Informed Trading and the Bid-Ask Spread: Evidence from an Emerging Market

Jan Hanousek and Richard Podpiera **

January 2002

Jan Hanousek
CERGE-EI,
P.O. Box 882
Politických vězňů 7
111 21 Prague
Czech Republic

Richard Podpiera
International Monetary Fund
700 19th Street, N.W.
Washington, D.C. 20431
USA

Correspondence and requests for reprints to:

Suggested running head: Informed trading and the bid-ask spread

** Jan Hanousek currently fills the Citibank Chair in Financial Markets at CERGE-EI, a joint workplace of Charles University and the Academy of Sciences of the Czech Republic. This research was supported by the National Science Foundation of the United States (grant number SPR-9712336) and by the PHARE/ACE Research Program of the European Union (grant number P97-8118-R). We would like to thank Libor Němeček, Randall K. Filer, Barbara Forbes, and Jan Kmenta for their suggestions and comments.
How Important Is Informed Trading for the Bid-Ask Spread? 
Evidence from an Emerging Market

Abstract: Bid-ask spread is a major determinant of trading costs and it therefore significantly affects the performance of financial markets. We explore the impact of informed trading on the composition of the bid-ask spread in high frequency data from the Czech equity market. This market has been plagued by informed trading due to the lack of regulation and missing institutions. We modify an earlier approach to estimating the components of the bid-ask spread to suit the setup of this market. Our estimates suggest that the share of the adverse-selection component is surprisingly low; only some 14 percent of the bid-ask spread is explained by informed trading. This roughly corresponds to the shares of the adverse-selection component found in earlier studies on developed markets.

Keywords: trading systems, market microstructure, informed trading, emerging markets

JEL Classification: G14, G15, P34, P59
1. Introduction

Since the bid-ask spread is an important determinant of trading costs and thus significantly impacts the performance of financial markets, the link between informed trading (adverse selection of traders) and the bid-ask spread has been the focus of plentiful research.\footnote{1} Some authors have suggested that if informed trading is common, it might lead to market shutdown as the spread would simply be too wide for investors to participate in trading.

Historically, the bid-ask spread has been regarded as a function of order processing and inventory costs. More recent research has brought adverse selection and informed trading into the picture. In this view, the market maker (as a provider of liquidity who always quotes prices for buying and selling) faces the possibility of trading with agents who have superior information. The market maker will lose money when trading with such individuals, and he or she thus sets a spread between the bid and ask price in order to compensate for this adverse selection problem. Glosten and Milgrom (1985) were the first to show formally that, with informed trading, a bid-ask spread would exist even if there were no order processing or inventory costs. The current literature thus distinguishes three components of the bid-ask spread, that is, inventory, order processing and adverse-selection components.

Despite the fact that a number of empirical studies have tried to estimate the components of the bid-ask spread, the problem of the size of the adverse-selection component has never been fully resolved. Earlier studies suggested that the share of the adverse-selection component is large. For instance Stoll (1989), who used a sample of
NASDAQ stocks, reported that 43 percent of the quoted spread is due to adverse selection. On the other hand, George, Kaul and Nimalendran (1991) estimate a much smaller share of adverse selection costs. For a sample of NYSE, AMEX and NASDAQ stocks, they put this share in the range of 8–13 percent. Huang and Stoll (1997) estimate a general model and offer two ways of decomposing the spread. They also estimate two values of this share, 9.6 percent and 21.5 percent. It is difficult to explain the differences of the estimated shares due to adverse selection since the cited studies differ both in terms of the data and the estimation methodology they use. Generally, recent studies suggest that the share of the adverse selection component is rather low in developed markets.

The current paper investigates the bid-ask spread components of the Czech stock market, with a focus on the adverse selection component. Our study uses high frequency data to provide evidence for the composition of the bid-ask spread from an emerging market. Previous studies have dealt almost exclusively with U.S. markets and, except for the most recent studies, have used only daily and weekly data. In estimating the adverse-selection component, we combine the recent findings of the inventory literature with older methods of estimation. In previous literature, the distinction between competitive market makers and a single specialist was largely ignored, perhaps due to the use of less detailed data. Our analysis offers an insight into the magnitude of the adverse-selection component in a market known for being seriously plagued by insider trading.

From the outset, the Czech equity market developed very rapidly, since many companies were floated as a result of coupon privatization. Market regulation, however, lagged significantly. Insider trading, price manipulation, fraud in the investment funds industry, and abuses of minority shareholder rights eroded much investor confidence. In
recent years regulation has improved, but enforcement still appears to be rather weak.\textsuperscript{2} The Czech market still offers wide latitude for informed and inside traders to disclose information. Besides abundant anecdotal evidence, Hanousek and Podpiera (2001) formally estimated the extent of informed trading and their results suggest that informed trading is indeed considerably higher than in developed markets.

Besides being an example of lax regulation and insufficient institutions, the Czech equity market offers a good opportunity for investigating the bid-ask spread thanks to the setup of its trading system. Its key component, the SPAD trading system, is based on market makers, who are obliged to quote prices on selected stocks. The setup corresponds in several ways to the theoretical models used for analyzing the bid-ask spread. For instance, the trading lots are rather large, so in most trades only one lot changes hands, which allows us to abstract from the trade size. Also, there are a number of market makers for each stock which compete for order flow. Only the most liquid Czech stocks are included in the system, but these are medium-sized by international standards.\textsuperscript{3}

In the next section, we describe the trading system and the data. In Section 3 we describe the models used to investigate the components of the spread. Initially, we examine the basic characteristics of market maker behavior based on the findings of inventory models. Then we present our strategy for estimating the-adverse selection component of the spread and review the Huang and Stoll (1997) approach, which we later use for comparative purposes. Section 4 presents the estimation results. Section 5 summarizes our findings and draws conclusions.
2. Trading System and Data Description

2.1. Trading System

The SPAD segment of the Prague Stock Exchange is formed by market makers who are obliged to quote prices for sale and purchase. The whole system is computer-based, and all the market makers and members of the PSE are able to see all the quotes and trades. Members of the PSE who apply and are approved serve as market makers in the SPAD system, which was launched in May 1998 with the aim of improving liquidity in the market. It was successful in attracting order flow from the OTC market and, currently, the vast majority of trades in securities listed in SPAD are channeled through this system.

The most liquid Czech stocks are traded in the system. The number of stocks in SPAD grew from a single stock at the outset to its current number of eight stocks. There are two telecommunication companies (Český telecom and České radiokomunikace), two banks (Česká spořitelna and Komerční banka), a petrochemical company (Unipetrol), an electricity generator (ČEZ), an investment fund (RIF) and a construction company (IPS). Daily trading volume in SPAD amounted to approximately 500 million CZK (some 17 million USD) for most of its existence and only at the beginning of 2000 grew sharply to almost 2 billion (bn) CZK (50 million USD). In the period under study (late 1999) daily trading volume hovered around (mn) 500 million CZK.

In late 1999 there were 16 market makers who quoted at least one stock in the system, although on average each market maker quoted approximately six stocks. Viewed differently, each of the eight stocks had some 12 market makers who were quoting it. The
SPAD rules stipulate that there must be at least 3 market makers for each stock for it to be traded in the system. In reality, the number of market makers for each stock is considerably higher than the required minimum.

Individual market makers are allowed to quote different ask and bid prices, but the maximum spread for each of them is limited. A committee of the PSE sets the exact limits, but we can say that it corresponds roughly to 2.5 percent of the stock’s price. Depending on the development of the stock’s price the maximum spread is irregularly changed. The system operates in two phases, closed and open. The closed phase can be viewed as a technical device that allows market makers to clear the trades that they did not manage to conduct during the open phase and is not important for our purposes. The actual trading occurs during the open phase of the system, which lasts from 9.30 a.m. to 4.00 p.m. each trading day and during which the market makers quote firm prices for a fixed number of shares of each stock.

The size of trading lots varies from 1,000 shares for České radiokomunikace to 20,000 shares for Unipetrol or ČEZ. The size of the lots is occasionally changed, depending on price development of the stock. The trading lots are rather large, compared to both the overall trading volume and the capital base of some of the market makers. The quotes are firm in the sense that if the quote is the best available on the market and if another party reacts to it by entering an instruction for a trade, the market maker is obliged to enter his instruction so that the trade can be executed. Blocks of shares that differ in size from the trading lot can be settled through the system as well, but these trades are negotiated in advance over the phone and, in fact, are not very frequent.
In order to limit the risk of default, there exists a standard settlement procedure and a guarantee fund, into which market makers must insert a deposit, and there are procedures that come into play if one side of the trade defaults. Overall, trading in SPAD appears to be safe, since no serious problems of default have been reported since its inception.

2.2. Data Description

Data on individual trades from SPAD were publicly available from early 1999 to July 2000. We were able to obtain more detailed data for two months, September and October 1999, and thus concentrate on this time period. We add data from other months when needed to estimate some of the models used below.

For the time period early 1999 to July 2000, we have basic data on each trade conducted in the SPAD system. For each trade, our database carries a stock identification, transaction price, number of shares, time the trade was concluded, and the best bid and ask quotes at the time the transaction took place. Also, we are able to identify so-called cross trades; that is, we are able to distinguish trades that are conducted between the inventory of a market maker and the market maker’s clients, since these must be reported in the system as well. For September and October 1999 we also identify the buyer and the seller and indicate whether there was an obligation to react on the instruction.

Table 1 depicts the basic characteristics of all eight stocks traded in the system. Even though these stock represent the most liquid equities on the Czech market, there are substantial differences among them. Their market capitalization ranges between a mere 2 bn CZK for IPS to 124 bn CZK for SPT Telecom. IPS averages only three trades per day,
while SPT Telecom averages 43 daily trades. Other stocks are concentrated in the range of 10–51 bn CZK of market capitalization and, with the exception of RIF, exhibit decent trading activity.

<INSERT TABLE 1>

As mentioned above, the total daily turnover slightly exceeded 500 mn CZK in September and October 1999 and the size of trading lots different considerably in the number of shares, but somewhat less in the market value of trading lots and, although the average spread varied in CZK terms, its relative value in percent of average price is more important. Here, the variation is smaller and, with the exception of RIF, the percentage spread depends more on the trading activity. It is largest for IPS, at 2.9 percent and lowest for SPT Telecom, at 1 percent. For the other stocks, the relation between the percentage spread and the trading activity is rather monotonic.

A comparison of the stocks in our sample with those used in previous studies of informed trading and the components of the bid-ask spread appears to be in order. Naturally, the volumes and market capitalization of SPAD stocks are dramatically smaller than those of the most liquid U.S. stocks. The average trading volume of the stocks in our sample just about equals the average trading volume of the fifth decile (thus approximately average) stocks from the NYSE included in Easley et al. (1996b). Huang and Stoll (1997) examined 1992 data for the 20 stocks in the Major Market Index. For these stocks, the mean percentage posted spread hovered between 20 and 70 basis points. The NASDAQ stocks used by Stoll (1989) are comparable in both volume and posted percentage spread, and even the reported average number of 13 to 14 market makers corresponds to the number of market makers in SPAD.
Overall, our stocks are less frequently traded and have larger posted spreads than the blue chips from the U.S. The differences are not so dramatic, however, as to prevent us from comparing our results with those of previous studies. In fact, the opposite is true, since our stocks are comparable to an average U.S. stock. It is important to note that the average absolute value of the posted spread of our stocks is comparable to the spread of average U.S. stocks used in the previous studies.

3. Adverse-Selection Component: Models and Estimation Method

Several different approaches to estimating the components of the bid-ask spread exist. In our view, the approach pioneered by Roll (1984) and developed by Stoll (1989) and George et al. (1991) is not suitable in an emerging market setting. Their approaches, in essence, use the covariance of transaction prices or quotes to infer the effective spread and its components. In order to do this, market efficiency must be assumed so that the only source of serial covariance of prices and quotes is the bid-ask friction and the factors behind it, like adverse selection. This assumption might be warranted in the case of developed markets, but we view it as hardly justifiable in an emerging market setting. We thus prefer another class of models—those that use the trade indicator to analyze the bid-ask spread.7

3.1. The Adverse-Selection Component of the Bid-Ask Spread: Our Model

We have already mentioned that the basic aim of this paper is to decompose the bid-ask spread into three components. The first is called the order processing component and is caused simply by the costs market makers incur when they provide market-making services. These costs include various items starting with the rent of office space and
ending with the salaries of traders. Order processing does not change with short-term fluctuations of the order flow and is assumed to be constant; a safe assumption because our sample period includes only a couple of months. The second component, inventory, exists because market makers run the risk of taking undesired inventory when quoting firm prices. The market maker’s inventory position, however, can change with order flow. This flow results in quote and price revisions, since the market maker changes the quotes and thus increases the probability of reversal in his inventory position. The third adverse-selection component of the spread occurs because the market maker faces the risk of trading with an agent who has private information about the value of the asset. The market makers will inevitably lose when trading with such informed agents and so must set a spread between their bid and ask quotes which compensates for this expected loss.

We should point out that there is a difference between the posted (quoted) spread, which is simply the difference between the bid and ask quotes, and the traded (effective) spread. The traded spread takes into account the fact that some trades are conducted within the inside quote, that is, at better prices than best bid or best ask.\textsuperscript{8}

The most serious problem in estimating all three components of the bid-ask spread is the distinction between the adverse-selection and inventory components. They both lead to the same revision after a trade. On the other hand, an incoming buy order lowers the market maker’s inventory, causing him to increase quotes in order to raise the probability of a sell order which would balance his inventory position. Similarly, a buy order in an environment with nonzero probability of informed trading increases the market maker’s beliefs about the value of the asset and leads to an upward revision of quotes. Thus, buy orders lead to quote increases and sell quotes to quote decreases due to
both adverse-selection and inventory effects; it is difficult to distinguish these two effects empirically.

This situation holds true, however, only if there is a single market maker or dealer like a specialist at NYSE. In the case of a competitive dealer system (for instance NASDAQ, SEAQ in London, or SPAD in Prague), market reaction due to inventory reasons will be different, a point not recognized in earlier papers. For instance, Stoll (1989) argues that the NASDAQ can be treated as a one-dealer market: “Competition among dealers, the desire of investors to trade with the dealer at the ‘inside’, knowledge by all dealers of quotes of other dealers, and the knowledge of transaction prices causes the inside quote [best bid and best offer] and transaction prices to behave as if there were one dealer” (Stoll, 1989, p. 123).

We disagree. Quote revisions behave differently when there are multiple dealers as opposed to only one specialist. In the first scenario, the same inventory risk is spread among a larger number of market makers and thus also across a broader capital base, which itself would make the inventory-induced reaction weaker. That, and the behavior of dealers lowers the reaction to inventory. First, dealers with extreme inventory positions tend to form the inside quote since they want their inventory positions to be reversed. Second, even if they had the best quotes and took an undesired inventory, they would revise the quote and thus cease to have the best quotes. The second-best quote, however, would not be affected by the change in inventory but would change only by the information content of the trade, assuming all market makers observed all trades.

Thus, even if the market makers with the best quotes did not like the inventory change, only the affected market makers would revise their quotes for inventory reasons.
All other dealers would revise quotes only due to adverse selection, that is a change in the expected fair value of the stock. They do not obtain any undesired inventory position. An argument might be made that the remaining dealers would revise quotes because they expect the dealer who obtained an undesired inventory position to try to get rid of it. Yet it would not be rational for them to revise their quotes other than in line with the new expected fundamental price. Of course, if a dealer knows there is a seller, the dealer might be tempted to lower the price further and pick up the stock more cheaply, but competition among market makers should prevent this.

The view that dealers set quotes according to their relative inventory positions appears in the literature, although it has not been used in the estimation of the bid-ask spread components. The first authors to deal with the issue of quote setting by competitive market makers were Ho and Stoll (1983). Their model implies that inventory position will affect the placement of competing quotes, with the market makers at the inside quote having extreme inventory positions. Lack of detailed data, however, made empirical testing of this prediction impossible for almost 15 years. Only recently two papers, Reiss and Werner (1998) and Hansch et al. (1998) tested the crucial predictions of this and other inventory models explicitly. These two papers use detailed data from the London Stock Exchange, which has been working as a multiple dealer market, to test the hypothesis that the positioning of quotes by one market maker relative to that of other market makers is a function of their inventories. Hansch et al. (1998) found that changes in quotes and inventories are strongly correlated and that standardized and relative inventories are mean reverting. They also report that market makers who post competitive quotes execute a significantly larger proportion of public trades (the data they use offer
the distinction between interdealer and public trades), so competitive quoting indeed attracts more trade flow. This supports the view that dealers with the best quotes are those with extreme inventory positions. Further evidence in Hansch et al. (1998) and the paper by Reiss and Werner (1998) suggest that dealers engage in interdealer trading primarily when their inventory position becomes extreme. This lends support to the view that a dealer with an undesired inventory position has two options: to make his quotes the best on the market and wait for a client order (which is more profitable, but uncertain) or to accept a worse price, but unwind the position quickly in an interdealer trade. When the undesired position becomes large, it is too risky to wait for a public order.

In fact, this weak inventory-induced response of the competitive dealer system might explain the results of Stoll (1989), who used NASDAQ data and found only a small inventory component (10% of the spread). This finding was also one of the arguments George et al. (1991) used to defend their assumption that the inventory component of the spread does not exist (they use this assumption for NYSE stocks as well). This would be inappropriate if indeed the competitive dealer system response to inventory pressure is different from that of a specialist system.

Our approach to the inventory component of the spread assumes that under normal circumstances the revision of quotes due to inventory reasons in response to a trade is negligible since those who have the best quotes actually want the inventory and there is no reason to expect pressure from inter dealer trading. If, however, the circumstances are not normal and there is thus substantial selling or buying pressure, several dealers accumulate undesired inventory and use inter dealer trades to unwind the positions. In that case, inventory reasons for quote revision might also become important for those
who are not directly affected by the current trade. We thus create a binary variable denoted as PRESS, which indicates whether a particular trade happened in a period of selling or buying pressure. We take a moving window of 10 trades prior to the particular trade and, given the number of sells and buys, determine whether there was trading pressure. We have chosen three different levels for this variable; we require the cumulative variable to exceed 4, 6 and 8 sells or buys, which selects approximately 50 percent, 20–30 percent, and 10 percent of all trades, as being conducted under selling or buying pressure. These frequencies do not fully correspond to the frequencies we would expect if the trades came from an independent binomial distribution with equal probability of buy and sell, which would be 51 percent, 9 percent, and 0.2 percent. This discrepancy is explained by the fact that our “draws” are not independent and by our expectation that trades in a similar direction are clustered under trading pressure. This expectation is borne out, since the frequencies in our data are higher than the theoretical frequencies.

Further, we assume that the traded spread is constant, given that the time period under study is only two months. Therefore,

$$P_t - M_t = S/2*Q_t + \varepsilon_t, \quad (4)$$

where $S$ is the constant traded spread, $P_t$ is the transaction price at time $t$, $M_t$ is the quote midpoint (average between best bid and ask quotes at the time of trade) at time $t$, and $Q_t$ is the trade indicator variable, which equals 1 if the trade is a buy, -1 if it is a sell, and 0 if it occurs exactly at the midpoint. We assume that the error term $\varepsilon$ has zero mean conditional on $Q$. 
The key part we estimate is based on the model of Huang and Stoll (1997), and hence we use the same notation as in their paper. First, the unobservable fundamental value of the security at time $t$, $V_t$, is driven by new information in the most recent trade (from time $t-1$) as indicated by the trade indicator variable $Q_t$ and by several additional characteristics of the trade:

$$V_t = V_{t-1} + \alpha S/2 Q_{t-1} + \delta \text{CROSS}_t + \lambda \text{ACTIVE}_t + \eta_t .$$

The variable CROSS indicates whether the trade was a so-called cross trade, that is, a trade between the dealer’s own accounting book and that of his client. Such trades naturally do not originate in the SPAD system, but they must be reported so that the market is aware of the order flow. The rationale for including this variable in the model is that such trades might be viewed by the market as having a different information value relative to normal trades. It is not clear, however, what sign the coefficient $\delta$ should have, since the market might view cross trades as transactions that will not affect the market (then cross trades would have lower information value) or as an indication of stronger order flow (then the information value would be higher). We have also identified the most active market makers and created the variable ACTIVE. This variable equals 1 if the trade was initiated by one of the most active market makers. That is, if the trade was a buy, one of the most active market makers was on the buy side of the trade and vice versa.\textsuperscript{12} We consider most active the top five market makers who taken together account for nearly 50% of trading volume. We include this variable because a trade initiated by the most active market makers might have a higher information value for other market participants. We assume that the error term $\eta$ has zero mean conditional on the right-hand side variables.
The actual quotes that we observe are affected by inventory effects, however, as discussed above. We assume that inventory matters only when there is significant buying or selling pressure. Thus, the quote midpoint $M_t$ is given by

$$M_t = V_t + \sum_{i=0}^{t-1} \beta \frac{S}{2} Q_i \text{PRESS}_i.$$ 

Taking first differences and substituting for $V_t$ yields

$$\Delta M_t = \alpha S/2 * Q_{t-1} + \beta S/2 * Q_{t-1} * \text{PRESS}_{t-1} + \delta \text{CROSS}_t + \lambda \text{ACTIVE}_t + \eta_t. \quad (5)$$

We estimate equations (4) and (5) to obtain the estimates of $\alpha$, $\beta$, $\delta$, $\lambda$, and $S/2$. We estimate the two equations simultaneously by the SUR routine in the TSP 4.5 package. We also test for both autocorrelation and heteroskedasticity.

### 3.2. Huang and Stoll (1997) Model

For the sake of comparison, we also estimate one of the two models of a three-way decomposition of the spread presented in Huang and Stoll (1997). We retain most of the notation from our model presented above. Huang and Stoll (1997) base their model on three equations. First, the unobservable fundamental value of the stock $V_t$ develops according to

$$V_t = V_{t-1} + \alpha S/2 * Q_{t-1} + \varepsilon_t. \quad (6)$$

Second, they assume that every trade affects the inventory position of the market maker (they use NYSE data, so they apparently have the specialist in mind). Thus, the position of the quote midpoint relative to the current fundamental value of the stock is

$$M_t = V_t + \sum_{i=0}^{t-1} \beta \frac{S}{2} Q_i. \quad (7)$$
Third, they assume the spread to be constant, with the random factor in the following equation reflecting the deviation of the observed spread from its constant value:

$$P_t - M_t = S/2*Q_t + \eta_t \quad (8)$$

Combining equations (6), (7) and (8) and taking first differences yields the basic regression model

$$\Delta P_t = S/2*(Q_t - Q_{t-1}) + \lambda*S/2*Q_{t-1} + e_t \quad (9)$$

where $\lambda = \alpha + \beta$ and thus the combined inventory and adverse-selection component of the model is estimated. This is the first model of Huang and Stoll (1997) that we estimate on our data.

Huang and Stoll offer two ways of fully decomposing the spread, or two ways to separate the inventory and adverse-selection components. First, they use serial correlation in trade flows. Second, they use the concept of portfolio trading pressure that we discussed above and that is similar to our approach. Since portfolio trading pressure as described by Huang and Stoll is disputable, especially as far as the specialist trading model is concerned, we have chosen to estimate the first model, which is based on the serial correlation of trade flows.

This way of differentiating between adverse-selection and inventory components is based on the observation that, given past order flow, the market forms an expectation about the next order. The conditional expectation of the trade indicator at time $t-1$ given $Q_{t-2}$ is

$$E(Q_{t-1}|Q_{t-2}) = (1-2\pi)Q_{t-2} \quad (10)$$
where $\pi$ is the probability of trade reversal, i.e., the probability that the sign of the next trade will be opposite. If we assume that the market knows equation (10), it will take this expectation into account and the development of the fundamental value will be driven by

$$\Delta V_t = \alpha S/2 Q_{t-1} - \alpha S/2 (1-2\pi) Q_{t-2} + \varepsilon_t. \quad (11)$$

Combining this with equation (7), which describes the impact of inventory on the position of the mid-quote, yields

$$\Delta M_t = (\alpha + \beta) S/2 Q_{t-1} - \alpha S/2 (1-2\pi) Q_{t-2} + \varepsilon_t. \quad (12)$$

Furthermore, adding the constant spread assumption yields the final expression

$$\Delta P_t = S/2 Q_t + (\alpha + \beta - 1) S/2 Q_{t-1} - \alpha S/2 (1-2\pi) Q_{t-2} + \varepsilon_t. \quad (13)$$

For the purposes of estimation, equation (10) can be rewritten as

$$Q_{t-1} = (1-2\pi) Q_{t-2} + \xi_t \quad (14)$$

and we assume that the error term $\xi$ has zero mean conditional on $Q_{t-2}$.

By estimating equations (13) and (14) we are able to distinguish between the adverse-selection ($\alpha$) and the inventory component of the spread ($\beta$). We estimate these equations simultaneously, again using the SUR routine of the TSP 4.5 package.

### 4. Adverse-Selection Component: Results of Estimation

#### 4.1. The Adverse-Selection Component of the Bid-Ask Spread—Our Model

We report the results for the middle choice of the variable PRESS, that is, the case in which we require the cumulative trade indicator to exceed a value of 6, in Table 2. The
estimates for the other two choices of the PRESS variable were not substantially different (except for the coefficient of the inventory variable itself).\textsuperscript{14} We present estimates for September and October 1999, since we have the advantage of using the ACTIVE variable for those trades initiated by the most active dealers. We have also estimated the model for the four-month period August through November 1999 without this variable, and the results were not significantly different.

The adverse-selection component ranges from 8 percent in the case of Unipetrol to 30 percent for IPS. It is not surprising that the highest share of adverse-selection is found for the stock (IPS) that has the highest - almost 50 percent - probability of informed trading. The most frequently traded stock, SPT Telecom, exhibited a 12 percent share of adverse selection component in the spread. It might be surprising but on average, the size of the adverse-selection component is relatively low, at 14 percent. In all eight cases (with the exception of RIF), the adverse-selection component was significant at the 5 percent level.

<INSERT TABLE 2>

As for the inventory component, \( \beta \), the results suggest that our assumptions on inventory impact were justified. The component increases from the least strict choice, which counts almost half of all trades as occurring under trading pressure, to the strictest choice, which classifies only approximately 10 percent of trades in this way. Moreover, statistical significance increases in this direction as well. While some of the coefficients at the least strict variables are not statistically significant, those at the strictest are for the most part highly significant. The adverse-selection component is small, on average only 5 percent. All these facts suggest that the inventory component is not very important to the
Czech market. The vast majority of the spread (on average some 80 percent) is thus formed by the order-processing component.

As for the other explanatory variables, it appears that in half of the cases (SPT Telecom, ČEZ, Komerční banka and to a limited extent, Unipetrol) it matters to the market that the trade is initiated by an active market maker. Interestingly, these are the four stocks with the highest turnover. The significant coefficients are positive, which implies that a trade initiated by a major market maker is viewed to have higher information value than other trades. The coefficient at the CROSS variable is only occasionally significant and hence the market does not attach much significance to the information that a trade is of the cross type.

The traded spread is smaller than the posted spread, which is in line with the findings of previous studies. The traded spread as a fraction of the quoted spread is rather uniform across the stocks in our sample; in all cases (except for RIF) the traded spread fits into the range of 70–80 percent of the quoted spread.

4.2. Huang and Stoll (1997) Model

The results of estimating the Huang and Stoll (1997) models are depicted in the following table. We have combined the estimate of $\lambda$ from equation 9 with the results of a joint estimation of equations 10 and 13.

<INSERT TABLE 3>

While the estimates of the combined share of adverse-selection and inventory components appear to be reasonable and correspond to the estimates implied by our model above (they average 0.22), the distinction between these two components
corresponds to our results in only a few cases (one of them is SPT Telecom). Moreover, some of the estimates of $\alpha$ are negative, which is impossible in our model.\textsuperscript{15} Adding more data points by extending the sample another two months does not substantially change the results. Overall, we believe the estimates of $\lambda$, the combined share, as it is robust since it comes as a product of a simple and straightforward model, and view the results as a confirmation of the fact that adverse selection is not a major component of the spread—its combined share with the inventory component is not estimated to be very large.

5. Conclusion

Abundant literature links informed trading and the size of the bid-ask spread. Some papers express the concern that a large amount of informed trading might substantially limit the liquidity of the market or even lead to its shutdown. The current literature is not settled on the issue of the relative importance of the three components (adverse-selection, inventory and order processing) of the bid-ask spread. We provide evidence on this issue, with a focus on the adverse-selection component, from a market in which lax regulation and insufficient institutions have allowed informed and insider trading to become widespread.

In order to estimate the components of the bid-ask spread, we use recent findings of studies that tested the inventory behavior of dealers in multiple-dealer trading systems to modify the general Huang and Stoll (1997) model. Earlier studies treated the systems of market makers as the same as single-dealer systems. However, there is a substantial difference between the inventory impact in a single dealer (specialist) system and a multiple-dealer system. First, multiple dealers have a higher capital base and a higher
risk-taking capacity than a single dealer. Second, the positioning of quotes relative to other dealers depends on the current inventory level, which means that many trades (even though not initiated by the market maker) do not bring undesired inventory, but rather bring the inventory to the desired level. Therefore in our model, inventory impacts quotes only in times of trading pressure. In fact, our results confirm that inventory is of rather low importance even in times of trading pressure.

While the absolute value of the spread in our sample is comparable to that of average U.S. stocks used in previous studies, our estimates of the bid-ask spread components suggest that the adverse-selection component amounts to only 14 percent on average, which is rather low and in line with recent estimates from developed markets. What makes even the widespread informed trading relatively unimportant as a determinant of the bid-ask spread remains a topic for further research.

References


Table 1: Basic characteristics of the stocks in our sample (September and October 1999)

<table>
<thead>
<tr>
<th>Company</th>
<th>Market cap. (mn CZK)</th>
<th>Average price (CZK)</th>
<th>Daily turnover (mn CZK)</th>
<th>Daily number of trades</th>
<th>Trading lot (number of shares)</th>
<th>Avg. spread* (CZK)</th>
<th>Avg. spread* (percent)</th>
<th>Number of market makers</th>
</tr>
</thead>
<tbody>
<tr>
<td>ČESKÁ SPOŘITELNA</td>
<td>11,873</td>
<td>183</td>
<td>33</td>
<td>15</td>
<td>10,000</td>
<td>4.1</td>
<td>2.2%</td>
<td>11</td>
</tr>
<tr>
<td>Č. RADIOKOMUNIKACE</td>
<td>36,996</td>
<td>1,203</td>
<td>39</td>
<td>26</td>
<td>1,000</td>
<td>16.8</td>
<td>1.4%</td>
<td>13</td>
</tr>
<tr>
<td>ČEZ</td>
<td>51,258</td>
<td>87</td>
<td>77</td>
<td>34</td>
<td>20,000</td>
<td>0.9</td>
<td>1.0%</td>
<td>15</td>
</tr>
<tr>
<td>IPS</td>
<td>1,831</td>
<td>132</td>
<td>4</td>
<td>3</td>
<td>5,000</td>
<td>3.8</td>
<td>2.9%</td>
<td>11</td>
</tr>
<tr>
<td>KOMERČNÍ BANKA</td>
<td>16,865</td>
<td>887</td>
<td>79</td>
<td>25</td>
<td>3,000</td>
<td>11.9</td>
<td>1.3%</td>
<td>12</td>
</tr>
<tr>
<td>RIF</td>
<td>12,557</td>
<td>1,309</td>
<td>9</td>
<td>5</td>
<td>1,000</td>
<td>11.5</td>
<td>0.9%</td>
<td>10</td>
</tr>
<tr>
<td>SPT (ČESKÝ) TELECOM</td>
<td>124,394</td>
<td>529</td>
<td>243</td>
<td>43</td>
<td>10,000</td>
<td>5.2</td>
<td>1.0%</td>
<td>14</td>
</tr>
<tr>
<td>UNIPETROL</td>
<td>10,573</td>
<td>58</td>
<td>50</td>
<td>19</td>
<td>20,000</td>
<td>1.2</td>
<td>2.1%</td>
<td>13</td>
</tr>
<tr>
<td>Average</td>
<td>33,293</td>
<td>210</td>
<td>67</td>
<td>170</td>
<td>n.a.</td>
<td>6.7</td>
<td>1.6%</td>
<td>12.4</td>
</tr>
</tbody>
</table>

Source: Prague Stock Exchange and authors’ calculation. The average exchange rate during the two months amounted to 34.4 CZK/USD.

Note: There were 42 trading days in September and October 1999. Thus, the total number of trades in these two months ranges between 122 for IPS and 1,823 for SPT Telecom. *This is the posted spread, that is, the difference between best bid and best ask prices.
Table 2: Results of estimation (for PRESS 6)

<table>
<thead>
<tr>
<th>Company</th>
<th>S/2</th>
<th>α</th>
<th>β</th>
<th>δ (Cross)</th>
<th>λ (Active)</th>
<th>NOB</th>
<th>R² (eq. 4)</th>
<th>R² (eq. 5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ČESKÁ SPOŘITELNA</td>
<td>1.56 ± 0.04</td>
<td>0.17 a</td>
<td>0.01 (inv. 6)</td>
<td>0.14 c</td>
<td>-0.03 (0.05)</td>
<td>630</td>
<td>0.67</td>
<td>0.09</td>
</tr>
<tr>
<td>ČESKÉ RADIOKOMUNIKACE</td>
<td>6.11 ± 0.16</td>
<td>0.12 a</td>
<td>0.07 (0.05)</td>
<td>0.15 (0.36)</td>
<td>-0.16 (0.23)</td>
<td>1,084</td>
<td>0.59</td>
<td>0.03</td>
</tr>
<tr>
<td>ČEZ</td>
<td>0.30 ± 0.01</td>
<td>0.13 a</td>
<td>0.04 (0.03)</td>
<td>0.02 c</td>
<td>0.03 a (0.01)</td>
<td>1,429</td>
<td>0.54</td>
<td>0.09</td>
</tr>
<tr>
<td>IPS</td>
<td>1.36 ± 0.08</td>
<td>0.30 a</td>
<td>-0.08 (0.09)</td>
<td>0.36 b</td>
<td>0.002 (0.10)</td>
<td>121</td>
<td>0.70</td>
<td>0.24</td>
</tr>
<tr>
<td>KOMERČNÍ BANKA</td>
<td>4.78 ± 0.12</td>
<td>0.10 a</td>
<td>-0.001 (0.03)</td>
<td>0.12 (0.17)</td>
<td>0.30 a (0.09)</td>
<td>1,043</td>
<td>0.59</td>
<td>0.08</td>
</tr>
<tr>
<td>SPT (ČESKÝ) TELECOM</td>
<td>2.04 ± 0.03</td>
<td>0.12 a</td>
<td>0.08 a (0.02)</td>
<td>-0.08 (0.05)</td>
<td>0.10 a (0.03)</td>
<td>1,822</td>
<td>0.66</td>
<td>0.12</td>
</tr>
<tr>
<td>UNIPETROL</td>
<td>0.48 ± 0.01</td>
<td>0.08 a</td>
<td>0.10 a (0.03)</td>
<td>-0.01 (0.02)</td>
<td>0.02 a (0.01)</td>
<td>791</td>
<td>0.67</td>
<td>0.08</td>
</tr>
</tbody>
</table>

Note: PRESS 6 denotes the case in which we require the cumulative trade indicator to exceed 6 for selling pressure to exist. The results for other definitions of the PRESS variable can be found in the Appendix. Standard errors are reported in parentheses.

The symbol a stands for rejection of the null hypothesis (that the coefficient equals zero) at the 1 percent level of significance, while b and c denote rejection at the 5 percent and 10 percent levels. In the case of RIF, we encountered problems with the convergence of estimates. The reason might be the rather low number of observations; we obtained implausible estimates and do not report them here.
Table 3: Results of the Huang and Stoll (1997) model

<table>
<thead>
<tr>
<th>Company</th>
<th>λ (from eq.9)</th>
<th>α</th>
<th>β</th>
<th>R² (eq.10)</th>
<th>R² (eq.13)</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>ČESKÁ SPOŘITELNA</td>
<td>0.18&lt;sup&gt;a&lt;/sup&gt; (0.05)</td>
<td>-0.02 (0.10)</td>
<td>0.20&lt;sup&gt;b&lt;/sup&gt; (0.08)</td>
<td>0.29</td>
<td>0.39</td>
<td>629</td>
</tr>
<tr>
<td>ČESKÉ RADIOKOMUNIKACE</td>
<td>0.14&lt;sup&gt;a&lt;/sup&gt; (0.04)</td>
<td>0.13 (0.09)</td>
<td>0.05 (0.08)</td>
<td>0.24</td>
<td>0.35</td>
<td>1,083</td>
</tr>
<tr>
<td>ČEZ</td>
<td>0.23&lt;sup&gt;a&lt;/sup&gt; (0.03)</td>
<td>0.06 (0.08)</td>
<td>0.18&lt;sup&gt;a&lt;/sup&gt; (0.07)</td>
<td>0.23</td>
<td>0.36</td>
<td>1,428</td>
</tr>
<tr>
<td>IPS</td>
<td>0.38&lt;sup&gt;a&lt;/sup&gt; (0.13)</td>
<td>-0.03 (0.26)</td>
<td>0.41&lt;sup&gt;b&lt;/sup&gt; (0.19)</td>
<td>0.47</td>
<td>0.21</td>
<td>120</td>
</tr>
<tr>
<td>KOMERČNÍ BANKA</td>
<td>0.17&lt;sup&gt;a&lt;/sup&gt; (0.03)</td>
<td>0.09 (0.08)</td>
<td>0.10 (0.07)</td>
<td>0.19</td>
<td>0.47</td>
<td>1,042</td>
</tr>
<tr>
<td>RIF</td>
<td>0.25&lt;sup&gt;a&lt;/sup&gt; (0.09)</td>
<td>-0.25 (0.20)</td>
<td>0.40&lt;sup&gt;a&lt;/sup&gt; (0.15)</td>
<td>0.35</td>
<td>0.30</td>
<td>205</td>
</tr>
<tr>
<td>SPT (ČESKÝ) TELECOM</td>
<td>0.20&lt;sup&gt;a&lt;/sup&gt; (0.02)</td>
<td>0.14&lt;sup&gt;a&lt;/sup&gt; (0.05)</td>
<td>0.10&lt;sup&gt;b&lt;/sup&gt; (0.05)</td>
<td>0.24</td>
<td>0.48</td>
<td>1,821</td>
</tr>
<tr>
<td>UNIPETROL</td>
<td>0.17&lt;sup&gt;a&lt;/sup&gt; (0.04)</td>
<td>0.28 (0.09)</td>
<td>-0.04 (0.08)</td>
<td>0.23</td>
<td>0.48</td>
<td>790</td>
</tr>
</tbody>
</table>

Note: The symbol <sup>a</sup> stands for rejection of the null hypothesis (that the coefficient equals zero) at the 1 percent level of significance, while <sup>b</sup> and <sup>c</sup> denote rejection at the 5 percent and 10 percent levels. Standard errors are reported in parentheses.
Appendix – Estimation results for different choices of the PRESS variable

Table A1: Results of estimation (for PRESS 4)

<table>
<thead>
<tr>
<th>Company</th>
<th>S/2</th>
<th>α</th>
<th>β</th>
<th>δ</th>
<th>λ</th>
<th>N</th>
<th>R^2</th>
<th>R^2</th>
</tr>
</thead>
<tbody>
<tr>
<td>ČESKA SPOŘITELNA</td>
<td>1.56</td>
<td>0.18</td>
<td>-0.02</td>
<td>0.14</td>
<td>-0.03</td>
<td>630</td>
<td>0.67</td>
<td>0.09</td>
</tr>
<tr>
<td></td>
<td>(0.04)</td>
<td>(0.03)</td>
<td>(0.04)</td>
<td>(0.07)</td>
<td>(0.05)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ČESKÉ RADIOKOMUNIKAČE</td>
<td>6.11</td>
<td>0.09</td>
<td>0.09</td>
<td>0.18</td>
<td>-0.18</td>
<td>1,084</td>
<td>0.59</td>
<td>0.03</td>
</tr>
<tr>
<td></td>
<td>(0.16)</td>
<td>(0.03)</td>
<td>(0.05)</td>
<td>(0.36)</td>
<td>(0.24)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ČEZ</td>
<td>0.30</td>
<td>0.13</td>
<td>0.03</td>
<td>0.02</td>
<td>0.03</td>
<td>1,429</td>
<td>0.54</td>
<td>0.09</td>
</tr>
<tr>
<td></td>
<td>(0.01)</td>
<td>(0.02)</td>
<td>(0.03)</td>
<td>(0.01)</td>
<td>(0.01)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IPS</td>
<td>1.36</td>
<td>0.30</td>
<td>-0.07</td>
<td>0.37</td>
<td>0.01</td>
<td>121</td>
<td>0.70</td>
<td>0.24</td>
</tr>
<tr>
<td></td>
<td>(0.08)</td>
<td>(0.08)</td>
<td>(0.09)</td>
<td>(0.14)</td>
<td>(0.10)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>KOMERČNÍ BANKA</td>
<td>4.78</td>
<td>0.11</td>
<td>-0.03</td>
<td>0.13</td>
<td>0.31</td>
<td>1,043</td>
<td>0.59</td>
<td>0.08</td>
</tr>
<tr>
<td></td>
<td>(0.12)</td>
<td>(0.02)</td>
<td>(0.03)</td>
<td>(0.16)</td>
<td>(0.09)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPT (ČESKÝ) TELECOM</td>
<td>2.04</td>
<td>0.13</td>
<td>0.04</td>
<td>-0.08</td>
<td>0.10</td>
<td>1,822</td>
<td>0.66</td>
<td>0.11</td>
</tr>
<tr>
<td></td>
<td>(0.03)</td>
<td>(0.01)</td>
<td>(0.02)</td>
<td>(0.05)</td>
<td>(0.03)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UNIPETROL</td>
<td>0.48</td>
<td>0.07</td>
<td>0.07</td>
<td>-0.01</td>
<td>0.02</td>
<td>791</td>
<td>0.67</td>
<td>0.08</td>
</tr>
<tr>
<td></td>
<td>(0.01)</td>
<td>(0.02)</td>
<td>(0.03)</td>
<td>(0.02)</td>
<td>(0.01)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table A2: Results of estimation (for PRESS 8)

<table>
<thead>
<tr>
<th>Company</th>
<th>S/2</th>
<th>α</th>
<th>β</th>
<th>δ</th>
<th>λ</th>
<th>N</th>
<th>R^2</th>
<th>R^2</th>
</tr>
</thead>
<tbody>
<tr>
<td>ČESKÁ SPOŘITELNA</td>
<td>1.56</td>
<td>0.15</td>
<td>0.12</td>
<td>0.13</td>
<td>-0.03</td>
<td>630</td>
<td>0.67</td>
<td>0.10</td>
</tr>
<tr>
<td></td>
<td>(0.04)</td>
<td>(0.02)</td>
<td>(0.06)</td>
<td>(0.07)</td>
<td>(0.05)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ČESKÉ RADIOKOMUNIKAČE</td>
<td>6.11</td>
<td>0.12</td>
<td>0.13</td>
<td>0.12</td>
<td>-0.17</td>
<td>1,084</td>
<td>0.59</td>
<td>0.03</td>
</tr>
<tr>
<td></td>
<td>(0.16)</td>
<td>(0.03)</td>
<td>(0.07)</td>
<td>(0.36)</td>
<td>(0.23)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ČEZ</td>
<td>0.30</td>
<td>0.13</td>
<td>0.08</td>
<td>0.02</td>
<td>0.03</td>
<td>1,429</td>
<td>0.54</td>
<td>0.10</td>
</tr>
<tr>
<td></td>
<td>(0.01)</td>
<td>(0.02)</td>
<td>(0.04)</td>
<td>(0.01)</td>
<td>(0.01)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IPS</td>
<td>1.36</td>
<td>0.25</td>
<td>0.02</td>
<td>0.37</td>
<td>0.01</td>
<td>121</td>
<td>0.70</td>
<td>0.23</td>
</tr>
<tr>
<td></td>
<td>(0.08)</td>
<td>(0.06)</td>
<td>(0.09)</td>
<td>(0.14)</td>
<td>(0.10)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>KOMERČNÍ BANKA</td>
<td>4.78</td>
<td>0.10</td>
<td>0.05</td>
<td>0.12</td>
<td>0.30</td>
<td>1,043</td>
<td>0.59</td>
<td>0.08</td>
</tr>
<tr>
<td></td>
<td>(0.12)</td>
<td>(0.01)</td>
<td>(0.05)</td>
<td>(0.16)</td>
<td>(0.09)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPT (ČESKÝ) TELECOM</td>
<td>2.04</td>
<td>0.13</td>
<td>0.16</td>
<td>-0.08</td>
<td>0.09</td>
<td>1,822</td>
<td>0.66</td>
<td>0.12</td>
</tr>
<tr>
<td></td>
<td>(0.03)</td>
<td>(0.01)</td>
<td>(0.03)</td>
<td>(0.05)</td>
<td>(0.03)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UNIPETROL</td>
<td>0.48</td>
<td>0.10</td>
<td>0.10</td>
<td>-0.01</td>
<td>0.02</td>
<td>791</td>
<td>0.67</td>
<td>0.08</td>
</tr>
<tr>
<td></td>
<td>(0.01)</td>
<td>(0.02)</td>
<td>(0.05)</td>
<td>(0.02)</td>
<td>(0.01)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: PRESS 4 and 8 denotes the cases in which we require the cumulative trade indicator to exceed 4 and 8 for selling pressure to exist. Standard errors are reported in parentheses. ^a^ stands for rejection of the null hypothesis (that the coefficient equals zero) at the 1% level of significance, while ^b^ and ^c^ denote rejection at the 5% and 10% levels. In the case of RIF, we have encountered problems with the convergence of estimates. The reason might be the rather low number of observations; we obtained implausible estimates and do not report them here.
“Bid-ask spread” is defined as the difference between the price at which the market maker is willing to sell and the price at which he is willing to buy.

The perception of the Czech equity market by the international investor community can be illustrated by articles in the press and assessments by international organizations. The Economist (April 1996) and the Wall Street Journal (May 1996) reported on “dealing in Prague as a losers' guide to investment,” and characterized the Czech capital market as “a muddy market” and as “anarchy to the outsider, sweet profit to those in the know.” More recently, The Economist (March 1997) quoted an investor as saying “…[the government should] fight the perception that the Prague stock exchange is just a vehicle for select insiders to enrich themselves at the expense of the ordinary shareholder.” In its 1999 Country Study, the World Bank argued that “The capital market needs to be further strengthened to recover credibility and to be a real source of corporate financing” (Summary Report, page 17). It is also illustrative that the Prague Stock Exchange has been unable to become a member of the Federation of European Stock Exchanges, even though both Budapest and Warsaw Stock Exchanges are associate members of this federation.

Thus, we do not face the problem that our sample is formed by large companies which tend to have a lower spread in absolute terms and, as shown by Easley et al. (1996b), also tend to have a lower adverse-selection component of the spread. For a more detailed discussion of the sample selection and comparison with developed markets, see the next section (Trading System and Data Description).

One more bank, IPB, had its stock traded in the SPAD system. In June 2000, however, IPB was put under forced administration and its stock was suspended from trading. Because it was introduced into SPAD only in November 1999 and thus was not traded in the system during the time period on which we focus, we leave it out altogether.

At the same time, the share of the SPAD system of the whole PSE trading volume was rather high in 1999, at 82%, as it was successful in attracting order flow from the direct trades segment.

The market value of one trading lot ranged from 0.7 mn CZK to 5.3 mn CZK in late 1999 and averaged slightly below 2.0 mn CZK.
The trade indicator is usually defined as equal to 1 if the trade is considered a buy, -1 for a sell and 0 if the type of trade is unclear, for instance, if the trade was executed exactly at the midpoint between bid and ask quotes. Some studies do not use 0 and classify all the trades as buys or sells by using additional characteristics of the order flow, for instance, the direction of previous trades.

The inside quote is formed by the best bid and best ask quotes.

The risk-sharing feature of multiple dealer systems is also recognized in Affleck-Graves et al. (1994). We assume that dealers do not view the undesired inventory of other dealers as their own.

In fact, Ho and Stoll solve the model only for two dealers. Also, the best quotes are not the reservation prices of dealers with extreme positions, but equal to the second-best positions (or only marginally better). This does not affect our analysis here, though.

This method is similar to Huang and Stoll (1997), also use a three-way decomposition of the spread based on portfolio trading pressure. They use an aggregate (cumulative) sell-buy indicator. Their approach is used for NYSE stocks, however, and is thus questionable, since it is difficult to argue that the specialist should react to inventory changes only when there is overall selling and buying pressure. Also, the selection of stocks that should be indicative of trading pressure is questionable and Huang and Stoll do not support this approach very strongly.

It should be noted that such trades were technically initiated by the dealer, but other market participants do not know whether the dealer conducts the transaction for a client or on its own account.

The treatment of the inventory component is the main difference of our model from that of Huang and Stoll (1997). It is important, since it allows us to use a rather simple estimation technique. Our estimation results and our comparison with the results of the Huang and Stoll (1997) approach appear to support our method.

Estimates for the other two choices of the PRESS variable can be found in the Appendix.

In fact, Huang and Stoll (1997) also obtained negative estimates of α initially. They argued that it was due to large orders being executed as a series of small trades over a short time period. They thus combined
all sequential trades at the same price and quotes into one trade. We do not consider this to be a problem here, especially since the trading frequency is considerably lower for our stocks.