LIQUIDITY AND INFORMATION AROUND ANNUAL EARNINGS ANNOUNCEMENTS: AN INTRADAY ANALYSIS OF THE SPANISH STOCK MARKET[*]

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ABSTRACT

This paper analyses the intraday reaction of the Spanish market to annual earnings announcements. Specifically, we examine the levels of stock liquidity, trading activity, volatility, and asymmetric information, as well as the order placement strategy around earnings disclosures. We also analyse the differences in the market reaction to announcements made during trading and non-trading hours. We find that stock liquidity and trading activity significantly improves after the announcement, although we do not find a significant reduction in the level of asymmetric information. Our results indicate that the stock market reaction differs according to the timing of the announcement. For overnight announcements, where investors have time to evaluate the earnings news before the market opens, the improvement in liquidity is immediate, caused by higher trading activity and less asymmetric information. On the contrary, for earnings announcements released when the market is open, the significant improvement in stock liquidity is observed after about one and a half hours of trading. The latter possibly occurs once informational advantages of investors who have superior information-processing abilities disappear, and therefore the level of asymmetric information decreases. The different reaction of the market to overnight and to daytime disclosures could explain the fact that Spanish firms prefer to release the announcement in trading (non-trading) hours when actual earnings are lower (higher) than forecast earnings.

JEL Classification: G14, G19, M49

Keywords: Earnings announcements, liquidity, trading activity, volatility, information asymmetry.

RESUMEN

En este trabajo analizamos la reacción intradía del mercado español ante el anuncio del beneficio anual. En concreto, se examinan los niveles de liquidez, actividad negociadora, volatilidad, asimetría informativa y las estrategias de introducción de órdenes en un breve intervalo de tiempo alrededor del anuncio. También se analiza la respuesta del mercado en función del momento en que se produce el anuncio: fuera o dentro de la sesión. Nuestros resultados muestran una mejora generalizada de la liquidez y la actividad después del anuncio, aunque no se observa una reducción significativa del nivel de asimetría informativa. Sin embargo, la reacción del mercado difiere atendiendo al momento del anuncio. En los anuncios que se realizan con el mercado cerrado, donde los agentes disponen de más tiempo para procesar la información antes de que el mercado abra, la mejora en la liquidez es inmediata, no sólo impulsada por la mayor actividad, sino también por un menor nivel de asimetría informativa. Por su parte, en los anuncios que tienen lugar con el mercado abierto, la mejora en liquidez se produce con retraso, aproximadamente hora y media después del anuncio, posiblemente una vez que desaparecen las ventajas informativas de aquellos agentes más diestros en la interpretación de la nueva información y, por tanto, cuando disminuye el nivel de asimetría informativa. Esta diferente respuesta del mercado ante los anuncios con el mercado abierto y cerrado podría justificar el hecho de que las empresas prefieran anunciar sus beneficios dentro (fuera) de la sesión cuando estos son peores (mejores) de lo esperado.

Palabras claves: Anuncios de resultados, liquidez, actividad negociadora, volatilidad, asimetría informativa.

1. Introduction

The earnings of a firm are one of the most relevant accounting factors of the fundamental value of its stock. Thus, earnings announcements should affect market information asymmetries, trading activity, and liquidity. Numerous theoretical and empirical studies have analysed the relationship between earnings announcements and the investors' behaviour at the market. In previous literature, we find different theoretical hypotheses on how earnings announcements affect the information environment and liquidity of stocks.

Most extant models predict an increase in information asymmetry in advance of an earnings announcement (Kim and Verrecchia, 1991, McNichols and Trueman, 1994, Demski and Fletan, 1994). As Lee, Mucklow and Ready (1993) suggest, given these types of announcements are predictable, some investors are more motivated to search for private information and information leakage could occur. The higher probability of informed trading before earnings announcements would provoke a widening of the bid-ask spread and a reduction in the depth, thus worsening market liquidity. At the same time, higher trading activity by informed investors increases trading volume and the higher uncertainty regarding the stock's value increases return volatility.

There is no similar consensus on effects of earnings releases in the post-announcement period. One hypothesis suggests that the earnings news reduces information asymmetry (Verrecchia, 1982, Diamond, 1985). So, spreads should decrease, depth and trading volume should increase and the volatility should be lower after these announcements. Alternatively, Kim and Verrecchia (1991, 1994) suggest that the level of asymmetric information should be higher immediately after the earnings announcement because the announcement is a noisy signal and certain traders have a superior ability to process the earning news. This hypothesis suggests the bid-ask spreads increases and the depth decreases immediately after earnings announcements. In addition, heterogeneous interpretations of the earnings news could provoke an increase in the trading volume and volatility. In any case, these two hypotheses are not mutually exclusive. After a certain period, once the new information disclosed has been incorporated into the stock price, information asymmetry returns to or falls below its normal levels.

Whereas theoretical model predictions are clear and not very contradictory, findings from empirical studies regarding the impact of earnings disclosures on information asymmetry and liquidity are mixed. Among the studies that use daily data, Morse and Ushman (1983) detect no change in bid-ask spreads around earnings announcements. Venkatesh and Chiag (1986) and Patell (1991) find a significant increase in spreads after

earning announcements. Yohn (1998) also finds a widening of spreads in the four days prior to an earnings announcement, on the announcement date itself, and on the day after the announcement. On the contrary, Acker, Stalker and Tonks (2002) document a narrowing of spreads quoted by market makers of the London Stock Exchange and a significant increase in trading volume once the earnings have been announced. Similarly, Otagawa (2003) finds that spreads decrease significantly in the days around the release of the quarterly earnings for the Tokyo Stock Exchange.

The availability of high frequency data has enabled us to analyse with more accuracy the consequences of public information disclosures on stock trading activity and liquidity. The findings of Lee et al. (1993), Gajewski (1999), and Wael (2004) indicate an increase in the levels of information asymmetry and a worsening of liquidity around earnings announcements. Only Ranaldo (2003) finds a significant improvement in liquidity and a reduction in the adverse selection costs immediately after public information arrivals on the Paris Bourse.

In this study, we analyse the intraday behaviour of the Spanish continuous market, or SIBE, around annual earnings announcements.[1] By using trades and quotes data, we examine different measures of liquidity, trading activity, volatility, and asymmetric information. As SIBE is an order-driven market, we also study the traders' order placement strategies around the release of this accounting information. The different analyses allow us to infer the effect of annual earnings announcements on the level of information asymmetry and market liquidity.

This paper is interesting for several reasons. First, most previous studies provide evidence from quote-driven markets, and very few deal with order-driven markets. Only Gajeswki (1999), for the *Paris Bourse;* Otogawa (2003), for the Tokyo Stock Exchange, and Wael (2004), for Euronext Paris, have focused on this type of market structure, which is increasingly widespread, providing contradictory findings. Given that SIBE is an order-driven market, and in order to clarify how these types of markets react to earnings announcements, our study presents new evidence.

Secondly, our analysis of the effects of earnings news in order-driven markets is more detailed than in earlier studies. Together with a more comprehensive analysis of liquidity, trading activity, and volatility measures, we use a precise measure of asymmetric information proposed by Hasbrouck (1991). Furthermore, for the first time, the changes in the investors' order submission strategies (use of market orders vs. limit orders) are analysed. In

[1] In Spanish, SIBE stands for Sistema de Interconexión Bursátil Español, or the Spanish Stock Exchange Interconnection System.

microstructure literature, numerous studies show that changes in market quality measures (spread, depth, volatility, etc.) affect the probability of using the different types of order by investors.[2]

Thirdly, this paper extends prior studies by analysing whether an order-driven market reacts in a different way depending on the announcement timing. Specifically, we differentiate between earnings announcements made during trading (*daytime* announcements) and non-trading hours (*overnight* announcements). The probability of informed trading and, therefore, the changes in liquidity around earnings announcements could depend on the timing of the release of this public information. Pronk (2001) hypothesizes that there is a greater probability of informed trading before and after announcements made during trading hours than announcements made during non-trading hours. Investors would be more motivated to search for private information and the probability of information leakage is greater before daytime announcements than before overnight announcements. In addition, Livne (2001) shows analytically that investors with private information trade less aggressively before overnight than before daytime announcements. Therefore, following the announcement, the probability of informed trading could differ between the two cases. In the case of earnings released when the market is closed, investors have more time to obtain, analyse and evaluate this new information, and they can observe the order flow during the pre-opening auction. However, for public information disclosures that occur when the market is open, investors have an immediate opportunity to trade. Thus, the differences in the investors' skills in interpreting the new information released become more relevant. Those traders who have better information-processing abilities could take advantage of their superior assessments of a firm's performance based on earnings news, and therefore the probability of informed trading increases.

Finally, to our knowledge, this paper is the first study that provides evidence on the intraday reaction of the Spanish stock market around public information arrivals (earnings). Previous studies on the effects of earnings announcements in the Spanish market implement daily analyses on the behaviour of stock prices and trading volume around the announcement date (Arcas and Rees, 1999; Sanabria, 2005).

The sample used includes 92 annual earnings announcements drawn between 2001 and 2003. Among them, we identified 50 daytime announcements and 42 overnight announcements. For the full sample, we detect a significant improvement in liquidity following earnings disclosures. This evidence is consistent with the argument that these

[2] Among theoretical articles, see Foucault (1999) and Handa and Schwartz (1996). Among empirical studies, see Biais et al. (1995), Griffiths et al. (2000) and Ranaldo (2004). For the Spanish market, Abad (2003) and Pascual and Veredas (2004).

events reduce information asymmetry encouraging stock liquidity. Our results differ from the findings provided by Lee et al. (1993), Gajeswki (1999) and Wael (2004), among others, and they are similar to the findings offered by Acker et al. (2002) and Otogawa (2003). Likewise, immediately after the announcement, we find that investors act in an aggressive way by submitting market orders to ensure its immediate execution and, at the same time, to take advantage of the observed narrowing of the bid-ask spread.

Our analyses, by considering the timing of the announcements, yield some very interesting results. We notice significant differences in the trading pattern between daytime and overnight announcements. For disclosures that occur when the market is open, we find large abnormal trading volume and high abnormal depth in the three hours prior to the announcement timing. In contrast, we detect no changes in either trading activity or liquidity measures prior to overnight announcements. Similarly, we observe differences between the two subsamples following the announcements. For the overnight announcements sample, during the first two hours after the market opens, quoted bid-ask spreads are significantly lower than the normal levels. On the contrary, just after daytime announcements, we detect no significant changes in any liquidity measures. In this case, after approximately one and half hours of trading, we find that bid-ask spread decreases significantly, quoted depth increases significantly, and volatility returns to its normal level. In summary, our findings suggest that, in the Spanish stock market, annual earnings announcements affect stock liquidity positively, although investors react in a different way according to the timing of the announcement.

Given the different behaviour of the investors depending on the timing of the earnings announcement, we analyse their potential causes. Therefore, we examine the possible existence of a pattern in the timing of earnings releases according to their sign. Based on the sign of the deviations of actual earnings from the forecast earnings, we classify the announcements into two categories: positive surprise earnings announcements and negative surprise earnings disclosures. Our evidence suggests that Spanish firms tend to release higher than expected earnings during non-trading hours. Perhaps, this strategy allows a large time interval for diffusion and unanimous interpretation by the market of this positive information. On the contrary, when the announced earnings are lower than expected, there is a tendency towards releasing this information during normal trading hours, perhaps with the aim of diminishing the negative effect that could this bad news provoke. It seems to be clear from the fact that improvements in liquidity and trading activity, which suggest a reduction in asymmetric information, are focused around positive surprise announcements fundamentally, whereas no significant changes are found in negative surprise disclosures.

The remainder of the paper is organised as follows. The next section describes the institutional background of the SIBE. Section 3 describes the data and sample selection. Section 4 presents the variables and research methodology. Section 5 provides empirical results on the intraday behaviour of the Spanish market around the annual earnings announcements. Section 6 analyses the existence of a pattern in the timing of earnings releases. Section 7 summarises and concludes.

2. Institutional background of the SIBE

The Spanish continuous market is a pure order-driven stock market, where there are no market makers, and which uses an electronic platform known as SIBE. This platform connects the four stock exchanges of the Spanish stock market, located in Madrid, Barcelona, Bilbao and Valencia. The orders submitted from electronic terminals to the system are routed to the centralised limit order book. The orders are managed according to a strict price-time priority.

In the SIBE, there are three submarkets: Main Trading, Block Trading and Special Operations. Most shares listed on the SIBE are traded through the Main Trading market, so this submarket accounts for approximately 90% of the effective daily trading volume. Within this principal trading market, there are two different trading systems: *General* trading and *Fixing* trading. The most liquid shares are traded in *General* trading while *Fixing* trading is reserved for less liquid shares within the SIBE. Unlike *General* trading, trading is not continuous in the *Fixing* mode, which consists of two call auctions that finish at 12:00 p.m. and at 4:00 p.m. In addition, there are two market segments with specific trading mechanisms aimed at addressing the individual characteristics of certain stocks. These segments are *Nuevo Mercado*, encompassing technological stocks with strong growth potential, and *Latibex*, comprised of Latin American stocks listed in euros on the SIBE. In *Nuevo Mercado* and *Latibex*, there are agents similar to market markers called *cuidadores de mercado*.

The daily session within *General* trading is divided into three phases: the opening auction (from 8:30 a.m. to 9:00 a.m.), open market phase (from 9:00 a.m. to 5:30 p.m.) and the closing auction (from 5:30 p.m. to 5:35 p.m.). During the auctions, orders can be entered, modified and cancelled, but not executed. The opening and the closing auctions conclude with a random end period that lasts up to 30-seconds fixing the opening and the closing prices, respectively. In the open market phase, trading is continuous and automatic. During this phase, a trade occurs whenever a submitted order finds counterparty on the other side of the book. The stocks are quoted in euros and there are two minimum price variations or *ticks*:

€0.01 for prices below €50 and €0.05 for prices above €50.

Normal trading is automatically halted for five minutes when an order could move the stock price outside the static and dynamic range, which are fixed for each stock based on the last auction price and the last transaction price, respectively.[3] During this non-trading period, a call auction takes place, know as a volatility auction, which finishes with a random end period of up to 30 seconds and determines the trading resumption price. In addition, *Comision Nacional del Mercado de Valores* (CNMV), the Spanish version of the American Securities and Exchange Commission (SEC), is authorised to suspend trading on any stock for any duration it deems necessary under particular circumstances that could disturb the normal development of trading. Likewise, trading is resumed with a call auction.

Three types of orders can be used in the SIBE: limit orders, market to limit orders, and market orders. A limit orders specifies a quantity and a maximum (minimum) price for the buy (sale). Limit orders are executed immediately at the limit price or better if there is counterparty on the other side of the book (marketable limit orders). The limit order, or part of the order, that is not executed (non-marketable limit order) is stored in the limit order book according to a price-time priority rule. Market to limit orders do not specify a limit price but are only executed at the best opposite side price on the limit order book. Any unexecuted part of the order is converted into a limit order at that price. Markets orders are executed immediately and fully against limit orders on the opposite side at the best quotes or at a less favourable price by walking down (up) the book.

The three types of orders used in the SIBE can be re-classified in the two categories typically used in market microstructure literature: *market orders* and *limit orders*. *Market orders* are orders that are executed immediately and include market orders, market to limit orders, and marketable limit orders. The category of limit orders includes non-marketable limit orders of the SIBE. This latter classification is very useful to understand the performance of an order-driven stock market. Limit orders supply liquidity and are used by patient investors, regardless of whether they are interested in the activity of liquidity provision. Market orders consume liquidity and they are submitted by impatient traders who demand immediacy. Intuitively, equilibrium is necessary between patient and impatient investors so that the market runs properly.

[3] The magnitude of static and dynamic ranges is determined according to the historic volatility of each asset.

3. Data and sample

Two data sets have been consulted in this study. Firstly, we use a file provided by Intermoney, S.A. that includes information on dates and times of the annual earnings announcements obtained from Bloomberg's network. Specifically, this file contains earnings disclosures released by IBEX35 firms during 2001, 2002 and 2003.[4] By using a sample that presents no important changes in its composition all through our study period, we control specific characteristics of sample stocks.

Secondly, the transaction and quotation data used for this study were obtained from the *Mercado Continuo* Database. This tape has been developed by the Finance Department of the University of Alicante working on intraday data from *Sociedad de Bolsas* SM files. SM files provide detailed time-stamped information about the first level of the limit order book for each stock listed on the SIBE. Every transaction, order submission and cancellation that affects best prices in the book generates a new record.[5]

Initially, the sample consists of 105 earnings announcements made by the 35 Ibex35 index firms in each of the three analysed years. For some years and stocks there are no intraday data available, hence seven announcements are excluded. The remainder of the sample is split into two groups depending on the time of the announcement. In the first group, we include *daytime* announcements, in other words, public earnings disclosures made during the trading session between the market opening at 9:00 a.m. and the closing at 5:30 p.m., local time. The second group, *overnight* announcements, comprises disclosures that occur when the equity market is closed.

We analyse the market reaction to daytime announcements over a 3 day-period, which includes the full trading day before the event day, the earnings disclosure date itself and the full trading day after it. For overnight announcements, we examine the market's behaviour during a two day-period, in which the second phase is the announcement day, if the firms release earnings before the market opening, or the next trading day if the announcement takes place after the market closes. In order to avoid possible contamination effects, we eliminate six earnings announcements in which we detected other current events (tender and public offerings, dividend payments, etc.) during the analysed days. The final sample is made up of 92 annual earnings announcements.

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[4] We consider those firms whose stocks are included in the calculation of IBEX35 index on December 2002. IBEX35 is a stock market index based on a statistical compilation of the share prices of the 35 most liquid stocks traded at the SIBE.

[5] *Mercado Continuo* Database applies the algorithm proposed by Abad (2003) in order to identify the event that gives rise to each record (transaction, order submission, or cancellation).

In Table 1, Panel A shows the sample selection process and Panels B and C report the frequency distribution of announcements by year and by timing. For the full sample, as seen in Panel B, the number of announcements is similar for the three years analysed: 29 for 2001, 33 for 2002 and 30 for 2003. Among the 92 earnings announcements finally included in the sample, we identified 50 daytime disclosures and 42 overnight announcements. As shown in Panel C, 15 overnight announcements were released before the market opening and 27 after the market closing. Moreover, daytime announcements tend to be concentrated in the first trading hour (about 62%). In contrast, the number of earnings announcements released in the time interval from American markets' opening time (3:30 p.m., local time) to the Spanish market closing time (5:30 p.m.) is marginal.

TABLE 1. Sample selection and sample distribution

The initial sample includes the 105 annual earnings announcements released by Ibex35 index firms between 2001 and 2003. The final sample used is of 92 earnings announcements. The announcements are classified into two categories according to the disclosure timing. Daytime announcements are those that occur when the equity market is open (9:00 am – 5:30 pm); Overnight announcements are those made when the market is closed. In the latter, we distinguish two groups: after-close group, disclosures issued after the market closing (between 5:30 p.m. and 8:00 p.m.) and before-open group, those released before that the market opens (8:00 a.m. - 9:30 a.m.). Panel A reports the sample selection process. Panel B shows the distribution of earnings announcements by year. Panel C presents the distribution of announcements by timing.

Panel A. Sample selection

	Daytime	*Overnight*	*Total*
Initial sample			105
Exclusions for:			
No available data	-	-	7
Current events in event period	2	4	6
* Tender and public offerings	1	2	3
* Dividend payments	1	2	3
Final sample			92

Panel B. Distribution of earnings announcements by years

	2001	*2002*	*2003*	*Total*	*Total (%)*
Daytime announcements	16	16	18	50	54.3
Overnight announcements:	14	17	11	42	45.7
Total	30	33	29	92	100
Total (%)	32.6	35.9	31.5	100	

Panel C: Distribution of earnings announcements by timing

Time interval	*Observations*	*Percentage (%)*
Daytime announcements	50	100
9:00:00 -11:00:00	37	74.0
From 9:00 to 10:00	31	
From 10:00 to 11:00	6	
11:00-15:30	10	20.0
15:30-17:30	3	6.0
Overnight announcements	42	
After-close	27	64.3
Before-open	15	35.7

4. Measures and methodology

In order to analyse the market reaction around annual earnings announcements, we examine several measurements of liquidity, trading activity, and volatility. All these measurements characterise, in one way or another, the informative environment of the market where investors trade. In addition, we examine a proxy for asymmetric information by using the VAR methodology proposed by Hasbrouck (1991). Finally, we study the traders' order placement strategies by examining the relative frequency of market and limit orders. As we are interested in the short-term reaction of the market, we divide daily trading sessions into 34 fifteen-minute intervals, starting with the 9:00-9:15 interval, and ending with the 17:15-17:30 interval.[6]

We examine four liquidity measures: relative quoted spread (RQS), absolute quoted spread over tick size (AQS/T), quoted depth in euros (QD€) and the Bi-dimensional Liquidity Measure (BLM) proposed by Pascual et al. (2004). RQS is the difference between the ask price and the bid price (absolute spread) divided by the bid-ask midpoint. AQS/T is the ratio of the absolute quoted spread to the tick size. QD€ is the value in euros of shares available at the prevailing bid and ask prices. For each interval, average values of these three measures are calculated by weighting the proportion of time that each pair of bid-ask quotes were in effect during the interval (time-weighted averages). Through these three variables, we are taking into account separately the two dimensions of liquidity pointed out by Lee et al. (1993): the trading cost dimension (bid-ask spread) and quantity dimension (market depth). BLM is a measure that simultaneously considers both dimensions of liquidity. BLM guarantee unambiguous inferences on the changes in overall liquidity, even when simultaneous changes in costs of immediacy and depth are ambiguous. We describe BLM below.

As trading activity measures, we estimate trading frequency (NT) and trading volume (VOL€). NT is the number of trades executed in each time-period by each firm. VOL€ represents the total euro value traded each interval for each stock. To examine the effects on volatility, we consider two measurements: Absolute return (AR) and the high-low price range (HLPR). Absolute return is the absolute value of the return from the last quote midpoint of the previous interval to the last quote midpoint of the current interval.[7] HLPR is the natural

[6] To check robustness, we also performed the same analyses for 30'-intervals and found results similar to those for 15'-intervals analysis. Due to the similarity of results, we do not report the 30'-interval results here. They are available from the authors upon request.

[7] For the first trading interval of each day, the return is calculated using the midpoints of the bid-ask spreads prevailing at the end and at the start of this interval.

logarithm of the ratio of the highest bid-ask midpoint to the lowest bid-ask midpoint in each fifteen-minute interval. The Appendix provides the variable computation description.

Additionally, we estimate the permanent impact of trades on prices (price impact) using the methodology proposed by Hasbrouck (1991). Price impact is a proxy for the level of information asymmetry. The model includes two fundamental variables: price change and trade flow. Price change is proxy for the revision in the midpoint of the quotes between two transactions, executed at *t* and at *t*-1, defined by $\Delta Q_t = Q_t - Q_{t-1}$. Trade flow is represented by an indicator variable corresponding to the direction of a trade, x_t, (+1 for a buyer-initiated trade and -1 for a seller-initiated trade). The model estimated is:

$$\left\{ \begin{array}{l} \Delta Q_t = \sum_{k=1}^{3} \alpha_k \Delta Q_{t-k} + \sum_{k=0}^{3} \beta_k x_{t-k} + \upsilon_{1t} \\ x_t = \sum_{k=1}^{3} \delta_k \Delta Q_{t-k} + \sum_{k=1}^{3} \gamma_k x_{t-k} + \upsilon_{2t} \end{array} \right\} \quad (1)$$

In Hasbrouck's model, there is a clear dichotomy between public and private information. The first disturbance term, υ_{1t}, represents public information arriving on the market between time *t*-1 and time *t*, which is incorporated into prices. The second disturbance term, υ_{2t}, represents the private information component of the trade (innovation). In particular, a trade innovation of one unit in trade 0 $(\upsilon_{20} = 1)$ leads to a mid-quote revision equal to $\Delta Q_0 = \beta_0$. The initial impact and the induced spread revision lead to a new trade (buy or sell). By iterating this process up to a fixed rank *n*, the sum of the mid-quote revisions measures the impact of a trade innovation on prices according to the following formula:

$$pimpact(v_{20}) = \sum_{t=0}^{n} E\left(\Delta Q_t \mid v_{20}\right) \quad (2)$$

The sum of successive quote revisions converges to efficient price revision. In other words, *pimpact* shows all the private information contained in the initial trade innovation. Therefore, this coefficient can be interpreted as either a measurement of the private information contained in a trade or a coefficient of asymmetric information between traders. The higher *pimpact* is, the more expensive the trade is in terms of adverse selection risk.

We use Hasbrouck (1991)'s methodology to estimate a proxy for information asymmetry instead of methodology based on the bid-ask spread decomposition for two reasons. Firstly, the model is based on the unexpected component of a trade (the trade innovation). As Hasbrouck note, if there is any private information to be inferred from a trade, it must be inferred not from the total trade but from the component that is unanticipated.

Secondly, the bid-ask spread decomposition methodology lacks dynamism. The decomposition models proxy the persistent price impact of a trade by immediate quotes revisions, which could be erroneous. Hasbrouck's methodology is based on the VAR model that reflects jointly the price change and the systematic behaviour of the trade flow. Additionally, the use of lagged variables provides dynamism to the model and allows the real permanent effect to be captured.

Finally, in order to analyse the changes in order submission strategies, for each 15' interval, we obtain the relative frequencies of the three order categories that indicate the level of investors' relative patience: (1) market orders (MO), (2) limit orders (LO), and (3) cancellations of limit orders submitted (CANC).

To examine the pattern of the market's intraday behaviour around the time of annual earnings announcements, we use event-study methodology. We compare the behaviour pattern of each variable around earnings announcements (event period) to its "normal behaviour" estimated from a *non-announcement* control period (benchmark period). In other words, we analyse the abnormal values of the measures analysed. For each variable and each interval, the abnormal measure is defined as:

$$\frac{V_{event} - \overline{V}_{benchmark}}{\overline{V}_{benchmark}} \tag{3}$$

where V_{event} is the event period interval, and $\overline{V}_{event}$ is the mean value over the benchmark period intervals. Specifically, the abnormal values of the bi-dimensional measure of liquidity proposed by Pascual et al. (2004), BLM, are estimated as:

$$BLM = \frac{\left(QD€_{event} - \overline{QD€}_{benchmark}\right)}{\overline{QD€}_{benchmark}} - \left(\frac{\sigma^{QD€}_{benchmark}}{\sigma^{RQS}_{benchmark}}\right)\frac{\left(RQS_{event} - \overline{RQS}_{benchmark}\right)}{\overline{RQS}_{benchmark}} \tag{4}$$

where $\sigma^{QD€}_{benchmark} / \sigma^{RQS}_{benchmark}$ is a rate of substitution between immediacy costs and depth, computed as the relative variability of both dimensions of liquidity. $\sigma^{QD€}_{benchmark}$ and $\sigma^{RQS}_{benchmark}$ are proxies of the volatility of each facets of liquidity in the benchmark period. A positive (negative) value of BLM indicates an improvement (worsening) in liquidity.

In order to test the statistical significance of the abnormal values of each variable, we use the non-parametric Corrado (1989) test, which takes into account the possibility that the measurements used are not normally distributed.

The event period for overnight announcements consists of 68 fifteen-minute intervals (2 full trading days), whereas for daytime announcements, the event period includes

102 intervals (3 daily trading sessions). For overnight announcements, interval 0 is defined as the first trading 15'-interval after earnings are released. This represents the first (observable) trading reaction to the announcement.[8] For daytime disclosures, interval 0 is that which includes the time of the announcement.

At first, the non-announcement control period includes 80 trading days, 40 before and 40 after the announcement. In order to guarantee that this benchmark period is not affected by the studied event, we exclude the 11 trading days prior to the first day of the event window and the 11 trading days following the last day of the event period.[9] In order to control confusing events during the benchmark period, we do not apply the same criteria used for the event period. For the control period, the approach consists of the following: for the trading volume measurement and for each 15-minute interval, we rank the eighty observations from the control period, and then we eliminate 5 percent of the observations above and below. Therefore, we only use 72 of the 80 valid values as non-announcement control period.[10]

We examine the abnormal measures in the event period because the previous literature reports, in many markets, deterministic intraday patterns in the variables analysed. That is, the behaviour of market liquidity, activity and volatility differs significantly depending on the moment of the trading session. To check the presence of these regular patterns in the assets of our sample, we represent the intraday pattern of some of the measures used for each year of our sample. Specifically, we calculate average values of AQR/T, QD€, VOL€ and AR for each fifteen-minute interval of a normal trading day, stated as a percentage of their respective full-day averages for ease of comparison. In this case, we only use the data from the benchmark period. The normal intraday patterns of each variable are depicted in Figure 1.

Firstly, figure 1 shows the resemblance of the three charts corresponding to each year. In all of them, we observe a clear pattern for all variables across the trading session. This pattern is quite similar to those detected in other equity markets. We can distinguish three different periods that correspond to the three areas indicated by dashed lines. The first extends approximately from the opening to the next two hours. This period is characterised by lower liquidity (wide spread and low depth) and by higher volatility. This pattern is typically attributed to the uncertainty generated during the overnight period. During these two hours,

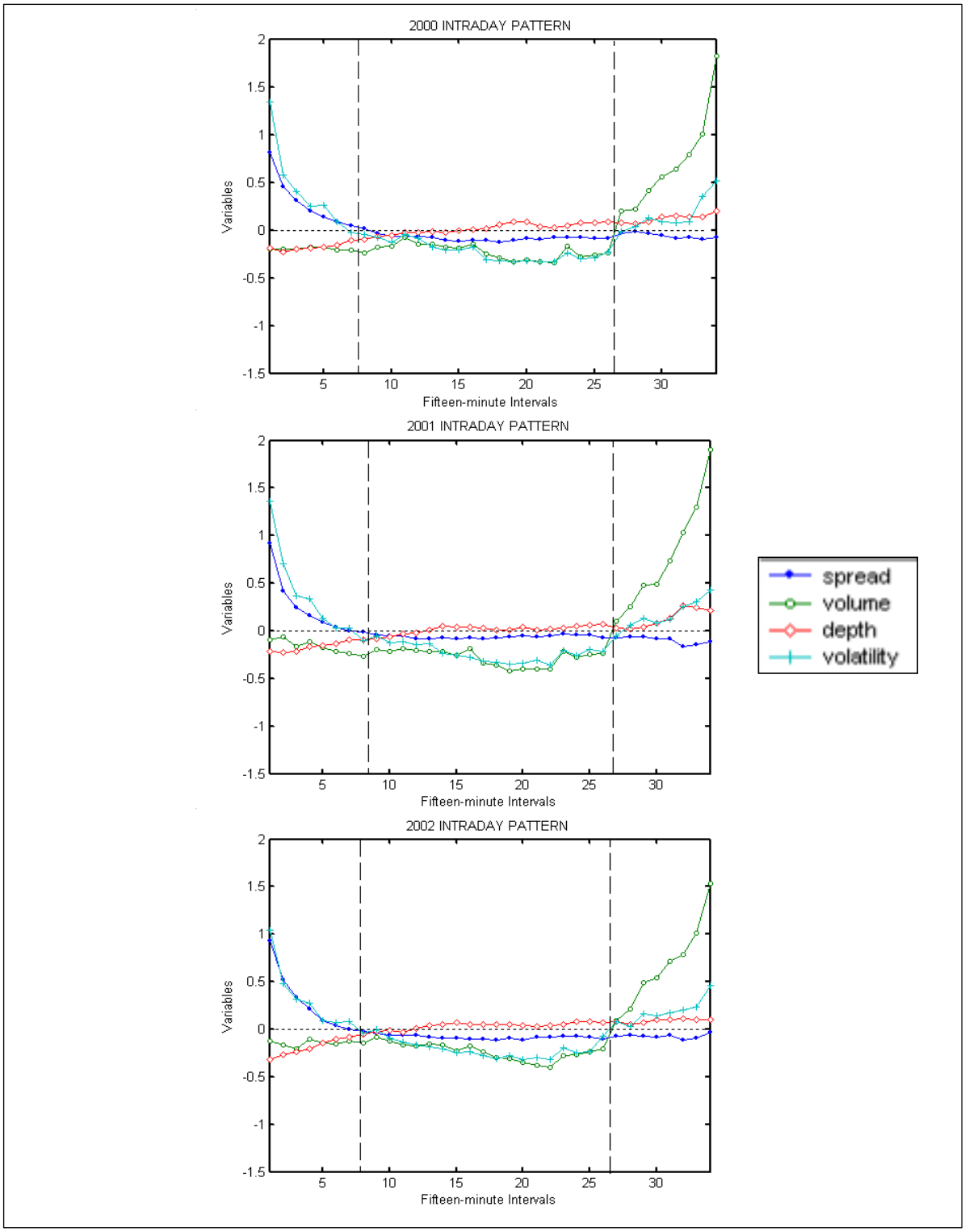
[8] The first reaction would take place in the opening auction. With our data, we cannot identify what happens during this period.

[9] Previous literature shows that the information effect remains up to five days after the announcement.

[10] The choice of volume, and no other variable, is because we consider that any abnormal behaviour of the market would be reflected fundamentally in this variable, comprising other potential extreme changes in any of the other measurements

FIGURE 1. Intraday patterns of liquidity, trading activity and volatility in the Spanish stock market

The three charts of this figure plot the intraday pattern of several measurements of market liquidity, trading activity and return volatility across the trading day. Specifically, the variables are: Absolute Quoted Spread over Tick (AQS/T), Quoted Depth in euros (QD€), Trading Volume in euros (VOL€) and Absolute Return (AB). The 34 fifteen-minute intervals into which the trading day is divided are shown on the horizontal axis. For each stock, all four statistics are expressed as percentage deviations from their respective full-day averages. Values shown are cross-sectional mean in each year. The data used come from the non-announcement control period.



we can see a progressive recovery in the liquidity and volatility proxies. When this phase finishes, a second one begins that lasts approximately until 3:30 pm local time, which coincides with the US markets opening. This phase shows a stability period of the market. Both volatility and volume measurements follow a similar pattern with a weak drop at lunchtime (from 1:00 pm to 2:00 pm approximately). Finally, from 3:30 pm to the close of trading, we notice that volume increases followed by a more moderate increase in volatility. We can also see a slight improvement in liquidity, more evident in 2001 and 2002.

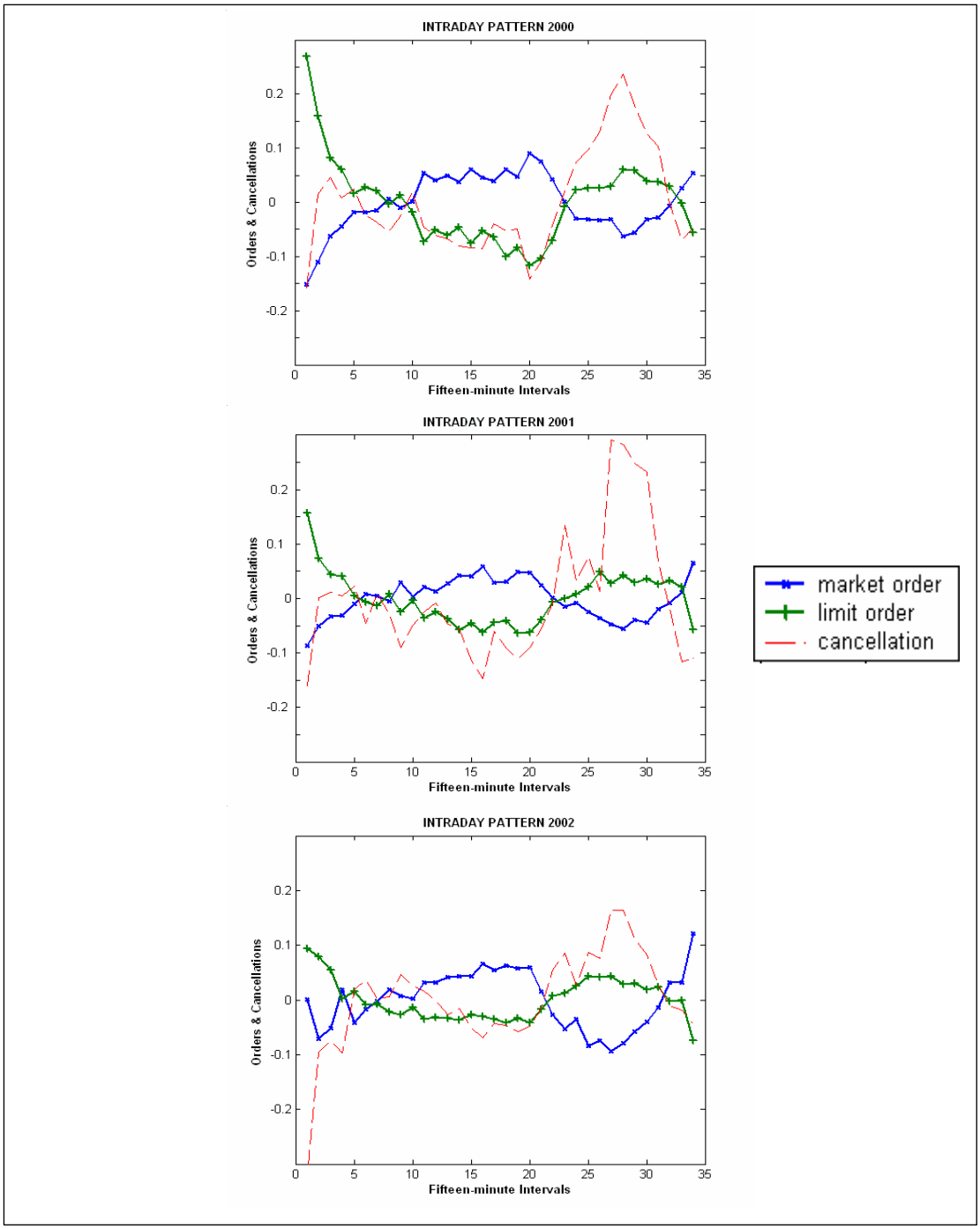
With regard to order submission, as seen in Figure 2, there is also an intraday pattern during a trading session. As with the previous variables, we find that the frequency of using MO, LO, and CANC differs significantly depending on the trading time. In the first period, characterised by high uncertainty, we find a wide use of limit orders and a low submission of market orders. The differences in the use of these types of orders decrease progressively until about two hours after the market opening. Moreover, in this first phase, the number of cancellations is small. This number increases significantly throughout these two first hours. During the second period, the three and half hours following, market orders are used more frequently than limit orders. In this second phase, cancellations behave in a similar way to limit orders. About one hour before American stock exchanges open, limit orders are again used more than market orders. During this third phase, cancellations increase significantly and peak just after the American markets opening. Finally, in the hour before the Spanish market closing, markets orders are submitted most, and the use of limit orders and cancellations decreases.

5. Empirical evidence regarding Spanish market behaviour around earnings announcements

This section provides empirical evidence on the intraday reaction of the Spanish equity market around annual earnings announcements. Firstly, we examine the behaviour of liquidity, trading volume and volatility around public earnings disclosures. We then go on to analyse the changes in the level of information asymmetry in the hours surrounding the announcement. In addition, using a multivariate analysis, we try to identify the determinants of changes in liquidity. Finally, we analyse the investors' order submission strategies. Together with results for the total sample, we report the findings obtained by comparing the market response to daytime disclosures and overnight announcements.

FIGURE 2. Intraday patterns of market orders, limit orders and cancellations

The three charts of this figure plot the intraday pattern of relative frequency of market orders (MO), limit orders (LO), and cancellations (CANC). The 34 fifteen-minute intervals into which the trading day is divided are shown on the horizontal axis. For each stock, all four statistics are expressed as percentage deviations from their respective full-day averages. Values shown are cross-sectional mean in each year. The data used come from the non-announcement control period.



5.1. Liquidity, trading activity and volatility

Table 2 presents mean abnormal values of different liquidity measures, trading volume and volatility around earnings announcements for the total sample. In the 15 minute-intervals prior to the earnings disclosure, we do not detect significant changes either in bid-ask spreads (both RQS and AQS/T), depth or BLM. These results suggest that with regard to liquidity there is no abnormal behaviour before public earnings disclosures. Similarly, volatility measurements do not present significant abnormal values. However, in the three hours prior to the earnings announcements, trading volume and trading frequency are unusually high. Therefore, there is no strong evidence of informed trading before earnings public disclosures.

In the post-announcement period, as Table 2 shows, quoted spreads are significantly lower than normal for approximately two trading hours. In addition, we find a significant increase in the quoted depth in the 15'-interval just after the earnings announcement. These results, joint with the positive and significant values of BLM observed during more two trading hours post-announcement, show a clear improvement in the liquidity just after the earnings releases. This evidence is in contrast to the empirical findings of Lee et al. (1994), Gajewski (1999), and Wael (2004). They find a significant decrease in the liquidity immediately following the earnings announcement. By analysing trading activity measurements, as in previous studies, we observe that volume and number of trades increase significantly following the announcement and remain at significant high abnormal levels for a full trading session. Nevertheless, volatility measurements only show high abnormal values, significant at 1% level, in the interval 0.[11] The improvement in stock liquidity, together with the increase in trading activity and the lack of significant changes in volatility, might suggest a decrease in the level of market information asymmetry.

Previous studies for American stock markets show that the market reaction differs depending on the time of the announcement; whether it is released when the market is open or is closed (Francis et al., 1992; Pronk, 2001). Therefore, we analyse the abnormal behaviour in liquidity, trading activity and volatility for daytime and overnight announcements separately. Thus, we test whether the effects caused by either of the two announcement types mainly determine the results for the total sample, reported above. Abnormal values of different variables for daytime announcements and for overnight announcements are shown in Table 3 and Table 4, respectively.

[11] We also analyse the changes in liquidity, trading volume and volatility for each year of our sample period separately. We find that the results are similar to those for our full sample.

TABLE 2. Liquidity, trading activity, and volatility changes around annual earnings announcements for the full sample

This table reports cross-section mean abnormal values of different measurements of market liquidity, activity and volatility for each 15'-interval. Liquidity measures are: relative quoted spread (RQS), absolute quoted spread over tick size (AQS/T), quoted depth in euros (QD€) and the Bi-dimensional Liquidity Measure (BLM) proposed by Pascual et al (2004). The measures of trading activity are: number of trades (NT) and trading volume (VOL). The volatility measures are: the abnormal return (AR) and the high-low price range (HLPR). The abnormal measurement is defined as the measurement in the event-period interval minus the mean value in benchmark-period interval, stated as a percentage of the benchmark-period interval mean. Time interval 0 is the 15'-interval during which the announcement occurs (for daytime announcements) or the first interval of the trading day just after the announcement (for overnight announcements). Due to space limitations, we only include the results for 4 hours before and after interval 0. The significance level of abnormal measurement is determined by the non-parametric test proposed by Corrado (1989). *, **, *** mean that interval *t* value is significantly different from zero at 10%, 5%, 1% level, respectively.

Interval	RQS	AQS/T	QD	BLM	NT	VOL	AR	HLPR
-16	-0.025	-0.033	-0.127	-0.101	-0.001	0.489	0.112***	0.100
-15	-0.078	-0.089*	-0.053	0.045	0.110	0.501	-0.074	-0.003
-14	-0.085	-0.094	-0.053	0.063	0.029	0.188	-0.082	-0.080
-13	-0.066	-0.078	-0.023	0.046	0.092	0.660**	0.118**	0.161*
-12	-0.049	-0.058	0.008*	0.105*	0.037	0.959	0.066*	-0.001
-11	-0.039	-0.048	0.116***	0.163*	0.283**	0.990***	0.325***	0.257
-10	0.031	0.024	0.071***	-0.041	0.108	0.293***	0.238**	0.124
-9	-0.005	-0.014	0.082**	0.099	0.159**	0.472***	0.071**	0.191**
-8	0.007	0.001	0.020	0.016	0.094*	0.544*	0.133	0.126
-7	-0.028	-0.033	0.054	0.055	0.010	0.226	0.052	0.029
-6	0.013	0.004	0.051*	0.019	0.413***	0.893***	0.332***	0.366***
-5	0.028	0.015	0.009	-0.011	0.196**	0.753***	0.157	0.210**
-4	-0.003	-0.013	-0.091	-0.073	0.046	0.323**	0.010	-0.001
-3	-0.043	-0.050	-0.079	-0.032	0.086*	0.384**	0.034	-0.066
-2	0.033	0.025	-0.013	-0.091	0.126	0.492	0.134	0.131
-1	-0.014	-0.023	0.150	0.185	0.068	0.349	0.116	0.115
0	-0.097	-0.102	0.001	0.162*	0.689***	2.135***	0.433***	0.457***
1	-0.141***	-0.147***	0.045***	0.220***	0.330***	1.270***	0.186	0.041*
2	-0.145**	-0.149**	0.003	0.186***	0.387***	2.056***	0.316	0.202
3	-0.107**	-0.116**	0.095	0.234***	0.151*	0.974***	-0.059	0.066
4	-0.160***	-0.167***	-0.008	0.201***	0.113	0.618	-0.055	-0.023
5	-0.167**	-0.174***	0.179***	0.393***	0.245**	1.275***	0.116	-0.003
6	-0.157***	-0.167***	0.064	0.276***	0.263***	0.846***	-0.148	-0.054
7	-0.099*	-0.107*	0.127***	0.272***	0.129*	0.966***	-0.017	-0.050
8	-0.120*	-0.128**	0.074***	0.202***	0.183***	1.095***	-0.043	0.021
9	-0.134**	-0.142***	-0.009	0.164	0.174***	0.599***	0.019	-0.025
10	-0.121	-0.126**	0.048	0.191***	0.164*	1.427***	0.062	0.044
11	-0.095	-0.102	0.045	0.154	0.113	0.909	0.345	0.067
12	-0.028	-0.035	0.123*	0.163	0.083*	0.603***	-0.060	0.013
13	-0.091**	-0.101**	0.050	0.239**	0.144*	0.890**	0.240**	0.098
14	-0.073	-0.083	0.011	0.101	0.120***	1.039***	0.036	0.111**
15	-0.103**	-0.112**	0.070*	0.220***	0.145*	0.698**	-0.085	0.027
16	-0.115***	-0.126***	0.147**	0.321***	0.204**	0.793***	-0.031	-0.075

In the pre-disclosure 15' intervals, we do not find significant abnormal values either in the measurements of liquidity or in the volatility measures for both of the two subsamples. However, for trading volume and frequency, we detect differences between daytime and overnight announcements. For the latter, we do not find significant changes in trading activity measurements. However, for daytime disclosures, we observe a significant increase in trading volume approximately from three hours before the time of the announcement. This fact could originate from trades by short-term investors. If they know in advance that the annual earnings will be released on this day, short-term traders are motivated to search for private information and speculate on the forthcoming public earnings disclosure to make use of their informational advantages.

In the post-announcement intervals, the market reaction is clearly different between the two analysed subsamples. For those disclosures made during trading hours, volume and trading frequency increase significantly just after the announcement and remain at high abnormal levels for the rest of trading day. On the contrary, we detect no significant changes in quoted spread and depth during the first four 15'-intervals following the announcement. However, after one and a half hours of trading, the bid-ask spread narrows and depth increases simultaneously. These changes provoke that BLM presents positive and significant values from that moment on. This significant improvement in liquidity suggests that the initial disparity of opinions on the earnings news released and the heterogeneous interpretations of the new information disappear. The volatility behaviour supports this argument. In the first three 15'-intervals following the announcements, volatility measurements present significant and positive abnormal values that subsequently return to normal levels. Therefore, these findings suggest that, for daytime earnings announcements, once investors receive, interpret and trade by taking in account the new information during a time-period, information asymmetry reduces significantly and liquidity improves.

For overnight announcements, we observe a significant reduction in the spread immediately after the earnings disclosure. Quoted spreads remain at unusually low levels during approximately the first two hours of the trading day. At the same time, quoted depth is unusually high in the first two 15 minute-intervals after the market opens. As a result, BLM measurement shows an immediate improvement in liquidity that last for more than two hours and a half. Similarly, and unlike what happens in daytime announcements, we detect significant and positive abnormal values in trading volume and frequency only from interval 0 to interval 2. After forty-five minutes of trading from market opening, trading activity measurements return to their normal levels. In this sample, we detect no abnormal volatility around the announcement. Therefore, in the case of overnight announcements, the post-announcement improvement in liquidity occurs immediately after the market opens. Given

TABLE 3. Liquidity, trading activity, and volatility changes around daytime annual earnings announcements

This table reports cross-section mean abnormal values of different measurements of market liquidity, activity and volatility for each 15'-interval from the daytime announcements subsample. Liquidity measures are: relative quoted spread (RQS), absolute quoted spread over tick size (AQS/T), quoted depth in euros (QD€) and the Bi-dimensional Liquidity Measure (BLM) proposed by Pascual et al (2004). The measures of trading activity are: number of trades (NT) and trading volume (VOL). The volatility measures are: the abnormal return (AR) and the high-low price range (HLPR). The abnormal measurement is defined as the measurement in the event-period interval minus the mean value in benchmark-period interval, stated as a percentage of the benchmark-period interval mean Time interval 0 is the 15'-interval during which the announcement occurs. Due to space limitations, we only include the results for 4 hours before and after interval 0. The significance level of abnormal measurement is determined by the non-parametric test proposed by Corrado (1989). *, **, *** mean that interval *t* value is significantly different from zero at 10%, 5%, 1% level, respectively.

Interval	RQS	AQS/T	QD	BLM	NT	VOL	AR	HLPR
-16	-0.025	-0.038	-0.065	-0.052	-0.009	0.765	0.291***	0.148
-15	-0.032	-0.048	-0.006	0.040	0.060	0.544	0.011*	0.062
-14	-0.058	-0.070	-0.021	0.062	-0.052	0.083	-0.108	-0.092
-13	0.007	-0.008	0.046	0.027	0.073	0.891	0.198	0.231
-12	0.002	-0.010	0.021*	0.067	-0.020	1.474	0.117	0.053
-11	-0.015	-0.028	0.108***	0.136	0.258	0.798**	0.343**	0.395
-10	0.053	0.043	0.057**	-0.116	0.144	0.500*	0.272	0.228
-9	0.009	-0.003	0.185***	0.189*	0.237*	0.586***	-0.039	0.226*
-8	0.030	0.022	0.102	0.052	0.239**	0.847***	0.275	0.269
-7	0.009	-0.001	0.230***	0.206	0.160	0.479	0.050	0.182
-6	0.032	0.021	0.083	0.039	0.320***	1.166***	0.315*	0.450***
-5	0.086	0.067	0.042	-0.042	0.310**	1.059***	0.386*	0.372**
-4	-0.040	-0.053	-0.051	0.044	0.122*	0.457**	0.138	0.066
-3	-0.067	-0.076	-0.100	-0.027	0.126*	0.316**	0.111	-0.022
-2	-0.006	-0.020	-0.030	-0.115	0.153	0.646	0.225	0.130*
-1	-0.025	-0.041	0.141	0.172	0.216	0.581	0.337	0.329*
0	-0.001	-0.011	0.069	0.087	0.657***	2.812***	0.657***	0.752***
1	-0.103	-0.115	0.049	0.167*	0.408***	1.533***	0.234**	0.058*
2	-0.084	-0.093	-0.036	0.045	0.495***	1.729***	0.756**	0.462**
3	-0.013	-0.027	0.030	0.053	0.267**	1.221***	-0.059	0.191
4	-0.085	-0.095	0.003	0.111	0.106	0.572*	-0.140	0.008
5	-0.103	-0.118	0.187***	0.331***	0.316**	1.903***	0.193	0.086
6	-0.141**	-0.158***	0.025	0.207**	0.250**	0.809**	-0.249	-0.118
7	-0.079	-0.094	0.141***	0.227**	0.153	1.553***	0.106	0.024
8	-0.129	-0.143	0.128**	0.270***	0.266**	1.446***	0.119	0.151
9	-0.147	-0.160**	-0.063	0.112	0.239**	0.781***	0.065	0.020
10	-0.129	-0.139*	0.058	0.188**	0.240*	2.189***	0.216	0.184
11	-0.128	-0.143	-0.021	0.093	0.151	1.357	0.567*	0.102
12	-0.031	-0.047	0.173**	0.195	0.179**	0.809***	-0.256	-0.072
13	-0.136*	-0.152**	0.046	0.258*	0.217**	0.743*	0.111	0.032
14	-0.063	-0.079	0.050	0.094	0.104**	0.759*	0.141**	0.040
15	-0.108*	-0.124	0.090	0.219*	0.198***	0.776**	-0.078	0.099
16	-0.109*	-0.128**	0.152	0.305**	0.172	0.789*	-0.043	-0.086

TABLE 4. Liquidity, trading activity and volatility changes around overnight annual earnings announcements

This table reports cross-section mean abnormal values of different measurements of market liquidity, activity and volatility for each 15'-interval from the daytime announcements subsample. Liquidity measures are: relative quoted spread (RQS), absolute quoted spread over tick size (AQS/T), quoted depth in euros (QD€) and the Bi-dimensional Liquidity Measure (BLM) proposed by Pascual et al (2004). The measures of trading activity are: number of trades (NT) and trading volume (VOL). The volatility measures are: the abnormal return (AR) and the high-low price range (HLPR). The abnormal measurement is defined as the measurement in the event-period interval minus the mean value in benchmark-period interval, stated as a percentage of the benchmark-period interval mean. Time interval 0 is the 15'-interval during which the announcement occurs. Due to space limitations, we only include the results for 4 hours before and after interval 0. The significance level of abnormal measurement is determined by the non-parametric test proposed by Corrado (1989). *, **, *** mean that interval *t* value is significantly different from zero at 10%, 5%, 1% level, respectively.

Interval	RQS	AQS/T	QD	BLM	NT	VOL	AR	HLPR
-16	-0.024	-0.027	-0.200	-0.160	0.010	0.160	-0.101	0.042
-15	-0.131*	-0.137**	-0.109	0.051	0.171	0.449	-0.176	-0.079
-14	-0.117	-0.124	-0.091	0.065	0.125	0.314	-0.050	-0.066
-13	-0.152*	-0.161*	-0.106	0.068	0.116	0.386	0.023	0.079
-12	-0.109	-0.116	-0.009	0.151	0.105	0.346	0.005	-0.065
-11	-0.068	-0.071	0.126	0.196	0.311*	1.220**	0.303**	0.092
-10	0.005	0.001	0.088*	0.049	0.064*	0.046*	0.198***	0.001
-9	-0.022	-0.027	-0.040	-0.009	0.066	0.335	0.203**	0.149*
-8	-0.020	-0.024	-0.077	-0.027	-0.078	0.184	-0.036	-0.044
-7	-0.071	-0.073	-0.155	-0.125	-0.167	-0.074	0.054	-0.152
-6	-0.010	-0.015	0.013	-0.004	0.522***	0.567***	0.352***	0.265**
-5	-0.041	-0.047	-0.030	0.026	0.060	0.388	-0.115	0.017
-4	0.041	0.035	-0.138	-0.212	-0.045	0.165	-0.142	-0.082
-3	-0.014	-0.019	-0.054	-0.038	0.037	0.466	-0.058	-0.118
-2	0.079	0.080	0.008	-0.064	0.094	0.309	0.026	0.132
-1	-0.002	-0.001	0.162	0.200	-0.108	0.072	-0.147	-0.139
0	-0.211***	-0.209***	-0.080	0.251**	0.726***	1.328***	0.166	0.104*
1	-0.185***	-0.185***	0.040*	0.283***	0.237***	0.957***	0.129	0.020
2	-0.217***	-0.215***	0.050**	0.353***	0.258**	2.445***	-0.207	-0.107
3	-0.219***	-0.221***	0.172	0.449***	0.013	0.680	-0.059	-0.084
4	-0.250***	-0.252***	-0.020	0.308***	0.121	0.672	0.045	-0.060
5	-0.242***	-0.242***	0.169**	0.466***	0.160	0.526*	0.023	-0.108
6	-0.177**	-0.177**	0.111*	0.359***	0.279	0.890	-0.027	0.022
7	-0.123*	-0.123*	0.109*	0.325***	0.101*	0.268	-0.163	-0.138
8	-0.109	-0.110	0.009	0.121*	0.084	0.677**	-0.237	-0.134
9	-0.119*	-0.120*	0.056	0.226	0.097	0.383	-0.036	-0.078
10	-0.113	-0.110	0.036	0.194	0.073	0.520**	-0.121	-0.123
11	-0.056	-0.053	0.123	0.227	0.067	0.377	0.081	0.026
12	-0.024	-0.020	0.063	0.125	-0.031	0.359	0.173	0.114
13	-0.037	-0.041	0.056	0.217	0.057	1.066	0.393	0.176
14	-0.085	-0.089	-0.036	0.109	0.140	1.372***	-0.088	0.197*
15	-0.098	-0.098	0.046	0.221	0.081	0.606	-0.094	-0.059
16	-0.121**	-0.123**	0.142*	0.339***	0.243	0.798*	-0.017	-0.062

that the earnings news is released when the market is closed, investors have enough time to obtain and interpret this new information and, furthermore, they can observe the order flow in the limit order book during the pre-opening auction. In this way, once the market opens and the information has become public, the probability of investors facing superior informational traders decreases significantly, thus improving market liquidity.

For overnight and daytime announcements, we also find an improvement in liquidity observed for the full sample. However, the immediate responses of the market to daytime and overnight announcements clearly differ. For overnight disclosures, liquidity improves immediately following the market opening. For daytime announcements, the improvement in liquidity is observed after time intervals of trading.

5.2. Information asymmetry – Price Impact-

Mean abnormal values of *price impact*, proxy for information asymmetry, are presented in Table 5. To calculate this measurement, we estimate the VAR model proposed by Hasbrouck (1991). In order to obtain a valid number of observations we used a four-hour time interval (16 fifteen-minute intervals before and after the announcement). Abnormal values are obtained as usual: the event-value for the four-hour interval is compared to the mean value across the same intervals from the benchmark period.

TABLA 5. ***Price Impact***

This table reports cross-section mean abnormal values of *price impact,* an asymmetric information measurement proposed by Hasbrouck (1991). The abnormal measurement is defined as the measurement in the event-period interval minus the mean value in benchmark-period interval, stated as a percentage of the benchmark-period interval mean. In this case, the time intervals considered are 4 hours before and 4 hours after the announcement. The significance level of abnormal measurement is determined by the non-parametric test proposed by Corrado (1989) (statistic value in brackets). *, **, *** mean that interval *t* value is significantly different from zero at 10%, 5%, 1% level, respectively.

Before the announcement			**After the announcement**		
Total	***Daytime***	***Overnight***	**Total**	***Daytime***	***Overnight***
0.159	0.139	0.182	0.047	0.109	-0.026
[0.753]	[0.568]	[0.495]	[0.584]	[1.203]	[-0.449]

As seen in Table 5, abnormal values of price impact are not statically significant in the hours before and after the announcement. This finding suggests that we must be cautious with regard to any conclusions made about the changes in the asymmetric information mentioned above. However, the sign of coefficients are consistent with much of what we have noted so far. In the pre-announcement period, price impact is positive for the total sample and for daytime and overnight disclosures. In the post-announcement period, the abnormal value of the coefficient is positive, and close to zero, for the total sample, positive for daytime announcements, and negative for overnight announcements. These results, by being

exclusively based on coefficient signs, suggest an increase in the level of information asymmetry after daytime disclosures and a reduction in it following overnight announcements.

From the univariate analysis, we do not observe significant changes in the level of information asymmetry, although we find a clear improvement in stock liquidity after the announcement. In order to identify the determinants of the post-announcement improvement in liquidity, we carry out a multivariate analysis, which takes into account the joint role played by trading activity, volatility, and information asymmetry. In particular, we propose the following regression:

$$\Delta Liq_{it} = \alpha + \beta_1 \Delta Neg_{it} + \beta_2 \Delta PImpact_{it} + \beta_3 \Delta Volat_{it} + u_{it} \qquad (5)$$

where ΔLiq_{it} represents the change in liquidity for stock i in period t (pre or post-announcement), proxy by the bid-ask spread, the quoted depth, or BLM; ΔNeg_{it} is the change in trading activity measured by the number of transactions (NT); $\Delta PImpact_{it}$ is the variation in the proxy for the level of information asymmetry, and $\Delta Volat_{it}$ represents the change in volatility, proxy by the HLPR variable. The cross-section regression is estimated using the median abnormal values in the four-hour periods before and after the announcement. We check that *ΔPimpact* and *ΔVolat* are correlated highly and positively. In order to avoid multicolineallity problems, we regress the latter variable on the former (with intercept). Afterwards, we replace the volatility variable by the residual of this regression in model (4). All regressions are estimated using the OLS method. The results for each sample and period are shown in Table 6. Panel A, B and C report the results of the model where the dependent variable is the bid-ask spread, the quoted depth and the BLM, respectively.

Earlier studies modelling the relationship between trading activity and liquidity in cross-section find that the most traded stocks are generally the most liquid assets (Lee et al, 1993; Rubio and Tapia, 1996, among others). Thus, accordingly, we expect a negative (positive) sign on β_1 when bid-ask spread (depth or BLM) is the dependent variable. At the same time, liquidity providers try to protect themselves by widening the spread and/or reducing quoted depth, from the higher levels of information asymmetry and volatility. Therefore, we expect a positive (negative) sign on coefficients β_2 and β_3 in the regression model where bid-ask spread (depth or BLM) is the dependent variable. The results shown in table 6 seem to confirm these predictions. Changes in liquidity can be partially explained by changes in trading activity (positive relationship) and by changes in volatility and asymmetric information (negative relationship). We can also point out the high explanation power of

models proposed, where the values of R^2 *adjusted* range between 10% and 50%, obtaining the highest values from the regressions of the spread and BLM in the post-announcement period.

Table 6. Changes in liquidity. Multivariate analysis

This table shows the regression results of the following model: $\Delta Liq_{it} = \alpha + \beta_1 \Delta Neg_{it} + \beta_2 \Delta PImpact_{it} + \beta_3 \Delta Volat_{it} + u_{it}$, where ΔLiq_{it} is the change in liquidity - proxy for relative spread (RQS) in panel A, for quoted depth (QD) in panel B, and for Bi-dimensional Liquidity Measure proposed by Pascual et al (2004) (BLM) in panel C - for asset *i* at the moment *t* (prior to or following the announcement); ΔNeg_{it} is the change in trading activity measured by the number of transactions (NTRAN); $\Delta PImpact_{it}$ is the change in the proxy for the level of asymmetric information; and $\Delta Volat_{it}$ is the change in volatility measured by HLPR. The cross-sectional regression is estimated using the mean values for each asset in the 4 hours prior to and following the earnings announcements. We verify that $\Delta PImpact_{it}$ and $\Delta Volat_{it}$ are highly and positively correlated. To avoid the problem of multicollinearity, we carry out an orthogonalization procedure by regressing $\Delta Volat_{it}$ on $\Delta PImpact_{it}$ firstly, and then $\Delta Volat_{it}$ is replaced with the residual of this latter regression in the original model. *, **, *** mean that interval *t* value is significantly different from zero at 10%, 5%, 1% level, respectively.

Panel A: Changes in relative quoted spread (RQS)

	Before announcement			After announcement		
Coef.	*Total*	*Daytime*	*Overnight*	*Total*	*Daytime*	*Overnight*
α	-0.156***	-0.141**	-0.173***	-0.149***	-0.136***	-0.171***
β_1	-0.245***	-0.221**	-0.280***	-0.189***	-0.106*	-0.265***
β_2	0.118***	0.130**	0.107**	0.217***	0.200***	0.230***
β_3	0.242***	0.260**	0.206	0.197***	0.083	0.384*
R^2 *fit.*	0.22	0.14	0.28	0.37	0.27	0.49

Panel B: Changes in quoted depth (QD)

	Before announcement			After announcement		
Coef.	*Total*	*Daytime*	*Overnight*	*Total*	*Daytime*	*Overnight*
α	-0.051*	-0.048	-0.054	-0.045	-0.024	-0.056
β_1	0.185**	0.071	0.390***	0.248***	0.250***	0.266***
β_2	-0.084**	-0.114*	-0.032	-0.177***	-0.253***	-0.005
β_3	-0.294***	-0.219**	0.519**	-0.360***	-0.439***	-0.162
R^2 *fit.*	0.13	0.11	0.20	0.25	0.34	0.20

Panel C: Changes in BLM

	Before announcement			After announcement		
Coef.	*Total*	*Daytime*	*Overnight*	*Total*	*Daytime*	*Overnight*
α	0.157***	0.129**	0.193***	0.147***	0.126**	0.184***
β_1	0.509***	0.394***	0.713***	0.451***	0.431***	0.500***
β_2	-0.191***	-0.213**	-0.148	-0.454***	-0.506***	-0.286*
β_3	-0.627***	-0.578***	-0.842**	-0.581***	-0.610***	-0.478*
R^2 *fit.*	0.29	0.26	0.31	0.41	0.43	0.37

In the post-announcement period, where the most important changes are observed, by comparing with the results from the total sample, we find that the spread regression has a higher (lower) explanation power for overnight (daytime) announcements, while depth

regression increases (decreases) its explanation power. This could indicate, as Lee et al (1993) note, that liquidity suppliers manage the two dimensions of liquidity depending on their expectations and the risks they face at each moment. The results from the multivariate analysis for the post-announcement period seem to be consistent with our interpretations inferred from the univariate analysis results.

In the case of daytime announcements, we find that price impact, which presents a positive coefficient, is the variable with the highest explanation power in the spread regression. In the univariate analysis, mean abnormal value of price impact showed a positive sign in the four hours after the announcement for daytime disclosures, which indicates a higher presence of informed traders. In this environment, on the one hand, liquidity providers would want to wide the spread to protect themselves from informed traders. However, on the other hand, the higher trading activity would provoke a narrowing of the spread. During the two first hours following the announcement, the two effects may offset each other, and that is why there are no significant changes in the spread during this trading interval. With regard to changes in the depth, we can conclude along the same lines, although in this case volatility has a more significant influence on this variable than on the spread. Finally, BLM regression confirms the results obtained in the above regressions showing a negative and significant coefficient related to price impact.

For overnight announcements, both trading activity and information asymmetry work in the same direction. In the post-announcement period, the univariate analysis results show an abnormal increase in the trading activity and that the sign of abnormal value of price impact indicates a reduction in the level of information asymmetry. Therefore, according to the results from the regression model, we could deduce that the significant post-announcement reduction in the bid-ask spread is motivated by the increase in trading activity as well as by the reduction in the mean levels of asymmetric information. However, for depth regression, only trading activity seems to have a significant influence, whereas price impact and volatility are not significant. Consequently, the price impact coefficient in the BLM regression shows a more weak relation between these two variables.

Briefly, the annual earnings announcements encourage trading activity, and provoke an improvement in liquidity. However, there is a difference between announcements released when market is open and when it is closed. For disclosures released during trading hours, liquidity providers try to defend themselves from investors with superior information-processing abilities by changing their quotes. In the case of overnight disclosures, the post-announcement risk of information asymmetry is lower because investors have more time and more information to analyse and interpret the earnings released prior to the first trading opportunity.

5.3. Order submission strategies

In this section, we analyse whether the release of annual earnings modify investors' order placement strategies. The trader's decision to use a market or limit order depends on his trading aggressiveness (relative patience) and market conditions (state of the book). In order-driven markets, investors are faced with a trade-off between immediate execution and transaction costs when they have to choose between posting limit orders and submitting market orders. If an investor wants immediacy, he will use market orders, which ensure its immediate execution at an additional cost (half-spread). If an investor wants to avoid these immediacy costs, he can place limit orders. Limit orders result in better execution but face a risk of non-execution and of trading with better-informed traders. Therefore, limit orders are primarily used by patient traders and market orders are submitted by impatient or aggressive traders. In addition, the choice between a market and a limit order depends on market conditions, for example, the size of the bid-ask spread and volatility. A wider spread discourages the submission of market orders because transaction costs are higher (Foucault, 1999). An increase in volatility encourages the placement of limit orders, because, *ceteris paribus*, the higher the volatility, the greater the probability that limit orders will be executed (Handa and Schwartz, 1996).

Table 7 reports mean abnormal values of relative frequencies of market orders, limit orders, and cancellations during each of 15' intervals around the announcement timing for our full sample. As we can see, after the earnings announcement, investors prefer to trade with market orders. In interval 0 and in the first intervals following, we find positive and significant abnormal values. On the contrary, we find no significant changes for limit orders, except a significant reduction in the use of limit orders in interval 0. Simultaneously, the frequency of cancellations decreases significantly. The larger use of market orders could be explained by the narrowing of the spread following the announcement, which supposes a significant decrease in the transaction costs. Therefore, our findings suggest that, after the release of new information, investors prefer to trade using market orders, instead of limit orders, to ensure trade execution and at lower relative transaction costs. The significant decrease in cancellations also reveals the traders' confidence in the submitted orders, taking into account the released information, and investors' interest in the execution of their trades.

The results for daytime announcements and overnight announcements seem to support the former conclusion. For both cases, investors prefer to use market orders for trading once the information asymmetry decreases, the bid-ask spread narrows, and volatility falls. Thus, for overnight announcements, we find a significant increase in the submission of market orders, together with a simultaneous reduction in the frequency of limit orders and cancellations, during the first two 15' intervals after the market opens. During this time, as a consequence of the low probability of informed trading and the low immediacy

costs, traders prefer to submit market orders to ensure the execution of their trades. For daytime announcements, we detect no changes in the order placement strategies during a certain time-period following the announcement. Only after approximately one trading hour do investors start to use relatively more market orders. As soon as the market assimilates the new information, the level of asymmetric information reduces, and liquidity improves accordingly, investors prefer to use market orders instead of limit orders.

Table 7. Market orders and limit order submission and cancellations

This table reports cross-section mean abnormal values of the relative frequency of the placement of market orders (MO) and limit orders (LM), and of cancellations (CANC) in the order book for each 15'-interval. The abnormal measurement is defined as the measurement in the event-period interval minus the mean value in benchmark-period interval, stated as a percentage of the benchmark-period interval mean. Time interval 0 is the first 15'-interval of the trading day just after the announcement. Due to space limitations, we only include the results for 4 hours before and after interval 0. The significance level of abnormal measurement is determined by the non-parametric test proposed by Corrado (1989). *, **, *** mean that interval *t* value is significantly different from zero at 10%, 5%, 1% level, respectively.

Interval	*Daytime Announcements*			*Overnight announcements*			**Total sample**		
	MO	LO	CANC	MO	LO	CANC	MO	LO	CANC
-16	-0.119***	0.085*	0.283***	-0.025	0.073	-0.200	-0.076*	0.080**	0.063**
-15	-0.004	0.054	-0.162	0.058	-0.025	-0.012*	0.024	0.018	-0.093**
-14	-0.032	0.071	-0.081	-0.007	-0.049	-0.185	-0.021	0.016	-0.129
-13	-0.099*	0.069	0.037*	0.040	-0.027	-0.163	-0.036	0.026	-0.055**
-12	-0.127**	0.081*	0.239***	0.010	-0.086	-0.215	-0.064	0.005	0.032*
-11	-0.025	0.068	-0.070	0.095*	-0.170***	0.125	0.029	-0.041	0.019
-10	-0.109	0.060	-0.012	0.019	0.056	-0.236	-0.050	0.058	-0.114
-9	-0.045	0.045	-0.039	0.026	-0.035	0.081	-0.012	0.008	0.016
-8	0.045*	-0.036	-0.075	0.035	0.003	-0.227	0.040**	-0.018	-0.144
-7	-0.070	0.050	0.004	0.040**	-0.017	-0.288*	-0.020	0.020	-0.129
-6	0.038	-0.043	-0.181	0.108***	-0.082*	-0.189	0.070***	-0.061**	-0.185*
-5	-0.008	-0.035	-0.014	0.034	-0.037	-0.036	0.011	-0.036	-0.024
-4	-0.003	0.025	-0.137	-0.003	-0.033	0.074	-0.003	-0.001	-0.041
-3	-0.005	-0.001	-0.033	0.133***	-0.102	-0.224**	0.058***	-0.047	-0.120
-2	-0.039	0.027	-0.087	-0.016	-0.006	0.061	-0.029	0.012	-0.019
-1	-0.034	0.029	0.067	0.058	-0.051*	-0.079	0.008	-0.008	0.000
0	0.004	-0.011	0.037	0.148***	-0.122***	-0.366***	0.070***	-0.062**	-0.147
1	0.032	-0.026	-0.166	0.045***	-0.055	-0.329**	0.038**	-0.040	-0.240**
2	0.084**	-0.067	-0.124	0.043	0.006	-0.334***	0.065***	-0.034	-0.220*
3	0.001	0.046	-0.090	0.001	0.014	-0.139	0.001*	0.032	-0.112
4	-0.023	0.077	-0.202	-0.037	0.055	-0.228	-0.029	0.067*	-0.214*
5	0.056*	0.014	-0.256*	0.005	0.015	-0.269	0.033**	0.015	-0.262**
6	0.077**	-0.004	-0.222	0.032	0.020	-0.212	0.056***	0.007	-0.217
7	-0.043	0.081	-0.010	0.070*	-0.020	-0.367	0.008	0.035	-0.173
8	0.087	0.041	-0.233	0.043*	-0.008	-0.230	0.067**	0.019	-0.231**
9	0.065	-0.041	-0.106	0.042	-0.049	-0.208	0.054*	-0.045	-0.153
10	0.058	-0.023	-0.060	-0.019	0.030	-0.012	0.023	0.001	-0.038
11	0.016	0.032	-0.096	0.127**	-0.099	-0.179	0.067**	-0.028	-0.134
12	-0.040	0.024	0.170***	-0.013	0.077	-0.157	-0.027	0.048	0.021*
13	0.050*	0.020	-0.158	-0.048	0.057	-0.226	0.005	0.037	-0.189
14	0.027	0.014	-0.090	-0.087	0.081**	-0.099	-0.025	0.045*	-0.094
15	0.039	0.028	-0.235	-0.090	0.095	-0.199	-0.020	0.059	-0.219
16	-0.013	-0.001	-0.155	0.060*	-0.097	-0.109	0.020*	-0.045	-0.134

6. Earnings disclosure strategy based on the announcement surprise

Previous studies have shown that firms choose the time to release financial information according to its favourable or unfavourable character. For earnings announcements, Patell and Wolfson (1982), and Woddruff and Sehchack (1988) show that, during their sample periods, NYSE firms tend to release good (bad) earnings news when the market is closed (open). Patell and Wolfson (1982) provide an explanation for the strategic timing of earnings disclosures: managers choose the timing of the announcement to minimise the impact of bad news on the price and maximise the price reaction to good news. For quote-driven markets, Genotte and Trueman (1996) prove theoretically that the reason for this strategy is that, when the market is closed, the market-maker is less able to discern the valuation implications from post-announcement trading because there is more time for orders from noise traders to accumulate as well as for the occurrence of other announcements that have an impact on firm value.

Given the different speed of the market reaction observed between daytime and overnight announcements (section 5.1), we examine the possibility that Spanish firms could follow a timing strategy of earnings disclosures depending on the surprise sign. In particular, we identify two types of announcements: those in which released earnings are higher than forecast earnings (positive surprise) and those in which actual earnings are lower that expected ones (negative surprise). To group sample announcements into the two categories, we compare the actual earnings to analysts' forecasts distributed by *JCF Quant*. Therefore, the earnings surprise $\left(UE_{i,t}\right)$ is calculated as follows:

$$UE_{i,t} = \frac{EPS_{i,t} - FEPS_{i,t}}{FEPS_{i,t}} \qquad (6)$$

where $EPS_{i,t}$ is actual earnings per share for firm *i* in year *t,* and $FEPS_{i,t}$ is mean JCF Quant analyst forecast for firm *i*'s earnings per share for year *t* forecasted in the day prior to the announcement. In our sample, we distinguish 34 positive surprise announcements and 56 negative surprise announcements. Only in two cases is *EPS* exactly equal to *FEPS*.

The distribution of announcements by sign of surprise and by timing is reported in Table 8. As we can see, around 66% of negative surprise announcements are released during trading hours. This contrasts with the high percentage of positive announcements, around 65%, made when the market is closed. This preliminary analysis suggests that Spanish companies tend to disclose earnings with positive (negative) implications for firm value when the market is closed (open). This disclosure strategy differs from that found in the US stock

markets, where the announcements made after the close of trading tend to contain bad news and good news tends to be released during trading hours.

Table 8. Distribution of announcements by earnings surprise

This table shows the distribution of earnings announcement according to the sign of the unexpected component of the earnings released by years and by the announcement timing. The surprise or unexpected component is defined as the difference between actual earnings per share and the consensus analysts' forecast of earnings per share. In brackets, we report the number of observations in each category for the subsamples of extreme negative and extreme positive earnings announcements.

	Positive surprise (extreme)			**Negative surprise (extreme)**		
	Daytime	*Overnight*	Total	*Daytime*	*Overnight*	Total
2000	3	6	9	13	8	21
2001	6	10	16	9	7	16
2002	3	6	9	15	4	19
Total	12 (7)	22 (16)	34 (23)	37 (15)	19 (8)	56 (23)
%	35 (30)	66 (70)	100 (100)	66 (65)	34 (35)	100 (100)

When analysing market reaction to earnings announcements taking into account the surprise sign, we have decided not to use the whole sample given the small difference (next to 0) between actual earnings and analysts' forecasts for quite a few observations. Alternatively, we form two portfolios including exclusively extreme observations. For this, we rank all sample observations using the unexpected component of the announcement (surprise). The first and fourth quartiles (23 announcements each) are our samples of negative and positive extreme surprises respectively.[12]. Changes in liquidity, activity and volatility for these samples are shown in Tables 9 and 10.

In the pre-announcement period, we do not detect significant changes in liquidity for any extreme surprise announcements subsamples. Nevertheless, in the post-announcement period, we find different changes depending on the sign of the surprise. In cases of positive surprise, as seen in Table 9, we detect a significant improvement in liquidity (narrower spreads, higher quoted depth and BLM) and an increase in trading activity. These findings are similar to those for overnight announcements'. This coincidence could originate from the concentration of positive earnings announcements during non-trading hours. This evidence could suggest that if the actual earnings are higher than expected, managers tend to release them when the market is closed for investors to have more time to receive and analyse the

[12] For the samples of extreme surprise earnings announcements, we find a similar timing pattern of disclosures to that observed for the total sample. Thus, 15 of 23 negative extreme surprise announcements (65%) are released in trading hours and only 8 (35%) during non-trading hours. For positive extreme surprise announcements, 7 of 23 (30%) are made when the market is open and 16 (70%) when the market is closed (see Table 8).

information, and thus avoid informational advantages of investors with superior information-processing abilities (informed traders).

TABLE 9. Liquidity, trading activity, and volatility changes around positive surprise earnings announcements.

This table reports cross-section mean abnormal values of different measurements of market liquidity, activity and volatility for each 15′-interval, and for the positive surprise earning announcements subsample. This subsample contains the quartile of extreme positive earnings surprise (23 observations). Liquidity measures are: relative quoted spread (RQS), absolute quoted spread over tick size (AQS/T), quoted depth in euros (QD€) and the Bi-dimensional Liquidity Measure (BLM) proposed by Pascual et al (2004). The measures of trading activity are: number of trades (NT) and trading volume (VOL). The volatility measures are: the abnormal return (AR) and the high-low price range (HLPR). Time interval 0 is the 15′-interval during which the announcement occurs (for daytime announcements) or the first interval of the trading day just after the announcement (for overnight announcements). Due to the space limitation, we only include the results for 4 hours before and after interval 0. The significance level of abnormal measurement is determined by the non-parametric test proposed by Corrado (1989). *, **, *** mean that interval *t* value is significantly different from zero at 10%, 5%, 1% level, respectively.

Interval	Extreme positive earnings surprise							
	RQS	AQS/T	QD	BLM	NT	VOL	AR	HLPR
-16	-0.071	-0.086	-0.166	-0.059	0.267	0.170	0.236***	0.337***
-15	-0.088	-0.102	-0.013	0.084	0.265*	1.497	0.103	0.055
-14	-0.080	-0.089	-0.120	-0.030	0.430	0.634	0.076	0.168
-13	-0.043	-0.060	-0.029	0.030	0.189	0.486	0.122*	0.358
-12	-0.023	-0.033	-0.086	-0.011	0.298	2.589	0.346	0.189
-11	0.010	0.004	0.175**	0.166	0.522	1.074**	0.307	0.387
-10	0.008	-0.005	0.171**	0.118	0.054	0.332	0.292	0.151
-9	-0.039	-0.051	-0.049	0.012	0.167	0.354	0.340*	0.309
-8	-0.091	-0.097	0.110	0.236	0.076	0.164	0.129	0.005
-7	-0.067	-0.070	0.101	0.252	-0.063	0.228	-0.108	-0.205
-6	-0.044	-0.053	0.131	0.167	0.481**	0.865***	0.351**	0.294
-5	-0.011	-0.036	-0.130	-0.138	0.262**	1.058***	0.131	0.188*
-4	0.106	0.094	-0.149	-0.335	0.011	0.380	-0.167	-0.075
-3	-0.054	-0.063	-0.005	0.028	0.049	-0.067	0.001	0.033
-2	0.096	0.093	0.086	-0.054	0.089	0.594	0.117	0.241
-1	-0.027	-0.032	0.447	0.472	0.067	0.447	-0.033	0.130
0	-0.201	-0.195	-0.119	0.129	0.730***	1.896***	0.387	0.535
1	-0.203*	-0.203*	-0.044	0.199	0.466***	1.729***	0.104	-0.003
2	-0.305***	-0.299***	0.033	0.361***	0.349**	3.714***	-0.061	-0.112
3	-0.348***	-0.347***	0.249**	0.657***	0.210*	1.294***	-0.011	0.082
4	-0.278***	-0.275***	0.161**	0.511***	0.205**	1.034**	0.205	0.117
5	-0.337***	-0.338***	0.186*	0.632***	0.366**	1.436***	-0.041	-0.104
6	-0.235**	-0.236**	0.004	0.336*	0.120	0.256	-0.157	-0.222
7	-0.106	-0.101	0.279**	0.515***	0.125	0.900	-0.290	-0.221
8	-0.130	-0.129	0.124	0.288*	-0.014	1.847	-0.353	-0.261
9	-0.202**	-0.199**	-0.087	0.177	0.103*	1.155**	-0.360	-0.305
10	-0.193*	-0.184**	0.003	0.240	0.155	2.576***	-0.171	-0.182
11	-0.005	0.003	-0.019	-0.005	0.068	1.173	0.454	-0.076
12	-0.034	-0.025	-0.014	0.078	0.057	0.559	-0.022	-0.063
13	-0.154	-0.158	-0.053	0.178	0.056	0.971	0.165	0.002
14	-0.061	-0.070	0.069	0.141	0.208	1.615	0.378**	0.438***
15	-0.012	-0.019	0.102	0.121	0.015	0.549	0.343	0.240
16	-0.059	-0.069	0.243	0.356	0.313	1.783	0.237	0.205

Table 10. Liquidity, trading activity, and volatility changes around negative surprise earnings announcements.

This table reports cross-section mean abnormal values of different measurements of market liquidity, activity and volatility for each 15'-interval, and for the negative surprise earning announcements subsample. This subsample contains the quartile of extreme negative earnings surprises (23 observations). Liquidity measures are: relative quoted spread (RQS), absolute quoted spread over tick size (AQS/T), quoted depth in euros (QD€) and the Bi-dimensional Liquidity Measure (BLM) proposed by Pascual et al (2004). The measures of trading activity are: number of trades (NT) and trading volume (VOL). The volatility measures are: the abnormal return (AR) and the high-low price range (HLPR). Time interval 0 is the 15'-interval during which the announcement occurs (for daytime announcements) or the first interval of the trading day just after the announcement (for overnight announcements). Due to space limitations, we only include the results for 4 hours before and after interval 0. The significance level of abnormal measurement is determined by the non-parametric test proposed by Corrado (1989). *, **, *** mean that interval *t* value is significantly different from zero at 10%, 5%, 1% level, respectively.

Interval	Extreme negative earnings surprise							
	RQS	AQS/T	QD	BLM	NT	VOL	AR	HLPR
-16	0.069	0.065	-0.076	-0.196	-0.325***	0.077	-0.175	-0.155
-15	-0.080	-0.086*	-0.001	0.155	-0.151	0.015	-0.332	-0.274
-14	-0.072	-0.080	0.092	0.179	-0.122	0.155	0.209	0.049
-13	-0.006	-0.017	0.089**	0.089	0.053	0.918	0.479*	0.349
-12	0.097	0.090	0.016	-0.080	0.074	1.092	0.193*	0.057
-11	-0.021	-0.026	-0.016	-0.008	0.323	1.097	0.513*	0.326*
-10	0.105	0.101	-0.096	-0.260	0.208	0.619	0.463	0.310
-9	0.029	0.025	-0.064	-0.070	0.321	0.623	-0.049	0.177*
-8	0.045	0.042	-0.091	-0.092	0.100	1.015	0.280	0.081
-7	-0.022	-0.026	0.064	-0.092	0.054	0.516	-0.106	-0.033
-6	-0.014	-0.021	-0.088	-0.150	0.344*	1.012	0.360**	0.244**
-5	-0.039	-0.046	0.037	0.064	0.167	1.114	0.052	0.096
-4	-0.003	-0.010	-0.089	-0.063	0.065	0.487	0.297	0.295**
-3	-0.034	-0.042	-0.146	-0.110	0.126	0.490	-0.221	-0.165
-2	0.083	0.080	0.007	-0.136	0.093	0.895	0.097	0.171
-1	-0.019	-0.031	0.211	0.209	-0.048	0.148	0.099	0.000
0	-0.063	-0.074	0.056	0.197	0.592***	2.595***	0.474*	0.564***
1	-0.123	-0.134	-0.032	0.128	0.327**	1.095***	0.244	0.087
2	-0.088	-0.097	-0.026	0.077	0.372*	2.559***	0.716*	0.372
3	0.005	-0.013	-0.099	-0.144	0.070	0.895	-0.106	-0.026
4	-0.059	-0.076	-0.068	-0.019	0.030	0.451	-0.304	-0.175
5	-0.093	-0.104	0.091	0.191	0.253	1.597	0.322	0.148
6	-0.108	-0.128*	-0.017	0.115	0.119	0.742	-0.099	-0.063
7	-0.077	-0.093	0.129	0.226	0.145	0.883	-0.069	-0.071
8	-0.008	-0.025	0.187	0.149	0.096	0.996	-0.255	0.158
9	-0.116	-0.132	-0.162	-0.006	0.161	0.361	0.165	0.050
10	-0.032	-0.055	-0.049	-0.084	0.185	2.345	0.588	0.563
11	-0.100	-0.114	-0.069	0.044	0.129	0.974	0.981	0.606
12	0.042	0.019	0.005	-0.109	0.028	0.842	-0.399	0.004
13	-0.057	-0.077	-0.074	-0.001	0.058	0.748	0.323	0.132
14	-0.022	-0.033	-0.025	0.004	0.012	0.435	0.052	-0.009
15	-0.160*	-0.169**	0.007	0.250	0.014	0.603	-0.319	-0.037
16	-0.162*	-0.173***	0.040	0.279**	0.072	0.607	-0.158	-0.165

However, as shown in Table 10, the effects of negative surprise earnings announcements are less than the effects of positive surprise disclosures. We only find abnormally high values in trading activity during the 45 minutes just after the announcement and for volatility in the interval 0. Liquidity measures, spread, depth, and BLM, do not present significant abnormal values in any of the post-announcement 15' intervals. The explanation for this weak market reaction could be the high percentage of these announcements made during the trading session. Managers might prefer to release earnings that represent bad news deliberately during trading hours in order to minimise and delay the negative impact. As noted above, in Section 5.1, the market reaction to daytime announcements is not immediate. Traders need time to process and interpret the new information, and so there is a certain level of uncertainty with regards the asset value just after the announcement. The significant abnormal values in trading activity and volatility immediately following the announcement are consistent with the uncertainty and heterogeneity in the first interpretations of the released earnings. However, after this period, for negative surprise announcements, we do not find the improvement in liquidity observed for daytime disclosures.

Therefore, we suggest that by releasing lower than forecast earnings during the trading session, managers minimise the negative effects. This conclusion is supported by the observed changes in the variable *price impact,* calculated by taking into account the extreme surprise announcements exclusively. As shown in Table 11, for the negative extreme earnings subsample and for the post-announcement period, *price impact* presents a positive and significant (at 10% level) abnormal value, which indicates an increase in the level of information asymmetry.

Table 11. *Price Impact* for extreme earnings surprise samples

This table reports cross-section mean abnormal value of the measurement of the asymmetric information level, price impact, estimated following the methodology proposed by Hasbrouck (1991). The abnormal measurement is defined as the measurement in the event-period interval minus the mean value in benchmark-period interval, stated as a percentage of the benchmark-period interval mean. The intervals considered are the 4 hours prior to and the 4 hours following the earnings announcements. The model is estimated for the subsamples of extreme positive earnings surprise (23 announcements) and of extreme negative earnings surprise (23 announcements). The significance level of abnormal measurement is determined by the non-parametric test proposed by Corrado (1989) – statistic value in brackets-. * mean that interval *t* value is significantly different from zero at 10% level.

Before the announcement			**After the announcement**		
Total	Positive surprise	Negative surprise	Total	Positive surprise	Negative surprise
0.159	0.226	0.118	0.047	-0.027	0.112*
[0.753]	[0.807]	[0.878]	[0.584]	[-0.370]	[1.868]

7. Summary and conclusions

This study analyses the intraday behaviour of the Spanish stock market around annual earnings announcements. We use a sample of 92 earnings announcements made in the period 2001-2003. We examine the changes in different measurements of liquidity, trading activity, volatility, asymmetric information, and in the traders' order placement strategies.

The first conclusion that we draw from our empirical work is that public disclosure of annual accounting earnings encourages trading activity and improves liquidity, narrowing the bid-ask spread and increasing the quoted depth. Our results differ from evidence provided by Lee et al. (1994), Gajewski (1999), and Wael (2004), who report a worsening in liquidity just after the earnings announcement. Our results are only consistent with Otogawa (2003)'s findings for the TSE.

We differentiate between announcements made during trading and non-trading hours (daytime and overnight announcements, respectively). When we compare the market response to the earnings announcements according to the timing, we can confirm that liquidity improves significantly following both daytime and overnight announcements. Nevertheless, the speed of the change in liquidity differs between the announcements released during trading hours and those made when the market is closed. For the latter, liquidity improves immediately after the market opens. In contrast, the increase in liquidity occurs after a certain time-period of trading for daytime announcements.

The post-announcement significant improvement in liquidity could suggest a decrease in information asymmetry provoked by the earnings release. However, from the univariate analysis of the asymmetric information measure proposed by Hasbrouck (1991), *price impact*, we find no significant change in this measurement. On the contrary, the multivariate analysis, performed in order to explain the post-announcement liquidity improvement, indicates that the changes in trading activity and in price impact significantly affect asset liquidity.

We draw the following conclusions from the different speed of the market reaction to daytime and overnight announcements. In the case of overnight announcements, investors have time and more information to interpret published earnings news before the market opens. Thus, given that the probability of informed trading diminishes, liquidity improves and trading activity increases just after the market opening. However, these consequences of earnings disclosures do not occur as quickly for daytime announcements. When earnings news is released during the trading day, the initial reaction observed in the market is an increase in volume and volatility, with no significant changes in liquidity. This could be due to heterogeneous interpretations of information disclosed and to uncertainty about the true

value of the stock. After approximately two hours of trading, once the information has been processed and incorporated into stock price through trading, information asymmetry reduces, and then we find a narrower spread and higher depth than normal.

The immediate improvement of liquidity for overnight disclosures versus the delayed improvement for daytime announcements suggests trading halts might be appropriate. In several markets, such as the US equity markets, individual security trading halts are called when a firm has pending news announcements on unusual earnings and dividends or other relevant matters. One argument for trading halts is that a non-trading period allows information to be transmitted to all market participants before trading. Thus, all investors have more time to evaluate new information and make rational decisions. Otherwise, this information gives one set of traders an advantage over others. Brooks et al. (2003) conclude along the same lines when they compare the equity market's reaction to unanticipated events that occur when the market is open and when the market is closed.

From the analysis of traders' order placement strategies, we find a significant increase (reduction) in the use of market (limit) orders following earnings announcements. This change is observed mainly immediately after overnight announcements. The higher frequency of market orders could be explained by the significant narrowing of the bid-ask spread. Narrower spreads suppose lower transaction costs, which encourage investors to trade with market orders. At the same time, by using market orders traders ensure the immediate execution of their trading decisions, which are made with the new information released in mind.

Finally, the different reaction of the market to overnight and to daytime announcements could be consequence of an intraday timing pattern of earnings disclosures. We find that Spanish firms tend to release lower than the expected earnings during normal trading hours, whereas higher than forecast earnings tend to be released when the market is closed. For announcements with positive surprise, the improvement in liquidity is immediate. In contrast, for those announcements with negative surprise, the liquidity measures do not change significantly in the hours following the announcement. These results could suggest that Spanish firms try to disseminate widely their good news and to "hide" their bad news by following a timing strategy for releasing their annual earnings. However, given the limitations of this study as the small size of the sample used, among others, we cannot state conclusively that our results are driven by the announcement timing or by the sign of the earnings surprise itself. This question is an interesting issue for further research that we are carrying out currently.

Appendix. Measurements computation description

Measures	Formula	
Liquidity		Where
Relative Quoted Spread RQS (Time-weighted)	$RQS_j = \frac{\sum_{t=1}^{T_j}\left[\left(Pask_t - Pbid_t\right)/MP_t\right]s_t}{900}$	- $j = 1, 2, ..., 34$, number of the fifteen-minute interval - T_j , number of records in interval j
Absolute Quoted Spread / Tick AQS/T (Time-weighted)	$AQST_j = \frac{\sum_{t=1}^{T_j}\left[\left(pask_t - pbid_t\right)/Tick_t\right]s_t}{900}$	- $Pask_t$, ask price in record t - $Pbid_t$, bid price in record t
Quoted Depth in € QD€ (Time-weighted)	$QD(€)_j = \frac{\sum_{t=1}^{T_j}\left[\left(Dask_t + Dbid_t\right)*MP_t\right]s_t}{900}$	- $MP_t = \frac{pask_t + pbid_t}{2}$, quoted mid-point in record t - s_t , time in seconds that record t stays in the book. - $Tick_t$ is 0.01€ if MP_t < 50€ or 0.05€ if MP_t > 50€ - $Dask_t$, number of shares at the best ask price in the record t - $Dbid_t$, number of shares at the best bid price in the record t
Trading Activity		
Number of Transactions NT	NT_j	- NT_j , number of transactions in interval j - $Ntit_t$, number of shares traded in transaction t - $Price_t$, transaction price in trade t - $LastMP_j$, last quoted mid-point in the interval j - $HighMP_j$, higher quoted mid-point in the interval j - $LowMP_j$, lower quoted mid-point in the interval j
Trading Volume in € VOL€	$VOL(€)_j = \sum_{t=1}^{NT_j} Ntit_t * Price_t$	
Return volatility		
Absolute Return AR	$AR_j = \left\lvert \ln\left(\frac{LastMP_j}{LastMP_{j-1}}\right)\right\rvert$	
High-low Price Range HLPR	$HLPR_j = \ln\left(\frac{HighMP_j}{LowMP_j}\right)$	

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