Information transmission around block trades on the Spanish stock exchange

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This study investigates the informational effects of large transactions, or Block Trades (BT), in the Spanish Stock Exchange (SSE). In the open market period, this topic was not facilitated in the SSE as it was in other markets until 1998. The SSE thus provides a special environment for analysing the information transmission of these specific transactions.

It is assumed that information can be better reflected by changes in true asset value, proxied by the midpoint of bid-ask best quotes. Therefore, we will look at changing true asset value orders instead of trades.

Three different effects are studied around BTs: price, liquidity and information transmission. To capture them, three different endogenous variables are considered: true asset returns, relative spreads and adverse selection spread component. With this approach, no clear effects of BTs are found. The main result of the study is that there seems to be an increase in information asymmetries when one looks at the adverse selection spread component in some of the different subsample classifications (buyer, seller and sweeping BT), but there is no significant permanent effect on returns. This result could be related to insiders trading in the market. In sharp contrast with adverse selection evidence, a temporary decrease in bid/ask spread around BTs is also observed. These changes reflect temporary liquidity effects related to other spread components (order processing costs and inventory costs).

I. Introduction

Information transmission through order flow is an important issue in financial research. The general markets efficiency assumption is based on this point. According to theoretical financial literature on information, the value of private information depreciates quickly (see, for example, Foster and Viswanathan, 1990). Thus, informed investors prefer large transactions (Block Trades, or BT henceforth) in order to get into a valuable position as soon as possible. Formal models of information disclosure

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through BTs can be found in Easley and O'Hara (1987) and Seppi (1990).[1] On the other hand, it is also known that informed investors, in order to conceal their superior private information, are interested in camouflaging their desired trades into small or medium size trades (Kyle, 1985). From the empirical point of view, it is not clear whether these BTs may be understood as strategic trading motivated by information or whether they may be viewed only as a consequence of institutional investors' balancing their portfolios.

Most of the empirical research into BTs focuses on information transmission by looking at permanent and temporary effects of BTs on asset prices or returns. The permanent part is interpreted as being information motivated, whereas the temporary one is associated with price pressure or liquidity costs. Kraus and Stoll (1972), Scholes (1972), Holthausen *et al*. (1987, 1990), Aggarwal and Chen (1990), Chan and Lakonishok (1993, 1995), LaPlante and Muscarella (1997) and Madhavan and Cheng (1997) are interesting examples of this issue on the NYSE. Both effects (permanent and temporary) seem to be present and the sign depends on the type of BT (buyer or seller). Similar analyses for order driven markets can be found in Ball and Finn (1989), for the Sidney Stock Exchange, and Riva (1996), for the Paris Bourse.[2]

This approach must be differentiated from the one in the corporate governance literature, in which block trades are related to publicly announced changes in the ownership structure of firms.[3] Some outstanding references of this alternative literature are Barclay and Holderness (1991), Bethel *et al*. (1998) and Bolton and Von Thadden (1998). Instead of analysing the public announcements of large purchases or sells of assets, the present focus is in the anonymous large transactions crossed in the open market.

This study investigates the impact of BTs in the Spanish Stock Exchange (SSE). The SSE offers a particularly appropriate testing ground for examining these issues. The reason is that in the open market period, this type of transaction was not facilitated as in other markets till 1998, so that BTs were dealt like small trades.[4] This market microstructure characteristic makes these transactions costly because of the effort required to cross them. In this way, the SSE provides a special environment for analysing the information transmission of these specific transactions.

In order to analyse whether these transactions transmit information, a new approach is proposed. In sharp contrast with previous BT research, it is assumed that information can be better reflected by changes in true asset value, proxied by the midpoint of bid-ask best quotes. By looking at these intrinsic value changes instead of price changes, the effects of liquidity (noninformative) trades are avoided which modify asset prices without affecting their true value (the so-called bid-ask bounce).[5] At the same time, this allows one to consider very informative bid-ask changes which do not result from a new transaction (so that no new price is established), but which reflect worthy changes in the investor's preferences for assets. Therefore, the study will look at changing true asset value orders instead of trades.

In relation to information effects, two variables are looked at. As previous studies have done, the impact of BTs on true asset returns is analysed and a different behaviour is expected depending on the type of BT. Also, as pointed out in market microstructure literature, changes in the adverse selection spread component show how prices absorb information.[6] Adverse selection can be understood as a measure of information asymmetries. Thus, if a decrease in adverse selection component around BTs is observed, one could conclude that BTs transmit information diminishing information asymmetries between agents. This adverse selection component must be differentiated from liquidity in general. Therefore, the behaviour of relative spreads around BTs will also be analysed to detect changes in liquidity not related to information transmission. These changes would be motivated by order processing costs and inventory costs.

[1] Easley and O'Hara (1987) show how BTs significantly increase the probability market participants attach to the existence of private information. Seppi (1990) develops a model where, under not very restricted circumstances, information-based BTs are traded in a partial-pooling equilibrium.

[2] Gemmill (1996), for the London Stock Exchange, has recently analysed the liquidity effects of BTs under different publication rules. In related literature, Seppi (1992) and Daley *et al*. (1995) among others, investigate the extent to which block price changes around quarterly earnings announcements.

[3] An anonymous referee is thanked for pointing this out.

[4] Examples of these special BT devices are the upstairs market in the NYSE (Hasbrouck *et al*., 1993) and the broader bid-ask spread in the Paris Bourse (Riva, 1996).

[5] Seppi (1992) also points out that the conclusions obtained by looking at price changes may be affected by the potential presence of a variety of price pressure effects.

[6] See O'Hara (1995).

This new approach is proposed, together with the special market microstructure that is analysed, makes this study innovative in current literature on information transmission around BTs.

Evidence of information transmission is found around some types of BTs when one looks at the adverse selection spread component. However, contrary to previous research, no significant permanent effect on true asset returns is found. Changes in liquidity around BTs are also observed, but this effect is related to temporary spread components.

The remainder of the article is organized as follows. Section II reviews briefly the microstructure of the SSE and, particularly, the block trading process. The data set and sampling rules are presented in Section III. Section IV discusses the methodology used and results obtained in the analysis. Finally, Section V offers some concluding remarks.

II. Institutional Settings of the Spanish Stock Market

The electronic continuous market for equities in SSE is a purely order driven market. Through this system, 142 companies are traded. The main characteristic is a single order book for every stock. Three main periods are found in the daily market:

1. Preopening period (from 09:00 h to 10:00 h): In this period, introduction, modification and cancellation of limit orders are allowed. Depending on supply and demand, the system calculates a preopening price in real time. At 10:00 h the system assigns shares to orders at prices better than or equal to the opening price.
2. Open market period (from 10:00 h to 17:00 h): During this period limit and market orders are introduced. If a counterparty is found they are automatically executed. If not, the order remains on the book until an incoming order fits it, or the order is cancelled. In this period, prices change in real time depending on the flow of buy and sell orders.
3. Special operations period (from 17:00 h to 20:00 h): In this period it is possible to report pre-agreed trades with an effective volume bigger than 20% of the daily turnover.

In order to identify the information effects of BTs clearly, the focus will be on the open market period.[7] In this way, other news is avoided that could affect the opening asset price during the closed periods.

As in other markets, an investor willing to buy or sell a large number of shares looks for a counterparty through brokerage houses establishing a preagreement in shares and price. However, in order to cross this preagreement in the open market in SSE, investors suffer two handicaps. First, traders must introduce a limit order to execute a BT, so it is impossible to cross it outside the limit order book. Second, in order to transact the BT, the limit order must be at the best level of buy or sell prices. As a result, it can be costly to trade large blocks of shares in this period.

In this context, a BT trader can face two different market situations: (i) When there is a level of prices available between best buy and best sell (spread bigger than tick size), traders quickly introduce pre-agreed sell and buy limit orders inside the spread and BT is transacted. (ii) When there is no such available price and traders do not want to wait, they sweep the necessary orders to open the spread and get a price available inside it. This sweeping activity is particularly necessary for stocks that are so liquid that it is very difficult to find an available price. Obviously, it imposes an additional cost.

On crossing the two types of BTs, when one side order has been introduced, there is always the possibility that another limit order may arrive and the pre-agreed BT cannot be completely crossed.[8] We call this issue 'interference risk'.

[7] During the period analysed, 11% of the total number of BTs was traded in the preopening period, and 15% in the special operations period. Regarding the effective volume, the percentages are 20% and 16%, respectively.

[8] Since 6 November 1998, a new device for reporting and trading BTs in the open market period has been operational. This feature allows market members, as other European markets already do, to trade BTs outside the best bid-ask spread of the book. In any case, this possibility is set according to a certain relationship with market prices. Specifically, there are currently two ways to trade a block: (i) For stocks belonging to the IBEX-35 Index (the 35 most liquid stocks on the SSE), members can report agreed blocks to the Exchange. As a result, interference risk has been eliminated. Minimum required amount of shares for trade is 5% of the daily turnover in the last quarter of the year and 100 million pesetas (0.59 million euros). In this context, the spread is the on line weighted average price of the six best levels of bid and ask. (ii) For all the stocks on the SSE, market members can introduce orders bigger than 10% of the daily turnover in the last quarter with a deviation of 15% from last closing price and 250 million pesetas (1.5 million euros). Here there is no time and price priority rule and members can select any order. Some modifications regarding the minimum required amount of shares and the price divergence were introduced on 1 June 2000.

Table 1. Size distribution of trades crossed in SSE, May 1996–April 1997

		Number of trades	Trading volume
<1 mil.		2 413 137 (60.28)	810 396 (5.9)
>1 mil. and <10 mil.		1 335 059 (33.35)	4 348 807 (31.6)
>10 mil. and <50 mil.		226 666 (5.66)	4 435 662 (32.2)
>50 mil.		28 420 (0.71)	4 174 179 (30.3)
	<5%	22 048 (0.55)	2 048 370 (14.9)
	>5% and <10%	2002 (0.05)	421 378 (3.1)
	>10% and <20%	1989 (0.05)	442 291 (3.2)
	>20% and <40%	1099 (0.03)	350 160 (2.5)
	>40%	1282 (0.03)	911 980 (6.6)
All trades		4 003 282	13 769 044

Notes: Number and effective trading volume (in millions of pesetas) of all trades crossed in the open SSE during the period May 1996–April 1997, sorted by trading volume. Those with trading volume greater than 50 million are additionally sorted by their percentage of the average trading daily volume. The percentage of the total is in parentheses.

III. Data

Data on all best bid and ask prices on the SSE in the open market during the one-year period from May 1996 to April 1997 were collected. As indicated, only quotes that change true asset value were selected because they reflect information arrival appropriately. The cause of these changes is the introduction of a new limit order that improves one of the best prices of the limit order book (bid or ask), the cancellation of the limit orders that are at these best levels of prices or a transaction that clears one of these best positions in the limit order book. The available information for each of these selected quotes includes: time (stamped to the nearest second), date, bid, ask, transaction price and number of shares transacted since the previous selected quote.[9] The value of the SSE Index (IBEX-35) for each second was also obtained from SSE.

As a description of the SSE, Table 1 presents some summary statistics about the size distribution of all trades crossed in the SSE during the period considered. As can be observed, the mean trading volume is 3.4 million pesetas.[10] Trades of 1 million or less represent more than 60% of all trades, but these trades only represent 5.9% of effective trading volume. Throughout this study, BTs are defined as any trade whose value is over 50 million pesetas and, at the same time, is greater than 20% of the average effective trading daily volume for the respective asset.[11] According to this definition, there were 2381 BTs during this period. They represent 9.1% of trading volume, but only 0.06% of the total number of trades.

Sampling rules

Given that one needs to observe information transmission, some filters are applied to the sample of BTs and firms. The objective of these sample selection rules is to obtain a sample of BTs that *ex-ante* were purely information motivated. First, only BTs involving the 50 most liquid firms are considered. This restriction allows one to use a highly continuous trading sample. In this way, disturbing nontrading effects are eliminated. Neither of these firms has been implicated in merger or takeover processes during the period of study. A BT is excluded if there is a payment or stock split (or any payment in the firm) in the 13 calendar-days window for each BT (six calendar-days before and six calendar-days after).[12] These BTs are likely to be noninformationally motivated, as Choe and Masoulis (1992) point out. BTs for which additional blocks occurred in the stock during the same 13 calendar-days window are also excluded. In this way, selected BTs are not affected by the close presence of another BT. For reasons of data availability (motivated by the estimation period chosen) BTs occurring less than 14 calendar-days after the beginning of the period analysed and 14 calendar-days before the end are also excluded. Finally, only blocks occurring between 11:00 h and 16:00 h are analysed. The first and the last hour of the trading day are excluded because of

[9] For orders that do not produce transactions, the price of the corresponding previous transaction is considered. For the first quote of the day the accumulated volume of shares transacted in the preopening period was used.
[10] The peseta/euro exchange rate has been 166.386 since 1 January 1999.
[11] This cut-off was chosen because it is the institutional requirement for 'specially communicated trades' on the SSE.
[12] There is nothing special in this figure. The only interest is to separate BT effects as far as possible from others.

the disturbing effects of opening and closing trades. Many large transactions at opening cannot be considered as BTs: They are merely a large number of individual transactions crossed together and printed as one transaction. Likewise, transactions during the last hour may incorporate end-of-the-day effects (see Amihud and Mendelson, 1986 and Harris, 1986).

It must be said that some of the BTs selected according to these criteria did not appear in the original sample of quotes changing the asset true value proxy. However, it was decided to include them because their information effects could operate with some delay or advance.[13]

After applying all these sampling rules, the number of BTs finally considered is reduced to 195, in 41 firms. They represent 1.3% of the trading volume during the whole of the period analysed. BT trading volume ranges from 51 to 27 668 million pesetas and the mean value is about 947 million pesetas.

The analyses will be performed individually for each BT. The estimation period considered is a 29 calendar-days window for each BT (14 calendar-days before and 14 calendar-days after BT).[14] It is clear, considering the differences between assets, that the number of quotes in this fixed period is very different from one asset to another. The range goes from 235 quotes for the least liquid asset to 4460 for the most liquid, with 1487 being the average number for all BTs in the sample.

Descriptive statistics

Unfortunately, the data set does not identify the party initiating the large transaction. However, as is clear from empirical literature on BTs, the signs of the expected effects differ for buyer and seller-initiated transactions. A buyer-initiated BT is expected to produce a permanent increase in the asset price, whereas the inverse effect is expected for a seller-initiated BT. In order to sort BTs as buyer or seller-initiated, the difference between the BT price and the true value proxy at the previous trade are calulated. If this difference is positive, the BT is classified as *buyer-initiated*, whereas if it is negative it is classified as *seller-initiated*. BTs whose price equals the previous asset true value are classified as *indeterminate-initiated*.[15]

The data set identifies most BTs according to an *inside the spread* or *sweeping* classification, as referred to in Section 2. BTs not included in either of these types are considered as *not classified*.[16] Intuitively, stronger effects are expected in sweeping BTs because of the additional cost they impose. BTs were also sorted by whether or not they change the asset true value. As above, greater effects in BTs that change the asset true value were expected. Additionally, BTs are classified in four groups according to their trading volume. Each group has about the same number of BTs, with *BB* being the group with the biggest BTs, *SS* the group with the smallest, and *BS* and *SB* the medium size group. A direct relationship between information transmission and BT size was expected.

Tables 2 and 3 illustrate some of the distinguishing features of the BTs in the sample. Table 2 shows the sample composition regarding the side initiating the BT, type and changes or not in asset true value. As can be observed in panel A, the sample distribution is very similar regarding the side initiating the BT, especially in the volume transacted. The number of indeterminate-initiated BTs seems to be greater than the other types for small and medium BTs. Panel B shows that the largest BTs by volume transacted are traded inside the spread, whereas the BTs not classified seem to be the small ones. However, the number of BTs in each group is very similar. Panel C shows that the biggest BTs change the asset true value. But this relationship is reversed for the other size BTs.

Table 3 describes the day-of-the-week and hour-of-the-day distribution of the BT sample. The first value in each cell is the percentage of the number of BTs and the second is the corresponding trading volume. A clear seasonal pattern is found in the sample. First, from the microstructure of the SSE, it is clear that investors tend to use the less competitive hours of the day to cross large transactions. It is seen in Table 3 that the 13:00–14:00 h period is the time of the trading day when the biggest BTs are crossed. Differences in days of the week are also observed. Surprisingly, on Friday (the day of the week when futures contracts expire) no special derivatives effect is observed,

[13] This possibility will be observed when traders choose not to introduce the BT order in the first level of book prices. If there is enough time another order may arrive and when the BT is crossed a change in true asset value will not be observed.
[14] The estimation period must be long enough to provide precise estimates of parameters and short enough to keep the data manageable. This period is considered as one that appropriately meets both requirements.
[15] This criterion has been used previously by Blume *et al*. (1989) and Hausman *et al*. (1992), among others. The 'tick test' algorithm (which classifies a transaction by looking at the previous transaction's price) proposed in Lee and Ready (1991), is a less information consuming, but also less accurate method (see Hausman *et al*., 1992).
[16] These are BTs whose limit orders were introduced in the book but not at the first level of prices, and which await execution.

Table 2. Size distribution of the BT sample

	BB		*BS*		*SB*		*SS*	
	N. of BT (%)	Vol. (%)	N. of BT (%)	Vol. (%)	N. of BT (%)	Vol. (%)	N. of BT (%)	Vol. (%)
Panel A								
Buyer-init.	0.35	0.32	0.26	0.32	0.21	0.34	0.22	0.33
Seller-init.	0.39	0.45	0.25	0.33	0.29	0.39	0.16	0.34
Indeterminate-init.	0.26	0.23	0.49	0.35	0.50	0.30	0.61	0.33
Panel B								
Inside the spread	0.47	0.76	0.34	0.49	0.35	0.48	0.30	0.39
Sweeping	0.31	0.20	0.33	0.43	0.32	0.40	0.31	0.53
Not classified	0.22	0.04	0.33	0.08	0.33	0.13	0.39	0.08
Panel C								
Change in true asset value	0.67	0.65	0.47	0.35	0.51	0.35	0.52	0.37
No change in true asset value	0.33	0.35	0.53	0.65	0.49	0.65	0.48	0.63

Note: Size distribution of the sample in number of BTs and trading volume (in percentage terms). Regarding trading volume, BTs are classified in four groups, including the biggest in *BB* and the smallest in *SS*. In panel A, BTs are classified according to the side of the market initiating the BTs (buyer, seller or indeterminate initiated), in panel B they are classified according to type (inside the spread, sweeping or not classified) and in panel C according to whether they change the asset true value or not.

Table 3. Daily and hourly seasonality of the BT sample

	Mon. (%)	Tue. (%)	Wed. (%)	Thu. (%)	Fri. (%)	All days (%)
11:00–12:00	5.64	5.64	3.59	2.05	1.03	17.95
	6.81	3.17	1.96	0.86	0.18	12.96
12:00–13:00	6.15	8.72	4.10	3.59	6.15	28.72
	5.45	7.63	2.11	3.94	2.45	21.58
13:00–14:00	4.62	4.10	5.64	1.54	6.15	22.05
	7.79	7.98	17.84	1.20	3.89	38.71
14:00–15:00	2.05	6.67	2.05	1.54	6.15	18.46
	0.51	12.10	1.43	0.43	1.29	15.75
15:00–16:00	2.56	3.59	2.05	2.56	2.05	12.82
	1.43	4.25	2.56	2.40	0.36	10.99
All periods	21.03	28.72	17.44	11.28	21.54	
	21.99	35.13	25.91	8.82	8.16	

Note: Day-of-the-week and hour-of-the-day distributions (in percentages terms) of the BT sample. The first value in each cell is the percentage of the number of blocks and the second one is the corresponding trading volume.

whereas a large volume activity is seen during the first part of the week.

IV. Methodology and Results

There are certain features that characterize the data set. First, quotes are sampled at irregularly spaced random intervals (whenever changes in true value occur), so observations are unlikely to be identically distributed, since some of them are very closely spaced in time while others may be separated by hours. Second, asset prices are always quoted in discrete units or ticks (discreteness). Among the existing models of stock price discreteness, ordered probit is the only specification that can easily capture the impact of explanatory variables on price changes while also accounting for price discreteness and irregular transaction intervals.[17] However, the use of an ordered probit specification comes up against a major problem with illiquid stocks. Tick movements must be limited because of the necessary degrees of freedom in the estimation procedure. So this method is not useful for the sample.

Therefore, in order to diminish the discreteness problem, returns will be used instead of prices.

[17] A description of this estimation procedure can be found in Hausman *et al*. (1992).

Furthermore, to solve the irregular random intervals problem, two alternative specifications will be used: the use of differences in time between consecutive quotes as an explanatory variable and the use of a time adjustment for the exogenous and endogenous variables.

As mentioned in the introduction, one of the variables that is focused on is changes in true asset value. The true value idea is taken from market microstructure literature. Glosten and Milgrom (1985) advocate the use of the midpoint of bid-ask prices as a proxy for the true value. For asset j, the true value after the kth quote is denoted by m_{jk}, and is obtained as:

$$m_{jk} = \frac{A_{jk} + B_{jk}}{2} \tag{1}$$

where A_{jk} and B_{jk} are the ask and bid prices of asset j on the kth quote, respectively. The point here is that if large trades convey valuable information, agents revise their estimation of the true price and their subsequent orders will modify the book quotes. These modifications are considered informative (whether or not there is a new transaction), because they represent changes in the amount investors are willing to pay or to receive for assets. Continuously compounded returns of relative change in the true value proxy are used as the information variable. This variable will be denoted by R_{jk}.

In addition to information transmission, BTs can involve temporary changes in liquidity. The idea is that BTs can affect investors' optimal portfolio or related variables and impose an inventory cost. These liquidity effects of BTs are analysed with regard to changes in relative spread. Many market microstructure articles focus on relative spread to study liquidity effects around dividend or earning announcements.[18] The relative spread for asset j after the kth quote is denoted by S_{jk}, and is defined by:

$$S_{jk} = \frac{A_{jk} - B_{jk}}{(A_{jk} + B_{jk})/2} \tag{2}$$

Additionally, it is considered that BTs can affect some variables such as accumulated volume and differences in time between quotes. Some papers have shown that it is important to control for some activity variables when one wants to measure the information flow. As Seppi (1992) indicates, when BTs are looked at one should consider a proxy of activity. One conclusion of market microstructure literature is that market activity can be measured by trading volume. In this way, volume appears as one appropriate variable reflecting information arrival.[19] This is denoted by VOL_{jk}, the square root of accumulated number of shares traded on asset j between quotes $k-1$ and k.[20] This is denoted further as $Dift_{jk}$, the square root of the time elapsed in seconds between quotes $k-1$ and k on asset j.[21] Engle and Lange (1997) show that this variable can signal changes in the order flow regime. So one also looks at these variables, looking for changes in regime around BTs.

Preliminary evidence of BT effects on previous variables is shown in Table 4. This table shows percentage changes in relative spread, differences in time and accumulated volume dividing each observation by its average along the estimation period by calculating the following statistic:

$$K_{jk} = \left(\frac{C_{jk}}{\overline{C}_j} - 1\right)100 \tag{3}$$

where C stands for S, $Dift$ and VOL. For returns one uses the statistic:

$$K_{jk} = R_{jk} - \overline{R}_j \tag{4}$$

The average of these statistics across all BTs is calculated for 10 quotes just before and after them. The cross-sectional distribution of each average is used to study the significant level of the event. We can observe different evidence in Table 4. First, relative spreads seem to decrease before and after BTs. This indicates an increase in liquidity. This effect is especially important just after BTs. According to market microstructure theory, this reduction may be caused by a reduction in information asymmetries or trading cost. No significant variation is observed in returns around BTs, but there is a decrease in volume before BTs that could indicate that agents are waiting for BTs to arrive. The only abnormal volume is the next BT quote. This could be a sign of agents updating their demands and portfolios. The positive and significant numbers found in time differences show that time between quotes increases just before and after a BT. Again, this could be an indication of investors waiting for trading and updating their expectations. However, this evidence is contrary to insider trading behaviour, as shown in Engle and

[18] Lee *et al.* (1993) and Rubio and Tapia (1996) are representative examples of this literature.

[19] Previous research (Lee *et al.* (1993) for the NYSE and Rubio and Tapia (1996) for the SSE) has found clear effects of trade volume on relative spread. Therefore, volume will be considered as a control variable.

[20] The square root is used to avoid the outlier problem.

[21] When a change of day occurs, the time from the market opening is used.

Table 4. Preliminary evidence of BT effects

	S_{jk}	$Dift_{jk}$	VOL_{jk}	$R_{jk}-\overline{R}_j$
−10	2.77	16.69	−25.43*	0.41E-05
−9	5.55	−10.11	−2.45	−1.33E-05
−8	1.56	3.74	−24.02*	−6.93E-05
−7	−1.93	8.00	−26.50**	−2.53E-05
−6	0.63	9.03	−22.09*	2.90E-05
−5	−7.28	58.39*	8.67	−4.65E-05
−4	−4.31	28.65*	−2.13	0.76E-05
−3	−13.44*	101.36*	4.41	−3.78E-05
−2	−5.11	74.35*	42.44**	−0.67E-05
−1	−25.45*	118.87*	35.92	−4.13E-05
0	−5.18	44.52*	5793.02*	−3.66E-05
1	2.13	75.39*	316.71*	1.62E-05
2	−6.98	54.37*	20.57	−3.72E-05
3	−6.33	53.76*	−14.70	1.17E-05
4	−5.88	58.32*	−0.27	−4.51E-05
5	−9.77*	56.42*	4.92	0.04E-05
6	−10.71*	56.35*	−12.53	−6.79E-05
7	−13.75*	28.21**	−16.45	−3.28E-05
8	−11.41*	51.11*	3.71	−3.25E-05
9	−11.26*	53.99*	42.33**	−6.29E-05
10	−6.82	22.16	16.56	2.12E-05

Note: For the characteristics of relative spread, differences in time and accumulated volume, it is shown the percentage changes, averaged across all BTs, according to the following statistic:

$$K_{jk}=\left(\frac{C_{jk}}{\overline{C_j}}-1\right)100$$

where $\overline{C_j}$ is the average of each characteristic along the estimation period. For returns the statistic: $K_{jk}=R_{jk}-\overline{R}_j$ is used. The asterisk indicates significance at 5% and double asterisk at 10%.

Lange (1997) and theoretical papers that indicate that insiders would use noisy trading intervals to camouflage their trades. So the preliminary evidence around BTs shows different behaviour of relevant variables such as spreads, volume and differences in time.

However, the observed effects on the variables may be due to variables affecting them other than BT information transmission. In order to isolate the BT effect, one needs to control the endogenous variables considered for alternative influential variables around BTs. The control variables used are well known in financial literature.

As has been pointed out, volume appears to be one appropriate control variable for information arrival. Therefore, VOL is used as an independent variable in the regression analysis. Three lags of this variable are considered in order to allow for some delay in its effects. In order to avoid the disturbing overnight effect, one also considers an end-of-the-day dummy variable.[22] This variable, denoted by *Dend*, is taken as 1 if the kth quote on asset j is the first quote of the day and 0 otherwise. Market return is also taken into account as an exogenous variable. The IBEX-35 Index is taken as the market index. The nearest in seconds value is taken for each quote in the sample period. Its return is denoted by R_{IBEX}. Three lags of this variable are also used in order to allow for some delay in its effects. The aforementioned *Dift* is also considered as a control variable.

Finally, to pick up effects around BTs, 21 dummy variables are considered (a window of 10 quotes before and after each BT) denoted by DBT_τ. Each dummy is given a value of 1 for the quote occurring τ quotes after the BT, and 0 otherwise. The quote corresponding to the BT itself is considered as the reference quote, $\tau=0$. So, after controlling by the aforementioned variables, the coefficients of these dummy variables will show us the effect of BTs on the endogenous variables before and after they occur.

As pointed out in the introduction, three different endogenous variables are considered: true asset

[22] It has been well documented that overnight returns differ substantially from intraday returns (Amihud and Mendelson, 1987 and Stoll and Whaley, 1990).

returns, relative spreads and adverse selection spread component. They capture price, liquidity and information transmission effects respectively. Because no two firms have an identical timing of quotes, regressions cannot be estimated as a multivariate system across all BTs, so one time-series regression is run for each BT. The coefficients are therefore averaged over all of them and over the different subsamples considered. If BTs are relevant for these variables, significant coefficients will be observed for the appropriate BT dummy variables. These are the relevant variables in the analysis. The remaining variables are included only to control for external effects.

Returns evidence

Next, the regression are shown for each BT used to analyse the BT effects on true asset returns. The time-series regression for each BT j is:

$$R_k = \alpha + \sum_{\tau=-1}^{\tau=-3} \phi_\tau R_\tau + \sum_{\tau=0}^{\tau=-3} \lambda_\tau R_{IBEX\tau} + \sum_{\tau=0}^{\tau=-3} \beta_\tau VOL_\tau + \gamma Dift + \varphi Dend + \sum_{\tau=-10}^{\tau=10} \delta_\tau DBT_\tau + \omega_k \quad (5)$$

where three lags of the endogenous variable are used and DBT stands for the dummy variable employed to pick up effects around BTs.[23]

The first column of Table 5 shows the results of the above regressions. Only the results for the total sample of BTs are reported. First, one observes mean reversion in returns. This expected result is consistent with other results in related literature. Second, clock time measured by $Dift$ is also significant. Other control variables seem relevant and coefficient signs are as expected (R_{IBEX}, VOL, $Dend$). So the use of these variables to control seems to be justified.

Next, the closest BT dummy coefficients are shown. In general, they are not statistically significant. The contemporary coefficient is negative and significant. The most striking result is that in the different subsample classifications this coefficient does not change its sign or is not statistically relevant.[24] This is especially important in the buyer and seller classification. This is not consistent with previous BT studies or with intuition. In the total sample results, this negative effect of the contemporaneous BT dummy is almost offset by the effect of two quotes later. In the end, it seems that there is no significant permanent effect on returns. The reason for this result could be the specific problems that traders face in the SSE in crossing a BT. These problems could cause the BT price not to be the real price. The idea is that investors willing to buy (sell) a BT would pay (renounce) an additional fee that is not observed by market participants. In this environment, BT prices might not be informative.

Alternatively in order to control for irregular interval problem, time returns are also calculated according to the expression:

$$TAR_k = \left[(1 + R_k)^{1/Dift_k}\right] - 1 \quad (6)$$

The analogous regressions now run for each BT are:

$$TAR_k = \alpha + \sum_{\tau=-1}^{\tau=-3} \phi_\tau TAR_\tau + \sum_{\tau=0}^{\tau=-3} \lambda_\tau TAR_{IBEX\tau} + \sum_{\tau=0}^{\tau=-3} \beta_\tau TAVOL_\tau + \varphi Dend + \sum_{\tau=-10}^{\tau=10} \delta_\tau DBT_\tau + \omega_k \quad (7)$$

where TAR_{IBEX} is calculated in the same way as TAR, whereas $TAVOL$ is VOL divided by $Dift$.

With this specification, the results are slightly different. In general, the control variables are not relevant or their coefficients are lower than before, and BT dummies are not significant. Although one cannot construct a statistical test to evaluate the appropriateness of time adjustment, by looking at adjusted R squared one can conclude that, in general, adjustment with $Dift$ as an exogenous variable is better than TAR adjustment. This is why these results are not included.

Adverse selection evidence

To test the information transmission hypothesis, the adverse selection spread component is looked at. The way in which we estimate this component is taken from Foster and Viswanathan (1993). These authors measure adverse selection as the returns response to unexpected volume. Given their model, the following time series regressions are estimated for each BT:

$$VOL_k = \alpha + \sum_{\tau=-1}^{\tau=-3} \phi_\tau R_\tau + \sum_{\tau=-1}^{\tau=-3} \beta_\tau VOL_\tau + \gamma Dift + \varphi Dend + \omega_k \quad (8)$$

$$R_k = \alpha + \lambda \omega_k + \sum_{\tau=-10}^{\tau=10} \delta_\tau \omega_k DBT_\tau + u_k \quad (9)$$

[23] The range of selected quotes for each regression goes from 235 to 4460. The study ran 195 regressions.
[24] The subsample results can be obtained from the authors by request.

Table 5. Aggregate results

	R	Adverse selection	VOL	S
CONS	1.56E-05	0.62E-05	13.49*	0.00*
$R_{(-1)}$	−0.32*	–	–	–
$R_{(-2)}$	−0.07*	–	–	–
$R_{(-3)}$	−0.04*	–	–	–
R_{IBEX}	0.40*	–	–	–
$R_{IBEX(-1)}$	0.16*	–	–	–
$R_{IBEX(-2)}$	0.10*	–	–	–
$R_{IBEX(-3)}$	0.05*	–	–	–
VOL	0.13E-05*	–	–	−2.41E-05*
$\mathrm{VOL}_{(-1)}$	0.00E-05	–	0.02*	1.59E-05*
$\mathrm{VOL}_{(-2)}$	−0.02E-05	–	0.06*	0.42E-05*
$\mathrm{VOL}_{(-3)}$	−0.02E-05	–	0.04*	0.07E-05*
$S_{(-1)}$	–	–	–	0.40*
$S_{(-2)}$	–	–	–	0.22*
$S_{(-3)}$	–	–	–	0.05*
Dift	−0.47E-05*	–	1.36*	−0.17E-05*
Dend	52.49E-05*	–	64.22*	0.00*
λ	–	0.00E-05	–	–
−5	1.55E-05	−0.01E-05	−2.93	−4.41E-05
−4	8.82E-05	0.38E-05	2.86	8.45E-05
−3	−7.31E-05	−0.04E-05	−1.99	−24.0E-05
−2	−17.42E-05	−0.03E-05	9.79*	26.2E-05
−1	3.82E-05	0.51E-05	−8.01*	−55.5E-05*
0	−72.46E-05*	−0.08E-05	348.24*	−0.00*
1	−11.36E-05	0.01E-05	4.38	−29.8E-05
2	58.36E-05*	5.64E-05	−26.57*	−12.2E-05
3	−8.64E-05	0.75E-05	−19.45*	31.1E-05**
4	19.33E-05	0.07E-05**	−5.95*	18.7E-05
5	−13.33E-05	−0.02E-05	−2.43*	−4.79E-05

Notes: For each BT in the sample, three time series regressions are run with three different specifications. In particular the regressions are:

$$R_k = \alpha + \sum_{\tau=-1}^{\tau=-3} \phi_\tau R_\tau + \sum_{\tau=0}^{\tau=-3} \lambda_\tau R_{IBEX\tau} + \sum_{\tau=0}^{\tau=-3} \beta_\tau VOL_\tau + \gamma Dift + \varphi Dend + \sum_{\tau=-10}^{\tau=10} \delta_\tau DBT_\tau + \omega_k$$

$$S_k = \alpha + \sum_{\tau=-1}^{\tau=-3} \phi_\tau S_\tau + \sum_{\tau=0}^{\tau=-3} \beta_\tau VOL_\tau + \gamma Dift + \varphi Dend + \sum_{\tau=-10}^{\tau=10} \delta_\tau DBT_\tau + \omega_k$$

$$VOL_k = \alpha + \sum_{\tau=-1}^{\tau=-3} \beta_\tau VOL_\tau + \gamma Dift + \varphi Dend + \sum_{\tau=-10}^{\tau=10} \delta_\tau DBT_\tau + \omega_k$$

where R_{IBEX} is the return of IBEX-35, VOL is the square root of accumulated volume between quotes changing asset true value, *Dift* is the square root of time elapsed between quotes, *Dend* is a dummy variable for end-of-the-day effects and *DBT* stands for the dummy variable employed to pick up effects around BTs. To test the BT effects on the adverse selection spread component two time series regressions are run with two different specifications:

$$VOL_k = \alpha + \sum_{\tau=-1}^{\tau=-3} \phi_\tau R_\tau + \sum_{\tau=-1}^{\tau=-3} \beta_\tau VOL_\tau + \gamma Dift + \varphi Dend + \omega_k$$

$$R_k = \alpha + \lambda \omega_k + \sum_{\tau=-10}^{\tau=10} \delta_\tau \omega_k DBT_\tau + u_k$$

The coefficients are averaged across all BTs. White (1980) standard errors are used.

Table 6. Adverse selection evidence in subsample classifications

	Buyer-init.	Seller-init.	Indeterminate-init.	Inside the spread	Sweeping	Not classified
CONS	−4.69E-06	9.02E-06	1.07E-05	1.15E-05	9.20E-07	1.52E-05
λ	4.16E-09	4.64E-09	1.19E-09	−1.31E-09	−3.10E-12	4.16E-08**
−5	−8.85E-07	1.73E-07	1.14E-07	8.59E-07	2.92E-07	−7.55E-06**
−4	5.27E-06	−2.14E-07	5.39E-06	3.73E-06	4.55E-06	−2.13E-07
−3	7.32E-07	−1.95E-06*	−8.77E-08	4.66E-07	−4.53E-07	−3.94E-06*
−2	−8.34E-08	−1.35E-07	−4.20E-07	−1.55E-07	−1.18E-07	−1.61E-06
−1	−1.87E-05	−5.33E-07	2.17E-05**	1.01E-05	−9.44E-06	7.47E-05
0	4.11E-06*	1.79E-06*	−5.02E-06	−6.44E-06	2.65E-06*	3.99E-06
1	−1.66E-07	−9.73E-07	9.00E-07	1.27E-06	−5.80E-07	−9.08E-07
2	2.69E-06	5.76E-08	1.19E-04	1.42E-04	1.46E-06	1.76E-06
3	−9.93E-07	3.98E-07	1.65E-05	1.97E-05	−3.24E-08	−1.60E-06
4	5.92E-07	1.16E-06	5.44E-07	4.45E-07	7.41E-07	1.95E-06
5	3.49E-09	−6.53E-07	−6.29E-08	−8.57E-08	4.11E-09	−2.13E-06
	BB	**BS**	**SB**	**SS**	**Change in true asset value**	**No change in true asset value**
CONS	3.18E-05*	6.66E-06	−2.70E-05*	1.27E-05	1.17E-05**	−9.93E-07
λ	1.89E-09	−3.22E-09	1.12E-08	1.91E-09	5.17E-09	−1.02E-10
−5	2.24E-07	−1.01E-06	2.92E-07	−2.37E-08	3.42E-08	−3.49E-07
−4	4.15E-06	−2.78E-06	5.99E-06	8.04E-06	4.19E-06	3.37E-06
−3	1.09E-07	−5.66E-07	−1.02E-06	−5.82E-08	−2.55E-07	−5.47E-07
−2	−3.66E-07	−2.71E-07	−7.65E-07	3.73E-07	−2.02E-07	−3.24E-07
−1	−1.14E-06**	5.61E-06	2.45E-05	−8.22E-06	1.06E-05	−2.25E-06
0	1.32E-06	9.50E-07	−7.30E-06	1.77E-06	−3.81E-06	3.21E-06*
1	1.45E-08	2.78E-06*	−9.08E-07	−1.46E-06	7.80E-07	−7.70E-07
2	−3.63E-07	4.11E-06	3.76E-06	2.17E-04	9.77E-05	1.82E-06
3	3.90E-07*	4.00E-07	−1.41E-06	3.06E-05	1.30E-05	3.07E-07**
4	1.59E-07	−4.12E-08	7.95E-07	1.99E-06	4.36E-07	1.11E-06
5	1.72E-08	−1.28E-08	−8.28E-07	−1.29E-08	−3.62E-07	6.75E-10

Notes: For each BT in the sample, two time series regressions are run:

$$VOL_k = \alpha + \sum_{\tau=-1}^{\tau=-3} \phi_\tau R_\tau + \sum_{\tau=-1}^{\tau=-3} \beta_\tau VOL_\tau + \gamma Dift + \varphi Dend + \omega_k$$

$$R_k = \alpha + \lambda\omega_k + \sum_{\tau=-10}^{\tau=10} \delta_\tau \omega_k DBT_\tau + u_k$$

where VOL is the square root of accumulated volume between quotes changing asset true value, $Dift$ is the square root of time elapsed between quotes, $Dend$ is a dummy variable for end-of-the-day effects and DBT stands for the dummy variable employed to pick up effects around BTs. The coefficients are averaged across all of them. White (1980) standard errors are used.

The first equation estimates the unexpected volume for each change in true return through residuals. The second equation measures the reaction of returns including as explanatory variables these residuals and BT dummies. In this context, coefficient λ measures mean adverse selection and coefficient δ measures abnormal adverse selection around BTs. Aggregate results are included in the second column of Table 5. It can be observed that the adverse selection component, measured as the coefficient of residuals, is not significant. The only significant coefficient is the one associated with four quotes after BT. These results are consistent with the Admati and Pfleiderer (1988) model where liquidity traders pool their trades. So insiders only act in these periods and not in the middle of the day, when they would be detected. So, BTs are not as informative as expected.

Table 6 looks at different subsample classifications. The results are slightly different. The contemporary BT dummy is significantly positive for buyer and seller BTs but not for indeterminate BTs. This is consistent with the sign of the initiator party. The same dummy is also significant and positive in sweeping BTs. This result is also consistent because of the additional cost this type of BTs imposes. Finally, a significant positive contemporary BT dummy is also found for no-changing-true-asset-value BTs. This coefficient may be justified by the ignorance of investors about the effects of this type of BT. These results are indicative of information transmission. There exists an increase in adverse selection spread component for these subsamples. These results are consistent with the presence of insiders trading with orders of these types. It seems that the knowledge of the BT initiator party increases information asymmetries among traders. Moreover, the implied greater cost of sweeping BT seems to be a signal of the quality of the information transmitted to the market. Additionally, information asymmetries among traders increase with BTs that do not change the true asset value.

As a last test of information transmission, volume is considered as an endogenous variable. Volume will measure abnormal activity around BTs. In this case, this would be a signal of insiders around BTs and information flow in the market.[25] The regressions for each BT are:

$$VOL_k = \alpha + \sum_{\tau=-1}^{\tau=-3} \beta_\tau VOL_\tau + \gamma Dift + \varphi Dend + \sum_{\tau=-10}^{\tau=10} \delta_\tau DBT_\tau + \omega_k \tag{10}$$

Results are in the third column of Table 5. Before the BT one sees an unclear pattern, with a negative coefficient just before the BT but a positive one two quotes before. However, after BTs there is a significant decrease in market activity that could be related to the presence of insiders. Those insiders could lead the rest of market participants to decrease transacted volume. This is associated with previous findings on adverse selection.

Liquidity evidence

For relative spread, S_k, the time-series regression run for each BT is shown by the following expression:

$$S_k = \alpha + \sum_{\tau=-1}^{\tau=-3} \phi_\tau S_\tau + \sum_{\tau=0}^{\tau=-3} \beta_\tau VOL_\tau + \gamma Dift + \varphi Dend + \sum_{\tau=-10}^{\tau=10} \delta_\tau DBT_\tau + \omega_k \tag{11}$$

The results are shown in the last column of Table 5. The lagged variables are positive and significant. As expected, an autorregresive process is observed in this variable. Another important variable is volume. A negative contemporaneous coefficient and positive lagged ones are observed. A negative relationship has been documented in other research into the SSE (Rubio and Tapia, 1996). This evidence is also consistent with Admati and Pfleiderer's (1988) model and, at the same time, is contrary to the results of Lee *et al.* (1993) for the US market.

The most important result related to liquidity is the negative and significant BT dummy coefficients just before and contemporary with BT arrival. This is related to an increase in liquidity. The increase in liquidity before BT can be explained by the necessary introduction of pre-agreed BT limit orders for the same amount of shares at the price available inside the spread. After BTs there is a decrease in liquidity, so part of the effect is temporary. This result is related to a decrease in temporary spread components such as inventory cost and operative cost. This is relevant because these coefficients have been obtained by taking volume into account as a control variable. Looking at the SSE, this is a stronger result because previous research did not find any effect on relative spread after controlling for volume.[26]

V. Concluding Remarks

To the best of knowledge, this study analyses for the first time the role of BTs in a market where this issue is not facilitated. This market microstructure characteristic gives us a special testing ground. Additionally, quotes are used that change true asset value instead of prices.

Three different effects around BTs are studied: price, liquidity and information transmission. To capture them, three different endogenous variables are considered: true asset returns, relative spreads and adverse selection spread component. With this approach, there are no clear effects of BTs.

There is no significant permanent effect on returns in the different subsample classification, which is contrary to previous evidence and to our intuition. In related papers, other authors have obtained clear effects of BTs on prices depending on BT type. One suspects that the reasons for these differences could be related to methodology and SSE market microstructure. To discover the source of these differences, this methodology should be applied to other markets with block trading facilities.

In addition to previous studies, adverse selection is analysed as a measure of information asymmetries and, as a consequence, of information transmission. It seems that there is an increase in information asymmetries when one look at adverse selection spread

[25] See Admati and Pfleiderer (1988).
[26] Rubio and Tapia (1996) show that relative spreads do not change in the SSE around dividend announcements when they control for activity variables such as volume and number of transactions.

component in the different subsample classifications (buyer, seller, sweeping and not-changing-true-asset-value BTs). This result could be related to insiders trading in the market.

In sharp contrast with adverse selection evidence, one also observes a temporary increase in liquidity around BTs. These changes reflect temporary liquidity effects related to other spread components (order processing costs and inventory costs). This opposite evidence could be explained by the fact that there are no special market participants such as specialists or dealers and as a result our market participants are not required to absorb temporary order imbalances.

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