OPTION-EXPIRATION EFFECTS IN SMALL MARKETS: THE SPANISH STOCK EXCHANGE

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This study analyzes the effect of the expiration of the Ibex-35 Index derivatives, as well as the first four stock options traded in the Spanish Equity Derivatives Exchange, on the return, conditional volatility, and trading volume of the underlying assets. The analysis covers the period from the introduction of the various derivatives to December 1995. This period has been divided into two subperiods in order to determine if there are changes in the conclusions. The expiration of the Ibex-35 index derivatives is associated with an increase in the trading volume of the underlying asset, but it has no significant effect on either the underlying asset prices or on the level

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of volatility on the expiration day. However, the expiration of the stock options has significant impact on their underlying assets. We observed a downward pressure on prices and a reduction of volatility level in the week before the expiration date and a significant increase in trading volume on the expiration day. The absence of futures contracts on individual stocks, among other possible causes, may explain these differences. Jrl Fut Mark 21:905–928, 2001

INTRODUCTION

Since the introduction of derivative markets two decades ago, a great number of studies have been published regarding possible interactions between derivative markets and underlying markets. The primary focus has been on the effects of the introduction of derivatives (e.g., Edwards, 1988; Stoll & Whaley, 1987) on price discovery in futures and cash prices (e.g., Garbade & Silber, 1983; Witherspoon, 1993) and on the expiration day effects.

Evidence has been found of abnormal behavior in the underlying assets around the expiration date. This effect, known as the *expiration* effect, may be associated with increased volatility, volume, and price reversals in the underlying cash markets.

The aim of this study was to test for expiration effects in the Spanish market. Most previous studies have analyzed the expiration effect on major international markets. However, there is scarce evidence for this effect on small markets. Because these markets are less liquid and deep, it is possible that arbitrage can result in a greater impact on prices, volatility, and trading volume. Moreover, small markets may be especially susceptible to market manipulation. Finally, the evidence from the expiration effect on small markets may complete the international evidence about the expiration effect. For this purpose, we have studied the influence of the expiration of the option and the futures on the Ibex-35 on this index. Additionally, to complete the study, we have analyzed the possible changes in the behavior of four securities. These securities are the stocks with the first options that started to trade in 1993.

In this line, the article will present two studies. In the first, an analysis was made of the joint effect of the expiration of both derivatives, futures and option on the Ibex-35 index. This is an European option and cash settles it. In the second, the effect of the expiration day on four securities with options was studied. Although these options are American, a greater effect was expected for two main reasons: they were settled by delivery and there were no futures markets for these individual assets. This study argues that the existence of futures contracts permits the arbitrageurs to exploit the benefits that come from abnormal behavior (like the expiration effect). In this sense, the hypothesis of this study is that the presence of futures markets may make an incomplete market more complete, and thereby change the opportunity set available to investors, particularly in small markets.[1]

With this in mind, the paper is organized as follows: the next section discusses the theoretical background and previous empirical evidence on this subject. The section thereafter presents the variables, the database used and a brief description of the characteristics of the Spanish market, immediately followed by a section describing the methodology used and results found in the returns of the derivatives underlying assets. The section following shows results in the conditional volatility of the underlying assets. The next section comprises the analysis carried out to determine effects on the trading volume of the underlying assets on the expiration date. The article closed with a summary of the most important conclusions that can be drawn from the study.

THEORETICAL BACKGROUND AND EMPIRICAL EVIDENCE

Theoretical Background

The reasons that may explain the abnormal behavior in the underlying asset can be related to the information flow generated at the expiration date. This information flow may be a result of, among other things, arbitrage, speculative strategies, and manipulation activity.

Index arbitrage represents a trading activity that links the cash price of an index to the price of the futures or options contract on that index. If dividends paid on the component stocks and interest rates are nonstochastic, and markets are perfect and there are no taxes, then the pricing of stock-index futures follows a simple arbitrage scheme called the cost-of-carry model. It can be expressed as follows:

$$F_{t,T} = S_t \cdot e^{\delta(T-t)} - D_{t,T} \tag{1}$$

where t is the current date; T is the expiration date of the futures contract; S is the price of the underlying asset at time t; $\delta = \ln(1 + i)$, with i being the riskless interest rate; $D_{t,T}$ is the time T value of dividends paid

[1]We can assume that, in small markets, it is more difficult to create "perfect" synthetic futures by using options because the *market impact costs* are greater than in major markets.

on the component stocks between t and T.[2] A violation of eq. (1) serious enough to overcome the transaction costs signals program trading.

Stoll and Whaley (1987) suggested that the expiration effect can be attributed to arbitrageurs placing market-on-close orders to unwind their stock positions. If many arbitrage programs are being unwound in the same direction late on the expiration day, order imbalances in the component stocks can result in unusually large price swings.

The speculative strategies around the expiration date are the second possible reason. These strategies are due to the deviations from the theoretical price that potentially are exploitable (Klemkosky, 1978).

The third reason may be market manipulation. Jarrow (1994) demonstrated that the introduction of derivative markets was a necessary condition to make market manipulation possible. It is interesting to note that manipulation of underlying asset prices may be especially profitable near the option expiration. In this way, option writers may attempt to manipulate the price of the underlying asset near the expiration to prevent profitable exercise ("capping"), and those with substantial purchased positions can affect transactions to prevent a decline in the stock prices ("pegging") (see Pope & Yadav, 1992).

Empirical Evidence

The first studies about interactions between derivatives and their underlying markets began when option trading started in the United States in 1973. In 1974, the Nathan Report supplied the first analysis of this interaction. This study concluded that the option expiration did not have an impact on the underlying securities. These results were contradicted by Klemkosky (1978), who detected a negative return of about 1% in the week before the option expiration, but a 0.4% positive return in the following week. The conclusions offered by Cinar and Vu (Cinar & Vu, 1987; Vu & Cinar, 1988) were very similar. In their second study, they asserted that the downward pressure on stock prices was greater than on the index S&P100 returns. This situation was not so obvious in their first study, in which they had only studied six individual assets.

Recent studies analyzed jointly the return, the volatility, and the trading volume. Stoll and Whaley (1987, 1991) found an excess of volatility and trading volume of the underlying asset on the expiration date. Edwards (1988) presented similar results in relation to the expiration of

[2]A similar relation can be established for call and put index options.

futures contracts. Pope and Yadav (1992) detected the existence of an abnormal trading volume, although they did not find important differences in volatilities. Recently, Karolyi (1996) asserted that, although the expiration days were associated with higher-than-average trading volumes, the intra-day return volatility in the last hours of trading on expiration days and in the first hours following expiration was only marginally greater than that on non-expiration days. Moreover, he found that the differences between the number of portfolio-return reversals during the last hour of trading at expiration and those during the first hours of trading following the expiration were insignificant statistically and smaller in magnitude than transaction costs would warrant.

Other studies have examined the joint effect of the expiration of different derivative assets. This situation is known as the "witching hour." The conclusions of Chamberlain, Cheung, and Kwan (1989) and Chen and Williams (1994) differed regarding the effect of the "Triple witching hour" (expiration of index futures, index options, and index future options). Whereas the former detected the presence of abnormal returns, but no abnormal trading volumes, the latter obtained evidence only of the presence of abnormally high trading volumes.

In this study, two hypotheses are tested, the first being that the expiration effect on prices, volatility, and trading volume is greater in smaller markets than in major markets. Because the former are less liquid and deep, they may be especially susceptible to market manipulation, and hence, arbitrage can produce a greater impact on prices, volatility, and trading volume. The second hypothesis is that the existence of futures markets reduces the effect of the options expiration date on their underlying assets. Hence, the presence of futures markets may make an incomplete market more complete, and thereby change the opportunity set available to investors, particularly in small markets. Although by using options we conceivably could create synthetic futures (selling/buying futures call and buying/selling futures put), in practice markets, imperfections—direct transaction costs, unequal borrowing and lending rates, margins and restrictions on short selling, etc.—must be considered. In particular, the *market impact costs* of trading (bid–ask spreads in the options markets, commissions to buy and sell the options) are higher in small markets, so synthetic futures are less "perfect" than in major international markets. Moreover, the existence of both options on futures and futures allows the agents to construct several synthetic instruments (futures, calls, puts, interest rates, etc.) that, as was mentioned before, may make an incomplete market more complete, particularly in small markets. This increase in the opportunity set available to investors and arbitrageurs may reduce the probability of order imbalances in the component stocks.[3]

DATABASE

Equity-derivatives trading in Spain began in January 1992. The first two contracts traded were options and futures on the Ibex-35 index. This index is a capitalization-weighted index comprising the 35 most-liquid Spanish stocks traded in the continuous market. The trades are cleared through Mercado Español de Futuros Financieros (MEFF) RV, which is the official Spanish market for futures and options for equity derivatives. MEFF RV is an integrated and self-regulated exchange and clearing house, under the supervision of the Comisión Nacional del Mercado de Valores (CNMV) (an agency under the Ministry of Economy).

The option on the Ibex-35 index is European. Thus, it only can be exercised on the expiration date, that is the third Friday of each month. The last trading day is the expiration day, and the trading calendar comprises the three nearest consecutive months and the other three months of the March–June–September–December quarterly cycle. The expiration date for futures contracts is the same as for options. This contract is very liquid.[4] Since 1997, the underlying asset of the option contract has been the Ibex-35 futures contract. The settlement of contracts at expiration is a cash settlement on the next business day after the expiration date. During the period under analysis, a screen-based system was used for trading the Ibex-35 futures and futures time-spreads, whereas a telephone-based system was used for trading Ibex-35 options. Now, a screen-based system is used for trading both contracts.

In 1993, MEFF RV started trading options on stocks. Four stock-option contracts were offered to investors (Endesa, Telefónica, Banco Bilbao-Vizcaya [BBV], and Repsol). Today, eighteen options on stocks are traded. Stock options are American, so they may be exercised on any business day before, and including, the expiration date. The expiration date coincides with that of the index options and futures.[5] The settle-

[3]The existence of futures allows the arbitrageurs to hedge a position either by buying/selling the underlying asset, or, in this case, buying/selling the futures. The non-existence of futures contracts on individual assets forces the arbitrageurs and investors to trade with the underlying asset if they unwind their positions on the expiration day.

[4]As an example, the number of index futures on index traded from January to April in 1998 are 2,800,000 MEFF (Madrid), 2,200,000 DTB (Frankfurt), 2,100,000 MONEP (Paris), and 1,400,000 LIFFE (London).

[5]Since March 1995, the trading calendar comprises only the three months of the March–June–September–December quarterly cycle.

ment of contracts is by delivery. The stock transaction takes place on the first business day after the exercise date. The screen-based system is used for trading the options on stocks.

The empirical work examined the joint expiration effect of futures and options on the Ibex-35 in the period January 1992 through December 1995, and the expiration effect of the options on the four stocks in the period February/May 1993 (depending on the date of introduction of the options) through December 1995. MEFF RV and Sociedad de Bolsas supplied the database used.[6]

The database is composed of a logarithm of the ratio of the daily prices, $R_t = \ln(P_t/P_{t-1})$ and of logarithms of the trading volume. The use of the logarithm is aimed at stabilizing the variance of the volume due to the fact that this is nonnegative and it tends to be more volatile at higher levels and less volatile at lower levels (Tauchen, Zhang, & Liu, 1996).

In order to account for the possible presence of daily seasonality, dummy variables that identify weekdays were created. The variables D_M, D_{TU}, D_W, D_{TH}, and D_F have the value 1 for Monday, Tuesday, Wednesday, Thursday and Friday, respectively, and 0 otherwise. Three additional dummy variables also were created to measure the expiration effect: $D_1 = 1$ if this day is a day of contract expiration and 0 otherwise, $D_2 = 1$ on expiration day and on the day before, and $D_5 = 1$ on expiration day and on the previous four days of market trading. Whereas these definitions may be somewhat arbitrary, the idea behind D_2 and D_5 was to pick up the possible changes that happen before the contract's expiration date.

EFFECTS ON THE RETURNS OF THE UNDERLYING ASSETS

Results from Regression Models

This section tests for expiration effect on conditional returns. The regression model includes an intercept, one expiration dummy variable $D_{\exp}(=D_1$ or D_2 or $D_5)$ and,[7] to correct for autocorrelation, the lag of the dependent variable,[8] i.e.:

$$R_t = \alpha + \beta_1 D_{\exp} + \beta_2 R_{t-1} + u_t \tag{2}$$

[6]We are very grateful to Jorge Yzaguirre (Sociedad de Bolsas) and Manolo Andrade, Arturo Piñera, and Remedios Romeo (MEFF RV), for supplying the database and for helpful comments.

[7]First, we included the dummies D_M, D_{TU}, D_W, D_{TH}, and D_F in a previous model. Nevertheless, our results showed that we cannot reject the null of absence of daily seasonality. (For the entire period $\chi^2_4 = 7.84$, Critical value $= 9.59$ at the 5% significance level.)

[8]In a previous OLS estimation of the model: $R_t = a + \beta_1 D_{\exp} + u_t$, the Ljung-Box test suggested that the residuals were autocorrelated. Results obtained from this estimation are available upon request.

Thus, three different estimations of this model were run, one for each of the D_{exp} dummy variables described before (D_1, D_2, and D_5). In this specification, the coefficient β_1 (using the dummy D_1) measures the additional return attributable to the expiration date.

In addition, since evidence of conditional volatility (using the Engle test for ARCH effects) was detected, the estimation procedure uses conditional volatility models.[9] The first model used is the GARCH(1,1) model, proposed by Bollerslev (1986).[10] The conditional variance in a GARCH(1,1) is:[11]

$$\sigma_t^2 = \alpha_0 + \alpha_1 u_{t-1}^2 + \alpha_2 \sigma_{t-1}^2 \tag{3}$$

where u_t follows: $N(0, \sigma_t^2)$.

Additionally, to allow lagged shocks to have an asymmetric effect on conditional volatility, the GJR model (Glosten, Jagannathan, & Runkle, 1993) was estimated, which may be a better approximation than the better known EGARCH,[12] since it is less sensitive to the presence of the outliers (Engle & Ng, 1993).

The variance with the GJR[13] model is the following:

$$\sigma_t^2 = \alpha_0 + \alpha_1 \sigma_{t-1}^2 + \alpha_2 \cdot u_{t-1}^2 + \alpha_3 \cdot S_{t-1}^- u_{t-1}^2 \tag{4}$$

where u_t follows a $N(0, \sigma_t^2)$ and where S_t^- is 1 when $u_t < 0$, and S_t^- is 0 when $u_t \geq 0$.

The first part of Table I shows estimations of the coefficients related to the three D_{exp} dummy variables using the GJR model. This specification has been selected based on the likelihood ratio test for nested models. Results from estimations of the Ibex-35 using the GJR model indicated that there were no effect at expiration. D_1 and D_2 are negative,

[9]We have used the Levene statistic to test for homoskedasticity across the days of the week. If this test detected that the variance was different across the days, it would have been necessary to include dummy variables representing the days of the week in the conditional volatility models. However, results obtained from the test allowed us to accept the hypothesis of the equality of variances across the days of the week ($F(4, \infty) = 1.97$, Critical value = 2.37 at the 5% significance level). Therefore, it is not necessary to include daily seasonality effects on the conditional variance.

[10]The GARCH(1,1) model specification has proven to be an adequate representation for most financial time series, as Lamoreux and Lastrapes (1990a) argued.

[11]In this section, we did not take into account the possibility of "the expiration" effect on the volatility because we discuss this topic specifically in the next section.

[12]Results from the EGARCH model are not very different from those obtained with the GJR model.

[13]It should be noted that we have used different orders in the model as $p = 1, 2, 3$ and $q = 1, 2, 3$. The likelihood ratio test employed denotes that $p = 1$ and $q = 1$ is a good fit of data.

TABLE I
Results from Estimations of the Ibex-35

	1992–1995		*1992–1993*		*1994–1995*	
	(1)	*(2)*	*(1)*	*(2)*	*(1)*	*(2)*
β_1^1	−0.67	−0.48	1.00	3.02	−2.98	−0.37
t	(−0.43)	(−0.31)	(0.52)	(1.47)	(−1.06)	(−1.53)
β_1^2	−0.30	−0.43	1.55	2.37	−2.99	−3.19*
t	(−0.25)	(−0.39)	(0.95)	(1.60)	(−1.56)	(−2.00)
β_1^5	0.43	0.18	1.77	1.77	−1.07	−1.25
t	(0.56)	(0.23)	(1.63)	(1.72)	(−0.94)	(−1.12)

Coefficients are multiplied by 10^3. (1) Results from a GJR model. (2) Results from TLS technique with α = 5%. Figures in parentheses are t-statistics. *Significant at 5% level.

Mean Equation: $R_t = \alpha + \beta_1 D_{\mathrm{exp}} + \beta_2 R_{t-1} + u_t$ where u_t follows a $N(0, \sigma_t^2)$; β_1^1 is the coefficient associated with $D_{\mathrm{exp}} = D_1$; β_1^2 is the coefficient associated with $D_{\mathrm{exp}} = D_2$; β_1^5 is the coefficient associated with $D_{\mathrm{exp}} = D_5$.

GJR model: $\sigma_t^2 = \alpha_0 + \alpha_1 u_{t-1}^2 + \alpha_2 S_{t-1}^- u_{t-1}^2 + \alpha_3 \sigma_{t-1}^2$.

but they do not appear significant in any case. In short, evidence has been found of abnormal returns on the expiration date for the spot index.

Because of the effects that outliers could have (and their implications for the rejection of normality) on the results obtained, an estimate based on Trimmed Least Squares (TLS)[14] has been made, so this procedure is used to evaluate the robustness of the results obtained from the previous method.

The new values also are displayed in Table I. As a rule, these results validate those obtained through the previous specification. This fact reduces the choice problems related to the conditional-volatility processes because it can be observed that conclusions are robust to any prior assumptions.[15]

The period analyzed has the unusual feature of including the start of options trading in Spain, which casts doubts as to the applicability of the results to the entire period. Reasons linked to the lack of initial liquidity, as well as to the lack of experience of the traders, justify testing for behavioral differences throughout the sample period. For these purposes, the entire period for the Ibex-35 has been divided into two subsamples. One covers the January 1992–December 1993 period, and the other covers the years 1994 and 1995.

[14]Under trimmed least squares regression, given the trimming proportion (α), the most extreme observations are identified and omitted, then OLS regression is applied to the remaining sample to obtain the coefficient estimators.

[15]Although we have shown the results from the GJR model, results from the GARCH model are very similar.

The results from Table I make it clear that the two subperiods exhibited a similar behavior. The market did not present a significant effect (at conventional significance levels) on dummy variables representing the expiration effect (D_1, D_2, and D_5), when estimations based on models of conditional heteroscedasticity were analyzed.[16]

Next, the effect of expiration in the first four securities with options on the Spanish Equity Derivatives Exchange was studied. Because there were no futures contracts on these individual securities, the main interest was in analyzing the difference between the behavior of the Ibex-35 and the stocks. Obviously, care was taken with the results obtained because there was no comparison to the same kind of assets.[17] However, useful information was able to be obtained about the effect of the trading of derivatives on the underlying assets in small markets. Therefore, the same procedure of estimation and testing was followed. Table II reports results for the four stocks analyzed. Estimations were made of the coefficients of dummy variables under a GARCH(1,1) model, a GJR model (although only the model chosen by the LRT is shown), and the TLS technique. In general, from 1993 to 1995, negative returns were observed, although the effect was only significant in the case of Endesa. It also was considered that, during the first year, the stocks behavior pattern could be affected by "anomalies" caused by a lack of knowledge of the option market on stocks.[18] Therefore, the period was divided into two subperiods: 1993 and 1994–1995. Results for these subperiods also are shown in Table II. In the first year, coefficients were not significant and no differences could be observed in the different estimations. However, some coefficients associated with the week before expiration became significant and less than zero in 1994–1995.

Results obtained in the second subperiod in the stocks could support the argument that predicts pressures on the sales in the underlying market when the expiration date arrives as a result of ordering positions (see Cinar & Vu, 1987; Klemkosky, 1978; Pope & Yadav, 1992; Swidler, Schwartz, & Kristiansen, 1994; Vu & Cinar, 1988;). Three main causes can explain the differences between the results we have obtained for the Ibex-35 index and for the individual stocks. The first is related to the existence of futures on the Ibex-35 index (there are no futures on individual stocks), because futures is the cheapest way for arbitrageurs to

[16]Nevertheless, the elimination of 5% of the outliers seems to provide some indication of the possible presence of this effect in the period 1994–1995.
[17]The first one (Ibex-35 option) is an index option and the others are options on stocks. The index option is European and the others are American options. They also have different settlement systems.
[18]A preliminary year-by-year analysis of the means confirms our suspicions.

TABLE II

Results from Estimations of the Individual Stocks

		1993–1995				1993				1994–1995			
		(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
(a)	β_1^1	−4.87*	0.20	−1.15	−2.14	−0.30	3.16	6.45	−0.15	−6.89*	−0.70	−3.87	−2.61
	t	(−2.04)	(0.08)	(−0.51)	(−0.75)	(−0.07)	(0.72)	(1.80)	(−0.02)	(−2.39)	(−0.20)	(−1.35)	(−1.06)
	β_1^2	−1.53	−0.37	−2.25	−2.69	1.75	0.87	3.51	−0.85	−3.10	−0.80	−3.38	−3.00
	t	(−0.89)	(−0.20)	(−1.36)	(−1.31)	(0.60)	(0.26)	(1.31)	(−0.01)	(−1.43)	(−0.35)	(−1.97)	(−1.67)
	β_1^5	−1.00	0.20	−0.59	−2.24	−1.47	1.76	1.66	−1.48	−0.83	−0.65	−1.25	−2.56*
	t	(−0.85)	(0.17)	(−0.93)	(−1.69)	(−0.77)	(0.92)	(0.74)	(−0.47)	(−0.58)	(−0.43)	(−0.98)	(−2.06)
(b)	β_1^1	−6.44*	−0.49	−1.97	−2.29	0.09	1.70	5.36	−0.29	−8.38*	−1.33	−3.85	−3.28
	t	(−2.73)	(−0.21)	(−0.94)	(−0.98)	(0.02)	(0.49)	(1.27)	(−0.06)	(−2.83)	(−0.46)	(−1.63)	(−1.26)
	β_1^2	−2.79	−1.01	−2.61	−2.42	1.89	−0.10	1.49	−0.44	−4.26*	−1.39	−3.90*	−3.35
	t	(−1.63)	(−0.61)	(−1.73)	(−1.43)	(0.66)	(−0.04)	(0.48)	(−0.12)	(−1.99)	(−0.67)	(−2.29)	(−1.77)
	β_1^5	−0.76	0.14	−1.11	−2.16	0.28	1.71	0.55	−0.61	−1.12	−0.36	−1.52	−2.70*
	t	(−0.64)	(0.13)	(−1.07)	(−1.88)	(0.14)	(0.96)	(0.25)	(−0.25)	(−0.75)	(−0.24)	(−1.31)	(−2.09)

Coefficients are multiplied by 10^3. (1) Endesa; (2) Telefónica; (3) BBV; (4) Repsol. (a) Results from a GARCH(1,1) model or a GJR model depending on the LRT. (b) Results from TLS technique with $\alpha = 5\%$. Figures in parentheses are t-statistics. *Significant at 5% level.

Mean Equation: $R_t = \alpha + \beta_1 D_{exp} + \beta_2 R_{t-1} + u_t$ where u_t follows a $N(0, \sigma_t^2)$; β_1^1 is the coefficient associated with $D_{exp} = D_1$; β_1^2 is the coefficient associated with $D_{exp} = D_2$; β_1^5 is the coefficient associated with $D_{exp} = D_5$.

GARCH(1,1) model: $\sigma_t^2 = \alpha_0 + \alpha_1 u_{t-1}^2 + \alpha_2 \sigma_{t-1}^2$.

GJR model: $\sigma_t^2 = \alpha_0 + \alpha_1 u_{t-1}^2 + \alpha_2 S_{t-1}^- u_{t-1}^2 + \alpha_3 \sigma_{t-1}^2$.

hedge. The second may be due to reasons associated with the different characteristics of the options analyzed (kind of options and settlement system). The third may be the joint effect of the expiration of its own option and the indirect effect of the expiration of the Ibex-35 index. It is interesting to note that the four securities analyzed have the greatest weight on the Ibex-35 index (Endesa, 13.25%; Telefonica, 13.11%; Repsol, 9.73%; and BBV, 6.41%), so they are the main candidates for arbitrage program trading; if not all of the stocks in the index are bought or sold, tracking risk may arise.

Robustness Test: Portfolio Return Reversal

In the previous section, we analyzed the price effect by using the regression approach to test for the presence of abnormal returns during the week before expiration, two days before the expiration, and at the expiration date. Nevertheless, following Stoll and Whaley (1987), most studies used price reversals to identify the impact of derivatives expiration on cash-market returns. If the price change on the expiration day is abnormal, the price should return to its equilibrium level on the following day. If the price does not return to its normal level by the market close, it is assumed that the initial price change is the result of new information, and not because of arbitrage activity or market manipulation. To apply a robustness check, the magnitude of the price reversal at the opening of the Ibex-35 spot index and in the four assets analyzed was examined.

The reversal REV_t is calculated as follows:[19]

$$\begin{aligned} \mathrm{REV}_t = {} & \mathrm{R}_{\mathrm{co},t} \quad \text{if } R_{\mathrm{c},t-1} \pm 0 \quad \text{or} \\ & -R_{\mathrm{co},t} \quad \text{if } R_{\mathrm{c},t-1} > 0 \end{aligned} \tag{5}$$

where

$$R_{\mathrm{c},t-1} = (I_{\mathrm{close},t-1} - I_{\mathrm{open},t-1})/I_{\mathrm{open},t-1} \tag{6}$$

$$R_{\mathrm{co},t} = (I_{\mathrm{open},t} - I_{\mathrm{close},t-1})/I_{\mathrm{close},t-1} \tag{7}$$

Following Karolyi (1996), the bootstrap technique was used to construct the control group. In the non-expiration days over the period analyzed, equal-sized groups of control days for the expiration days with 1000 replications was repeatedly sampled. These control groups also

[19]Stoll and Whaley (1987) calculated price reversals using intra-day data from the last hour of the expiration date and the first half-hour of the following day. We have tried to approximate this measurement by using opening and closing prices for the index and the four assets analyzed.

TABLE III
Results from Return Reversals for the Ibex-35 and for the Four Stocks Analyzed

	1992–1995		*1992–1993*		*1994–1995*	
	Mean t-Value	*Simulated p-Value*	*Mean t-Value*	*Simulated p-Value*	*Mean t-Value*	*Simulated p-Value*
Ibex-35 Index	−0.44	0.721	−0.55	0.804	−0.56	0.770
Endesa	0.52	0.237	0.57	0.235	0.19	0.398
Telefónica	−0.34	0.705	−0.12	0.587	−0.39	0.730
BBV	0.19	0.377	0.17	0.428	0.09	0.445
Repsol	0.95	0.109	0.84	0.114	0.56	0.221

Mean *t*-value is the average of the simulated *t*-statistics for the difference between the mean reversal on expiration days and that of equal-sized random subsamples of non-expiration days matched by day of the week. Simulated *p*-values count the frequency of expiration days reversals that are less or equal to those for the random subsamples of non-expiration days.

were matched by the day of the week (see Karolyi, 1996, for further details).

In addition, the differences were assessed between expiration and non-expiration by computing two-tailed *t*-statistics relative to each of the random draws of non-expiration days. Table III reports the average of these simulated *t*-statistics (mean *t*-value), and counts the fraction of these statistics that is less or equal to the critical value of zero (simulated *p*-value). This procedure was applied for the Ibex-35 spot index and for the four assets analyzed. The entire period was divided into two subperiods, as in the previous section.

The results for the entire period and for the two subperiods indicated no price reversal in the Ibex-35 index. Similarly, the evidence for the four assets also suggested no price reversal in these assets. Although the sign of REV_t was positive for the three assets analyzed (BBV, Endesa, and Repsol), it was not significant at the 5% significance level.

In summary, there was no evidence of price reversal (between the expiration day and the following day) in any of the assets analyzed. However, it is important to emphasize that, with this analysis, the effect at the expiration date was studied, so the previous conclusion about effects in the week before expiration holds.

EFFECTS ON THE CONDITIONAL VARIANCE OF THE UNDERLYING ASSETS

A considerable number of studies in financial economics regard the volatility and the trading volume as a typical measurement of the variability in information flows. Thus, the impact of the information at expiration may appear in the variance or in the trading volume, but not in the returns. This section contains an analysis of the effects of the derivatives expiration on the conditional variance of the underlying assets.

Standard methodology considers the hypothesis that the expiration of derivatives raises the volatility of the underlying market because there is an increase in the flow of information. Significantly higher return volatility on the expiration date may be associated with the unwinding of short arbitrage positions and order imbalance. However, this is not the only explanation of volatility, because some authors associate movements in volatility with hedging strategies. Grossman (1988) examined the implications of program trading for stock and futures price volatility. He argued that synthesized securities, as used in portfolio insurance strategies, represented unrevealed trading plans, and therefore unrevealed information, which, if disclosed, could have some effect in reducing volatility. In contrast, Gennotte and Leland (1990) argued that hedging programs, such as portfolio insurance, generally were believed to make the stock market more volatile. They suggested that unobserved hedging strategies could destabilize a market, leading to greater volatility.

Given the previous evidence in favor of ARCH effects on the variance, the expiration effect on conditional volatility has been analyzed. Following the approach of the fourth section, two of these models were used for the purpose of this study, the GARCH and the GJR.[20]

Antoniou and Holmes (1995) analyzed the effect of the introduction of derivatives on the conditional volatility by including a dummy variable in the model chosen. As stated earlier, the dummy variable in the models of this study represents the expiration day or some of the days before expiration. The equation of the mean used to obtain the residuals is the following:[21]

$$R_t = a + \beta \cdot R_{t-1} + u_t$$

where u_t follows a $N(0, \sigma_t^2)$.

When a GARCH(1,1) model was estimated:

[20]As in previous tables, we have shown only the model selected by the LRT.

[21]Because we have not found clear evidence of effects on the mean of the Ibex-35 returns, we avoided introducing the expiration dummy variable in the equation of the mean. Nevertheless, we have introduced the dummy D_1 in the equation of the mean of Endesa (periods 1993–1995 and 1994–1995), D_2 in BBV (period 1994–1995), and D_5 in Repsol (period 1994–1995).

TABLE IV
Estimation of Conditional Volatility of the Ibex-35 Index Using GJR Model

	1992–1995			*1992–1993*			*1994–1995*		
	D_1	D_2	D_5	D_1	D_2	D_5	D_1	D_2	D_5
α_0	0.09*	0.10*	0.09*	0.13*	0.12*	0.12*	0.02	0.04	0.06*
t	(2.92)	(3.02)	(3.13)	(2.65)	(2.57)	(2.61)	(0.79)	(1.15)	(2.13)
α_1	0.02	0.03	0.03	0.05	0.05	0.04	0.01	0.03	0.08
t	(1.51)	(1.60)	(1.60)	(1.50)	(1.52)	(1.18)	(0.04)	(0.21)	(0.46)
α_2	0.82*	0.80*	0.83*	0.74*	0.76*	0.77*	0.92*	0.91*	0.89*
t	(16.75)	(15.25)	(18.32)	(9.45)	(10.22)	(10.42)	(24.51)	(20.53)	(19.05)
α_3	0.10*	0.11*	0.10*	0.12*	0.11*	0.12*	0.07*	0.07	0.09*
t	(3.13)	(3.07)	(3.03)	(1.97)	(1.96)	(1.99)	(2.01)	(1.92)	(2.16)
α_4^1	0.20			0.27			0.27		
t	(1.31)			(0.97)			(1.33)		
α_4^2		0.05			0.04			0.04	
t		(0.67)			(0.39)			(0.41)	
α_4^5			−0.01			0.02			−0.04
t			(−0.41)			(0.46)			(−0.84)

Coefficients α_0 and α_4 are multiplied by 10^4. α_1 in 1994–1995 is multiplied by 10. α_4^1 is the coefficient associated with $D_{exp} = D_1$; α_4^2 is the coefficient associated with $D_{exp} = D_2$; α_4^5 is the coefficient associated with $D_{exp} = D_5$. Figures in parentheses are t-statistics. *Significant at 5% level.

Mean Equation: $R_t = \alpha + \beta_1 D_{exp} + \beta_2 R_{t-1} + u_t$ where u_t follows a $N(0, \sigma_t^2)$.

GJR model: $\sigma_t^2 = \alpha_0 + \alpha_1 u_{t-1}^2 + \alpha_2 S_{t-1}^- u_{t-1}^2 + \alpha_3 \sigma_{t-1}^2 + \alpha_4 D_{exp}$.

$$\sigma_t^2 = \alpha_0 + \alpha_1 u_{t-1}^2 + \alpha_2 \sigma_{t-1}^2 + \alpha_3 D_{exp} \tag{8}$$

The GJR model, when the expiration dummy is introduced, is:

$$\sigma_t^2 = \alpha_0 + \alpha_1 \sigma_{t-1}^2 + \alpha_2 \cdot u_{t-1}^2 + \alpha_3 \cdot S_{t-1}^- u_{t-1}^2 + \alpha_4 D_{exp} \tag{9}$$

where S_t^- is 1 when $u_t < 0$, S_t^- is 0 when $u_t \geq 0$ and D_{exp} collects the three specifications created.

Results obtained for the conditional variance of the Ibex-35 index are reported in Table IV for the entire period using, as before, the GJR model and the D_{exp} dummy variables (D_1, D_2, and D_5). The results reject the existence of the expiration effect on the conditional volatility because the dummy variables are not significant at usual significance levels.[22]

To study the time stability of results presented here, the whole period was divided into the two subperiods and the analysis repeated. Results contained in Table IV show that the volatility in the expiration

[22]The choice of the variance model does not change the results, so they seem to be quite robust.

date is similar to that in non-expiration dates; this occurs in both of the subperiods analyzed.

Results for the stocks are shown in Table V. In order to save space, only the coefficient of the dummy variable at expiration of GARCH(1,1) or GJR models, depending on the LRT, and for the different samples taken is reported.[23] Empirical evidence suggests that the choice of sample period is very important because the behavior in the first year of trading is different from the following years. While, in 1993, only one stock presented a decrease in the conditional volatility on the expiration day (D_1) and on the day before (D_2), in 1994–1995, results across three stocks indicated that five days before expiration (D_5) the volatility decreased significantly. Consequently, this indicated a decrease in uncertainty as the expiration date drew near.[24]

Different patterns of behavior of conditional volatility on the Ibex-35 index and on the stocks on the expiration date have been detected. Characteristics of the options on stocks, for example, the fact that they can be exercised before the day of expiration, together with the same reasons as we have offered in the analysis of the returns, might be the cause of these results.

EFFECTS ON THE TRADING VOLUME OF THE UNDERLYING ASSETS

The flow of information in the markets usually is measured using both the volatility and trading volume. These magnitudes have a positive correlation with the level of information that reaches the market (Karpoff, 1987). Lamoreux and Lastrapes (1990b) introduced the trading volume directly into the GARCH variance equation. Observing its significance, they argued that volatility and volume could be generated by the same factors.

Nevertheless, Andersen (1996) asserted that the impact of information flow on the return volatility and on the trading volume depended on how the new information arrived and on the process by which this information was incorporated into the market. He pointed out two cases: 1) macroeconomic news, and 2) the process linked with the "Triple witching hour." In these situations, trading volume pointed towards a higher information flow that disappeared quickly; yet results obtained from price change series did not show any appreciable changes in returns.

[23]Initial comparisons between the two models did not reveal important differences.

[24]It is important to note that these results are obtained with daily data. If intra-day data were used, additional results about hourly effects could be discovered on the expiration day. However, the aim of this study is focused on global daily effects.

TABLE V

Estimation of Conditional Volatility of the Individual Stocks

	1993–1995				1993				1994–1995			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
α_3^1	−0.41	−0.53*	0.30	−0.59*	−0.44	−0.66*	0.82	−0.75	−0.79*	−0.30	0.20	−0.49*
t	(−1.54)	(−3.13)	(1.51)	(−2.37)	(−0.77)	(−2.80)	(0.95)	(−0.85)	(−2.66)	(−0.86)	(0.96)	(−2.12)
α_3^2	−0.14	−0.32*	0.15	−0.50*	−0.08	−0.34	0.19	−0.10*	−0.39*	−0.24	0.14	−0.29*
t	(−0.94)	(−3.69)	(1.41)	(−3.28)	(−0.22)	(−1.49)	(0.51)	(−1.98)	(−2.26)	(−1.27)	(1.22)	(−2.19)
α_3^5	−0.08	−0.17*	−0.03	−0.31*	0.13	0.04	−0.12	−0.91	−0.25*	−0.22*	−0.05	−0.24*
t	(−1.14)	(−3.87)	(−0.78)	(−4.57)	(0.57)	(0.25)	(−0.51)	(−1.95)	(−2.97)	(−2.52)	(−1.02)	(−3.36)

GARCH(1,1) or GJR. Coefficient α_3 is multiplied by 10^4. (1) Endesa; (2) Telefónica; (3) BBV; (4) Repsol. α_3^1 is the coefficient associated with $D_{exp} = D_1$; α_3^2 is the coefficient associated with $D_{exp} = D_2$; α_3^5 is the coefficient associated with $D_{exp} = D_5$. Figures in parentheses are t-statistics. *Significant at 5% level.

Mean Equation: $R_t = \alpha + \beta_1 D_{exp} + \beta_2 R_{t-1} + u_t$ where u_t follows a $N(0, \sigma_t^2)$.

GARCH(1,1) model: $\sigma_t^2 = \alpha_0 + \alpha_1 u_{t-1}^2 + \alpha_2 \sigma_{t-1}^2 + \alpha_3 D_{exp}$.

GJR model: $\sigma_t^2 = \alpha_0 + \alpha_1 u_{t-1}^2 + \alpha_2 S_{t-1}^- u_{t-1}^2 + \alpha_3 \sigma_{t-1}^2 + \alpha_4 D_{exp}$.

Therefore, volatility and volume of trading are not coincidental measurements of information flow. Volatility is linked more closely with the uncertainty that goes with the information. Volume, on the other hand, provides information about the sum total of transactions traded in the market, although it also is associated with the degree of disagreement between traders about the interpretation of the information. The different meaning of both variables provides further justification for studying the trading volume, although some evidence has been found on the returns and on the volatility.

The same regression methodology used for the returns has been proposed to study the effects on the volume. For this purpose, the logarithm of volume is taken (as was mentioned earlier). The first issue to consider is whether the volume series are stationary around an intercept or around a deterministic trend. Andersen (1996) proposed to detrend the volume data by extracting a time trend when it exists and not ignore the fact that trading-volume data typically have a strong trend component. The studies by Campbell, Grossman, and Wang (1993) and Gallant, Rossi, and Tauchen (1992) contain similar lines of argument.

To determine the stationary aspect of the logarithm of volume series, the augmented Dickey–Fuller test (Said & Dickey, 1984) was used. Results obtained for the Ibex-35 are the following: −2.46 for the test without trend and −3.51 for the test with trend. Because the critical values at 5% level of significance are −2.86 (without trend) and −3.41 (with trend), it can be asserted that the trading volume series is stationary around a deterministic trend. Results obtained for the individual stocks were in the interval (−3.47 to −4.51) without trend and in the interval (−3.77 to −4.94) with trend. In this case, the trading volume of stocks always appeared stationary without trend. Therefore, to test the expiration effect a trend variable will be added in the equation of the Ibex-35 index; this will be removed when individual securities are analyzed.

Trading volume was purged of the seasonal effects of the day of the week by introducing five dummy variables representing each day. The dummy variables indicating the expiration day or the previous days (D_2 and D_5) were also included. Moreover, taking into account the partial autocorrelation function, five lagged dependent variables were added. The model used is the following:

$$V_t = \beta_1 D_M + \beta_2 D_{TU} + \beta_3 D_W + \beta_4 D_{TH} + \beta_5 D_F + \beta_6 D_{\exp} + \sum_{j=1}^{5} \beta_{j+6} V_{t-j} + (\beta_{12} T) + u_t \qquad (10)$$

TABLE VI

(1) Results from Estimation of the Trading Volume of the Ibex-35 Index Using White's Matrix; (2) Results from TLS Estimation with $\alpha = 5\%$

	1992–1995		*1992–1993*		*1994–1995*	
	(1)	*(2)*	*(1)*	*(2)*	*(1)*	*(2)*
β_6^1	0.19*	0.21*	0.23*	0.26*	0.15*	0.15*
t	(3.91)	(4.17)	(2.79)	(3.73)	(2.81)	(2.19)
β_6^2	0.09*	0.08*	0.11*	0.12*	0.06	0.04
t	(2.57)	(2.42)	(2.02)	(2.47)	(1.48)	(0.99)
β_6^5	0.06*	0.06*	0.08*	0.08*	0.02	0.02
t	(2.68)	(2.64)	(2.44)	(2.73)	(0.81)	(0.67)

β_6^1 is the coefficient associated with $D_{exp} = D_1$; β_6^2 is the coefficient associated with $D_{exp} = D_2$; β_6^5 is the coefficient associated with $D_{exp} = D_5$. Figures in parentheses are t-statistics. *Significant at 5% level.

Model: $V_t = \beta_1 D_M + \beta_2 D_{TU} + \beta_3 D_W + \beta_4 D_{TH} + \beta_5 D_F + \beta_6 D_{exp} + \Sigma_{j=1}^{5} \beta_{j+6} V_{t-j} + \beta_{12} T + u_t$.

Note: L-B(5) tests are between (0.14–3.17).
Breusch-Pagan tests are between (16.42–39.02).
Engle tests are between (0–3.47).
Glesjer tests are between (23.13–33.85).

where V_t is the logarithm of the trading volume and T is the deterministic trend; the parentheses indicate that it is used for the Ibex-35, but not for the stocks.

A first OLS estimation of the trading volume of the Ibex-35 detects the presence of heteroskedasticity in the series (as shown in the footnote in Table VI), although, in this case, the Engle test is not significant. Thus, ARCH effects are not present. Therefore, the estimation was calculated using the consistent-covariance-matrix estimation proposed by White (1980).

Table VI shows values of coefficients of the expiration dummy for both the whole period and the two subperiods. The most important conclusion that can be drawn is that there is a significant increase in the trading volume on the expiration day in the three sample periods analyzed.

Comparing average trading on the expiration day with trading on other days, it has been found that, on the expiration day in the entire period, the Ibex-35 is traded 27% more than on other days. In the first subperiod, the increase is approximately 34%, and in the second subperiod, the increase is 22%. The results are interesting because they contribute empirically to the theoretical argument presented at the start of this section. Thus, the hypothesis that the expiration effect is caused by the action of arbitrageurs who unwind their hedging positions when the expiration arrives, increasing the trading volume, can be accepted. In the

Ibex-35 index, these movements have not provoked important changes in prices or in the uncertainty in the market.

The days before the expiration (before day D_2 and the week of the expiration D_5) show the presence of an abnormally high volume in both the whole sample and the first period, but not in the second period. This corroborates the differences between subperiods. It also verifies that, in the second period, the effect on trading volume is detected only at the expiration day. These conclusions remain the same when a regression was run removing the possible influence of the outliers on these results (Table VI), thus validating the previous conclusions.

Table VII provides results regarding the individual stocks. In general, both estimates (using White's matrix and using the TLS technique) show the same significant variables. In the whole period, the expiration day and the day before are higher than others are and significant. Moreover, in the week of expiration, there was a higher trading volume. When the subperiods were analyzed, some differences were found. In the first subperiod, an increase was found in trading volume on the expiration day that is significant for the majority of stocks analyzed. However, in the second subperiod, the abnormal trading volume was detected on the expiration day and on the day before expiration. Results obtained from individual stocks indicate a clear expiration effect in the options on stocks. The higher trading volume when the day of expiration arrives is a clear sign.

Again, in line with previous results presented earlier, the effect on stocks was greater than the effect on the Ibex-35 index. Besides, of the existence or non-existence of futures contracts, there was another aspect that could play an important role in the explanation of the differences: the settlement of the contract. In the options on stocks, it is necessary to settle by delivery; the settlement of the options on the Ibex-35 index is a cash settlement. Obviously, the absence of futures contracts on individual assets forces the arbitrageurs and investors to trade with the underlying asset and, if they unwind their positions on the expiration day, this could create an abnormal trading volume. In this sense, the greater effect on the trading volume for the stocks should be attributed to the joint effect of both factors: the settlement system and the absence of futures contracts on individual stocks.

CONCLUSIONS

This study has dealt with a topic of growing interest in the financial literature, namely, the behavior of the underlying market on the expiration

TABLE VII

(a) Results from Estimation of the Trading Volume of the Individual Stocks Using White's Matrix; (b) Results from TLS Estimation with $\alpha = 5\%$

		1993–1995				1993				1994–1995			
		(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
(a)	β_6^1	0.31*	0.16	0.28*	0.34*	0.57*	0.23	0.40	0.56*	0.19*	0.15	0.26*	0.28*
	t	(3.94)	(1.92)	(2.83)	(4.60)	(2.97)	(1.10)	(1.73)	(3.31)	(2.69)	(1.86)	(2.55)	(3.53)
	β_6^2	0.12	0.07	0.16*	0.13*	0.20	0.09	0.16	0.18	0.08	0.07	0.16*	0.12
	t	(1.82)	(1.22)	(2.48)	(2.24)	(1.44)	(0.78)	(1.23)	(1.33)	(1.23)	(1.21)	(2.32)	(1.88)
	β_6^5	0.10*	0.01	0.06	0.08*	0.14	0.10	0.04	0.14	0.08*	−0.01	0.07	0.06
	t	(2.67)	(0.50)	(1.50)	(2.09)	(1.74)	(1.46)	(0.53)	(1.80)	(1.96)	(−0.32)	(1.27)	(1.37)
(b)	β_6^1	0.28*	0.18*	0.31*	0.34*	0.53*	0.05	0.37*	0.58*	0.20*	0.17	0.35*	0.29*
	t	(3.32)	(2.30)	(3.04)	(4.13)	(3.32)	(0.39)	(2.22)	(3.81)	(2.07)	(1.90)	(2.92)	(3.05)
	β_6^2	0.13*	0.06	0.15*	0.15*	0.21	0.03	0.07	0.17	0.09	0.10	0.19*	0.13*
	t	(2.27)	(1.19)	(2.12)	(2.50)	(1.88)	(0.32)	(0.61)	(1.65)	(1.40)	(1.62)	(2.18)	(2.01)
	β_6^5	0.10*	0.02	0.07	0.09*	0.14	0.08	0.01	0.16*	0.08*	−0.01	0.10	0.07
	t	(2.57)	(0.66)	(1.63)	(2.49)	(1.87)	(1.29)	(0.19)	(2.36)	(2.01)	(−0.33)	(1.83)	(1.62)

(1) Endesa; (2) Telefónica; (3) BBV; (4) Repsol. β_6^1 is the coefficient associated with $D_{exp} = D_1$; β_6^2 is the coefficient associated with $D_{exp} = D_2$; β_6^5 is the coefficient associated with $D_{exp} = D_5$. Figures in parentheses are t-statistics. *Significant at 5% level.

Model: $V_t = \beta_1 D_M + \beta_2 D_{TU} + \beta_3 D_W + \beta_4 D_{TH} + \beta_5 D_F + \beta_6 D_{exp} + \Sigma_{j=1}^{5} \beta_{j+6} V_{t-j} + u_t$.

Note: L-B(5) tests are between (0.10–3.05).
Breusch-Pagan tests are between (7.13–33.90).
Engle tests are between (0.10–3.16).
Glesjer tests are between (11.70–38.82).

date. The study has focused on the analysis of the effects caused by the expiration of the Ibex-35 futures and options on the underlying index and by the expiration of the options on four individual stocks. The aim of this study was to verify whether these effects are greater in small markets. In the same way, the study analyzed the role that the existence of futures contracts can play in small markets within the context of the "expiration effect."

For this purpose, the analysis of the behavior of the returns, the conditional volatilities, and the trading volume of the underlying market was carried out.

Results from the Ibex-35 index indicate no effects on the returns at expiration date. As regards the four stocks analyzed, a downward pressure on prices during the week before the expiration has been found, although there was neither significant effect on the expiration day nor price reversal between the expiration day and the following day.

The effects on conditional volatility also are different. On the Ibex-35, significant effects were not observed on conditional volatility when the expiration date arrived. However, the conditional volatility of the individual stocks decreased in the week of expiration.

Finally, it has been found that the Ibex-35 index and the four stocks have the following in common: an abnormally high trading volume on expiration day is observed in all of the assets, although this effect seems to be higher in the stocks than in the index. The results obtained for the Ibex-35 index are similar to those offered in recent literature for major international markets: the main effect observed is the abnormally high volume on the expiration day. Moreover, in this sense, the hypothesis about the greater effect in small markets cannot be accepted. However, if the results obtained for the four stocks analyzed are taken into account, there may be some empirical evidence to support the hypothesis of this study.

On the other hand, important differences have been found between the effect on the Ibex-35 index and on the four stocks analyzed. Because the option contracts analyzed have different characteristics (the kind of option and the settlement procedure), it is not easy to find the reasons behind the results obtained. Nevertheless, the absence of futures contracts on individual stocks may explain these differences. These contracts, especially in small markets, allow the market to be more complete and, therefore, to increase the arbitrage trading that could eliminate the exploitable effects.

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