total assets in million EUR	14,732.13	36,104.59	134.08	228,578.00
Common shares in million	108.00	134.33	7.43	802.13
Market to book value	2.32	1.81	0.24	12.61
Number of DS	1.47 0.95	0.00	5.00	
Price	37.93	37.03	3.04	316.80
Trading volume in shares	657.91	436.25	103.75	3,016.37
Trading volume in EUR	16,273.12	7,028.99	3,120.04	63,957.06
Monthly turnover in million EUR	121.82	150.34	1.07	1130.45

TecDAX averages of	Mean	Std. Dev.	Min.	Max
Market cap. in million EUR	1,061.62	2,105.193	34.28637	13,368.98
Total assets in million EUR	817.09	1,178.84	38.37	6,308.60
Common shares in million	93.31	225.24	5.68	1,223.89
Number of DS	1.97	1.04	0.00	6.00
Market to book value	2.33	1.70	0.52	12.51
Price	17.62	13.73	2.24	63.32
Trading volume in shares	828.92	571.45	162.13	7,800.51
Trading volume in EUR	9,810.37	4,949.18	1,025.00	69,307.39
Monthly turnover in million EUR	50.37	79.89	0.00	940.70

SDAX averages of	Mean	Std. Dev.	Min.	Max
Market cap. in million EUR	409.37	398.46	15.59	2,862.94
Total assets in million EUR	2,288.15	14,223.24	101.05	117,859.10
Common shares in million	34.41	32.10	3.78	165.91
Market to book value	2.26	2.03	0.17	16.92
Number of DS	1.45	0.68	0.00	4.00
Price	20.66	19.81	1.35	157.42
Trading volume in shares	705.95	501.88	69.69	4,189.80
Trading volume in EUR	9,323.04	5,532.27	1,350.84	69,382.88
Monthly turnover in million EUR	7.54	10.57	0.04	102.85

This table contains summary statistics for the 110 sample stocks divided by trading segment. Key financial figures are obtained from DATASTREAM.

Table 3: Regression results with $\mathbf{1}_{DS}$ for quoted and effective half spreads in %

	Quoted Half Spread in %		Effective Half Spread in%	
	FE	GMM	FE	GMM
Specification	(1a)	(1b)	(2a)	(2b)
Variable	Coef. ($\|t-stat.\|$)	Coef. ($\|z-stat.\|$)	Coef. ($\|t-stat.\|$)	Coef. ($\|z-stat.\|$)
$\mathbf{1}_{DS}$	-0.364***	-0.245**	-0.297**	-0.125***
	(2.98)	(2.48)	(2.07)	(2.96)
$LnMarketcap$	-0.100*	-0.215***	-0.013	-0.123*
	(1.82)	(4.24)	(0.22)	(1.91)
$Volume$	-5e-06*	-2e-06	-3e-06	3e-06
	(1.90)	(1.25)	(0.73)	(1.17)
SD	2.368**	1.733**	1.496	1.279**
	(2.21)	(1.96)	(1.49)	(2.06)
$Price$	0.001	0.002***	5e-05	0.001
	(1.31)	(2.66)	(0.10)	(0.90)
$\mathbf{1}_{2003}$	0.165***	3e-04	0.185***	0.103
	(3.56)	(0.01)	(3.64)	(1.16)
$\mathbf{1}_{2004}$	0.014	-0.008	0.033*	0.004
	(0.84)	(0.44)	(1.86)	(0.19)
$\mathbf{1}_{2005}$	-0.048***	-0.047***	-0.018	-0.015*
	(3.15)	(3.85)	(1.08)	(1.76)
$\mathbf{1}_{MDAX}$	-0.229***	-0.046	-0.208***	-0.044
	(6.59)	(1.16)	(6.02)	(1.45)
$\mathbf{1}_{TecDAX}$	0.044	-0.261*	0.302	-0.134**
	(0.19)	(1.75)	(1.10)	(2.00)
$\mathbf{1}_{SDAX}$	-0.092***	-0.012	-0.072***	-0.017
	(3.46)	(0.27)	(3.08)	(0.54)
$Const.$	2.866**		0.869	
	(2.52)		(0.70)	
$Obs.$	4,802	4,578	4,803	4,580
R^2 within	0.07		0.04	

Remark: ***, ** and * denote significance at the 1%, 5%, and 10% level, respectively. z-statistics and t-statistics are based on the robust Huber/White sandwich variance estimator. Specifications (1a) and (2a) are estimated by OLS fixed effects estimation (FE, within estimator), specifications (1b) and (2b) by GMM with lagged levels from $t-2$ of average trading volume instrumenting current average trading volume. $\mathbf{1}_{DS}$ is an indicator variable taking on the value 1 if the firm has one or more designated sponsors in the current month on average and 0 otherwise. For the definition of the other variables and more details, compare section 4.2.

Table 4: Results with No_DS and $(No\_DS)^2$ for quoted and effective half spreads in %

	Quoted Half Spread in %		Effective Half Spread in%	
	FE	GMM	FE	GMM
Specification	(3a)	(3b)	(4a)	(4b)
	Coef.	Coef.	Coef.	Coef.
Variable	$(\|t-stat.\|)$	$(\|z-stat.\|)$	$(\|t-stat.\|)$	$(\|z-stat.\|)$
No_DS	-0.151**	-0.179***	-0.100	0.061
	(2.07)	(2.62)	(1.18)	(0.38)
No_DS^2	0.022*	0.030**	0.013	-0.002
	(1.74)	(2.36)	(0.89)	(0.09)
$LnMarketcap$	-0.087	-0.209***	-0.002	-0.113*
	(1.58)	(4.14)	(0.04)	(1.83)
$Volume$	-5e-06*	-2e-06	-3e-06	3e-06
	(1.75)	(1.19)	(0.70)	(1.09)
SD	2.548**	1.710*	1.649	1.243*
	(2.32)	(1.96)	(1.60)	(1.93)
$Price$	3e-04	0.002**	-4e-04	0.001
	(0.51)	(2.41)	(0.67)	(0.61)
$\mathbf{1}_{2003}$	0.178***	0.001	0.195***	0.088
	(3.95)	(0.06)	(3.98)	(1.21)
$\mathbf{1}_{2004}$	0.018	-0.007	0.035**	-0.008
	(1.17)	(0.41)	(2.22)	(0.33)
$\mathbf{1}_{2005}$	-0.044***	-0.045***	-0.015	-0.022**
	(3.13)	(3.82)	(1.01)	(2.07)
$\mathbf{1}_{MDAX}$	-0.223***	-0.044	-0.204***	-0.051
	(6.33)	(1.11)	(5.78)	(1.53)
$\mathbf{1}_{TecDAX}$	0.055	-0.262*	0.309	-0.161*
	(0.24)	(1.74)	(1.14)	(01.78)
$\mathbf{1}_{SDAX}$	-0.094***	-0.010	-0.074***	-0.020
	(3.64)	(0.24)	(3.24)	(0.61)
$Const.$	2.427**		0.488	
	(2.13)		(0.40)	
$Obs.$	4,802	4,578	4,803	4,580
R^2 within	0.07		0.04	

Remark: ***, ** and * denote significance at the 1%, 5%, and 10% level, respectively. z-statistics and t-statistics are based on the robust Huber/White sandwich variance estimator. Specifications (3a) and (4a) are estimated by OLS fixed effects estimation (FE), specifications (3b) and (4b) by GMM using lagged non-exogenous variables as instruments (GMM). No_DS denotes the average number of hired designated sponsors for the current month, $(No\_DS)^2$ denotes its square. For the definition of the other variables and the econometric specifications, compare section 4.2.

Table 5: Results with $DS12$ and $DS3456$ for quoted and effective half spreads in %

	$S^{Quoted}/2$ in %		$S^{Eff.}/2$ in%	
	FE	GMM	FE	GMM
Specification	(5a)	(5b)	(6a)	(6b)
	Coef.	Coef.	Coef.	Coef.
Variable	$(\|t-stat\|)$	$(\|z-stat\|)$	$(\|t-stat\|)$	$(\|z-stat\|)$
$DS12$	-0.360***	-0.245**	-0.293**	-0.126***
	(2.95)	(2.48)	(2.05)	(2.97)
$DS3456$	-0.406***	-0.245**	-0.346**	-0.115***
	(3.22)	(2.52)	(2.34)	(2.71)
$LnMCap$	-0.098*	-0.215***	-0.012	-0.124*
	(1.78)	(4.23)	(0.19)	(1.91)
$Volume$	-5e-06*	-2e-06	-2e-06	3e-06
	(1.89)	(1.25)	(0.72)	(1.17)
SD	2.396**	1.721**	1.529	1.281**
	(2.23)	(1.96)	(1.53)	(2.07)
$Price$	7e-04	0.002***	-3e-05	0.001
	(1.35)	(2.66)	(0.07)	(0.91)
$\mathbf{1}_{2003}$	0.170***	3e-4	0.190***	0.103
	(3.59)	(0.01)	(3.66)	(1.16)
$\mathbf{1}_{2004}$	0.015	-0.007	0.034*	0.003
	(0.92)	(0.44)	(1.93)	(0.18)
$\mathbf{1}_{2005}$	-0.046***	-0.047***	-0.016	-0.016*
	(6.59)	(3.85)	(0.97)	(1.78)
$\mathbf{1}_{MDAX}$	-0.230***	-0.046	-0.209***	-0.044
	(6.59)	(1.16)	(6.02)	(1.46)
$\mathbf{1}_{TecDAX}$	0.043	-0.261*	0.301	-0.134**
	(0.19)	(1.75)	(1.09)	(2.00)
$\mathbf{1}_{SDAX}$	-0.095***	-0.012	-0.075***	-0.017
	(3.55)	(0.27)	(3.19)	(0.54)
$Const.$	2.840**		0.839	
	(2.48)		(0.67)	
$Obs.$	4,802	4,578	4,803	4,580
R^2 within	0.07		0.04	

Results for $DS1$, $DS2$ and $DS3456$

$DS1$	-0.361***	-0.238**	-0.298**	-0.147***
	(3.01)	(2.45)	(2.12)	(2.81)
$DS2$	-0.355***	-0.297***	-0.269*	0.044
	(2.66)	(2.77)	(1.71)	(0.22)
$DS3456$	-0.403***	-0.290***	-0.329**	0.029
	(3.04)	(2.76)	(2.12)	(0.16)

Remark: ***, ** and * denote significance at the 1%, 5%, and 10% level, respectively. z- and t-statistics are based on robust standard errors. Estimation methods are as before. $DSxy$ are indicator variables equal to 1 if the average number of designated sponsors for the current month equals x or y. Compare also section 4.2. In the lower panel, estimates for another specification including $DS1$, $DS2$ and $DS3456$ are reported. Controls are as above.

Table 6: Results with $DS12$ and $DS3456$ for quoted half spreads in % by index segment

	$S^{Quoted}/2$ in %		$S^{Quoted}/2$ in %		$S^{Quoted}/2$ in %	
	FE	GMM	FE	GMM	FE	GMM
Specification	(5d)	(5e)	(5f)	(5g)	(5h)	(5i)
Index	MDAX		TecDAX		SDAX	
	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.
Variable	($\|t-stat\|$)	($\|z-stat\|$)	($\|t-stat\|$)	($\|z-stat\|$)	($\|t-stat\|$)	($\|z-stat\|$)
$DS12$	-0.145***	-0.105*	-1.291**	-0.571	-0.114*	-0.156***
	(4.10)	(1.78)	(2.02)	(1.44)	(1.77)	(4.39)
$DS3456$	-0.106***	-0.072	-1.394**	-0.577	-0.188**	-0.123
	(3.29)	(1.35)	(2.17)	(1.46)	(2.47)	(1.47)
$LnMCap$	-0.097***	-0.129***	0.203	-0.245***	-0.212***	-0.066
	(7.11)	(3.48)	(0.93)	(3.92)	(5.86)	(1.04)
$Volume$	-3e-06***	-5e-06***	-8e-06*	-3e-06	-1e-05***	-9e-06***
	(5.05)	(3.56)	(1.71)	(1.47)	(6.60)	(2.94)
$TradeFreq$	-1e-04***	-4e-05	-3e-4	-1e-05	-0.002***	-9e-04***
	(6.27)	(1.62)	(1.25)	(0.17)	(6.79)	(2.73)
SD	3.821***	2.020***	1.302	0.129	6.238***	4.657***
	(7.07)	(5.95)	(0.55)	(0.15)	(2.75)	(3.41)
$Price$	7e-04***	0.002***	-0.013*	0.002**	0.002**	0.002
	(3.84)	(3.44)	(1.86)	(1.96)	(2.35)	(1.48)
$\mathbf{1}_{2003}$	0.019	0.007	0.223*	0.043*	0.041	0.066
	(1.23)	(0.33)	(1.67)	(1.95)	(1.46)	(0.88)
$\mathbf{1}_{2004}$	-0.041***	-0.008	-0.076**		-0.015	0.032
	(4.24)	(0.47)	(2.21)		(0.77)	(0.60)
$\mathbf{1}_{2005}$	-0.053***	-0.021	-0.048		-0.109***	-0.104***
	(6.60)	(1.52)	(1.22)		(6.80)	(2.94)
$Const.$	2.419***		-2.066		4.943***	
	(8.44)		(0.49)		(7.09)	
$Obs.$	1,756	1,513	940	777	1,537	1,307
R^2 within	0.36		0.10		0.42	

Results for $DS1$, $DS2$ and $DS3456$

$DS1$	-0.143***	-0.105*	-1.296**	-0.570	-0.081	-0.118***
	(4.00)	(1.78)	(2.01)	(1.44)	(1.23)	(2.73)
$DS2$	-0.159***	-0.105*	-1.283**	-0.601	-0.197***	-0.282***
	(4.51)	(1.74)	(2.02)	(1.52)	(2.92)	(5.81)
$DS3456$	-0.113***	-0.072	-1.387**	-0.601	-0.240***	-0.248***
	(3.54)	(1.33)	(2.18)	(1.52)	(3.04)	(2.78)

Remark: ***, ** and * denote significance at the 1%, 5%, and 10% level, respectively. z- and t-statistics are based on robust standard errors. Specifications are estimated by GMM using lagged instrumental variables as indicated (GMM), or by OLS fixed effects estimation (FE). $DSxy$ are indicator variables equal to 1 if the average number of designated sponsors for the current month equals x or y. $TradeFreq$ denotes the average number of daily trades. For the definition of the other variables and the econometric specifications, compare section 4.2.

Table 7: Regression results for specifications (1), (3) and (5) using dynamic Arellano-Bond GMM estimator

	Quoted Half Spread in %		
Specification	GMM (1c)	GMM (3c)	GMM (5c)
Variable	Coef. ($\lvert z-stat.\rvert$)	Coef. ($\lvert z-stat.\rvert$)	Coef. ($\lvert z-stat.\rvert$)
$\mathbf{1}_{DS}$	-0.110**		
	(2.10)		
No_DS		-0.109***	
		(2.82)	
No_DS^2		0.022***	
		(2.61)	
$DS12$			-0.114**
			(2.17)
$DS3456$			-0.062
			(1.10)
$S^{Quoted}/2_{t-1}$	0.143***	0.144***	0.142***
	(6.10)	(6.30)	(6.08)
$LnMarketcap$	-0.113***	-0.112***	-0.114***
	(2.74)	(2.71)	(2.74)
$Volume$	-7e-06***	-7e-06***	-7e-06***
	(4.21)	(4.19)	(4.20)
$TradeFreq$	-1e-04**	-1e-04**	-1e-04**
	(2.12)	(2.10)	(2.11)
SD	2.628***	2.635***	2.622***
	(3.88)	(3.88)	(3.87)
$Price$	0.002***	0.002***	0.002***
	(3.05)	(2.89)	(3.09)
$\mathbf{1}_{2003}$	0.093*	0.092*	0.091*
	(1.89)	(1.90)	(1.84)
$\mathbf{1}_{2004}$	0.075	0.074	0.076
	(1.63)	(1.61)	(1.64)
$\mathbf{1}_{2005}$	-0.040	-0.039	-0.040
	(1.45)	(1.42)	(1.45)
$\mathbf{1}_{MDAX}$	-0.023	-0.023	-0.023
	(0.50)	(0.48)	(0.49)
$\mathbf{1}_{TecDAX}$	-0.159**	-0.159**	-0.159**
	(2.03)	(2.03)	(2.03)
$\mathbf{1}_{SDAX}$	-0.033	-0.033	-0.032
	(0.79)	(0.80)	(0.77)
$Obs.$	3,499	3,499	3,499

Remark: ***, ** and * denote significance at the 1%, 5%, and 10% level, respectively. This table presents estimation results for specifications (1), (3) and (5) using the dynamic Arellano-Bond (1991) GMM estimator with one lag. The AR(1) term is denoted by $S^{Quoted}/2_{t-1}$. $TradeFreq$ denotes the average number of daily trades. All other variables are as indicated before.

Table 8: Results with *Broker* and *Bank* for quoted and effective half spreads in %

	Quoted Half Spread in %		Eff. Half Spread in %	
Specification	FE (7a)	GMM (7b)	FE (8a)	GMM (8b)
Variable	Coef. ($\|t-stat\|$)	Coef. ($\|z-stat\|$)	Coef. ($\|t-stat\|$)	Coef. ($\|z-stat\|$)
$Broker$	-0.191***	-0.084***	-0.205***	-0.040**
	(4.08)	(2.95)	(3.80)	(2.26)
$Bank$	0.093	-0.033	0.160*	-0.024
	(1.17)	(0.79)	(1.76)	(0.93)
$DS12$	-0.414***	-0.204**	-0.396**	-0.102**
	(3.11)	(2.11)	(2.56)	(2.49)
$DS3456$	-0.365***	-0.173*	-0.349**	-0.077*
	(2.81)	(1.79)	(2.32)	(1.72)
$LnMarketcap$	-0.102**	-0.212***	-0.020	-0.122*
	(2.02)	(4.20)	(0.37)	(1.89)
$Volume$	-6e-06**	-2e-06	-3e-06	3e-06
	(2.02)	(1.28)	(0.86)	(1.20)
SD	2.427**	1.730**	1.558	1.286**
	(2.30)	(1.97)	(1.59)	(2.08)
$Price$	0.001	0.002***	-1e-04	0.001
	(1.08)	(2.60)	(0.29)	(0.89)
$\mathbf{1}_{2003}$	0.158***	0.002	0.173***	0.104
	(3.79)	(0.08)	(3.84)	(1.17)
$\mathbf{1}_{2004}$	0.008	-0.008	0.022	0.004
	(0.54)	(0.45)	(1.49)	(0.20)
$\mathbf{1}_{2005}$	-0.046***	-0.046***	-0.018	-0.015*
	(3.18)	(3.79)	(1.11)	(1.73)
$\mathbf{1}_{MDAX}$	-0.262***	-0.046	-0.248***	-0.044
	(5.99)	(1.16)	(5.39)	(1.45)
$\mathbf{1}_{TecDAX}$	0.009	-0.261*	0.258	-0.134**
	(0.04)	(1.74)	(0.99)	(2.00)
$\mathbf{1}_{SDAX}$	-0.122***	-0.012	-0.107***	-0.018
	(4.17)	(0.28)	(3.79)	(0.55)
$Const.$	2.980**		1.067	
	(2.84)		(0.94)	
$Obs.$	4,802	4,578	4,803	4,580
R^2 within	0.09		0.06	

Remark: ***, ** and * denote significance at the 1%, 5%, and 10% level, respectively. z-statistics and t-statistics are based on robust standard errors. Specifications are estimated by GMM using lagged instrumental variables as indicated (GMM), or by OLS fixed effects estimation (FE). *Broker* and *Bank* are indicator variables being equal to 1 if the firm has hired a sponsor firm being originally a brokerage house or as a bank, respectively, and 0 otherwise. $DSxy$ are indicator variables equal to 1 if the average number of designated sponsors for the current month equals x or y. Compare also section 4.2.

Table 9: Estimates of Glosten-Harris model for sub-sample period January to March 2005

Stock	$\hat{c}_0$	$\|t\|$	$\hat{c}_1$	$\|t\|$	$\hat{z}_0$	$\|t\|$	$\hat{z}_1$	$\|t\|$	Obs	F-stat.
MDAX										
ARL	0.015***	24.6	-1.9E-07	0.5	0.008***	14.8	5.4E-04***	4.3	10,040	476
AMD	0.018***	25.4	1.1E-06	1.0	0.013***	13.4	6.1E-06***	3.1	15,495	745
AWD	0.015***	27.0	-3.3E-07	0.9	0.010***	14.2	3.1E-06***	3.1	10,022	545
BEI	0.020***	22.9	-9.5E-08***	3.4	0.014***	15.0	3.2E-05***	9.5	13,523	586
BZL	0.065***	8.6	-1.3E-05***	2.8	0.051***	7.2	-1.8E-06	0.4	1,297	54
GBF	0.012***	25.4	-2.4E-06***	4.0	0.007***	16.3	5.6E-06***	8.7	14,417	664
CLS1	0.009***	24.7	-2.2E-06***	3.5	0.009***	25.0	9.5E-06**	11.5	30,737	1,138
CON	0.006***	64.9	-6.9E-07***	7.7	0.004***	37.9	2.5E-06***	21.5	89,355	4,729
TecDAX										
AIX	0.005***	47.5	-3.2E-07***	7.5	0.001***	9.0	9.4E-07***	13.9	12,407	1,401
AUS	0.021***	28.3	-3.6E-06***	5.6	0.007***	9.5	8.3E-06***	9.7	4,394	505
BBZ	0.035***	23.6	-8.9E-06*	1.9	0.011***	9.8	1.2E-05***	3.4	5,216	432
DRW3	0.037***	27.8	-1.1E-05***	4.9	0.014***	12.4	1.5E-05***	6.3	7,324	492
ELG	0.014***	21.5	-2.2E-06***	4.2	0.006***	8.3	4.8E-06***	5.4	4,044	317
EPC	0.005***	50.4	-4.0E-07***	7.9	0.002***	19.2	9.9E-07***	17.0	27,688	2,041
EVT	0.006***	25.8	-3.2E-07**	2.3	0.002***	8.0	1.3E-06***	9.8	6,619	690
FJH	0.022***	9.5	-6.1E-06***	3.7	0.007***	3.5	7.8E-06***	4.1	796	70
SDAX										
AVA	0.110***	7.0	-1.5E-04***	3.1	0.016	1.4	1.6E-04***	2.8	577	27
BAD	0.008***	30.9	-5.6E-07***	4.3	0.002***	10.9	1.7E-06***	10.9	7,228	614
USE	0.036***	20.9	-3.0E-06***	2.9	0.012***	8.0	1.6E-07	0.3	1,745	207
BSK	0.030***	15.4	-6.3E-06***	3.4	0.005***	3.2	1.2E-05***	5.0	1,998	142
BSY	0.092***	11.8	-6.8E-06	1.2	0.049***	8.3	9.4E-07	0.2	1,227	79
CWC	0.064***	12.2	-9.7E-06	1.6	0.028***	5.9	-1.9E-06***	3.1	1,591	98
COM	0.007***	34.6	-4.9E-07***	4.5	0.001***	8.1	1.4E-06***	7.8	8,838	620
DRN	0.010***	19.1	-7.0E-07***	4.1	0.005***	11.1	1.7E-06***	9.2	3,382	289

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

Table 10: Signs of Estimates of Glosten-Harris Model for sub-sample period January to March 2005

Stock	$\hat{c}_0$	$\hat{c}_1$	$\hat{z}_0$	$\hat{z}_1$	Obs.	Segment
AAREAL BANK	+	-	+	+	10,040	MDAX
AMB GENERALI	+	+	+	+	15,495	MDAX
AWD HOLDING	+	-	+	+	10,022	MDAX
BEIERSDORF	+	-	+	+	13,523	MDAX
BERU	+	-	+	-	1,297	MDAX
BILFINGER+BERGER	+	-	+	+	14,417	MDAX
CELESIO	+	-	+	+	30,737	MDAX
CONTINENTAL	+	-	+	+	89,355	MDAX
DEUTSCHE BOERSE	+	-	+	+	12,941	MDAX
DEGUSSA	+	-	+	+	5,784	MDAX
DEPFA BANK	+	-	+	+	45,302	MDAX
DOUGLAS HOLDING	+	-	+	+	14,082	MDAX
DYCKERHOFF	+	-	+	+	1,268	MDAX
EADS	+	-	+	+	5,751	MDAX
FRAPORT	+	-	+	+	12,864	MDAX
AIXTRON	+	-	+	+	12,407	TecDAX
AT+S AUSTRIA	+	-	+	+	4,394	TecDAX
BB BIOTECH	+	-	+	+	5,216	TecDAX
DRAEGERWERK	+	-	+	+	7,324	TecDAX
ELMOS SEMICOND.	+	-	+	+	4,044	TecDAX
EPCOS	+	-	+	+	27,688	TecDAX
EVOTEC	+	-	+	+	6,619	TecDAX
FJH	+	-	+	+	796	TecDAX
GPC BIOTECH	+	-	+	+	11,709	TecDAX
IDS SCHEER	+	-	+	+	5,610	TecDAX
JENOPTIK	+	-	+	+	11,184	TecDAX
KONTRON	+	-	+	+	7,078	TecDAX
LION BIOSCIENCE	+	-	+	+	1,771	TecDAX
MEDIGENE	+	-	+	+	9,256	TecDAX
MICRONAS	+	-	+	+	2,196	TecDAX
AVA	+	-	+	+	577	SDAX
BALDA	+	-	+	+	7,228	SDAX
BEATE UHSE	+	-	+	-	1,745	SDAX
BHW HOLDING	+	-	+	+	1,998	SDAX
BOEWE SYSTEC	+	-	+	-	1,227	SDAX
CEWE COLOR HOLD.	+	-	+	+	1,591	SDAX
COMDIRECT BANK	+	-	+	+	8,838	SDAX
DAB BANK	+	-	+	+	3,382	SDAX
DEUTZ	+	-	+	+	3,764	SDAX
DIS DEUT. IND. SERV.	+	-	+	-	907	SDAX
DT. BETEILIGUNG	+	-	+	+	1,884	SDAX
DUERR	+	-	+	+	724	SDAX
ESCADA	+	-	+	+	1,521	SDAX
FIELMANN	+	-	+	+	3,208	SDAX
FUCHS PETROL.	+	-	+	+	3,323	SDAX

Table 11: Decomposition of the Glosten-Harris Estimates

Eq.	Dependent variable			Endogenous variables					Exogenous variables			Obs.	R^2
		$Const.$ (|z|)	$Volume^d$ (|z|)	$\hat{s}^{Trans}/P$ (|z|)	$\hat{s}^{Adv}/P$ (|z|)	No_DS (|z|)	No_DS2 (|z|)	$L2.\hat{s}^{Trans}/P$ (|z|)	SD (|z|)	IC (|z|)	$Size$ (|z|)		
(9)	$\hat{s}^{Trans}/P$	1.598***	-0.095***			-0.125*	0.052***		4.150***		-0.009	1,126	35.28%
		(5.66)	(8.54)			(1.80)	(2.85)		(6.28)		(0.51)		
(10a)	$\hat{s}^{Adv}/P$	-0.273		0.421***		0.022	0.003		1.355***	-0.014	0.110	1,126	24.54%
		(1.33)		(7.23)		(0.50)	(0.19)		(3.32)	(0.21)	(1.14)		
(10b)		0.365*				-0.010	-0.001	0.093***	1.878***	0.126	-0.016*	1,126	15.15%
		(1.92)				(0.21)	(0.06)	(3.02)	(3.86)	(1.64)	(1.72)		
(11)	$Volume^d$	5.197*		-1.894	-9.015**	0.573	-0.148		61.579***		0.393***	1,126	47.32%
		(1.86)		(0.98)	(2.37)	(0.99)	(0.95)		(8.56)		(3.07)		

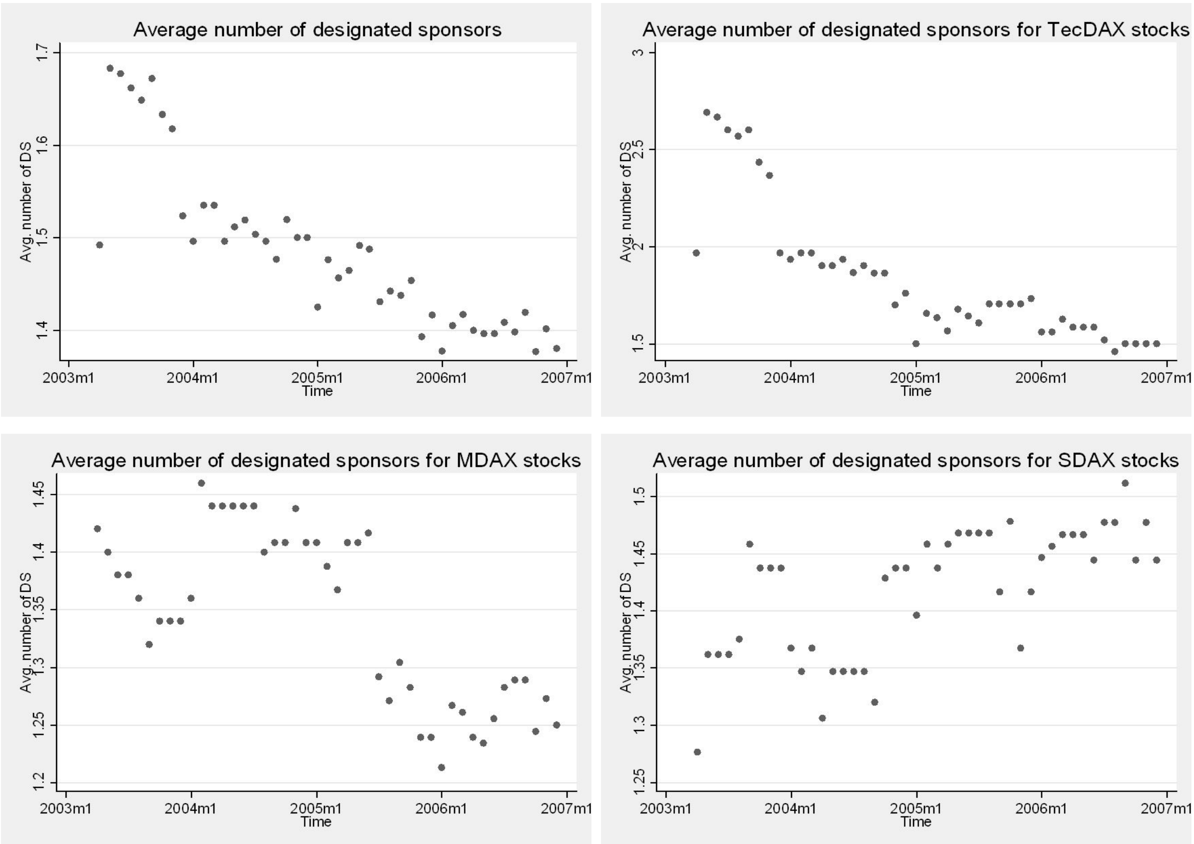
Remarks: ***, ** and * denote significance at the 1%, 5%, and 10% level, respectively. The endogenous variables are specified as follows: $\hat{s}^{Trans}/P$ and $\hat{s}^{Adv}/P$ stand for the estimated transitory resp. adverse selection component of the Glosten-Harris model, evaluated at the average trading volume. $Volume^d$ denotes the natural logarithm of average daily trading volume per stock. No_DS and No_DS2 denote the average number of designated sponsors of the firm in the three month sample period and its square. With respect to the exogenous variables, $L2.\hat{s}^{Trans}/P$ is the 6 month lag of the transitory spread component, SD is the average of daily standard deviations in returns. IC measures the percentage of shares held by either members of the management board or their families directly or in form of holdings in which they as well participate in one of the boards. $Size$ denotes the log of total assets for the firm. The multivariate cross-sectional system is estimated using two-stage least squares and fixed effects estimation. The sample contains 106 firms and a maximum of 15 periods. The overall sample size for which all variables are available is 1,126.

Table 12: Spread Decomposition Employing Realized Half Spreads

Eq.	Dependent variable			Endogenous variables					Exogenous variables			
		Const. ($\lvert z \rvert$)	$Volume^d$ ($\lvert z \rvert$)	$s^{Real.}/2in\%$ ($\lvert z \rvert$)	$s^{Adv.}/2in\%$ ($\lvert z \rvert$)	No_DS ($\lvert z \rvert$)	No_DS2 ($\lvert z \rvert$)	SD ($\lvert z \rvert$)	IC ($\lvert z \rvert$)	$Size$ ($\lvert z \rvert$)	Obs.	R^2
(9)	s^{Trans}/P	1.933***	-0.082***			-0.250**	0.065*	2.143*		-0.026	1,126	94.09%
		(3.80)	(4.07)			(2.01)	(1.83)	(1.86)		(0.90)		
(10a)	s^{Adv}/P	-1.111		0.622*		0.492*	-0.181**	6.271***	0.539*	0.039	1,126	17.72%
		(0.91)		(1.78)		(1.87)	(2.14)	(3.12)	(1.69)	(0.71)		
(11)	$Volume^d$	6.052		-3.036*	-8.387***	0.519	0.101	63.579***		0.346*	1,126	38.80%
		(1.29)		(1.73)	(3.74)	(0.51)	(0.39)	(6.09)		(1.69)		

Remarks: ***, ** and * denote significance at the 1%, 5%, and 10% level, respectively. The endogenous variables are specified as follows: $s^{Real.}in\%$ and $s^{Adv.}in\%$ stand for the estimated transitory resp. adverse selection component of the spread, while the first part is computed as the percentage realized half spread and the second part is the difference between effective and realized half spreads in percent. $Volume^d$ denotes the natural logarithm of average daily trading volume per stock. No_DS and No_DS2 denote the average number of designated sponsors of the firm in the three month sample period and its square. SD is the average of daily standard deviations in returns. IC measures the percentage of shares held by either members of the management board or their families directly or in form of holdings in which they as well participate in one of the boards. $Size$ denotes the log of total assets for the firm. The multivariate cross-sectional system is estimated using two-stage least squares and fixed effects estimation. The sample contains 106 firms and a maximum of 15 periods. The overall sample size for which all variables are available is 1,126.

Figure 1: Plots of the average number of designated sponsors per stock over time



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