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The informational role of thin options markets: Empirical evidence from the Spanish case*

El papel informativo de los mercados de opciones estrechos: Evidencia empírica del caso español

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Abstract

This study investigates the informational role of thin options markets, specifically the Spanish options market. Firstly, we examine the effect of options markets by analysing stock market reaction to earnings news, conditional on the availability of options markets. Secondly, we examine options trading activity before the release of earnings news (including the announcement period). The results show that the impact on prices before the earnings release is significantly bigger when options trading is available. Moreover, the dissemination of earnings news is associated with significant unusual activity in the options market due to informed trading, especially when the earnings surprise is highly good.

Key words: *options market, thin market, informed trading, price discovery process, earnings announcement.*

JEL Classification: *G12, G13, G14.*

Resumen

El trabajo analiza el papel informativo de los mercados de opciones para el caso de escasa negociación, centrándose en el mercado español. Estudiamos el efecto de la llegada de nueva información relevante, como es el anuncio de beneficios, en el mercado de contado bajo la presencia de opciones sobre dichas acciones. Además, examinamos la actividad negociadora en el mercado de opciones ante dicho suceso. Los resultados muestran que el impacto de

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la información es superior cuando existen opciones cotizadas sobre dichas acciones. Adicionalmente, se observa una actividad negociadora anormal en el mercado de opciones debido a la negociación informada, principalmente cuando la noticia es muy buena.

Palabras clave: *Mercado de opciones, mercado poco líquido, negociación informada, proceso de formación de precios, anuncio de beneficios.*

Clasificación JEL: *G12, G13, G14.*

1. Introduction

This study analyses the informational role of options markets. Although traditionally options are seen as redundant assets, nowadays a recurring topic in financial literature is the role that options markets play in the financial system. Specifically, informed traders might prefer trading in the options market due to the advantages that this market offers in terms of trading costs (Black, 1975; Manaster and Rendleman, 1982), higher leverage (Back, 1993; Biais and Hillion, 1994), absence of short sales restrictions, and a greater range of trading strategies by combining positions in options and in the underlying stock. Ultimately, it is the presence of these informed agents in the options market that leads one to hypothesize the improvement of stock market efficiency. For example, as shown in the previous literature, the availability of the options market contributes to overall stock price efficiency in several ways: the stock price adjustment is faster (Jennings and Stark, 1986), market price reactions to earnings announcements are smaller (Skinner, 1990; Ho, 1993), and post-announcement drifts are less pronounced (Botosan and Skinner, 1993) in stocks with listed options.

The purpose of our study is to analyse the stock market reaction to the arrival of new information conditional on the availability of options trading, in particular the release of earnings news. The fact that the earnings announcements have a clear impact on the value of a firm[1] makes this an optimal event to analyse whether options markets enhance the informational efficiency of stock markets (Amin and Lee, 1997; Mendenhall and Fehrs, 1999; Donders *et al.* 2000; Roll *et al.* 2010; Billings and Jennings, 2011; Johnson and So, 2012; and Hu, 2014, among others).

The first aim of our study is to test whether the formation of the price in the stock market is more efficient with the existence of listed options and if there is a migration of informed agents in favour of the options market. To this end, we study the stock market behaviour in terms of price formation, trading activity and liquidity around the announcement of quarterly and annual earnings in a sample of companies that present such information at two different times, that is, before and after the options listing. We expect that the response to the earnings

[1] One must highlight previous literature (Beaver, 1968; Ball and Brown, 1968; Beaver *et al.*, 1979; Atiase, 1985, 1987; Pope and Inyangete, 1992; Opong, 1995; Elsharkawy and Garrod, 1996; Booth *et al.*, 1997; Gajewski and Quéré, 2001; among others, and for the Spanish market: Arcas and Rees, 1999; Sanabria, 2005; and Garcia *et al.* 2008, 2010).

announcement of prices of optioned stocks is larger and more complete than similar non-optioned stocks because of their higher informational efficiency and also a reduction in the informed trading on the stock market.

Moreover, we analyse the behaviour of the trading activity in the options market around the release of the earnings in order to detect if there is any activity related to the information released. Due to the presence of informed agents, abnormal trading activity on the options market is expected.

Finally, we investigate if informed agents anticipate earnings announcements and take advantage of this knowledge by trading on the options market. For this purpose, we consider the relation between the cumulative abnormal returns prior to the release of the new information and the previous trading activity on the options market. We expect that options traders execute orders in the right direction for the upcoming earnings surprise.

The results of the analysis of the stock markets show that the impact on prices is significantly bigger when there are options listed. Additionally, the trading activity shows that the number of orders is significantly larger and the average size of the transactions shows a significant decrease. In light of these results, we can hold that there is an increase in the trading activity of uninformed agents. With respect to the options market, the results show significant abnormal trading activity whose sign depends on the analysed variable and the degree of moneyness. Finally, we observe that in those announcements where the impact is the greatest, there is more trading in options prior to an earnings release, which is reflected in a greater number of open positions. Our results suggest that there are informed agents that trade actively in the options markets in anticipation of earnings news, mainly when the earnings surprise is good. This behaviour improves the efficiency of the market.

To the best of our knowledge, the first look at trading activity on the Spanish options market around the release of economic news is Blasco *et al.* (2010), who analyse the relationship between informed trading volume in the options market and variations in underlying index prices around the arrival of economic news. We expand this evidence for the Spanish market using firm specific news, earnings announcements, stock options and two additional measures of informed trading.[2] Moreover, we contribute to the literature in different ways. Firstly, our study analyses the relevance of accounting information in the options market in order to determine whether thin markets, such as the Spanish options market, play a similar role to that observed in other markets with higher trading activity. Secondly, we contribute by considering the behaviour of the open interest in options markets before earnings announcements from the point of view of informed trading. Although trading volume in the options market may be informative about the price discovery process in financial markets, volume by itself does not give any indication of the direction of the transactions. In this regard, changes in open interest may provide additional evidence with respect to the informational role of options. Finally, we control for stock volume with the relative trading activity in options and stock markets, measures developed by Roll *et al.* (2010). As well, we bring new evidence employing panel data

[2] A preliminary version of this paper was presented at the XXVII AEDEM Annual Meeting, Huelva 2013.

methodology focused on the Spanish market. The panel data model provides estimators that are more efficient than linear regression models and allow one to control for individual unobserved heterogeneity (one of the major problems in non-experimental research).

The remainder of the paper is organized as follows. Section 2 provides the background motivation and a literature review and sets forth the tested hypotheses. In section 3 we describe our data sets. The methodology and results for the analysis of the stock market reaction to earnings news conditioned on the availability of options markets are detailed in section 4. Section 5 presents the results of the regression analysis of the determinants of options trading variables. Section 6 analyses the relation of options trading variables to cumulative abnormal returns. Section 7 concludes.

2. Hypotheses and previous literature

In general, if the markets are incomplete, one supported hypothesis is that the options market improves equity market efficiency (Black, 1975; Mayhew *et al.*, 1995). The arguments in favour of this hypothesis are based on, firstly, a higher level of information around stocks with options and, secondly, that certain characteristics of the options market make it more attractive to informed traders (lower transaction costs, absence of short sales restrictions, and greater financial leverage). The above-mentioned hypothesis would not be supported if the markets were complete because in that case options are redundant securities (Black and Scholes, 1973; Merton, 1973).

The role of the options market in the underlying stock price discovery has received considerable attention in previous studies. Specifically, the effect of the options market on stock market efficiency around earnings announcements has been extensively studied. The main findings are consistent with a significantly different price discovery between non-optioned and optioned stocks, with a key finding being that the options market increases the informational efficiency of the stock market motivated by informed trading.

In this regard, Jennings and Starks (1986) study the effects of options trading on the behaviour of underlying stock prices around earnings releases. The authors find that the non-optioned firms require substantially more time to adjust the price to the new information than optioned ones. Furthermore, Mendenhall and Fehrs (1999) measure the impact of options listing on the magnitude of the absolute stock price movement at the time of earnings announcements. They argue that options trading increases the speed of price adjustment to earnings before the release. Their results indicate a larger and more complete earnings announcement response for optioned firms as a result of informed traders.

The idea that informed traders prefer to trade in options markets is also supported by Skinner (1990) who studies the stock price response to earnings when the stock is listed in the options market. He finds that market price reactions to earnings announcements are smaller after options listing. The same result is obtained by Ho (1993), who finds a smaller earnings response for optioned firms on the announcement date because stock prices of optioned firms anticipate earnings information. Similar results are obtained by Botosan and Skinner

(1993) who conclude that the post earnings announcement price drift is lower for optioned firms.

On the other hand, several studies have investigated the impact of stock options listings on several aspects of the market quality of the underlying stocks. Kumar *et al.* (1998) suggest that options listings improve the market quality of the underlying stocks. They observe an improvement in the liquidity –a decrease in the spread and an increase in the quoted depth–, and an increase in trading volume, trading frequency and transaction size after options listing. Fedenia and Grammatikos (1992) study the effect of options listing on the bid-ask spread of the underlying stocks and they report that the bid-ask spread declines for highly liquid stocks, but increases for illiquid stocks.

Earnings announcements convey relevant price information and their timing is largely predictable. This fact can motivate informed traders to trade on private information and take advantage of it. Under the hypothesis that informed traders prefer to trade in the options market for the advantages that this market offers, and in light of previous literature, we consider the follow hypotheses:

H1. After options listing, a larger proportion of the total stock price adjustment associated with earnings release takes place before the announcement.
H2. We expect a substitution effect in informed trading activity in favour of the options market.
H3. We expect an improvement in stock market liquidity because of the new allocation of information in the financial markets after options listing.

The improvement in stock market efficiency as a result of the presence of options means, as noted above, that informed traders take positions in options markets ahead of the release of the information about corporate events, and that there is more information circulating in optioned firms. If the reason for the improvement in efficiency is the presence of informed agents taking advantage of their information, we expect an abnormal volume reaction to these information releases in the options market.

In this regard, some empirical studies have sought to explain the interaction of the options market and equity returns surrounding public events. Cao *et al.* (2005) relate option volume to returns of underlying stocks and show evidence of informed traders in the options market around takeover announcements. Arnold *et al.* (2006) find abnormal trading activity in the options market around tender offer announcements, and this abnormal trading volume precedes abnormal stock volume. In addition, Amin and Lee (1997), looking at earnings announcements, find that options traders initiate a greater proportion of long (short) positions immediately before good (bad) earnings news. Mendenhall and Fehrs (1999) find that options trading allows for increases in the speed of adjustment of prices to earnings. Roll *et al.* (2010) consider the relative trading volume in options and stocks and find that it is higher around earnings announcements, suggesting increased trading in the options markets. Moreover, they observe that part of the options trading prior to the release is informed. Truong *et al.* (2012) conclude that the options market absorbs the information conveyed by the earnings announcement and that this news has a profound impact on option value. For the Spanish market, Blasco *et al.* (2010) analyse the price impact on the underlying stock index of informed trading in the options market in the presence of eco-

nomic news, concluding that potential informed trading is channelled through out-of-the-money options.

Many papers analyse both options and equity trading volume as determinants of equity prices. The impact of open interest has been a less developed topic. Open interest measures options positions created through past trading that are not yet liquidated. Intuitively, open interest is a better measure of the beliefs of investors about future stock returns than trading volume. Schachter (1988) documents a significant decline in options open interest prior to quarterly earnings announcements. Specifically, this effect is most pronounced in those options with a short time to maturity and more sensitivity to volatility. On the contrary, Donders *et al.* (2000) find an increase in the open interest during the days before the earnings announcements. After the news dissemination, traders cancel part of their options position, thereby reducing open interest to normal levels.

Moreover, previous literature suggests that informed trading depends on the degree of option moneyness, that is, at the money (ATM), in the money (ITM) or out of the money (OTM). Chakravarty *et al.* (2004) and Chen *et al.* (2005), among others, argue that this is an important issue because options with different degrees of moneyness have different levels of liquidity and different degrees of leverage. Theory suggests that informed agents would prefer OTM options due to their greater leverage, while investor trading on volatility will tend to concentrate on ATM options, as they provide camouflage for their intensions, while commissions tend to be lowest for ITM options.

The relative importance of these factors is an empirical question that has not yet been resolved. Blasco *et al.* (2010) for the Spanish market find that informed investors trade in OTM and ATM options. Meanwhile, Truong *et al.* (2012) and Billings and Jennings (2011) argue that ATM options will attract the most trading interest due to their high sensitivity to changes in implied volatility. Other authors such as De Jong *et al.* (2006) argue that informed agents use ITM options to increase their trading profits because they are more sensitive to underlying equity price changes than other options.

In the light of this literature, we formulate the following hypothesis:

H4. Trading activity in options markets experiences abnormal variations before and on the day of the publication of the earnings announcements.

Following previous studies, we will contrast this hypothesis by considering the relationship between the option's strike price and the underlying stock's closing price to check whether informed trading exists and, if so, where it is found. Thus we will split options trading volume into ATM, OTM and ITM options and make the analysis for each of the three groups.

Finally, as suggested by Roll *et al.* (2010), if the options trading activity around the earnings release is because of informed agents, we should find a relationship between trading activity in the options market and post-announcements returns, indicating whether informed options traders are acting in the right direction.

H5. We expect a negative (positive) and significant relation between options trading activity and the post-announcements returns when the earnings release has a negative (positive) impact on prices.

3. Sample description

We intend to study the price formation process around the quarterly and annual earnings announcements released by those Spanish firms listed on the Spanish electronic stock market (hereinafter SIBE) that have optioned stocks.

The contracts on stocks in the Spanish options market are on the largest and most liquid companies of the Spanish stock market. These aspects are of great importance when studying the price formation process around the arrival of new information since these companies are the most informative for investors. Appendix 1 exhibits the firms with Spanish stock options listed and the number of contracts listed and traded for the period of study.

Since its inception in 1993, the number of stocks on which options are traded in the Spanish Futures and Options Exchange (MEFF) has increased from four in 1993 (BBVA, Endesa, Repsol y Telefónica) to the 42 that are currently listed. Table 1 shows some characteristics of the Spanish stock options market for the sample period. Obviously, the growth in the number of contracts outstanding each year has been progressive, although this trend is not observed in the number of contracts that were traded at least one day. These features, together with the behaviour observed in the trading volume and the number of days, allow us to state that the Spanish stock options market is thin.

The study extends from January 2004 to May 2012 and we have used the data described below.

- We have daily stock market data for all the firms that have optioned stocks. This data set has been obtained from *Sociedad de Bolsas*. Specifically, this data set includes closing prices, dividends, capital increases and changes in nominal value, the number of shares listed, the number of transactions and volume (number of shares) traded and the daily average spread. The data set includes the closing prices from the Madrid Stock Exchange Index –hereinafter IGBM– for the period analysed.
- We have obtained from the Bank of Spain the daily return on *Letras del Tesoro* (Spanish Treasury Bill) for the same period.
- We prepared a database consisting of the date of the announcement of quarterly and annual earnings released by Spanish firms on SIBE for the period from the first quarter 2004 to the last quarter 2011. This data set was obtained from the Spanish Security Exchange Commission (hereinafter CNMV) and by consulting the financial press.
- Daily information on stock options is provided by MEFF, the Spanish Financial Futures Market, a subsidiary of *Bolsas y Mercados Financieros* (BME), the company which runs Spain's securities markets. Specifically, we have used daily data of all contracts traded in this market, expiration date, strike price, the volume traded (number of contracts), delta and implicit volatility.

For an earnings announcement to be included in the final sample, we imposed several conditions:

- We have selected those firms listed in the SIBE for which there are optioned stocks and for which stock market data was available in the period that comprises 50 days before the event day and 5 days after it.

TABLE 1
SUMMARY STATISTICS FOR THE SPANISH OPTIONS MARKET

The table exhibits for the period 2004-2012 some characteristics of the Spanish stock options market: the number of contracts outstanding each year, the number of contracts that were traded at least one day and, for them, the daily average mean and standard deviation for the trading volume, the open interest and the number of days traded.

CALL OPTIONS		2004	2005	2006	2007	2008	2009	2010	2011	2012
Number of contracts		5,873	5,018	4,373	6,846	21,932	38,162	24,260	39,921	47,642
Number of contracts traded at least one day		1,899	1,422	1,254	1,692	2,016	4,381	4,634	3,465	4,061
Trading volume	Mean	24.62	44.59	49.87	39.35	51.84	91.31	47.63	47.78	47.22
	St.D.	69.48	179.24	154.30	147.59	220.47	570.58	208.94	199.19	227.90
Open interest	Mean	900.60	1581.46	1963.58	1575.63	1981.73	2399.84	1831.80	2,034.50	2,093.39
	St.D.	2,624.89	5,829.46	6,259.09	5,058.89	6,182.66	8,689.13	7,579.93	7,842.83	8,884.56
Days traded	Mean	13.60	11.07	11.19	10.19	8.52	7.33	8.34	6.56	1.05
	St.D.	16.63	14.66	16.67	15.68	11.43	11.68	11.77	9.51	3.66

PUT OPTIONS		2004	2005	2006	2007	2008	2009	2010	2011	2012
Number of contracts		5,873	5,018	4,373	6,846	21,920	38,173	24,274	39,952	47,598
Number of contracts traded at least one day		2,042	1,575	1,321	1,778	2,097	4,930	5,067	3,704	4,370
Trading volume	Mean	19.04	27.72	38.03	40.91	54.26	81.99	49.44	52.94	53.58
	St.D.	54.00	82.38	116.42	153.69	191.49	564.74	215.08	218.89	336.02
Open interest	Mean	727.90	1,249.56	2,017.90	1,915.98	2,394.95	2,415.40	1,881.37	2,224.75	2,216.91
	St.D.	2,415.39	3,399.98	6,746.95	8,053.13	9,621.37	9,974.04	7,495.86	7,848.68	9,552.03
Days traded	Mean	12.62	8.41	8.62	9.00	9.70	7.24	8.85	7.44	1.04
	St.D.	15.42	11.94	13.17	14.49	12.42	12.47	13.89	12.44	3.91

- No other contaminating event must exist in the five days on either side of the event day that may affect firm price, such as dividend payments, equity issues or stock splits.

It is well known that financial and non-financial companies behave very differently in several aspects. We have carried out the analysis both with the whole sample (aggregate sample) and the reduced sample after removing the financial companies.

4. Analysis of the Effect of Options on Stock Markets: Methodology and Results

4.1. Objective

The goal of this section is to investigate whether the availability of options trading enhances the price efficiency of equity markets around the release of quarterly and annual earnings announcements.

4.2. Sample, data and methodology

As the study is limited to the available data detailed above, the period extends from the first quarter of 2004 to the fourth quarter of 2011. Moreover, given the difficulty in finding companies with traded options with similar characteristics in terms of size and liquidity, we have decided to compare the price formation process around the dissemination of new information for the same companies in periods with and without traded options. For this reason, the announcements included in this first analysis have been those made by firms whose stocks were optioned during the study period and for which we have information for the two years prior to its incorporation into the options market.

Table 2 reports some characteristics of sample firms before and after options listing, specifically price, liquidity and trading volume. To analyse whether the results are significantly different before and after options listing, we applied a two-paired samples test for equal means. The comparison of the reported data indicates that firms' characteristics do not change significantly after options listing. So, the above-mentioned requirements allow us to have a homogeneous sample in terms of size, liquidity and number of announcements for the period with no options listed and with them. The only downside is that the size of our sample is considerably reduced. Specifically, fifteen companies meet the requirements and the number of earnings announcements included in the sample was 144 that is, 77 prior to the issuing of stock options and 77 after this date.

We employ conventional event study methodology in order to compute abnormal returns (AR). We define the event day (t_0) as the date of the announcement. The event window is defined to be an eleven–day window centred on the day of the announcement (t_0–5, t_0+5), and the estimation window ('uncontaminated' interval) is defined to be a 40–day window (t_0–50, t_0–11). The estimation period has been chosen in order to have the maximum number of observations while avoiding overlap with the estimation window of previous quarterly events from the same company. Additionally, this length guarantees that the estimation period

TABLE 2
DESCRIPTIVE ANALYSIS OF THE FIRMS OF THE SAMPLE BEFORE AND AFTER OPTIONS LISTING

The table exhibits descriptive statistics for the sample firm's characteristics for the year before and after options listing. The table shows the mean and the standard deviation (in brackets) for the daily closing price (P), the daily relative average spread (AS), the daily weighted average spread (WAS), the trading volume in number of millions of shares (TV) and the number of orders in thousands of shares (NO).

Year before options listing						Year after options listing				
P	AS	WAS	TV	NO		P	AS	WAS	TV	NO
Mean (StD)	Mean (StD)	Mean (StD)	Mean (StD)	Mean (StD)		Mean (StD)	Mean (StD)	Mean (StD)	Mean (StD)	Mean (StD)
19.01	0.0015	0.0051	1.52	1.65	A3TV	14.46	0.0016	0.0069	0.92	1.47
(2.22)	(0.0005)	(0.0012)	(1.2)	(0.72)		(2.25)	(0.0005)	(0.002)	(0.52)	(0.54)
29.19	0.0024	0.0078	0.55	1.17	ABG	17.66	0.0031	0.0104	0.44	0.94
(3.31)	(0.0007)	(0.0018)	(0.35)	(0.56)		(4.16)	(0.0013)	(0.0038)	(0.2)	(0.38)
34.72	0.0012	0.0039	1.32	1.40	ACS	43.2	0.001	0.0036	2.1	2.95
(4.47)	(0.0004)	(0.0009)	(0.86)	(0.51)		(3.57)	(0.0003)	(0.0008)	(1.55)	(0.99)
124.06	0.0019	0.0062	0.25	0.99	ANA	187.46	0.0018	0.0059	0.34	2.06
(11.74)	(0.0005)	(0.0013)	(0.21)	(0.44)		(24.59)	(0.0004)	(0.0011)	(0.18)	(0.79)
14.49	0.0011	0.0046	0.98	0.75	BTO	15.98	0.0014	0.0055	1.19	1.09
(1.30)	(0.0002)	(0.0007)	(0.52)	(0.34)		(2.06)	(0.0004)	(0.0014)	(0.72)	(0.42)
17.46	0.0015	0.0053	1.85	1.33	ENG	18.39	0.0011	0.0047	2.92	2.39
(1.27)	(0.0005)	(0.0013)	(2.84)	(1.11)		(1.14)	(0.0003)	(0.001)	(1.74)	(0.89)
63.15	0.002	0.007	0.46	0.97	FCC	66.77	0.0015	0.0058	0.68	1.91
(7.54)	(0.0006)	(0.0018)	(1.27)	(0.37)		(9.52)	(0.0003)	(0.001)	(0.49)	(0.67)
64.81	0.0015	0.0055	1.03	1.53	FER	67.32	0.0013	0.0053	1.02	2.51
(5.64)	(0.0004)	(0.0011)	(4.67)	(0.62)		(9.44)	(0.0003)	(0.001)	(0.44)	(0.86)
16.92	0.0015	0.0053	1.95	1.45	GAM	27.76	0.0013	0.0045	2.10	3.00
(2.06)	(0.0004)	(0.0009)	(2.11)	(0.61)		(3.42)	(0.0003)	(0.0009)	(0.89)	(1.19)
14.48	0.0019	0.0076	1.2	1.4	GRF	16.83	0.0018	0.0068	1.51	2.34
(1.91)	(0.0005)	(0.0017)	(0.77)	(0.62)		(2.45)	(0.0008)	(0.0025)	(0.76)	(0.94)
31.14	0.003	0.0127	0.18	0.34	MTS	27.32	0.0011	0.003	0.79	1.78
(17.59)	(0.0015)	(0.0071)	(0.19)	(0.3)		(3.30)	(0.0003)	(0.0012)	(0.44)	(0.88)
28.96	0.0017	0.0052	1.05	0.90	REE	35.6	0.0013	0.0047	1.65	1.87
(2.37)	(0.0006)	(0.0013)	(1.48)	(0.66)		(3.54)	(0.0004)	(0.0012)	(1.28)	(0.87)
7.03	0.0013	0.0041	4.33	0.98	SAB(*)	7.96	0.0014	0.0063	6.52	1.72
(0.66)	(0.0004)	(0.0008)	(8.65)	(0.39)		(0.8)	(0.0004)	(0.0018)	(7.99)	(0.67)
31.7	0.0022	0.006	0.85	1.03	SYV	35.57	0.0025	0.0075	0.68	1.54
(8.83)	(0.0008)	(0.0016)	(0.83)	(0.43)		(7.18)	(0.0008)	(0.002)	(0.33)	(0.63)
20.31	0.0014	0.0049	1.65	1.33	TL5	19.98	0.0012	0.0053	1.54	2.12
(1.12)	(0.0004)	(0.0011)	(4.09)	(0.59)		(1.53)	(0.0003)	(0.0012)	(0.94)	(0.71)

(*) Banco Sabadell completed a capital increase after options listing.

for the sample with options listed stays within the post-listing period. Finally, in order to guarantee that this benchmark period is not affected by the studied event, we exclude the five trading days prior to the first day of the event window.

Furthermore, we study the trading activity from daily observations of trading volume in number of shares, number of orders and the average size of the

transaction measured as volume in number of shares by number of orders, and the liquidity from the daily relative average spread and daily weighted average spread.

To achieve this purpose, we have defined the time series of daily return (R_{it}) of the assets as reflected in the expression [1]:

$$[1] \qquad R_{it} = \frac{(P_{it} + D_{it}) - P_{it-1}}{P_{it-1}}$$

where P_{it} is the closing price of asset *i* at t, D_{it} is the dividend or the value of the subscriptions rights, if any, of asset *i* at *t*, and P_{it-1} is the closing price of asset *i* at *t-1*. All variables were adjusted for changes in the asset's nominal value.

We estimate the expected returns following the four-factor model developed by Carhart (1997) shown in expression [2]:[3]

$$[2] \quad R_{it} - R_{ft} = \alpha_i + \beta_{im}(R_{mt} - R_{ft}) + \beta_{iSMB}SMB_t + \beta_{iHML}HML_t + \beta_{iPR1YR}PR1YR_t + \varepsilon_{it}$$

where R_{it} is the simple daily return of the asset *i* on day *t*, R_{ft} is the daily return on *Letras del Tesoro* (Spanish Treasury Bill), R_{mt} is the return on a value–weighted market index (specifically the Madrid Stock Exchange Index –IGBM–), SMB_t, HML_t and $PR1YR_t$ are returns on value weighted, zero-investment, factor mimicking portfolios for size, book to market equity, and one year momentum in stock returns, respectively. We have constructed local SMB and HML factors following the methodology proposed by Fama and French (1992, 1993) and Carhart (1997).

We have calculated the absolute abnormal return $|AR_{it}|$ as the difference in absolute value between the actual return and the estimated expected return.[4] In order to measure the stock price global reaction to the announcement, the results are aggregated to sum their absolute value on each day of the event window. Specifically, we have calculated the sum of absolute abnormal returns (SAAR) surrounding an earnings announcement for the pre-window [-5, -2], the event-window [-1, +1] and post-window [+2, +5] as: $SAAR = \sum_{t=a}^{t=b} | AR_{it} |$ where *a* and *b* are the lower and higher limits of each window, respectively.

These variables are calculated for the same sample of companies by averaging the values across all earnings announcements before and after options listing. To analyse whether the results are significantly different before and after the options have been listed, we applied a two-paired samples test for equal means. Given the size of our sample, and in order to take into account the possibility of non-normality, we test the significance with a bootstrap methodology for

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3 We have also estimated the expected return following the three factors model developed by Fama and French (1993). The results are robust to the methodology showing, as Fama (1998) affirms, that in the short term the results are robust to the model employed to estimate the expected return.

4 We calculate the absolute value of abnormal returns since the effects of good and bad earnings announcements have not been separated and the empirical evidence shows effects of contrary signs in this variable [García *et al.* (2008, 2010)].

t-statistic following Wehrens *et al.* (2000) and we use the Sign and Wilcoxon non-parametric tests.[5]

4.3. Results

The results in Table 3 show that, in general, the impact on prices is significantly bigger when there are options listed, especially for the previous period. This result partially supports our first hypothesis and it may be argued that the availability of the options market means that certain traders may have foreknowledge of earnings news. However, the results do not show that options listing causes a decline in the stock price response to earnings at the time of the release.

Thus, our results shows that the options market should be an important vehicle for responding to earnings news and that the impact of earnings is greater and more complete after options listing.

We have compared trading activity and liquidity around earnings announcements for the aggregate and reduced sample of companies by averaging the values across all earnings announcements before and after options listing. To analyse whether the results are significantly different between these two samples, we applied a two-paired samples test for equal means. Given the size of our sample, and in order to take into account the possibility of non-normality, we test the significance with a bootstrap methodology and some non-parametric tests.

The results show that the number of orders and the trading volume are, in general, significantly bigger when there are options listed. On the other hand, with respect to the average size of the transaction, which is used in financial literature as a proxy for informed trading (Easley and O'Hara, 1987; and Garcia *et al.*, 2012), we observe a significant and robust decrease.[6]

In the light of the results for trading activity, we can even assume, as in the second hypothesis, the slight presence of informed agents. The reduction in the average size of the transaction indicates that informed traders prefer to take positions in the options market. Assuming that small average trade size is associated with uninformed agents, our results would point to an increase in the trading activity of these agents. In the next sections, we shed further light on these results by analysing the determinants of trading activity in stock options around the release of earnings news.

The results in Table 4, panel D and E, show that changes in liquidity around earnings announcements are not significant. This evidence does not support the third hypothesis. However, this result is not directly related to liquidity improvements due to options listing.

Our evidence seems to confirm that options market availability appears to be associated with a larger and more completed earnings announcements, as pointed out by Mendenhall and Fehrs (1999), among others.

Moreover, the evidence about trading activity suggests that informed agents migrate to the options market. We can also observe an increase in small investor

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5 For more details on these tests, see Friedman (1937) and Wilcoxon (1945).

6 Easley and O'Hara (1987) conclude that a larger trade size carries more information since trading on larger quantities allows informed traders to take advantage of their private information, especially for short-term information.

TABLE 3

DIFFERENCE OF DAILY ABSOLUTE ABNORMAL RETURNS (|AR|) AND THE SUM OF ABSOLUTE ABNORMAL RETURNS SURROUNDING AN EARNINGS ANNOUNCEMENT (SAAR) FOR THE SAMPLE OF PERIOD WITH AND WITHOUT OPTIONS

The table exhibits the difference of mean and median daily absolute abnormal returns (|AR|) and the sum of absolute abnormal returns surrounding an earnings announcement (SAAR) for the sample of periods with and without options and the p-value of the different tests.

	Aggregate sample					Reduced sample				
	Mean	Bootstrap	Median	Sign	Wilcoxon	Mean	Bootstrap	Median	Sign	Wilcoxon
$\|AR_{-5}\|$	0.0080	0.057***	0.0042	0.301	35	0.0089	0.053***	0.0042	0.266	22
$\|AR_{-4}\|$	0.0022	0.140	0.0019	0.607	52	0.0017	0.426	0.0019	0.581	36
$\|AR_{-3}\|$	0.0163	0.001*	0.0120	0.000*	15*	0.0174	0.000*	0.0122	0.003*	13**
$\|AR_{-2}\|$	0.0110	0.001*	0.0078	0.035**	36	0.0123	0.002*	0.0078	0.022**	24
$\|AR_{-1}\|$	–0.0010	0.263	0.0099	0.030**	7*	–0.0027	0.247	0.0093	0.092***	7*
$\|AR_{0}\|$	–0.0014	0.182	0.0036	0.301	27***	–0.0037	0.134	0.0036	0.581	23
$\|AR_{+1}\|$	0.0120	0.144	0.0084	0.000*	6*	0.0120	0.223	0.0084	0.034*	5*
$\|AR_{+2}\|$	–0.0018	0.197	0.0048	0.301	32	–0.0033	0.292	0.0039	0.581	28
$\|AR_{+3}\|$	0.0035	0.268	0.0047	0.301	43	0.0033	0.197	0.0019	0.581	39
$\|AR_{+4}\|$	0.0071	0.104	0.0043	0.607	53	0.0076	0.117	0.0068	0.999	40
$\|AR_{+5}\|$	0.0048	0.130	0.0019	0.301	44	0.0071	0.194	0.0046	0.092***	22
$SAAR_{[-5,-2]}$	0.0371	0.001*	0.0283	0.007*	23**	0.0404	0.000*	0.0282	0.003*	10*
$SAAR_{[-1,1]}$	0.0095	0.203	0.0188	0.118	35	0.0055	0.375	0.0188	0.266	30
$SAAR_{[2,5]}$	0.0136	0.135	0.0045	0.301	42	0.0148	0.177	0.0045	0.266	28
$SAAR_{[-5,5]}$	0.0603	0.007*	0.0542	0.035**	32	0.0608	0.009*	0.0542	0.0224**	16**

*,**,*** Significantly different from zero at the 1%, 5% and 10% level, respectively.
The critical values for a two-tailed Wilcoxon test 1%, 5% and 10% level with a sample size of 15 are 16, 25 and 30 and for a sample size of 13 are 10, 17 and 21.

TABLE 4
DIFFERENCES IN TRADING ACTIVITY FOR THE SAMPLE PERIOD WITH AND WITHOUT OPTIONS

The table exhibits the difference of mean and median of trading volume (TV), the number of orders (NO), the average size of the transaction (TM), the daily relative average spread (AS) and daily weighted average spread (WAS) for the sample period with and without options and the p-value of the different tests in Panel A, B, C, D and E respectively.

	Aggregate sample					Reduced sample				
	Mean	Bootstrap	Median	Sign	Wilcoxon	Mean	Bootstrap	Median	Sign	Wilcoxon
Panel A. Average Trading Volume										
$TV_{[-5,-2]}$	755,144.05	0.004*	186,873.67	0.118	43	793,955.19	0.0010*	186,873.67	0.092***	30
$TV_{[-1,1]}$	637,088.59	0.025**	198,284.48	0.302	51	736,653.30	0.0170**	376,647.27	0.266	37
$TV_{[2,5]}$	666,944.75	0.007*	388,079.17	0.118	44	752,118.96	0.0080*	428,798.13	0.092***	28
$TV_{[-5,5]}$	690,874.63	0.004*	231,975.23	0.118	43	763,114.23	0.0110**	231,975.23	0.092***	27
Panel B; Average Number of Orders										
$NO_{[-5,-2]}$	1,039.48	0.001*	1,003.21	0.001*	11*	1,161.03	0.0010*	1,200.35	0.000*	0*
$NO_{[-1,1]}$	942.80	0.002*	1,125.17	0.007*	25**	1,023.69	0.0030*	1,139.19	0.022**	21***
$NO_{[2,5]}$	881.44	0.001*	617.50	0.035**	42	946.43	0.0020*	625.92	0.092***	36
$NO_{[-5,5]}$	955.64	0.001*	1,017.18	0.007*	25**	1,045.54	0.0010*	1,232.65	0.022**	22
Panel C; Average Size of the Transaction										
$TMT_{[-5,-2]}$	–209.77	0.029**	–182.76	0.035**	25**	–117.75	0.0179**	–182.76	0.092***	21***
$TMT_{[-1,1]}$	–244.86	0.034**	–137.81	0.035**	21**	–80.02	0.2747	–106.26	0.092***	16**
$TMT_{[2,5]}$	–224.82	0.033**	–72.60	0.035**	27***	–108.51	0.3186	–65.72	0.092***	22
$TMT_{[-5,5]}$	–224.81	0.023**	–161.73	0.035**	25**	–104.04	0.0848***	–161.73	0.092***	21***
Panel D; Average Relative Spread										
$AS_{[-5,-2]}$	0.00013	0.250	0.00014	0.302	41	0.00007	0.5604	0.00013	0.581	35
$AS_{[-1,1]}$	0.00026	0.074***	0.00023	0.118	33	0.00022	0.2348	0.00023	0.266	28
$AS_{[2,5]}$	0.00006	0.352	0.00003	0.999	42	–0.00001	0.2967	0.00000	0.999	36
$AS_{[-5,5]}$	0.00014	0.176	0.00012	0.302	36	0.00008	0.4885	0.00002	0.581	31
Panel E; Average Weighted Spread										
$WAS_{[-5,-2]}$	–0.00005	0.472	–0.00054	0.607	42	–0.00052	0.1357	–0.00132	0.266	24
$WAS_{[-1,1]}$	0.00037	0.279	–0.00005	0.999	46	–0.00001	0.3157	–0.00046	0.581	27
$WAS_{[2,5]}$	–0.00037	0.329	–0.00122	0.607	48	–0.00085	0.1460	–0.00145	0.266	29
$WAS_{[-5,5]}$	–0.00005	0.474	–0.00076	0.607	40	–0.00050	0.1269	–0.00098	0.266	23

*,**,*** Significantly different from zero at the 1%, 5% and 10% level, respectively.
The critical values for a two-tailed Wilcoxon test 1%, 5% and 10% level with a sample size of 15 are 16, 25 and 30 and for a sample size of 13 are 10, 17 and 21.

trading activity as optioned stocks catch their attention, because the introduction of options trading implies more intensive information collection around earnings announcements. To conclude, the availability of options markets does not reflect improvements in liquidity around earnings announcements.

5. Reaction of Trading Activity in Stock Options to the Release of Earnings Announcements

5.1. Objective

This section examines the trading activity in the stock options market before the release of quarterly and annual earnings announcements (including the announcement period). Trading volume has been used to determine whether an event has informational content and its study applies not only to trades on common stocks but applies equally well to stock options whose prices are determined by the value of the firm. To address this issue, we have analysed the trading volume in the options markets both in absolute terms and, following Roll *et al.* (2010), in relative terms related to trading volume in their underlying assets to control for stock volume.

Although trading volume in the options market may be informative about the price discovery process in financial markets, the volume by itself does not indicate the direction of the transaction. In this regard, changes in open interest may provide additional evidence with respect to the informational role of options. Open interest measures the total number of options contracts that are currently open, in other words, contracts that have been traded but not yet liquidated by either an offsetting trade or an exercise or assignment.

5.2. Sample, data and methodology

To illustrate how investors react to news events, we take a sample of 514 announcements from the first quarter of 2006 to the last quarter of 2011. In order to maintain the sample homogeneity taking only American options, we have reduced the analysis period from the first analysis because American options began trading in Spain in 2006. Moreover, we restrict our analysis to the options series with a time to maturity between 70 and 10 calendar days during the complete event period and focus our attention on three variables to estimate the trading activity:

- Options trading volume (O) in number of contracts. We calculate the total daily number of contracts traded for each stock by adding the contracts traded across all options listed on the stock.
- The options/stocks trading volume ratio (O/S). This is the ratio for a given day between the trading options volume for each firm (calculated by multiplying the total contracts traded in each option by 100 shares and aggregating across all options listed on the stock) and the corresponding trading volume (number of shares) on the stock market of a given firm.
- The open interest (OI), measured as the daily variation of the number of contracts that remain open, aggregated across all options listed on the stock.

Besides the information released, there are other factors that may explain part of the surge in trading activity that follows an accounting earnings announcement. Market participants may be trading based on volatility or may have placed hedges ahead of the earnings announcements, which might be unnecessary after the release, leading to additional trading activity. To pick up these effects, we also include other variables for which we have available data, namely implied volatility (V), delta (Δ) and firm size (S) , measured as the capitalization of the firm, which could explain the activity in the options market.[7]

Table 5 presents summary statistics for the dependent and explanatory variables. A daily cross-sectional mean is computed for each trading day in the sample and then mean, median, standard deviation, maximum and minimum are computed from the daily means across all the trading days in the sample.

The daily means and medians are close, showing that they are not outliers. The O/S indicates that on average the activity in the stock market is bigger than the activity in the options market.

TABLE 5
DESCRIPTIVE STATISTICS OF INDEPENDENT AND DEPENDENT VARIABLES

The table shows some statistics for size (S) measured as the capitalization of the firm, the intrinsic volatility (V), the delta (Δ) and options trading activity variables, i.e. the options trading volume in number of contracts (O), the options/stocks trading volume ratio in number of shares (O/S) and the open interest (OI). A daily cross-sectional mean is computed for each trading day in the sample, and then the mean, median, standard deviation, maximum and minimum are computed from the daily means.

	Size	Volatility	Delta	Ln(O/S)	Ln(O)	Ln(OI)
Mean	9.5396	0.3328	0.4403	–11.0500	4.4570	12.4382
Median	9.5513	0.3095	0.4349	–6.3753	4.3820	12.4388
SD	0.3890	0.1012	0.0636	0.7369	0.7743	0.0392
Maximum	10.9392	0.7729	0.7182	–4.3342	7.3837	12.5020
Minimum	8.6993	0.1797	0.2598	–9.2964	2.1171	11.0573

The regression model we propose to explain the behaviour of options market trading activity is presented in the expression [3]:

$$[3] \qquad \ln\left(TA_{it}\right) = C + \beta_1 D_{it} + \beta_2 V_{it} + \beta_3 \Delta_{it} + \beta_4 \ln\left(S_{it}\right) + e_{it}$$

where *TA* refers to the measures of trading activity above mentioned and *D* is a dummy variable that takes a value of 1 in the days of the window -5 to 1 with respect to the earnings announcement and 0 otherwise. We try to analyse whether in the five days before an earnings announcement, the announcement day and the day after there is additional informed options trading volume. Clearly, if the earnings announcement has informational content, we expect a positive relationship between trading activity and the dummy variable. Finally, to reduce the influence of possible outliers, we use the natural logarithm of the

[7] Implied volatility (V) and delta (Δ) have been taken from the information supplied by the Spanish Options Market (MEFF).

trading volume variables as the dependent variables in the results presented. For convenience, we will often refer to the logged variables as simply option volume (O), options/stock trading volume ratio (O/S), open interest (OI) and size (S).

Following the rule of the previous section, we have estimated the models using both the full sample of announcements (denoted aggregate sample) and the existing sample after removing all the announcements referring to financial companies (reduced sample).

Table 6 shows the average correlations of explanatory and dependent variables employed in the regression model. Correlations are computed for each trading day in the sample among all dependent variables. The correlations are then averaged across all trading days in the sample. The correlations between the independent variables and the explanatory variables show modest values. The independent variable with the highest correlation with the dependent variables is the size of the firm. With respect to the correlation between the dependent variables, the values are low.

In addition to using all the options contracts available every day, we also study separately OTM, ATM and ITM options. As Easley *et al.* (1998), Chakravarty *et al.* (2004) and Chen *et al.* (2005) among others, point out, the options with different degrees of moneyness have different characteristics that attract different agents. So we can consider that informed traders would prefer to trade OTM options since they are cheaper and have a higher degree of leverage (Roll *et al.*, 2010). Investors trading on volatility would prefer ATM options because the spread tends to be lower and they offer high liquidity (Billings and Jennings, 2011)

We compute an option's moneyness by comparing the option's strike price to the underlying asset price. Specifically, we calculate the price ratio for options as the strike price divided by the underlying asset price. We define ATM options as when the price ratio falls between 0.925 and 1.075, ITM options as when the price ratio is lower than 0.925 for call options and greater than 1.075 for put options, and OTM options as when the price ratio is greater than 1.075 for call options or lower than 0.925 for put options. The ratio values were chosen according to the existing literature (Chen *et al*. 2005; Billings and Jennings, 2011)

TABLE 6

AVERAGE CORRELATIONS OF INDEPENDENT AND DEPENDENT VARIABLES

The table shows the average correlations of explanatory and dependent variables. Correlations are computed for each trading day in the sample among all dependent variables: the options trading activity variables, i.e. the options trading volume in number of contracts (O), the options/stocks trading volume ratio in number of shares (O/S) and the open interest (OI), and the explanatory variables, i.e. the size (S) measured as the capitalization of the firm, the intrinsic volatility (V), the delta (Δ) and the earnings date (D). The correlations are then averaged across all trading days in the sample.

	Dummy	Volatility	Delta	Ln(O/S)	Ln(O)	Ln(OI)
Size	–0.0040	–0.1491	0.0408	0.1318	0.5551	0.2171
Dummy		0.0288	–0.0201	0.0204	0.0118	0.0022
Volatility			–0.0358	–0.0396	–0.0396	–0.0052
Delta				–0.0143	0.1030	–0.0275
Ln(O/S)					0.6702	0.2738
Ln(O)						0.3558

The availability of information allows for the use of the double temporal and cross-sectional dimension of the sample through an econometric model of panel data. This provides us, compared to just cross-sectional databases, with a more informative dataset (with more variability, less collinearity and more degrees of freedom) that permits us to attain more efficient estimates in an econometric linear regression model and to control for individual unobserved heterogeneity (one of the major problems in non-experimental research). We use an unbalanced panel data set with the daily data from 33 firms and 514 earnings announcements from the first quarter of 2006 to the last quarter of 2011.

5.3. Results

Table 7 shows the coefficients obtained after applying the best estimate procedure. To this end, a Breusch-Pagan test was applied which showed that the ordinary least square estimation was not the appropriate model and, after that, a Hausman test was carried out to determine which model, the fixed or random effects, was more appropriate.[8]

The result for the variable object of our interest, the dummy variable, is positive and highly significant in the options trading volume and options/stock volume ratio regression. Moreover, this behaviour is repeated, except for ITM options in the relative measure. This implies an increase in options trading activity in the analysis period. Agents trade in the options market in anticipation of the earnings announcement to profit from their knowledge of the unanticipated earnings surprise. These results are in line with previous literature (Philbrick and Stephan, 1993; Roll *et al.*, 2010, among others) and confirm our hypothesis that, with the arrival of new information, investors trade in the options market. Additionally, the reaction in the options market is larger than in the stock market for OTM and ATM options.

Of special interest for our study is the open interest variable. The results show, as in Schachter (1988), a significant decrease for the full sample. Considering the degree of moneyness, this result is only supported for ITM options. However, for ATM and OTM options the results show a significant increase, as in Amin and Lee (1997) and Donders *et al.* (2000). This result indicates that trading in the options market in the days prior to the earnings announcement is an offsetting trade in ITM options, and that it is in ATM and OTM options where investors decide to trade to take advantage of their information by opening new contracts. For the reduced sample, this result is observed only for ATM options.

[8] The results in Table 7 show that panel data works more appropriate than pooled OLS. Specifically, the fixed effects model is the best model.

TABLE 7
PANEL DATA REGRESSIONS OF TRADING ACTIVITY VARIABLES ON THEIR DETERMINANTS

The table exhibits the results of the regressions of options trading activity variables on their proximate determinants for a sample of 514 earnings announcements for Spanish stocks with listed options from the first quarter of 2006 to the last quarter of 2011. The options trading activity variables are the options trading volume in number of contracts (O_{it}), the options/stocks trading volume ratio in number of shares ($(O/S)_{it}$) and the open interest (OI_{it}).
The model regressions are the following:

$$\ln(TA_{it}) = C + \beta_1 D_{it} + \beta_2 V_{it} + \beta_3 \Delta_{it} + \beta_4 \ln(S_{it}) + e_{it}$$

where: TA_{it} refers to measures of trading activity, D_{it} is a dummy variable that reflects the earnings date and takes a value of 1 on trading dates -5 to +1 relative to the announcement day and 0 otherwise, V_{it} is the intrinsic volatility, Δ_{it} is the delta, and S_{it} is the size of the firm i, measured as the capitalization on day t.
The results are presented for all the options contracts and separately for out of the money (OTM), at the money (ATM) and in the money (ITM) options contracts.

	ALL CONTRACTS			ITM			ATM			OTM		
	Ln(O)	Ln(O/S)	Ln(OI)	Ln(O)	Ln(O/S)	Ln(OI)	Ln(O)	Ln(O/S)	Ln(OI)	Ln(O)	Ln(O/S)	Ln(OI)
Aggregate sample												
C	0.5677	–11.8882*	12.4353*	0.8827	–7.7951*	12.5284*	2.2613	–9.8862*	10.3490*	1.3188	–10.9933*	9.8238*
Dummy (D)	0.3182*	0.2052*	–0.0068*	0.2680*	0.0956	–0.0202**	0.3270*	0.2039*	0.0057**	0.2337*	0.1066***	0.0071***
Volatility (V)	0.9478**	0.3415	0.0133**	2.1825*	1.0805*	–0.0087**	–0.7353	–1.4613*	0.0331*	2.2231*	1.7237*	0.0945*
Delta (Δ)	0.4126**	0.0994	–0.0153	3.0447*	3.0080*	–0.0521	0.3465	–0.1864	–0.0161**	–0.4504	–0.7693	0.0451***
Size (S)	0.3444	0.5631*	0.0068	–0.0797	–0.3159	–0.0034	0.1839	0.3573**	0.0047	0.1749	0.3305**	0.0057
F Statistic	8.44	6.52	7.79	16.55	25.07	8.62	11.77	22.08	9.81	44.19	12.31	5.48
Prob > F	0.0001	0.0006	0.0004	0.000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
F test (all u_i=0)	168.99	43.61	29.79	10.77	12.06	10.01	100.21	26.01	4.65	58.35	17.35	7.34
Prob > F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Hausman Statistic	16.01	22.16	35,52	26.60	11.01	10.25	21.55	15.04	25.24	13.85	874.21	13.97
Prob (Hausman)	0.0010	0.0002	0.0000	0.0000	0.0011	0.0001	0.0002	0.0046	0.0000	0.0018	0.0000	0.0010
R-squared	0.5017	0.0928	0.0240	0.1649	0.1330	0.0400	0.4314	0.0873	0.0374	0.3286	0.0652	0.0360

Table 7 (continuation)

	ALL CONTRACTS			ITM			ATM			OTM		
	Ln(O)	Ln(O/S)	Ln(OI)	Ln(O)	Ln(O/S)	Ln(OI)	Ln(O)	Ln(O/S)	Ln(OI)	Ln(O)	Ln(O/S)	Ln(OI)
Observations	18,397	18,395	18,397	7,021	7,021	7,021	14,800	14,800	14,800	11,462	11,461	11,462
Groups	33	33	33	32	32	32	33	33	33	33	33	33
Reduced sample												
C	2.5594	–9.1587*	12.4529*	–3.9739	–16.4789*	12.5484*	3.7510	–7.6480*	10.3524*	2.2980	–9.7094*	9.8044*
Dummy (D)	0.2566*	0.1787*	–0.0099*	0.2346***	0.1297	–0.0308**	0.2942*	0.2145*	0.0030**	0.1341**	0.0409	0.0017***
Volatility (V)	0.4909	0.0711	0.0138	1.8099*	1.5433*	–0.0081	–1.1330**	–1.8901*	0.0407	1.8654*	1.5029**	0.0763**
Delta (Δ)	0.3811***	0.0456	–0.01715*	3.0138*	2.9469*	–0.0581	0.5011***	–0.0897	–0.0163***	–0.7212	–0.8838	0.0499
Size (S)	0.1070	0.2967**	–0.0011	0.4000***	0.5713***	–0.0047	–0.0036	0.1468	0.0042	0.0570	.02402	0.0084
F Statistic	4.58	4.67	5.71	7.78	12.92	5.14	5.10	43.52	8.20	16.74	4.85	5.12
Prob > F	0.0060	0.0060	0.0001	0.0003	0.0000	0.0056	0.0034	0.0000	0.0002	0.0000	0.0044	0.0031
F test (all u_i=0)	169.57	40.21	52.32	8.61	13.49	14.49	104.97	20.53	5.68	61.64	6.66	8.47
Prob > F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Hausman Statistic	22.34	18.59	34.67	18.28	47.65	17.65	22.28	6.30	29.77	11.06	14.00	30.71
Prob (Hausman)	0.0010	0.0072	0.0000	0.0082	0.0014	0.0014	0.0002	0.0029	0.0000	0.0025	0.0073	0.0000
R-squared	0.4608	0.0985	0.0240	0.1642	0.1382	0.058	0.4194	0.073	0.051	0.3047	0.0300	0.0547
Observations	13,788	13,786	13,786	4,297	4,297	4,297	10,792	10,792	10,792	8,244	8,244	8,244
Groups	28	28	28	27	27	27	28	28	28	28	28	28

*,**,*** Significantly different from zero al the 1%, 5% and 10% level, respectively.

The command vce(cluster name) in STATA, which specifies that the standard errors allow for intragroup correlation, relaxing the usual requirement that the observations be independent, has been used.

6. Cumulative Abnormal Returns Around Earnings Announcements and Options Trading Activity

6.1. Objective

As our results confirm that investors consider the options market as an alternative place to make their investments, this section assesses whether the increase in trading activity before earnings announcements is due to increased trading in options by informed agents attempting to profit from their views about the unanticipated earnings surprise.

6.2. Sample, data and methodology

To address this issue we relate the value of post-CAR, calculated as the cumulative abnormal return on days zero through five after the announcement day, with the trading activity variables defined in the previous section.

In the light of the previous results and following Roll *et al.* (2010), the relation could depend on the size of the pre-CAR because the activity of informed traders before the announcement could anticipate the incorporation of new information. Thus, larger pre-CAR would imply less informative post-CAR. To pick up this effect we include pre-CAR, defined as the cumulative abnormal return from five to two days before the announcement date, as an explanatory variable.

Previous empirical literature (Atiase, 1985, 1987; Pope and Inyangete, 1992; García, *et al.*, 2012, among others) shows that the level of previous information depends on the firm size, so for this reason we include firm size as an explanatory variable.

Since earnings surprise can be either good news or bad news and since options volume is unavailable, we examine absolute pre- and post-CAR in 514 earnings announcements *j* by all firms *i* with listed options from the first quarter of 2006 to the last quarter of 2011.

The regression has the following form:

$$[6]\quad Abs\left(CAR_{0,5}\right)_{ij} = C + \beta_1 ln\left(TA_{-5,-2}\right)_{ij} + \beta_2 Abs\left(CAR_{-5,-2}\right)_{ij} + ln\left(S_{-5,-2}\right)_{ij} + u_{ij}$$

The model relates the absolute value of the post-CAR to the options trading activity variables (*TA*), that is, options trading volume, the options/stock volume ratio or the open interest, all of them averaged over the pre-announcement window (days -5 to -2) and with the absolute value of pre-CAR and with size (*S*) measured as the market capitalization averaged over the pre-announcement window.[9]

As in the previous sections, we have estimated the models using both the aggregate sample and the reduced one.

[9] Similar to the previous section, to reduce the influence of possible outliers we use the natural logarithm of the trading volume variables and size.

6.3. Results

The results, presented in Table 8, show that options trading volume and open interest are positive and significant in the preannouncement period and that the options/stock trading volume ratio is not significant in the same period. This indicates that in those announcements where the impact is greater, there has been more trading in options prior to an earnings release, which is reflected in a greater number of open positions. For the reduced sample, only open interest is significant. This result confirms the significance of this variable as a proxy for the trading activity in the options market.

The results support the notion that some of the agents that trade actively in the options markets prior to an earnings announcement are informed.

Firm size has a negative and significant impact on prices, indicating, as expected, that the impact of the announcement is bigger on small firms for which there is less public information before the release and it is more difficult to anticipate the new information.

The pre-CAR variable is positive and significant indicating that more impact on prices before the earnings announcement is associated with more impact on prices after the release. This result is not as expected and could be affected by the fact that the returns are in absolute terms regardless of the direction of the prices.

To address this issue, we also run regressions through the aggregated and reduced sample of signed post-CAR on volume variables for two separate cases, one for 232 (175) announcements with positive post-CAR (good news) and one for 282 (228) with negative post-CAR (bad news). Moreover, to consider if this relation is affected by the impact of the earnings announcement on prices, we use the technique of quantile regression of Koenker and Bassett (1978).[10]

TABLE 8
CUMULATIVE ABNORMAL RETURN ON OPTIONS TRADING ACTIVITY

The table relates the absolute value of the post-CAR (from zero to five days after the earnings announcement) to the options trading activity (TA) variables (options volume, options/stock volume ratio and open interest) accumulated over the pre-announcement windows (days -5 to -2) and with the absolute value of pre-CAR (from five to two days prior to the announcement) and the size of the firm. Heteroskedasticity is accounted for through White robust standard errors.

$$Abs\left(CAR_{0,5}\right)_{ij} = C + \beta_1 ln\left(TA_{-5,-2}\right)_{ij} + \beta_2 Abs\left(CAR_{-5,-2}\right)_{ij} + ln\left(S_{-5,-2}\right)_{ij} + u_{ij}$$

		Aggregate sample			Reduced sample		
Trading activity	C	0.0756*	0.0705*	0.0269	0.0917*	0.0860*	0.0687*
	Ln($O_{-5,-2}$)	0.0012***			–0.0003		
	Ln((O/S)$_{-5,-2}$)		0.0005			–0.0006	
	Ln($OI_{-5,-2}$)			0.0028*			0.0019*
	Pre-CAR ($CAR_{-5,-2}$)	0.4319*	0.4395*	0.4409*	0.2878*	0.2883*	0.2865*
	Size (Ln(S) $_{-5,-2}$)	–0.0053*	–0.0037**	–0.0033***	–0.0055**	–0.0059*	–0.0062*

*,**,*** Significantly different from zero at the 1%, 5% and 10% level, respectively.

[10] Quantile regression considers some of the typical statistical problems of financial series, such as sensitivity to outliers and heteroskedasticity, among others.

TABLE 9
SIGNED CUMULATIVE ABNORMAL RETURN ON OPTIONS TRADING ACTIVITY

The table relates the value of the signed post-CAR (from zero to five days after the earnings announcement) to the options trading activity (TA) variables (option volume, option/stock volume ratio and open interest) accumulated over the pre-announcement windows (days -5 to -2) and to the value of pre-CAR (from five to two days prior to the announcement) and the size of the firm. The table shows quantile regression results in comparison with OLS results.

$$\left(CAR_{0,5}\right)_{ij} = C + \beta_1 ln\left(TA_{-5,-2}\right)_{ij} + \beta_2 \left(CAR_{-5,-2}\right)_{ij} + \beta_3\ ln\left(S_{-5,-2}\right)_{ij} + v_{ij}$$

Aggregate sample		OLS			0;25 Quantile regression[a]			0;50 Quantile regression[a]			0;75 Quantile regression[a]		
		O	O/S	OI	O	O/S	OI	O	O/S	OI	O	O/S	OI
PANEL A $CAR_{0,5}>0$ N=232	C	0.0831*	0.0761*	0.0183	0.0423**	0.0500*	0.0437	0.0672*	0.0826*	0.0039	0.1016*	0.1142*	0.0314
	Ln($TA_{-5,-2}$)	0.0030**	0.0018	0.0025	–0.0001	0.0006	–0.0001	0.0021	0.0020	0.0021	0.0025***	0.0031	0.0035*
	Ln($CAR_{-5,-2}$)	–0.1980*	–0.2079*	–0.2123*	0.0386	0.0520	0.0392	0.0034	0.0061	0.0269	–0.0665	–0.1062	–0.0823
	Ln($S_{-5,-2}$)	–0.0062**	–0.0023	–0.0009	–0.0031	–0.0036**	–0.0032	–0.0049	–0.0039	–0.0003	–0.0587	–0.0034	–0.0018
	R-squared	0.0851	0.0726	0.0688	0.0088	0.0084	0.0091	0.0250	0.0058	0.0114	0.0703	0.0574	0.05138
PANEL B $CAR_{0,5}<0$ N=282	C	–0.1317*	–0.1214*	0.6684	–0.2040*	–0.2304*	0.5989	–0.0817*	–0.0808*	–0.1582	–0.0369*	–0.0248	–0.0933
	Ln($TA_{-5,-2}$)	–0.0010	0.0001	–0.0618	–0.0028	–0.0035	–0.0605	–0.0001	0.0002	–0.0187	–0.0004	0.0013	0.0045
	Ln($CAR_{-5,-2}$)	0.0352	0.0322	0.0357	0.1432	0.0322	0.0842	–0.0015	–0.0041	–00189	0.02951	0.0015	0.0217
	Ln($S_{-5,-2}$)	0.0092*	0.0076*	0.0079*	0.0161*	0.0148*	0.0115*	0.0045	0.0026**	0.0044**	0.0020	0.0013	0.0015
	R-squared	0.0379	0.0358	0.0377	0.0343	0.0295	0.0369	0.0348	0.0344	0.0359	0.0261	0.0186	0.0299

Table 9 (continuation)

Reduced sample		OLS			0;25 Quantile regression[a]			0;50 Quantile regression[a]			0;75 Quantile regression[a]		
		O	O/S	OI	O	O	O/S	OI	O	O	O/S	OI	OI
PANEL A $CAR_{0,5}>0$ N=175	C	0.0863*	0.0854*	0.0607	0.0487**	0.0486**	0.0568**	0.0658*	0.0478	0.0530	0.1035**	0.1015**	0.0577
	$Ln(TA_{-5,-2})$	–0.0001	–0.0001	0.0018	–0.0007	–0.0005	–0.0001	–0.0020	–0.0020	0.0012	–0.00084	–0.0004	0.0033**
	$Ln(CAR_{-5,-2})$	0.0690	0.0689	–0.0699	0.0641	0.0647	0.0632	0.0466	0.0449	0.0587	0.0794	0.0896	0.0798
	$Ln(S_{-5,-2})$	–0.0050***	–0.0051**	–0.0049*	–0.0033	–0.0040***	–0.0044**	–0.0028**	–0.0033	–0.0042	–0.0045	–0.0051	–0.0045
	R-squared	0.0369	0.0369	0.0396	0.0353	0.0361	0.0362	0.0291	0.0264	0.0309	0.0357	0.0363	0.0381
PANEL B $CAR_{0,5}<0$ N=228	C	–0.1348*	–0.1267*	–0.2415	–0.1923*	–0.1859*	0.0353	–0.0763*	–0.0748*	0.0709	–0.0482*	–0.0351**	–0.3257
	$Ln(TA_{-5,-2})$	0.0001	0.0007	0.0082	0.0001	0.0003	–0.0180	–0.0001	0.0004	–0.0114	0.0002	0.0009	0.0217
	$Ln(CAR_{-5,-2})$	–0.0165	–0.0179	–0.0167	–0.0696	–0.0751	–0.0685	–0.0456	–0.0330	–0.0432	0.0036	0.0047	0.0025
	$Ln(S_{-5,-2})$	0.0092*	0.0088*	0.0093*	0.0137*	0.0134*	0.0142*	0.0042	0.0042	0.0041***	0.0031	0.0025	0.0031***
	R-squared	0.0440	0.0446	0.0440	0.0432	0.4347	0.0431	0.0389	0.0428	0.0391	0.0425	0.0393	0.0418

*,**,*** Significantly different from zero at the 1%, 5% and 10% level, respectively

(a) The command qreg2 in STATA, which estimates quantile regression and reports standard errors and t-statistics that are asymptotically valid under heteroskedasticity or under heteroskedasticity and intra-cluster correlation, has been used.

The results are presented in Table 9, with respect to the trading activity, we do not observe in bad news the presence of informed agents trading to exploit their informational advantage. This would be in line with the fact that for bad news there is a delay in the incorporation of the full information on prices due to the uncertainty that negative news transmits to the market (Hayn, 1995; Lipe *et al.*, 1998; Acker, 2002; and García *et al.*, 2014). [11]

However, for good news the results support the idea that there are informed agents who take advantage of their knowledge and trade actively in the options markets in anticipation of the impact of the earnings release. Quantile regressions reveal that the impact of the trading activity is related to the impact of the announcement and is only significant for the highest quantile. The results do not show a significant relationship between post-CAR and pre-CAR variables. As expected, the relation of size and the prior impact on prices remains unchanged relative to those in the previous regressions.

7. Conclusions

The study provides new evidence that may be useful for the analysis of the markets of less developed countries. However, the cost of focusing on the Spanish options market is the small number of firms in the sample.

The aim of this research is to analyse the impact of the dissemination of new information conditional on the availability of the options market specifically in the thin markets. We study the role of the options market both in the price efficiency of the equity market and in the behaviour of informed agents. For this purpose, we consider the announcement of annual and quarterly earnings in the Spanish stock market. These events convey relevant price information and their timing is largely predictable, facts that can motivate informed trading.

The stock market study reveals that the availability of an options market appears to be associated with a larger and more complete earnings announcements response, and that trading options could be more attractive than trading stocks for informed agents, as in other markets with more trading activity.

Evidence found in the options market analysis suggests that trading activity is higher before and on the date of earnings announcements, but it is only in ATM and OTM options where agents open new contracts. The increase of trading activity in ITM options is offsetting trades. This result shows that if there are informed traders profiting from their knowledge advantage, it is in ATM and OTM options.

Furthermore, post-announcements returns are positively related to pre-announcement volume and open interest for highly good news, suggesting that part of the options trading activity is motivated by informed agents opening contracts. These results, together with those observed in the stock market for the price discovery process, indicate that the availability of an options market increases price efficiency in the equity market, even if the options market is thin.

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[11] The results could be influenced by the fact that the analyzed period coincides with the existence of restrictions on short sales on shares in the Spanish financial market (from August 2011 to February 2012 and from July 2012 to January 2013).

However, for bad news we do not observe informed trading in options markets before the release of the earnings, consistent with the previous literature that shows a delay in the incorporation of negative information.

To conclude, our results are consistent with the idea that options provide alternative opportunities for trading on information beyond those provided by stock markets, and they facilitate the price discovery process for the underlying securities regardless of their liquidity.

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APPENDIX I

The table exhibits for the Spanish stock options market (period 2004-2012) and for every firm listed on SIBE the number of contracts (Put and Call) outstanding each year and between brackets the number of contracts that were traded at least one day.

COMPANY NAME (TICKER)	2004	2005	2006	2007	2008	2009	2010	2011	2012
ANTENA 3TV (A3TV)				310 (33)	988 (11)	2052 (15)	1356 (57)	2400 (51)	2553 (41)
ABERTIS (ABE)			336 (133)	310 (155)	878 (193)	1792 (266)	1654 (238)	4074 (227)	2406 (130)
ABENGOA (ABG)					830 (13)	1714 (151)	1146 (203)	1873 (75)	3623 (131)
ACESA (ACE)	559 (160)	456 (165)							
ACS (ACS)				300 (23)	688 (93)	1314 (230)	961 (185)	1756 (99)	2458 (206)
ACERINOX (ACX)	738 (240)	354 (125)	326 (193)	336 (132)	2360 (137)	3040 (263)	1526 (182)	1982 (172)	1733 (185)
ALTADIS (ALT)	468 (148)	322 (118)							
AMADEUS (AMS)	607 (226)	280 (45)						968 (3)	1706 (47)
ACCIONA (ANA)				282 (14)	1326 (75)	799 (168)	662 (170)	1912 (94)	3084 (160)
BBVA (BBVA)	592 (236)	660 (211)	924 (257)	818 (294)	3244 (387)	5728 (950)	5772 (1203)	2585 (848)	2437 (806)
BANKIA (BKIA)								1210 (0)	3422 (32)
BANKINTER (BKT)	474 (162)	334 (139)	330 (144)	458 (135)	830 (63)	3482 (259)	1289 (214)	2261 (115)	2907 (86)
BOLSAS Y MERCADOS ESP. (BME)				198 (1)	964 (65)	1438 (287)	1270 (267)	1723 (127)	2235 (238)
BANESTO (BTO)				246 (97)	653 (73)	1560 (33)	940 (39)	2461 (17)	2431 (8)
CAIXABANK (CABK)								2150 (8)	2567 (37)
DIA (DIA)									1988 (54)
EBRO FOODS (EBRO)								926 (2)	1688 (63)
ENDESA (ELE)	790 (244)	764 (208)	1534 (247)	1256 (66)	754 (9)	1720 (5)	838 (1)	1750 (2)	1626 (52)
ENAGAS (ENG)				212 (110)	816 (119)	1446 (245)	910 (199)	1556 (141)	1513 (153)
FADESA (FAD)				48 (0)					
FOMENTO DE CONST. Y CON. (FCC)				224 (19)	898 (84)	1649 (173)	1390 (203)	1844 (95)	2934 (153)
FERROVIAL (FER)							1210 (218)	1589 (77)	1648 (110)
GAMESA (GAM)	449 (127)	258 (87)		242 (11)	1040 (26)	1687 (145)	1422 (346)	2979 (157)	2399 (103)

COMPANY NAME (TICKER)	2004	2005	2006	2007	2008	2009	2010	2011	2012
GAS NATURAL (GAS)			274 (105)	410 (219)	2822 (201)	8578 (527)	1688 (252)	1671 (185)	1994 (265)
GRIFOLS (GRF)					678 (25)	1104 (151)	976 (207)	1600 (71)	2858 (150)
IAG (IAG)								1506 (0)	1310 (9)
IBERDROLA (IBE)	559 (194)	716 (153)	1130 (207)	2372 (289)	2632 (287)	3582 (559)	2068 (512)	2167 (384)	2895 (620)
INDRA (IDR)	465 (129)	484 (147)	298 (134)	380 (200)	704 (137)	1376 (256)	878 (211)	1856 (144)	2246 (174)
INDITEX (ITX)	537 (224)	384 (130)	452 (200)	396 (196)	944 (244)	1731 (442)	1891 (584)	3188 (420)	4743 (514)
MAPFRE (MAP)				268 (11)	698 (31)	1304 (154)	1096 (159)	1560 (78)	1650 (45)
ARCELORMITTAL (MTS)						1382 (86)	1044 (149)	2416 (179)	1734 (194)
METROVACESA (MVC)				68 (1)					
NH HOTELES (NHH)				222 (5)	1098 (0)	2400 (1)	1340 (9)	3324 (34)	1676 (6)
OBRASCÓN HUARTE (OHL)								1526 (3)	2014 (58)
BANCO POPULAR (POP)	447 (200)	512 (164)	436 (137)	334 (181)	2988 (211)	4769 (460)	2288 (507)	2369 (403)	4525 (279)
RED ELECTRICA (REE)				272 (142)	742 (145)	1268 (226)	1020 (232)	1870 (205)	1740 (195)
REPSOL (REP)	583 (245)	908 (223)	874 (241)	780 (240)	2890 (310)	4209 (675)	1908 (589)	1917 (557)	2690 (750)
BANCO SABADELL (SAB)				342 (170)	774 (150)	1860 (351)	1260 (209)	1654 (78)	2562 (40)
BANCO SANTANDER (SAN)	841 (302)	744 (264)	934 (280)	854 (286)	6085 (565)	5780 (1084)	2486 (1087)	2585 (1011)	2645 (1062)
SACYR VALLEHERMOSO (SCYR)				536 (60)	1228 (37)	1844 (4)	2028 (35)	3718 (42)	4163 (77)
SOGECABLE (SGC)	657 (225)	464 (183)							
TELEFONICA (TEF)	595 (265)	1098 (303)	898 (297)	1004 (367)	2357 (392)	3757 (914)	2065 (915)	1999 (910)	2225 (1016)
TELEFONICA MOVILES (TEM)	547 (151)	300 (80)							
MEDIASET (TL5)				214 (13)	943 (30)	1970 (231)	2152 (319)	3542 (149)	2444 (50)
TPI (TPI)	630 (172)	310 (102)							
TÉCNICAS REUNIDAS (TRE)								1406 (6)	1768 (102)
TERRA (TRR)	707 (135)	356 (22)							
UNION FENOSA (UNF)	501 (156)	332 (128)							