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The Anatomy of a Call Market: Evidence from Germany

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The Anatomy of a Call Market: Evidence from Germany

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Abstract: This paper provides a detailed empirical analysis of the call auction procedure on the German stock exchanges. The auction is conducted by the Makler whose position resembles that of a NYSE specialist. We use a dataset which contains information about all individual orders for a sample of stocks traded on the Frankfurt Stock Exchange (FSE). This sample allows us to calculate the cost of transacting in a call market and compare them to the costs of transacting in a continuous market. We find that transaction costs for small transactions in the call market are lower than the quoted spread in the order book of the continuous market whereas transaction costs for large transactions are higher than the spread in the continuous market.

We further address the question whether active participation of the Makler is advantageous. On the one hand he may accomodate order imbalances, increase the liquidity of the market and stabilize prices. On the other hand, the discretion in price setting gives him an incentive to manipulate prices. This may increase return volatility. Our dataset identifies the trades the Maklers make for their own accounts. We eliminate these trades and determine the price that would have obtained without their participation. Comparing this hypothetical price series to the actual transaction prices, we find that Makler participation tends to reduce return volatility. A further analysis shows that the actual prices are much closer to the surrounding prices of the continuous trading session than the hypothetical prices that would have obtained without Makler participation. These results indicate that the Maklers provide a valuable service to the market. We further calculate the profits associated with the positions taken by the Maklers and find that, on average, they do not earn profits on the positions they take. Their compensation is thus restricted to the commissions they receive.

JEL classification: G10

Keywords: Call Markets, Liquidity, Price Formation, Specialist Trading

1 Introduction

Call market trading bears many resemblances to the textbook Walrasian tâtonnement process and is therefore frequently considered to be an efficient way of organizing securities trading. The temporal consolidation of the order flow may enhance price discovery and reduce the price impact of individual orders. On the other hand, call markets do not offer immediate access to the market and therefore impose waiting costs on the investors.[1]

Many exchanges (the New York Stock Exchange, the Tokio Stock Exchange, the Paris Bourse and the Frankfurt Stock Exchange, to name but a few) rely on call markets to establish the opening price but employ some sort of continuous trading mechanism throughout the rest of the trading day. This is certainly to the benefit of those demanding immediacy but at the same time it may raise the total transaction costs borne by the market participants.

Resolving this trade-off requires knowledge of the transaction costs in call and continuous markets. Although empirical work on the cost of transacting in continuous markets is abundant in the market microstructure literature, surprisingly little is known about the cost of transacting in a call market. One reason for this is the non-existence of a simple measure of transaction costs. In continuous markets, trading costs are usually measured by the quoted or effective bid-ask spread. This measure does not extend to call markets because no explicit spread exists. Estimating the spread from transactions data using ROLL's (1984) serial covariance estimator or modifications thereof is, as will be shown in the sequel, not appropriate.

BROOKS / SU (1997) use an indirect approach to assess the transaction costs in a call market. In a simulation study they demonstrate that a small liquidity trader can reduce transaction costs by trading at the opening. A problem with this approach is that the simulation assumes that orders submitted to the opening call do not have a price impact.[2] In reality the submission of an additional order may cause the price to change. This price

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1 This trade-off has been formalized by GARBADE / SILBER (1979).

2 BROOKS / SU (1997) address this problem by re-running the simulation and adding a one-tick penalty to the opening price whenever the trading volume at the opening is no more than ten round lots. Both the magnitude of the simulated transaction cost and the condition under which it is imposed are, however, ad-hoc.

impact is the transaction cost in the call market. It can, in principle, be calculated from order book data. However, this kind of data is usually not available.

We use a unique dataset which contains information about all individual orders for a sample of stocks traded on the Frankfurt Stock Exchange (FSE). This sample allows us to calculate the cost of transacting in a call market. We also obtained data on bid and ask quotes from the continuous trading sessions and are therefore able to compare the cost of transacting in call and continuous markets. We find that transaction costs for small transactions in the call market are lower than the quoted spread in the order book of the continuous market whereas transaction costs for large transactions are higher than the spread in the continuous market.

We further address the question whether the participation of an auctioneer is advantageous. The Frankfurt Stock Exchange actually relies on an auctioneer (the *Makler*) who has some price setting discretion and may trade for his own account whenever this is necessary to clear the market. The electronic trading system XETRA (*Exchange Automated Trading*) which operates parallel to the floor, on the other hand, relies on a price setting algorithm without auctioneer participation. The same holds true for the opening call auction in the CAC system of the Paris Bourse.

Auctioneer participation may be desirable because the auctioneer accomodates order imbalances and thus increases the liquidity of the market. At the same time the discretion in price setting gives him an incentive to manipulate prices. STOLL / WHALEY (1990) argue that this may increase return volatility.

Our dataset allows us to identify the trades the auctioneer made for his own account. We can thus eliminate these trades and determine a price that would have obtained without participation of the auctioneer. Comparing this hypothetical price series to the actual transaction prices we find that auctioneer participation reduces return volatility. A further analysis shows that the actual prices are much closer to the surrounding prices of the continuous trading session than the hypothetical prices that would have obtained without auctioneer participation. These results indicate that the auctioneer provides a valuable service to the market. We further calculate the profits associated with the positions taken by the auctioneers and find that, on average, they do not earn profits on the positions they take. Their compensation is thus restricted to the commissions they receive.

Our main results are consistent with those reported by MADHAVAN / PANCHAPAGESAN (1998). They analyze the opening auction at the NYSE and find that specialist participation enhances price discovery and reduces return variability. They also find that the specialists' trading decisions are affected by inventory considerations. The returns earned on the specialists' transactions are modest.

The results of this line of research have important policy implications. First, comparing trading costs in call and continuous markets is important to resolve the trade-off between the reduction in transaction costs through the temporal consolidation of the order flow on the one hand and the reduced accessability of the market on the other hand. Second, the results shed light on the question whether auctioneer participation is desirable.

The rest of the paper is organized as follows. Section 2 describes the organization of trading at the Frankfurt Stock Exchange, in section 3 we describe our data set. In section 4 we analyze the determinants of the market share of the call and continuous market. Section 5 reports the results on transaction costs in the call market, section 6 is devoted to the analysis of the impact of auctioneer participation. Section 7 concludes.

2 The Trading Mechanism

Equity trading in Germany is fragmented between eight exchanges and an additional computerized trading system (in our sample period IBIS, *Integriertes Börsenhandels- und Informationssystem* which, in November 1997, was replaced by XETRA, *Exchange Electronic Trading*). The Frankfurt Stock Exchange (FSE) and IBIS / XETRA are the dominating markets.

Two trading regimes are employed on the FSE, a call market, or batched auction, regime and a continuous trading regime. During our sample period floor trading started at 10.30 with an opening call auction.[3] For this auction (as well as for the continuous trading session and the closing call auction) only round lot orders are admissible.[4] The auction is conducted by the *Amtlicher Kursmakler* (henceforth Makler). His position resembles that of a NYSE specialist. Several stocks are assigned to each Makler. He has exclusive access to the limit order book. On the basis of the orders therein he announces a tentative price or a tentative spread called *Taxe*. Thereafter, floor traders can revise their orders and submit new orders. The Makler then determines the price that maximizes the trading volume. If several prices are possible, the Makler has limited discretion as to

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3 Sine July 1998, trading starts at 8.30.
4 50 or 100 shares (depending on the par value) constitute a round lot.

which price to choose. He is also free to take the other side of the trade, i.e. to accomodate the excess demand or supply.

The midday call auction (usually called the *Kassamarkt)* is held at noon. Here, odd lot orders are allowed. Since the noon auction is the only possibility for odd lot orders to transact, the average order size is much smaller than in the opening or closing auction.

Between the call auctions, a continuous trading mechanism called *variabler Handel* is in place. The Makler may (but is not obliged to) trade for his own account, but limit orders in his book have to be filled with priority. He quotes bid and ask prices that may either represent limit orders in his book or his willingness to trade for his own account. In practice the Makler is involved in the majority of the transactions. FREIHUBE / KEHR / KRAHNEN (1998) report participation rates ranging from 18.4% to 71.4% of the trading volume. The (unweighted) average across stocks is 43.3%. These figures are higher than the comparable figures for the New York Stock Exchange reported by MADHAVAN / SOFIANOS (1998).

Investors who trade on the floor have to pay a commission (*Courtage*) of 0.04% for stocks included in the DAX index and 0.08% for all other stocks.[5] A part of this commission goes directly to the Makler to whom the traded stock is assigned. The rest is paid into a pool which is distributed among the Maklers.

During our sample period the computerized trading system IBIS operated parallel to the floor. IBIS was an anonymous electronic open limit order book. No call auctions were conducted in IBIS. Traders were free to act as market makers, i.e. to permanently quote bid and ask prices, but there was no obligation to do so. A transaction occurred whenever a standing bid or ask was accepted. The counterparty to the transaction remained anonymous until 4 pm. IBIS trading started at 8.30 in the morning, two hours before the floor opened, and extended until 5 pm. The system remained active during floor trading. Maklers were allowed to trade in IBIS.[6]

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5 Rates for floor brokers (*Freimakler*) are lower. Institutional investors may reduce the commission by transacting through a Freimakler and negotiating the commission with him. The rates given in the text are thus upper bounds to the commission actually paid.

6 They could enter quotes with an identification code that revealed to other market participants that the quote was entered by a Makler. If such quotes were accepted the Makler received courtage; in all other cases he did not receive courtage.

3 Data

In the datasets usually available each call auction appears as one transaction with the respective trading volume attached to it. The order book and the position taken by the Makler are thus not observable.

We obtained our dataset from a regulatory unit at the exchange (*Handelsüberwachungs-stelle*). It was double-checked with the hand-written notes of the Makler. These contain transactions that result from orders that were not routed electronically into the order book but were communicated verbally on the floor.

The final data set contains the complete order book for each of the daily call auctions. We further obtained all bid and ask quotes and the order book prior to each transaction of the continuous trading session. Sales and purchases by the Makler are identified.

The sample consists of 16 stocks and spans the 21 trading days from September 26th through October 25th, 1996. The sample selection process was structured such that stocks of differing liquidity are represented.[7] 10 of the sample stocks are part of the index DAX which comprises the 30 most liquid German stocks. The remaining 6 sample stocks are contained in the MDAX, a mid-cap index comprising 70 stocks. One stock (Beiersdorf) was removed from the sample. The Makler who traded this stock during our sample period retired. Therefore, we did not have access to the hand-written notes which are necessary to complete and double-check the data. The market did not move much in the sample period, and both realized and expected volatility[8] were low. Table 1 gives summary statistics for the stocks in the sample.

Insert Table 1 about here

The figures in Table 1 reveal that the sample stocks differ significantly in market capitalization and trading volume. A comparison of the total capital and the free float reveals that large differences in the fraction of the capital held by long-term shareholders exist.

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[7] The 100 stocks forming the DAX (the 30 most liquid stocks) and MDAX (a mid-cap index consisting of 70 stocks) indices were ranked according to their 1994 DM trading volume. We first selected the three stocks with the highest trading volume. We further selected four of the stocks ranking 4-10, two of the stocks ranking 11-20, four of the stocks ranking 21-50, and three of the stocks ranking 51-100. Stocks from these groups were selected randomly.

[8] Expected volatility is measured using the VDAX (DAX volatility index) which is calculated on the basis of implied volatilities from index option prices.

The turnover ratios, defined as the annualized FSE trading volume, expressed as a percentage of the market value of equity, reveal a tendency for the shares of smaller firms to be traded more frequently. There is, however, an offsetting tendency in the computerized trading system operating parallel to the floor.

4 Choice of Trading Location

The co-existence of call auctions and continuous trading sessions offers market participants the opportunity to choose between two different trading mechanisms. Both ADMATI / PFLEIDERER (1988) and SPIEGEL / SUBRAHMANYAM (1995) show that liquidity traders who have discretion to time their trades have an incentive to pool their trades. In SPIEGEL / SUBRAHMANYAM (1995) this incentive results from the desire to optimally share inventory risk in the absence of asymmetric information. In ADMATI / PFLEIDERER (1988) liquidity traders pool their trades in order to protect themselves against losses to informed traders. A call auction may serve as a focal point for this endogenous temporal consolidation of the order flow (PAGANO / RÖELL 1990, 1992). The results of BROOKS / SU (1997) support this view. They show that transaction costs for a small liquidity trader are lower in the opening call auction.

It is often hypothesized that call markets are especially suited for low-volume stocks (see for example STOLL 1985). Empirical results by EASLEY / KIEFER / O'HARA / PAPERMAN (1996) give support to this hypothesis. They find that the fraction of informed orders is negatively related to market capitalization. Therefore, the degree of asymmetric information and hence the transaction costs are higher for less liquid stocks. As a consequence, the incentives for uninformed investors to forego immediacy for the sake of lower transaction costs are higher the less liquid a stock. The same conclusion can be derived from empirical research on the components of the bid-ask spread. It has been found (e.g. STOLL 1989, GEORGE / KAUL / NIMALENDRAN 1991) that adverse selection costs represent a certain percentage of the total spread. This implies that the adverse selection cost measured in DM is larger for less liquid stocks. These arguments lead to the hypothesis that the fraction of the trading volume in the call markets is negatively related to total trading volume and market capitalization.

Results by STOLL / WHALEY (1990) for the NYSE, by LEHMAN / MODEST (1994) for the Tokyo Stock Exchange and by SCHMIDT / OESTERHELWEG / TRESKE (1995) for the Frankfurt Stock Exchange confirm this hypothesis. We perform a similar analysis by relating the volume of the call auctions to the total trading volume. Table 1 gives the percentages for the three call auctions separately and for the total call market trading volume. The results are striking. The percentage of the call market trading volume is strongly negatively related to the total trading volume. The correlation coefficients are -0.54 for the opening call auction, -0.75 for the noon auction, -0.68 for the closing auction and -0.81 for the aggregated call market volume.[9] Each coefficient is significantly different from zero at better than the 5% level (two-tailed test). Taking the market capitalization instead of the total trading volume as a proxy for liquidity yields similar results; the only difference is that the correlation between market capitalization and the percentage volume of the opening auction is significant only at the 10% level. These results give strong support to the hypothesis that the advantages of call market trading are more pronounced for less liquid stocks.

Another important issue is whether there are systematic differences between the orders that are submitted to the call auction and those submitted to the continuous trading session. Traders face a trade-off between immediate order execution which is only possible in the continuous market and transaction costs which are likely to be lower in the call auction.

Analyzing the average transaction size may shed light on the question whether this leads to some sort of self-selection. Table 2 gives the average size of limit orders that were executed in the call auctions and the continuous auction.[10]

Insert Table 2 about here

The figures show that the average order size is much lower in the noon auction. This was expected because odd-lot orders can only transact in the noon auction. The table also reveals a distinct pattern of the order size in the opening and closing auction and the continuous trading session. With very few exceptions the average size of executed orders in the continuous trading session is higher than the order size in the opening auction but lower than the order size in the closing auction.

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9 The results for the noon auction and for the total call auction volume may be biased by the fact that odd lot orders can only transact in the noon auction. This potential bias is not present in the figures given for the opening and closing auctions. Each order submitted to one of these auctions was also eligible for the continuous trading sessions.

10 Similar calculations for market orders cannot be performed because our dataset does not contain information on the number of market orders. It only contains the total number of shares offered and sought by these market orders.

The closing auction is special not only with respect to order size. The number of executed limit orders in the closing auction is low despite a considerable trading volume. Even for the most liquid stocks it frequently happens that no limit order is executed in the closing auction. This suggests that the closing auction is used to match market orders at a price set by the Makler. The high average order size is consistent with market participants desiring to close positions at the end of the trading session (cf. BROCK / KLEIDON 1992).

There is large cross-sectional variation in the average order size. A more detailed analysis shows that for the continuous trading session and the opening and closing auction the average order size is positively related to the total DM trading volume and the price level of the stock. In a cross-sectional regression these variables explain between 67.6% (closing auction) and 86.9% (continuous trading session) of the cross-sectional variation in order size. These results are plausible because the price level of a stock determines the DM volume associated with a round lot. Therefore, the higher the share price the higher the average DM order volume. Higher total trading volume indicates that the price impact of a given order should be lower. There is thus less need to split orders for high-volume stocks.

For the noon auction the relation between order size and price level is not significantly different from zero. This is plausible because there is no minimum order size in the noon auction. The relation between order size and total trading volume is negative for the noon auction. This may be explained by the fact that for low-volume stocks a larger fraction of the total trading occurs at the noon auction (see Table 1). Thus, orders which are eligible for the continuous market are instead submitted to the noon auction. This leads to an increase in the average order size.

5 The Cost of Transacting in Call and Continuous Markets

The argument that call markets are particularly suited for low volume stocks rests on the assumption that transaction costs are lower in a call market and that the transaction cost differential is larger for low-volume stocks. There are several arguments in support of this view.

First, limit orders represent a free trading option for other market participants. In a continuous auction, a limit order is executed at the specified price limit. In contrast, in a call market the limit order is executed at the market clearing price which is usually more favorable than the price specified in the limit order. The call market protects limit order traders from being „picked off“. There is thus a greater incentive to supply liquidity through limit orders and less need to adjust the price limit to account for the adverse selection problem.

Second, potential insider profits (and thus losses of uninformed traders) are lower in a call market. Consider an insider with valuable short-lived information. In a continuous auction she can work up or down the order book until the price reaches her estimate of the true value. In a continuous dealer market the insider trades until the quote of the market maker equals her value estimate. In both cases the insider price discriminates. She trades until the marginal price equals her value estimate. In a call market the insider can only transact once. Therefore, she cannot price discriminate. Given the demand or supply schedule the insider faces, this results in lower insider profits.[11] Of course, in equilibrium the demand and supply schedules are not „given“ but reflect the fact that potential losses to informed traders are lower. This, in turn, again implies a stronger incentive to submit limit orders and less need to adjust the price limits in order to account for adverse selection. It should be noted that this improvement comes at a cost. The market clearing price in the call market does not reflect all of the insider's information. Prices are thus likely to fall short of being informationally efficient. An implication derived from this argument is that returns in a call market exhibit positive serial correlation in the presence of insider trading activities.

The arguments just outlined give support to the hypothesis that transaction costs are lower in the call market. Given the evidence that the degree of asymmetric information is higher for low-volume stocks (EASLEY / KIEFER / O'HARA / PAPERMAN 1996), it is also plausible that the relative advantage of call market trading is higher for less liquid stocks. This view is consistent with the results of BROOKS / SU (1997) who find that the cost savings associated with trading at the opening call auction rather than in the continuous market are larger for smaller firms' stocks. However, the simulation study of BROOKS / SU (1997) neglects the price impact of orders submitted to the call market. Their result may therefore just reflect the fact that spreads in the continuous market are higher for small firms' stocks.

What is needed for a valid test is a reliable measure of the execution costs in the call market. Since an explicit spread does not exist, the serial covariance estimator of ROLL

(1984) has been used. However, this estimator is not an adequate measure of the transaction cost in a call market. To show this, assume that the price process is described by $p_t = v_t + e_t$ where v_t is the value of the asset at time t and e_t is an i.i.d. random disturbance with zero mean and variance s_e^2. The Roll measure s_r can then be shown to be $s_r = 2s_e$ irrespective of the trading mechanism. This is equivalent to the usual formulation since there $e_t = s/2$ and $e_t = -s/2$, both with probability 0.5, and therefore $s_e = s/2$ where s denotes the (explicit) spread. Thus the Roll measure can, in principle, be applied to call markets. However, the interpretation of the resulting estimate is different. In both a continuous auction and a dealer market, $e_t = s/2$ for a market participant who buys assets using a market order and $e_t = -s/2$ for a sale. Therefore, the spread estimate can readily be interpreted as a measure of execution costs. In the call market, however, the realization of e does not depend on whether an individual market participant buys or sells but depends on aggregate demand and supply conditions. Although a single order may have a price impact, e is likely to largely overstate this impact and can thus not be interpreted as a measure of execution cost.[12] Besides that, the positive return autocorrelation caused by insider trading activities (as outlined above) may bias the serial covariance estimator.

A valid measure of the transaction cost is the price impact of an individual order. Since our data set contains the complete order book we can measure this impact. We proceed as follows. First, we eliminate the position taken by the Makler. This is necessary because the Makler decides on his participation in the trade after having seen the orders submitted by other traders. Elimination of the Makler order enables us to consider only those orders that have been submitted without knowledge of the order book. This is equivalent to the situation encountered by traders in a computerized call market with closed order book.

Using the order book information we calculate the market clearing price. This is the price that maximizes the trading volume in shares. If there is no single market clearing price we choose the price in the middle of the interval of market clearing prices.[13]

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[11] This argument is the basic intuition behind the model of KYLE (1985).

[12] This has been confirmed in an experimental comparison of call and continuous trading systems by THEISSEN (1998a).

[13] Alternatively, we used the price which is closest to the previous transaction price. This alternative price setting rule lead to very similar results.

In order to measure the price impact of an additional order we recalculate the market clearing price after adding a market buy or sell order to the order book. We choose two different order sizes: one round lot and the average transaction size of the stock, rounded to the next round lot. Choosing two order sizes allows us to address the question of market depth.

We calculate a bid-ask spread by adding the price impact of a buy order and a sell order of equal size. This is done separately for the opening, noon, and closing auctions. This distinction is useful given the results shown in Table 2. In order to compare the transaction costs in the call market to those of the continuous trading session we also calculated quoted and effective spreads for the continuous trading sessions. Results are shown in Table 3.

Insert Table 3 about here

Transaction costs in the call auction are, as was hypothesized, low for small transactions. The average is 0.332% for the opening auction, 0.15% for the noon auction and 0.162% for the closing auction. Higher transaction costs at the opening indicate that a given order imbalance has a larger price impact. Our result is thus consistent with the finding by AMIHUD / MENDELSON (1987) and others that the volatility of open-to-open returns is larger than the volatility of close-to-close returns.

Looking at the large transaction size results in a different picture. Transaction costs increase dramatically. The averages, 2.369%, 1.596% and 1.423% for the opening, noon, and closing auction, respectively, are approximately ten times as high as those for the small transaction size.[14] This is evidence of insufficient market depth. Again, transaction costs at the opening auction are higher.

Transaction costs decrease with the total trading volume. The correlation between the average transaction cost in the call auction and the log of the total trading volume is -0.76 for the small transaction size and -0.62 for the large transaction size.

The figures in Table 3 allow a direct comparison of the transaction costs in the call market and the continuous auction. We use three measures of transaction costs for the continuous markt. The first is the book spread, defined as the quoted spread calculated

[14] It should be kept in mind that our transaction cost measure abstracts from the potentially beneficial function of the Makler. It is therefore likely to overstate the actual transaction costs paid by investors at the Frankfurt Stock Exchange.

from the orders in the order book.[15] This measure is comparable to the transaction cost measure for the call market because it is calculated on the basis of customer orders only. The spread quoted by the Makler is usually lower than the book spread. This improvement reflects the Makler's willingness to trade for his own account. The effective spread is, on average, lower than the spread quoted by the Makler because transactions at prices inside the quoted spread frequently occur (see FREIHUBE / KEHR / KRAHNEN 1998 for details). Since the effective spread measures the cost ultimately borne by the investors, we include this measure in Table 3. We calculated the effective spread separately for small and large transactions where a small transaction is defined as a transaction with a DM volume smaller than the median transaction size for the stock in question.

The bid-ask spread for the small transaction size in the call market is significantly lower (t-value 2.76, z-value from Mann-Whitney u-test 2.99) than the book spread in the continuous auction. The picture changes when the large transaction size is considered. Here the spread in the call market is larger than the spread in the continuous auction (t-value 1.92, z-value 2.55). These results imply that small orders may obtain better execution in the call market whereas the price impact of large orders is considerable.

Using the effective spread as the transaction cost measure in the continuous market yields results which are more favorable for the continuous market. The spread for the small transaction size in the call market is, on average, still smaller than the effective spread for small orders, but the difference is not significant (t-value 0.24, z-value 0.93). For large orders, the spread in the call market is significantly larger than the effective spread in the continuous market (t-value 2.60, z-value 3.84).

Among the major stock-specific determinants of the bid-ask spread are the market capitalization and the trading volume. It is interesting to see whether the relationship between these determinants and the spread is the same in call and continuous markets. To address this question we estimate the following regression:

$$s_{i,j} = a + b_1 D_j + b_2 TO_i + b_3 D_j TO_i + b_4 Log(Cap_i) + b_5 D_j Log(Cap_i) + e_{i,j}$$

[15] Our data set contains the order book immediately before a transaction occurs. If the transaction is triggered by a limit order, the spread in the order book is zero or negative because the limit order that triggered the transaction is already contained in our data set. We eliminated these observations. The book spread reported in Table 3 is thus calculated as the average quoted spread in the order book where an observation is recorded prior to each transaction triggered by a market buy or sell order.

$s_{i,j}$ is the bid-ask spread of stock *i* in market *j* where *j* = 0 for the call market and *j* = 1 for the continuous auction. In the call market we use the spread calculated for the small transaction size. In the continuous auction we use the book spread and, in a second regression, the effective spread for small transactions. D_j is a dummy variable taking on the value 1 when the observation is taken from the continuous auction. The log of the market capitalization, the turnover ratio defined as the ratio of trading volume and market capitalization,[16] and two interaction terms are included as explanatory variables. We expect that the spread declines with both market capitalization and the turnover ratio. The results are (t-values in parantheses, adjusted R^2 = 0.75 and 0.73, respectively)[17]:

	a	b_1	b_2	b_3	b_4	b_5
book spread	5.744 (3.90)	5.33 (2.56)	-0.0168 (-3.55)	-0.0056 (-0.84)	-0.2215 (-3.68)	-0.206 (-2.43)
effective spread, small transactions	5.744 (6.68)	-1.135 (-0.93)	-0.0168 (-6.09)	0.0124 (3.19)	-0.2215 (-6.32)	0.0368 (0.74)

Consider first the results for the book spread. The positive coefficient b_1 captures the observation, already documented in Table 3, that the transaction costs for small trades in the call market are significantly lower than the book spread in the continuous auction. Transaction costs decline, as expected, with both market capitalization and turnover. Both interaction terms are negative although only b_5 is significantly different from zero. This indicates that the inverse relationship between market capitalization and transaction costs is less pronounced in the call market. This result is in line with our expectations. We expected the call market to be better suited for less liquid stocks. This implies that transaction costs are relatively low for smaller firms and relatively high for larger firms, resulting in a flatter relationship between the spread and its stock-specific determinants.

Consider next the results for the effective spread. The coefficient b_1 is not significantly different from zero, indicating that there are no systematic differences between the average transaction costs in the call and the continuous market. Again, transaction costs

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16 We use the turnover ratio instead of the trading volume because the latter is strongly positively correlated with the market capitalization whereas the turnover ratio is not.

17 Inference in this pooled regression requires that the conditional disturbance variances $E\left(e^2 \middle| D_j = 0\right)$ and $E\left(e^2 \middle| D_j = 1\right)$ are equal. We tested this assumption. The F-test did not reject the null of equal variance for the second regression. For the first regression, the null was rejected at the 5% level (p =

decline with market capitalization and turnover. This relationship is, however, now *more* pronounced in the call market. A possible explanation for this surprising finding rests on the fact that transaction costs in the call market have been calculated from hypothetical prices which would have obtained without Makler participation whereas the effective spread in the continuous auction is calculated from prices set with Makler participation. Both theoretical arguments (BENVENISTE / MARCUS / WILHELM 1992) and empirical evidence (GARFINKEL / NIMALENDRAN 1995) suggest that the Makler may be able to identify informed orders and adjust his price setting behavior accordingly, thus mitigating the effect of asymmetric information. This function of the Makler may result in the flatter relationship between firm size and transaction costs found in the continuous market.

To summarize the results of this section, transaction costs for small transactions in the call market are lower than the book spread in the continuous market whereas transaction costs for large transactions are higher than the book spread. Considering the effective spread rather than the book spread yields results which are more favorable for the continuous market. This reflects the liquidity improvement caused by the existence of the Makler in the continuous market. Makler participation may also be beneficial in the call auction. We therefore now turn to an analysis of the impact of Makler participation in the call market.

6 The Impact of the Auctioneer

Call auctions conducted on the floor, like those at the New York and Frankfurt Stock Exchange, rely on an auctioneer with a certain degree of price setting discretion. The auctioneer - the specialist in New York and the Makler in Frankfurt - has an informational advantage because he decides on his participation in a trade after having seen the order book.

On the one hand, the auctioneer may stabilize prices and thus decrease volatility. Further, he may accomodate excess demand or supply by trading for his own account and thus contribute to the liquidity of the market. On the other hand he may exploit his informational advantage and his price setting discretion and earn profits at the expense of other traders. This point is made by STOLL / WHALEY (1990) and BROCK / KLEIDON (1992).

0.017). Using the robust Brown-Forsythe statistic we could not reject the null of equal variance in both cases.

Our data set allows us to address these questions empirically. We first analyze the extent of Makler participation. For each stock and each auction type we calculate the Makler participation rate as the position taken by the Makler expressed as a percentage of the total trading volume.

Insert Table 4 about here

Results are shown in Table 4. They reveal that the Makler participation is very significant, accounting for approximately 20% of the trading volume. There is no distinct pattern in the cross-sectional variation.[18] If anything, participation rates are *higher* for high volume stocks. The results are therefore not driven by some high participation rates for illiquid stocks.

There is a tendency for participation rates to be higher in the closing auction. Together with the results shown in Table 2 this implies that the Makler takes considerable fractions of the large orders matched in the closing auction in his own book. This may be a reflection of his inventory management because he may offset a position accumulated over the trading day in the closing auction.[19]

HAKANSSON / BEJA / KALE (1985) analyze the impact of specialist participation in a call market in a simulation study. Their „specialist" is an algorithm that sets prices and trades for his own account following one of several tested trading rules. Although the characteristics of the simulated stock were such that a rather thin market was analyzed, HAKANSSON / BEJA / KALE (1985) obtained participation rates slightly above 10%. These rates are clearly lower than those shown in Table 4. This raises questions about the specific price setting rules used by the Maklers that we will now address.

The Makler may use his informational advantage and his price setting discretion either to make profitable trades or to stabilize prices. In the first case one would expect Makler trades to be profitable on average and to increase return volatility. This is the view taken in STOLL / WHALEY (1990). In the second case, the Makler should, on average, earn zero profits on his trades and his participation should result in lower return volatility.

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18 The sample stocks are handled by different Maklers. This may explain some of the variation. Our sample is too small to explicitly control for the person of the Makler.

19 We did not test this hypothesis. Although we do observe sign and size of Makler trades, we do not know his inventory because the Makler may (and usually does) also trade in IBIS.

We first address the issue of return volatility. The actual transaction prices are set after inclusion of the Makler trades. The hypothetical price series that we calculated in order to measure the transaction costs excludes the Makler trades. Therefore, comparing the volatility of the corresponding return series allows us to disentangle the impact of the Makler trades.[20] For each sample stock we calculate, using both the actual and the hypothetical transaction price series, four return series. We calculate three 24-hours return series from opening, noon and closing auction prices. Further, we calculate a return series including all call auction prices. The standard deviations of the return series are shown in Table 5.

Insert Table 5 about here

With only one exception (the open-to-open return for Deutsche Babcock), the volatility of the actual return series is lower than the volatility of the hypothetical return series. Thus, Makler participation tends to decrease return volatility. This is consistent with the results MADHAVAN / PANCHAPAGESAN (1998) report for the NYSE.[21]

The results on return volatility can be combined with the participation rates shown in Table 4. We calculated the ratio of the variances of the hypothetical and the actual return series. The higher this variance ratio, the more the actual price improves (in the sense of reducing return volatility) on the hypothetical price. If the trades the Makler makes for his own account were destabilizing, the variance ratio should be negatively related to the participation rate. We find, however, that for the opening transaction the variance ratio is positively related to the mean participation rate (correlation 0.61). No relation is found for the noon auction (correlation 0.04) and the closing auction (0.05). These results

[20] In some cases the deviation between actual and hypothetical price is very large. This may happen when only limit orders with „unrealistic“ (e.g. outdated) limits are in the book. We used a 5% filter to correct these values: whenever the deviation between actual and hypothetical price was more than 5% we replaced the hypothetical price with the actual price. This resulted in replacing 20 hypothetical prices. The filter has a function similar to that of price change limits used on many exchanges.

[21] MADHAVAN / PANCHAPAGESAN (1998) use a different methodology. They use actual and hypothetical opening prices from the NYSE. They then define a benchmark price (the midquote at 3 pm) and calculate the difference between the log of the (actual and hypothetical) call auction price and the benchmark price. The variance of this price differential for the hypothetical call auction prices is, on average, more as eight times as high as the variance of the price differential for the actual call auction prices. Thus, the actual call auction price which is set by the specialist is a much more accurate estimate of the benchmark price than the hypothetical price calculated from the order book. Our results reported in Table 6 are comparable to those of MADHAVAN / PANCHAPAGESAN (1998). There we also use prices and midquotes from the continuous trading session as a benchmark.

support the conclusion that the Maklers do not use their price setting discretion in a way that increases volatility.

So far we have analyzed the impact of Makler participation on return volatility solely in the context of the call auction prices. An alternative is to confront the actual and hypothetical call market prices with the prices of the continuous trading sessions. For each stock we measure the average absolute deviation between the call market prices and the continuous auction prices immediately prior to and immediately after the call auction. Results are presented in Table 6. Since prices of the continuous trading session are affected by bid-ask bounce, we also used the midquote in effect before and after the call auction. Results were similar to those obtained from using transaction prices.

Insert Table 6 about here

The results show that the actual call market prices are much closer to the surrounding continuous auction prices than the hypothetical prices.

We related the price deviations depicted in Table 6 to the participation rates shown in Table 4. We divided the deviation between hypothetical call market prices and continuous auction prices by the deviation between actual call market prices and continuous auction prices. Similar to the variance ratios used above, a higher ratio indicates that the actual transaction price improves more on the hypothetical price. The ratios are (not significantly) positively related to the mean participation rate. This adds to the evidence that Makler participation tends to reduce rather than increase return volatility.

Taken together, the results in Table 5 and Table 6 indicate that the actual prices deviate considerably from the hypothetical prices calculated on the basis of the orders in the book. This suggests that the Maklers do make use of their price setting discretion. They use this discretion to set prices that are closer to the prices of the continuous trading session. Together with the observation that the actual return series depict lower volatility this indicates that the Maklers stabilize prices.

The final question we wish to address is the profitability of the Makler trades. We only consider positions taken in the call auctions. Assuming zero initial inventory we use the information about the Makler trades to calculate the position at the end of the sample period. It should be noted that this imputed inventory will not equal the Makler's actual inventory because we only include transactions made in the call auctions. This is sufficient since we are only interested in the profitability of these transactions.

Shares are valued at the closing price of October 25th, the end of our sample period. We assume a 5% interest rate. We use two benchmarks. The first (termed zero profit benchmark) is simply zero because we assume zero net investment. The second benchmark (termed equal risk benchmark) is the return on a zero net investment portfolio consisting of the average share holding of the Makler (which may be a long or a short position).[22] The results are shown in Table 7. We do not identify the stocks because the Makler trades are proprietary information.

Insert Table 7 about here

The results indicate that the transactions the Maklers make for their own accounts are, on average, not profitable. Measured against the zero profit benchmark, the average profit is -7,361 which is not significantly different from zero. Using the equal risk benchmark instead results in an even greater (and statistically significant) loss. This conclusion is insensitive to the choice of the interest rate used to calculate the benchmark.

The result is not caused by a general stock market trend in the sample period. Only three of the stocks had a (positive or negative) cumulated return of more than 3% over the 21 trading days. We therefore interpret our results as indicating that the Maklers do, on average over all stocks, not earn profits on their trades in the call auctions. They may not even receive a compensation for the inventory risk they assume. It thus appears that the commissions paid by the investors are the dominating source of income to the Maklers.

Looking at individual stocks we find that the profitability of the Makler trades is negatively related to the total trading volume. The correlation is -0.35 for the zero profit benchmark and -0.63 for the equal risk benchmark. The latter value is significantly different from zero at the 5% level. This indicates that the gross trading profits are higher the less liquid the stock. There are two possible explanations for this result. First, the competition by the computerized trading system IBIS may limit the ability of the Makler

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[22] Note that in calculating the second benchmark we assume that the Makler does not possess private information about the underlying value of the stock. If he does possess private information about the stock value, his average position may reflect this private information. This is because he will tend to buy shares when he expects price increases and to sell shares when he expects price decreases.

to extract rents from trading liquid stocks.[23] Second, the higher profits for less liquid stocks may be a compensation for higher inventory risk.

7 Conclusion

This paper provides a detailed analysis of the call auction procedure on the German stock exchanges. Our dataset contains information about all individual orders for a sample of stocks traded on the Frankfurt Stock Exchange (FSE). We analyze the market share of the call market, the transaction costs in the call market, the impact of auctioneer participation on prices and return volatility, and the profitability of the trades the Maklers make for their own accounts.

We find that the market share of the call market is negatively related to market capitalization and trading volume. This is consistent with theoretical arguments implying that call market trading is especially suited for low-volume stocks.

Transaction costs in the call markets are measured by the price impact of an additional order. If this additional order is small, transaction costs in the call market are lower than the spread in the order book of the continuous market and are of the same order of magnitude as the effective spread in the continuous trading session. If additional orders of larger size are considered, transaction costs in the call market increase dramatically. This is evidence of insufficient market depth.

These results do, however, not imply that call markets generally suffer from insufficient depth. Our transaction cost measure is based on hypothetical prices calculated from all orders submitted to the closed order book. This method abstracts from the potentially beneficial function of auctioneer participation. However, the Frankfurt Stock Exchange actually relies on an auctioneer (the Makler). It may be argued that auctioneer participation is desirable because the auctioneer accomodates order imbalances, increases the liquidity of the market and stabilizes prices. On the other hand, the discretion in price setting gives him an incentive to manipulate prices. This may increase return volatility.

Our dataset allows us to identify the trades the auctioneer made for his own account. We can thus eliminate these trades and determine a price that would have obtained without participation of the auctioneer. Comparing this hypothetical price series to the actual

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[23] The market share of the computerized trading system IBIS is very strongly positively related to the total trading volume (see THEISSEN 1998b). Therefore, competition between floor and screen trading is more intense for more liquid stocks.

transaction prices we find that Makler participation tends to reduce return volatility. A further analysis shows that the actual prices are much closer to the surrounding prices of the continuous trading session than the hypothetical prices that would have obtained without Makler participation. We calculated the profits associated with the positions taken by the Makler and found that, on average, the Maklers do not earn profits on the positions they take.

These results suggest that Makler participation is beneficial at least in cases where the order book is closed. Existing electronic call markets like the opening auction in the CAC system of the Paris Bourse (see BIAIS / HILLION / SPATT 1996) or the call auction in XETRA disseminate indicative prices and/or information about the orders in the book. Future research should address the question whether this can fully substitute for the service now provided by the Makler.

References

ADMATI, ANAT / PFLEIDERER, PAUL (1988): A Theory of Intraday Patterns. Review of Finacial Studies 1: 3-40.

AMIHUD, YAKOV / MENDELSON, HAIM (1987): Trading Mechanisms and Stock Returns: An Empirical Investigation. Journal of Finance 42: 533-553.

BENVENISTE, LAWRENCE M. / MARCUS, ALAN J. / WILHELM, WILLIAM J. (1992): What's special about the specialist? Journal of Financial Economics 32: 61-86.

BIAIS, BRUNO / HILLION, PIERRE / SPATT, CHESTER (1996): Price Discovery and Learning During the Preopening Period in the Paris Bourse. Working Paper, September.

BROCK, WILLIAM A. / KLEIDON, ALLAN W. (1992): Periodic Market Closure and Trading Volume. Journal of Economic Dynamics and Control 16: 451-489.

BROOKS, RAYMOND M. / SU, TIE (1997): A Simple Cost Reduction Strategy for Small Liquidity Traders: Trade at the Opening. Journal of Financial and Quantitative Analysis 32: 525-540.

EASLEY, DAVID / KIEFER, NICHOLAS M. / O'HARA, MAUREEN / PAPERMAN, JOSEPH B. (1996): Liquidity, Information, and Infrequently Traded Stocks. Journal of Finance 51: 1405-1436.

FREIHUBE, THORSTEN / KEHR, CARL-HEINRICH / KRAHNEN, JAN P. (1998): Limitorderbücher und der Liquiditätsbeitrag der Kursmakler. Working Paper, University of Frankfurt, August.

GARBADE, K.D. / SILBER, W.L. (1979): Structural Organization of Secondary Markets: Clearing Frequency, Dealer Activity and Liquidity Risk. Journal of Finance 34: 577-593.

GARFINKEL, JON A.; NIMALENDRAN, M. (1995): Market Structure and Trader Anonymity: An Analysis of Insider Trading. Working Paper, Loyola University of Chicago and University of Florida, September.

GEORGE, THOMAS J. / KAUL, GAUTAM / NIMALENDRAN, M. (1991): Estimation of the Bid-Ask Spread and its Components: A New Approach. Review of Financial Studies 4: 623-656.

HAKANSSON, NILS H. / BEJA, AVRAHAM / KALE, JIVENDRA (1985): On the Feasibility of Automated Market Making by a Programmed Specialist. Journal of Finance 40: 1-20.

HOPPENSTEDT: Saling Aktienführer 1997, Darmstadt.

KYLE, ALBERT S. (1985): Continuous Auctions and Insider Trading. Econometrica 53: 1315-1335.

LEHMAN, BRUCE N. / MODEST, DAVID M. (1994): Trading and Liquidity on the Tokyo Stock Exchange: A Bird's Eye View. Journal of Finance 49, S. 951-984.

MADHAVAN, ANANTH / PANCHAPAGESAN, VENKATESH (1998): Price Discovery in Auction Markets: A Look Inside the Black Box. Working Paper, University of Southern California, March.

MADHAVAN, ANANTH / SOFIANOS, GEORGE (1998): An Empirical Analysis of NYSE Specialist Trading. Journal of Financial Economics 48, 189-210.

PAGANO, MARCO / RÖELL, AILSA (1990): Trading Systems in European Stock Exchanges: Current Performance and Policiy Options. Economic Policy 10: 63-115.

PAGANO, MARCO / RÖELL, AILSA (1992): Auction and Dealership Markets? - What is the Difference?. European Economic Review 36: 613-623.

ROLL, RICHARD (1984): A Simple Implicit Measure of the Bid / Ask Spread in an Efficient Market. Journal of Finance 39: 1127-1139.

SCHMIDT, HARTMUT / OESTERHELWEG, OLAF / TRESKE, KAI (1995): Investor Acceptance of Call Market Trading in Germany. Paper prepared for the New York University Salomon Center Symposium on Electronic Call Market Trading, April 20th, 1995, revised May.

SPIEGEL, MATTHEW / SUBRAHMANYAM, AVANIDHAR (1995): On Intraday Risk Premia. Journal of Finance 50: 319-339.

STOLL, HANS R. (1985): Alternative Views of Market Making. In: Amihud, Yakov / Ho, Thomas S.Y. / Schwartz, Robert A. (Ed.): Market Making and the Changing Structure of the Securities Industry, Lexington, MA.: 67-91.

STOLL, HANS R. (1989): Inferring the Components of the Bid-Ask Spread: Theory and Empirical Tests. Journal of Finance 44: 115-134.

STOLL, HANS R. / WHALEY, ROBERT E. (1990): Stock Market Structure and Volatility. Review of Financial Studies 3: 37-71.

THEISSEN, ERIK (1998a): Market Structure, Informational Efficiency and Liquidity: An Experimental Comparison of Auction and Dealer Markets. Working Paper, University of Frankfurt, February.

THEISSEN, ERIK (1998b): Floor versus Screen Trading: Evidence from the German Stock Market. Working Paper, University of Frankfurt, June.

Table 1: Stocks in the sample

Figures on market capitalization are taken from the fact book 1996 of Deutsche Börse AG. Figures on institutional holdings used to calculate the free float were taken from HOPPENSTEDT Aktienführer and double-checked with other sources.

Firm	Market capitalization (Dec. 1996. million DM)		FSE trading volume 9/26 - 10/25, 1996, million DM)	annualized turnover ratio		Percentage of total trading volume in the call auctions			
	total	free		total	free	open	noon	close	total
Bayer	44,359	42,234	509.12	13.77	14.47	11.45	5.06	7.02	23.53
BMW	21,106	8,801	238.67	13.57	32.54	9.2	11.42	10.9	31.52
Continental	2,627	1,668	78.67	35.94	56.6	12.06	7.71	9.94	29.71
Daimler	54,575	35,170	716.68	15.76	24.45	9.99	4.86	5.31	20.17
Dt. Babcock	287	244	13.86	57.95	68.16	20.93	11.89	6.8	39.62
Deutsche Bank	36,130	33,771	624.28	20.73	22.18	11.25	4.23	5.65	21.12
Dresdner Bank	21,406	12,249	324.57	18.2	31.8	9.14	4.95	8.84	22.93
FAG Kugelfischer	1,274	1,203	80.22	75.56	80.02	15.42	9.27	13.51	38.19
Heidelbg. Zement	5,478	1,863	35.31	7.73	22.74	15.19	20.18	22.22	57.6
Karstadt	4,368	2,197	84.34	23.17	46.07	9.64	11.78	12.98	34.39
Mannesmann	24,484	24,484	511.92	25.09	25.09	10.19	6.79	6.86	23.83
Siemens	39,944	36,713	573.45	17.23	18.74	12.66	5.62	7.52	25.8
VEW	6,778	542	17.56	3.11	38.88	14.55	20.36	12.14	47.04
Viag	16,063	7,350	261.07	19.5	42.62	10.27	8.4	11.28	29.95
Volkswagen	22,236	16,768	473.48	25.55	33.88	9.86	8.03	7.73	25.63
average	20,074	15,017	302.88	24.86	37.22	12.12	9.37	9.91	31.4

Table 2: Order size

The table gives the mean and median size (in DM order volume) of executed limit orders in the call auctions and the continuous trading sessions.

Firm	Call auctions						continuous trading session	
	open		noon		close			
	mean	median	mean	median	mean	median	mean	median
Bayer	64,060.7	50,628.8	8,087.6	5,668.4	249,267.5	205,905	145,807.5	113,300
BMW	223,496.3	153,340	64,643.6	38,200	483,580.5	462,400	266,528	221,250
Continental	19,553.2	15,521.4	30,557.9	24,166.2	129,901	84,658	71,051.6	54,100
Daimler	69,112.7	54,482.1	9,112.3	8,748.5	465,447.7	436,750	200,458.4	114,009.8
Dt. Babcock	11,752.1	10,000	7,140.3	5,497	26,131.4	15,249.5	14,625.9	10,800
Deutsche Bank	47,898.7	43,362	8,225.2	6,488.3	257,777.3	214,350	132,380.3	71,850
Dresdner Bank	47,882.8	35,207.1	11,587.4	5,762	171,912.5	197,000	138,728.7	82,200
FAG Kugelfischer	24,337	20,140	18,413.3	16,047.9	129,300.1	53,687.5	55,683	42,683.3
Heidelbg. Zement	72,269.8	43,328.3	38,402.7	26,450	54,139.6	55,975	88,341.4	56,400
Karstadt	84,641.2	61,250	28,303.3	15,790.5	180,171.5	162,300	160,236.2	106,400
Mannesmann	122,075.7	108,197.5	13,139.8	10,848.6	315,984	288,950	246,085.3	202,650
Siemens	54,108.9	39,645.5	14,379	10,058.7	388,204.2	401,100	184,660.7	111,728.6
VEW	57,536.7	50,400	26,394	16,830	78,862.5	50,575	71,935.5	54,250
Viag	133,153.2	78,666.7	19,212.8	11,310	363,264.3	286,000	189,209.8	170,100
Volkswagen	153,255.9	120,055.7	12,477.6	10,344.7	259,743.2	282,500	236,272.4	174,000

Table 3: Transaction costs in the call and continuous markets

Transaction costs in the call market are measured as follows. We use all customer orders submitted to the auction. We then add an additional market buy order and calculate the hypothetical market clearing price. Analogously, we add a market sell order to the book and calculate the resulting price. The difference between these prices is our spread measure. We choose two different order sizes, one round lot („small") and the average transaction size of the stock in question („large"). Since this measure of transaction costs is calculated on the basis of customer orders only, it abstracts from the potentially beneficial function of the Makler.

Transaction costs in the continuous market are measured by the book spread and the effective bid-ask spread. The book spread is defined as the quoted spread calculated from the orders in the order book. This measure is comparable to the transaction cost measure for the call market because it is calculated on the basis of customer orders only. The effective spread was calculated separately for small and large transactions where a small transaction is defined as a transaction with a DM volume smaller than the median transaction size for the stock in question.

Firm	Transaction costs in the call market								Bid-ask spread in the continuous market (%)		
	open		noon		close		average		book	effective	
	small	large	small	large	small	large	small	large		small	large
Bayer	0.017	0.516	0.039	0.557	0	0.322	0.019	0.465	0.302	0.071	0.102
BMW	0.158	2.196	0.051	0.814	0.013	0.928	0.074	1.313	0.295	0.127	0.158
Continental	0.185	2.195	0.117	1.083	0.05	1.367	0.117	1.548	0.47	0.182	0.202
Daimler	0.003	0.26	0	0.386	0.03	0.265	0.011	0.304	0.264	0.057	0.083
Dt. Babcock	0.458	2.216	0.114	3.019	0.529	2.338	0.367	2.524	1.634	0.901	1.003
Deutsche Bank	0.007	0.28	0.01	0.354	0.023	0.326	0.013	0.32	0.245	0.046	0.067
Dresdner Bank	0.104	1.662	0.039	0.804	0.039	0.406	0.061	0.957	0.37	0.084	0.123
FAG Kugelfischer	0	0.865	0.022	0.514	0.011	0.444	0.011	0.608	0.576	0.464	0.438
Heidelbg. Zement	0.693	10.37	0.417	8.881	0.736	8.359	0.615	9.202	1.758	0.438	0.474
Karstadt	0.805	3.463	0.213	1.614	0.115	0.706	0.378	1.928	0.511	0.234	0.296
Mannesmann	0.102	1.383	0.112	0.58	0.047	0.42	0.087	0.794	0.303	0.094	0.109
Siemens	0.005	0.56	0.043	0.418	0	0.436	0.016	0.471	0.279	0.066	0.077
VEW	1.77	6.168	0.765	2.293	0.551	2.211	1.029	3.557	1.549	0.609	0.713
Viag	0.507	2.442	0.182	2.019	0.195	2.272	0.295	2.244	0.556	0.114	0.134
Volkswagen	0.16	0.965	0.124	0.599	0.09	0.55	0.125	0.705	0.569	0.085	0.112
average	0.332	2.369	0.15	1.596	0.162	1.423	0.215	1.796	0.645	0.238	0.273

Table 4: Makler participation

The participation rate is the position taken by the Makler expressed as a percentage of the total trading volume.

Firm	Makler participation rate					
	open		noon		close	
	mean	median	mean	median	mean	median
Bayer	0.102	0.094	0.157	0.125	0.205	0.174
BMW	0.272	0.25	0.221	0.166	0.408	0.405
Continental	0.111	0.034	0.243	0.233	0.135	0.078
Daimler	0.117	0.091	0.32	0.251	0.181	0.144
Dt. Babcock	0.21	0.2	0.268	0.263	0.471	0.45
Deutsche Bank	0.118	0.088	0.211	0.167	0.251	0.167
Dresdner Bank	0.295	0.213	0.274	0.306	0.437	0.344
FAG Kugelfischer	0.163	0.115	0.166	0.161	0.221	0.216
Heidelbg. Zement	0.255	0.156	0.2	0.11	0.157	0.054
Karstadt	0.103	0	0.133	0.079	0.092	0.014
Mannesmann	0.323	0.323	0.269	0.28	0.344	0.341
Siemens	0.179	0.108	0.167	0.109	0.229	0.24
VEW	0.358	0.2	0.32	0.194	0.406	0.333
Viag	0.148	0.111	0.22	0.18	0.289	0.239
Volkswagen	0.3	0.255	0.247	0.248	0.289	0.258
average	0.204	0.149	0.228	0.191	0.274	0.23

Table 5: Makler trades and return volatility

The table shows the standard deviation of actual and hypothetical returns. Actual returns are 24-hour returns calculated from opening, noon and closing auction prices and a return series calculated from all auction prices. Hypothetical prices are those prices that would have obtained without Makler participation.

Firm	Return volatility							
	open-to-open		noon-to-noon		close-to-close		all auctions	
	actual	hypoth.	actual	hypoth.	actual	hypoth.	actual	hypoth.
Bayer	1.131	2.05	1.059	1.558	0.961	1.793	0.571	1.62
BMW	0.547	0.846	0.74	0.779	0.697	0.866	0.324	0.615
Continental	1.158	1.602	0.999	1.19	1.131	1.636	0.642	1.077
Daimler	1.026	1.483	0.984	1.256	1.017	1.203	0.462	0.908
Dt. Babcock	5.763	5.246	5.787	6.057	1.925	2.305	3.403	3.473
Deutsche Bank	0.722	1.013	0.588	0.794	0.529	0.743	0.386	0.658
Dresdner Bank	0.812	1.276	0.806	1.417	0.855	1.46	0.463	1.418
FAG Kugelfischer	1.22	2.099	1.594	1.913	1.497	1.754	0.979	1.529
Heidelbg. Zement	1.094	1.937	1.014	1.854	1.338	2.489	0.677	1.625
Karstadt	1.194	1.41	1.123	1.58	1.289	1.368	0.777	1.194
Mannesmann	0.869	2.316	0.753	1.05	0.759	1.423	0.464	1.571
Siemens	0.708	1.012	0.663	0.893	0.694	0.978	0.38	0.918
VEW	1.575	3.043	1.477	2.198	2.031	2.716	1.115	2.341
Viag	0.996	1.32	1.071	1.31	1.195	2.22	0.639	1.624
Volkswagen	1.006	2.217	0.889	1.565	0.912	2.122	0.493	2.288

Table 6: Deviation between call auction prices and continuous auction prices

The table shows the mean absolute deviation between the actual and hypothetical call market prices and the price of the continuous auction session immediately before or after the call auction.

Firm	Mean absolute deviation							
	open - after		before - noon		noon - after		before - close	
	actual	hypoth.	actual	hypoth.	actual	hypoth.	actual	hypoth.
Bayer	0.027	0.287	0.019	0.221	0.025	0.224	0.049	0.333
BMW	0.738	2.131	0.524	1.417	0.381	1.25	0.655	2.593
Continental	0.062	0.178	0.029	0.088	0.028	0.067	0.03	0.115
Daimler	0.043	0.251	0.025	0.287	0.033	0.263	0.017	0.209
Dt. Babcock	0.448	0.552	0.162	0.457	0.219	0.429	0.256	0.54
Deutsche Bank	0.029	0.18	0.018	0.207	0.028	0.196	0.033	0.188
Dresdner Bank	0.028	0.228	0.029	0.306	0.013	0.285	0.021	0.241
FAG Kugelfischer	0.05	0.135	0.039	0.083	0.026	0.06	0.047	0.106
Heidelbg. Zement	0.247	0.865	0.347	0.779	0.227	0.463	0.34	1.237
Karstadt	1.452	2.643	0.69	2.108	0.857	2.251	0.89	1.533
Mannesmann	0.429	5.455	0.433	3.048	0.319	2.99	0.238	2.379
Siemens	0.032	0.399	0.023	0.242	0.04	0.254	0.047	0.345
VEW	2.6	6.75	1.7	3	2.8	4.4	1.179	3.339
Viag	0.731	2.674	0.602	3.819	0.588	3.338	0.633	4.569
Volkswagen	0.56	4.257	0.25	5.871	0.3	5.726	0.236	4.162

Table 7: Profitability of Makler trades

The table shows the profits associated with the Makler transactions in the call auctions.

Firm	zero profit benchmark	equal risk benchmark
A	-70,867.22	-76,427.75
B	2,331.29	-6,729.06
C	18,467.75	18,421.56
D	123,892.02	-26,829.61
E	-132,843.78	-25,670.51
F	-37,318.92	-55,359.19
G	117,100.09	25,662.6
H	8,102.36	4,568.2
I	2,453.74	-92,788.47
J	-178,466.35	-140,857.68
K	-15,575.83	-5,058.58
L	5,485.73	5,411.07
M	5,880.83	-266.17
N	12,881.9	8,234.83
O	28,061.12	26,467.22
average (t value)	-7,361.02 (-0.38)	-22,748.1 (-1.88)

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