EVALUATION OF THE FIXING TRADING SYSTEM IN THE SPANISH MARKET*

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ABSTRACT

In 1998 the **Fixing trading system** was implemented in the Spanish Stock Market. It is considered an alternative to the traditional system of continuous negotiation, applicable to those stocks that have a series of basic characteristics in common. It represents an important innovation, the fundamental purpose of which is to reduce the volatility of stocks and thus improve their liquidity. The main motive of this study is to verify whether the improvements that the advocates of the new trading system have been predicting have actually taken place, as we believe that any innovation that is introduced into the market should be subjected to empirical evaluation. To do so, the effect that this innovation has had on the indicators of liquidity, returns and volatility of the stocks involved is examined, using parametric and non-parametric tests and employing a methodology based on the technique of the event study. We concluded that the evidence observed seems to contradict the very expectations that motivated the imposition of the new negotiating system, since a significant worsening was observed in liquidity and returns, whereas, on the other hand, no apparent decrease is observed in volatility.

Key Words: Fixing, Liquidity, Returns, Volatility, Thin Trading.
JEL Classification: G10, G19

RESUMEN

Durante 1998 se implantó en el mercado español el *sistema de contratación de valores con precios únicos en cada periodo de ajuste*, más conocido como *sistema de negociación fixing*. Este sistema representa una fórmula alternativa al sistema tradicional de negociación continua, aplicable a aquellos valores que reúnen una serie de determinadas características. A su vez, constituye una importante innovación cuya finalidad es, fundamentalmente, reducir la volatilidad de los títulos y mejorar su liquidez. La motivación fundamental del presente trabajo consiste en contrastar si se han producido las mejoras que vaticinaban los impulsores del nuevo sistema de contratación, en la creencia de que cualquier innovación llevada a cabo en el mercado debe ser sometida a evaluación. Para ello, se estudia el efecto sobre indicadores de liquidez, rendimiento y volatilidad medios de los títulos a los que esta innovación afectó, utilizando pruebas paramétricas y no paramétricas y metodología basada en la técnica del *event study*. La conclusión a la que se llega en este estudio es que la evidencia observada parece ser contraria a las expectativas que motivaron la implantación del nuevo sistema de contratación, pues se observa un empeoramiento significativo en los niveles de liquidez y rentabilidad y, en cambio, no se observa disminución aparente en el nivel de volatilidad.

Palabras Clave: *Fixing*, liquidez, volatilidad, rendimiento, negociación infrecuente.

1. INTRODUCTION

At the international level, whether in developing markets or in those that are already well established, important investments and innovations are taking place in market microstructure, enforcing the implementation and evaluation of new negotiating systems. With such a view, the Spanish Stock Market has recently outlined new operational norms for the stock trading, in an effort to improve its competitiveness in the light of the emerging European single market. These reforms have focused fundamentally on improving liquidity by increasing the transparency and quality in the execution of the transactions. In doing so, it is hoped that the negotiating of certain assets will be facilitated, making them more accessible to a wider range of investors. To this aim, two novelties were introduced into our market during 1998.

First, a block market was developed for two different categories of shares, one, "at agreed prices", for stocks registered in the IBEX35 index. Another one, "by prices", for all shares traded on the continuous market[1]. The reason for creating such a market was to facilitate the contracting of large volumes. This is a great improvement for big companies and institutional investors.

Secondly, the Fixing system, which is the focal point of this study, was introduced. This new contracting mechanism was designed to increase the liquidity of the less frequently traded stocks. It could be envisioned as an effort on the part of the Spanish Stock Market to facilitate the trading of small and medium-sized stocks. The system is intended to improve on prices formation for less attractive values, by concentrating the contracting at just two moments during the session.

It should therefore be of great interest, not only to financial economists but to anyone who participates in market activities, to verify whether this type of investment in the improvement of trading systems really yields positive results.

[1] Including the stocks negotiated in the Fixing system.

Amihud and Mendelson (1997) argue that for the market microstructural improvements to be considered valuable, the prices of the assets traded in the new system should increase[2]. In fact, any change or novelty introduced into the market should be subjected to an empirical evaluation to determine just how effective it is and whether it was really worth implementing at all. Therefore, if any great divergence from the predicted outcome is observed, measures should be taken to correct the misguided course.

The aim of the present study is to analyze the behavior of the shares traded in the Fixing system and measure the extent to which the desired improvements have been achieved. To do so, the effect that this innovation has had on the indicators of liquidity, returns and volatility of the stocks that were included in the Fixing system is analyzed.

This study should be considered as an addition to the extensive empirical research which analyzes the effects that the announcement and subsequent change to an alternative trading system has on the shares involved. Among others, Cooper et al. (1985); McCowell and Sanger (1986); Bhandari et al. (1989), and Christie and Huang (1994), stand out for their work on assets traded on the stock exchange that had previously traded OTC. Baker and Edelman (1992) analyze the case of stocks transferred from NASDAQ to NASDAQ/NMS. Amihud and Mendelson (1997) study changes in the Tel-Aviv Stock Exchange trading systems and Ko and Lee (1997) do the same in the case of assets traded in *A* and *B* systems of the Korean Stock Market.

On the other hand, the move to the Fixing system supposes a change of the negotiating system from one of "continuous auction" to one of "call auction". So, this study could also be classified among the literature devoted to the theoretical and empirical analysis of the advantages and inconveniences of these two systems for

[2] This effect on the price coincides with the findings of Amihud and Mendelson (1986), Amihud and Mendelson (1991) and Brennan and Subrahmanyam (1996), who find negative correlations between the levels of liquidity and the expected returns (after taking a series of other factors into account).

order-driven markets. The main conclusions and results obtained from previous studies are summarized in the following epigraph.

The paper is organized as follows: In the next section we describe how the Fixing system functions in the Spanish market. In section three we explain the methodology and the data used in the study. In the fourth and fifth sections, the main results obtained for the indicators of liquidity, returns and volatility are shown. Finally, in the sixth section, the evidence obtained in the analysis is summarized and the main conclusions are arrived at.

2. THE FIXING SYSTEM

From July 1st 1998, the Spanish market has been operating with a new contracting model: *"Sistema de fijación de precios únicos para cada periodo de ajuste"*, better known as the Fixing Trading System. Although this system is a novelty to our market, it has its precedents in other European markets, like Germany and France, for example. The motive behind such a change is to increase the liquidity of those less frequently traded stocks. Periodically, certain assets are assigned to this negotiating system, based on the levels of their activity and liquidity among other characteristics. They no longer trade continuously throughout the day, but rather, are traded exclusively at two fixed moments during the day. In other words, there is a change from a system of continuous auction to one of call auction.

Now, from a rather general point of view, we should like to comment on the main advantages and inconveniences of the two different systems involved, as highlighted in the literature. Afterwards, we shall describe in more detail, how the Fixing system functions in the Spanish market, the approach employed for the selection of the stocks that should be incorporated into the new system and the main prospects it holds.

Call Auction vs. Continuous Auction

Under the call auction system, orders accumulate for predetermined periods of time during the trading session. At the end of each of these adjustment periods, orders are batched for execution at a single price to maximize the number of shares negotiated. In contrast, under the continuous auction method, orders are executed whenever submitted bids and offers cross during a trading session. This method generates a single price for each cross.

Several theoretical and empirical studies have analysed the advantages and inconveniences of the two different contracting models. Price stability is, perhaps, the most important advantage of the call auction method over the continuous auction. This greater stability is achieved because batching orders over time eliminates price fluctuations caused by the bid-ask bounce and reduces price volatility induced by the random sequence in which orders and information arrive. Likewise, as trading orders accumulate over a fixed time interval, the impact of a single large order becomes less severe (Cohen and Schwartz, 1989). The system also represents an effective mechanism for dealing with asymmetric information problems between informed and uninformed liquidity traders (Stoll, 1985). The imposition of delays forces the informed agents to reveal, by the location of their orders, the existence of information, which, in turn, helps to reduce price volatility[3]. However, this acclaimed reduction of volatility is achieved at the expense of price discontinuity and the lack of information (Madhavan, 1992) which all translates into a lower level of liquidity.

In contrast to the call method, the most frequently mentioned advantage of the continuous auction system is the supply of immediacy to buyers and sellers. By allowing the immediate execution of transactions, a higher degree of market liquidity may be expected. It would seem, therefore, that there is a certain volatility-liquidity trade-off in the choice between these two systems.

[3] The informed agents had the option of introducing the orders a few moments before the execution of orders.

We should point out that the call auction system coincides with that of continuous auction when the intervals for accumulating orders tends towards zero, or, which is the same thing, when the number of negotiation moments tends towards infinity. The width of the interval (or similarly, the pre-determined number of moments at which orders are batched) proves to be a fundamental variable by which to quantify the range of the interaction between volatility and liquidity.

These two negotiation systems can be used jointly and, in fact, some markets allow both methods for the same assets, although at different moments of the day. So, in many cases call auctions are used exclusively to determine the stocks opening prices, and then changing to continuous auction during the remainder of the trading session. Moreover, the two systems may be used simultaneously for different stocks. It is the case analyzed in this paper, the Spanish Fixing trading system proposes a kind of call auction method for certain stocks with peculiar characteristics in common.

Description of the Fixing System in the Spanish market

The new trading method allows the admission of orders from 9:00 hours to 16:00 hours. The peculiarity is just that shares are traded at a single price at two specific moments during the trading session. Prices are first set at 12:00 noon, and then again at 16:00 hours. This final price being taken as the closing price. Apart from setting the price that maximizes the number of shares that can be traded, the contracting units that correspond to each case are assigned. The algorithm and the system of distributing shares used for this purpose, are exactly the same as those used from 1989 in the opening up of the market to all stocks.

The stock selection is done by the *Comisión de Contratación y Supervisión de la Sociedad de Bolsas, S.A*. (Commission for the Recruiting and Supervision of the Stock Market, S.A.) by observing the levels of activity and liquidity of the assets during the six previous months[4]. The following variables are employed for this purpose[5]:

- Daily volume in ordinary operations.
- Number of crossed operations per day.
- Average spread between best bid price and best ask price.
- Annual rotation rate: the number of contracted units traded in ordinary operations divided by the number of shares admitted on the market.
- Trading frequency: Percentage of sessions during which the stock has been negotiated.

In addition to the foregoing, other parameters that may be required to establish the degree of liquidity of each asset can also be used. In the case of stocks that are incorporated into the market for first time, their assignment to the system depends on their dimensions, their diffusion and other distinguishing characteristics, as well as on the companies market expectations.

The stock selection decision is made every six months, except in the case of new incorporations or in circumstances in which the market's conditions indicate the need for an extraordinary revision.

The precursors to the Fixing system suggest that "... *this is the system that adapts best to the conditions of the selected stock's liquidity and market activity",* (Revista de la Bolsa de Madrid, nº 67 June 1998*). "With the new system a concentration of orders is effected at given moments during the trading session, thereby increasing their trading activity and their liquidity, as well as reducing the high volatility"* (Revista de la Bolsa de Madrid, nº63, February 1998*). "This system*

[4] Except in the case of the first group of stocks, for which only the three previous months were used.
[5] In several studies, the decision to change trading system is voluntary and is therefore taken exclusively by the companys. This implies an previous optimization program and private information. This could cause autoselection bias (Amihud and Mendelson, 1997). In this case that interests us, the decision is exogenous and this type of bias does not exist.

accumulates purchase and selling orders for given moments, thereby achieving equity prices between offer and demand with lower volatility (not only intraday volatily, but closing price volatility, too), with somewhat lower transaction costs and with less impact on the prices of the orders introduced than when they are negotiated in on the open market for 7 hours a day" (Revista de la Bolsa de Madrid nº 67, June of 1998*). "The new system…tries to concentrate the operators´ attention at 12.00 hours and 16.00 hours during each trading session and so reduce the spread between bid and ask prices, thereby reducing their volatility and increasing the volume of negotiation in stocks involved. These objectives are much more difficult for certain assets to achieve in a continuous market of 7 hours of trading" (*Anuario de la Bolsa, 1998).

As we can see, the promoters trust the new contracting system as an effective way of eliminating the trading problems for the stocks concerned, on the grounds that continuous contracting generates high price volatility and makes this kind of stocks less attractive. So, the fact that orders and the attention of the investors are concentrated on just two moments during the session, should create more efficient and less volatile prices. It should, in turn, generate greater and more economic negotiation.

3. DATA AND METHODOLOGY

So far, two groups of assets have been transferred to the Fixing system, and the next inclusions are programmed for July 1st, 1999. The first group of 25 stocks were announced in the Stock Market's Operating Instruction nº 9/1998 on the 10th of June 1998, and began trading in the new system on July 1st, 1998. The second group, composed of 24 assets (the most of which are the same that those of the first group) was announced in the Operating Instruction nº 30/1998 on the 17th December 1998. These stocks began trading on January 4th, 1999. In Table 1, the evolution of the first two series of stocks negotiated under the new trading model is detailed.

Table 1: Evolution of the stocks traded in the Fixing system

The following table presents the groups of stocks that changed to the Fixing system

1st GROUP	**SITUATION (4-1-1999)**			**2nd GROUP**
(1-7-1998)	**CONTINUE**	**DO NOT CONTINUE**	**NEW**	**(4-1-1999)**
Bco. Andalucía (AND) (1)	AND		AFR	Aforasa (AFR)
Bco. Atlántico (ATL)	ATL			Bco. Andalucía (AND)
Bco. Castilla (CAS) (1)	-	CAS*		Bco. Atlántico (ATL)
Bco. Galicia (GAL) (1)	GAL			Bco. Galicia (GAL)
Bco. Vasconia (VAS) (1)	VAS			Bco. Herrero (HRR)
Bco. Herrero (HRR)	HRR			Bco. Vasconia (VAS)
Bco. Simeón (SIM)	-	SIM**		Bayer (BAY)
Bayer (BAY) (1)	BAY			Bco de Crédito Balear (CBL)
Inbesós (BES) (1)	BES		CUN	Cia. Vinícola Norte España (CUN)
Citroen Hispania (CIT)	-	CIT**		Electra de Viesgo (VGO)
Commerzbank (CBK)	-	CBK**		Estacionamientos Subterráneos (HES)
Bco. de Crédito Balear (CBL)	CBL		FYM	Financiera y Minera (FYM)
Dimetal (DMT)	DMT		FNZ	Finanzauto (FNZ)
Estacionamientos Subterráneos (HES)	HES		ANY	Grupo Anaya (ANY)
E.p.p.i.c. (EPC)	-	EPC**		Dimetal (DMT)
Hornos Ibéricos Alba (HSB)	HSB			Hornos Ibéricos Alba (HSB)
Iberpistas (IBP)	-	IBP*		Inbesós (BES)
Indo Internacional (IDO)	-	IDO*		La Corporación Banesto (LCB)
La Corporación Banesto (LCB)	LCB			Lafarge (LFG)
Lafarge (LFG)	LFG		LGT	Lingotes Especiales (LGT)
Saltos del Nansa (NAN)	NAN			La Papelera Española (PAP)
La Papelera Española (PAP)	PAP			Saltos del Nansa (NAN)
Urbanizaciones y Transportes (UBS)	-	UBS**	UND	Uniland Cementera (UND)
Electra de Viesgo (VGO)	VGO			Volkswagen (VWG)
Volkswagen (VWG)	VWG			

* Went back to the continuous market.
** Stopped trading.
(1) Stocks that have undergone splits after 1/7/1998 and before 31/12/ 1998

The database used for this study was compiled from information taken exclusively from the first of group of stocks traded in Fixing system. As from the beginning of the year 1999, all stocks are traded in Euros, the inclusion in the sample of the second group would have caused a possible distortion. The currency change, the minimum variations in the prices of the assets and other factors linked to the new currency, could have generated biases and interferences that would have made it very difficult to isolate the effects that we have sought to analyze.

Certain stocks from the first group of the 25 initial assets were also eliminated (see Table 1). PAP, EPC and DMT were finally excluded from the sample as they eventually went into liquidation. The SIM stock was also eliminated, as it had previously been trading on the outcry market and not on the continuous market. Finally, CIT, CBK and UBS stopped trading in the Fixing system before the end of the year, so that the data available was not sufficiently complete to allow the comparison of both systems. The study, therefore, is concentrated exclusively on those stocks that had previously been traded on the continuous market, were changed to the Fixing system and traded until the end of 1998.

For the 18 certificates finally selected, we have considered a sample of daily returns (calculated with closing prices and corrected for splits, dividends and capital increases) between October 21 1997 and December 31 1998. Based on this data, after modeling the return and the volatility, an analysis is done on the repercussions that the change of negotiation system has had on these variables. For a shorter period (from April 1st to September 30th, 1998) we employed the daily series of the negotiated volumes (in pesetas), and the number of daily transactions. With this data, and by parametric and non-parametric tests, we studied the effect that the new system has had on liquidity. All the data was taken from *Servicio de Información Bursátil de la Bolsa de Madrid* (Service for Market Information of the Madrid Stock Exchange).

4. REPERCUSSIONS ON STOCK LIQUIDITY

In this section, we examine the effect that the new negotiating system has had on the liquidity of the stock involved. As Kyle (1985) points out, the liquidity of a market is too wide a concept for a single clear definition, as it is composed of multiple dimensions. Deciding whether a certain event produces a significant change on a stock liquidity or not, therefore, is a rather risky task, since an unequivocal improvement or worsening of this variable merely implies that its multiple dimensions vary in a certain direction.

In this study, we concentered exclusively on the trading activity of the stocks, measured by the daily volume (expressed in monetary units) and the number of daily transactions. Another commonly used dimension for measuring a market's liquidity is the transaction costs, measured by the spread. Even though, we could not consider this dimension since the change of system causes a series of problems in the calculation of the spread, making a direct and reliable comparison of the two contracting systems practically impossible. The main problem is that the spreads for the Fixing System stocks are abnormally low. The standard method employed to calculate the spread in the database, consists of averaging the best bid and ask prices at each moment, so that spreads of the shares traded in the Fixing system are zero most of the time. Therefore, the spread calculated for those assets is an inconsistent and unreliable measure of the actual transaction costs.

Concentrating exclusively on the negotiating activity of a market, it is obvious that the higher the level of activity, the greater the probability of finding a buyer/seller for the investors, and therefore, less time for execution. The advocates of the new system herald an increase in the activity of the stocks transferred to the Fixing system as a result of a more effective formation of their prices and the reduction of the volatility than they previously had in the continuous system.

The lack of reliable models for establishing the "normal" behavior of the variables under study here (and especially for infrequently traded stocks) indicates the need for an adequate descriptive methodology, supported by parametric and non-parametric tests. Such tests consist of determining whether significant differences take place in the average values of the variables between the moment previous to and the following the system change. To do so, different equidistant periods to the event date were used. Specifically, the windows employed were days 5, 10, 15, 20, 30, 40, 50 and 60 before and after the date of the change[6]. By considering the periods this way, we could detect not only immediate effects but the short-term and long-term effects as well.

On the other hand, we observed that seven of the eighteen stocks that compose the sample carried out splits shortly after incorporation into the Fixing system. The split is a practice that produces significant alterations in the level of liquidity around the date that it is done, as Gómez Sala (1999) points out. This author finds in his study of splits in the Spanish market, a rather significant increase in the number of a stock's transactions on the dates immediately following its split. He finds an irregular, though not significant change, in the volume on these same dates as well. For this reason, we have considered both the entire sample and a sub-sample of 11 stocks that did not carry out splits. It allows to give greater robustness to the analysis of the effect on the negotiating activity.

First, we have compared the number of transactions and the volume negotiated for the individual assets, for the aggregate of the 18 certificates and for the 11 assets that did not carry out splits. Each of these observations was then normalized, by dividing them by the daily equivalent of the market. In this way, the tendency of the market is considered as the normal tendency in the behavior of the variables. The procedure also avoids the possibility that any sort of seasonal behavior could bias the results. (During the Summer months, for example, the negotiating activity decreases). After completing this operation, we compared our results to see if significant differences existed between average and median for the different windows proposed. The results for the variables, the relative number of transactions and the relative volume negotiated are presented in tables 2.1, 2.2 and 3.1, 3.2. respectively.

[6] The event day is taken as the first day of the following periods.

Table 2.1. Relative number of transactions for the sample of 18 assets

In the following table, the change in the average and the median in the relative number of transactions are shown for different windows. Each window is centered on the event date and has the duration that appears in the first column. The second and third column show the average/median before and after the event date, given each duration. For the average, the difference is shown in 4th column and its significance is evaluated (5th column) by a t-tes (p-value in brackets). Finally, the 6ª and 7ª columns show, respectively, the number of companies that experienced decreases/ increases in their relative number of transactions, with respect to the average. For the median, the significance of the difference between the previous and later periods is measured by the non-parametric tests of Wilcoxon, median and Kruskal-Wallis. In brackets, the p-value are shown. Finally, the number of companies that experienced decreases and increases in the number of transactions relative to their median are given.

SAMPLE OF 18 ASSETS

	AVERAGE						MEDIAN							
Window	**Before**	**After**	**Diff.**	**t-test [p-value]**	**Falls**	**Rises**	**Before**	**After**	**Diff.**	**Wilcoxon Test**	**Median Test**	**K-W Test**	**Falls**	**Rises**
±5 days	0.526	0.242	-0.284	-12.17 [0.000]	16	2	0.530	0.241	-0.289	2.51 [0.012]	10.00 [0.001]	6.82 [0.009]	12	6
±10 days	0.445	0.438	-0.007	-0.09 [0.927]	9	9	0.466	0.373	-0.093	0.34 [0.733]	0.00 [1.000]	0.14 [0.705]	11	7
±15 days	0.410	0.400	-0.010	-0.17 [0.865]	10	8	0.405	0.314	-0.091	0.95 [0.340]	1.20 [0.273]	0.95 [0.329]	10	8
±20 days	0.421	0.367	-0.054	-1.14 [0.259]	12	6	0.403	0.292	-0.111	2.09 [0.036]	3.60 [0.058]	4.45 [0.034]	10	8
±30 days	0.413	0.581	0.168	1.76 [0.083]	12	6	0.403	0.362	-0.041	0.57 [0.569]	0.27 [0.606]	0.32 [0.564]	11	7
±40 days	0.412	0.604	0.192	2.59 [0.011]	12	6	0.403	0.425	0.022	1.01 [0.310]	0.80 [0.371]	1.04 [0.307]	12	6
±50 days	0.425	0.551	0.126	2.04 [0.044]	12	6	0.412	0.380	-0.032	0.15 [0.876]	0.64 [0.423]	0.02 [0.874]	12	6
±60 days	0.447	0.509	0.062	1.16 [0.248]	12	6	0.444	0.357	-0.086	1.78 [0.073]	4.80 [0.028]	3.20 [0.073]	12	6

Table 2.2. Relative number of transactions for the sample of 11 companies.

In the following table, the change in the average and the median in the relative number of transactions are shown for different windows. Each window is centered on the event date and has the duration that appears in the first column. The second and third column show the average/median before and after the event date, given each duration. For the average, the difference is shown in 4th column and its significance is evaluated (5th column) by a t-tes (p-value in brackets). Finally, the 6ª and 7ª columns show, respectively, the number of companies that experienced decreases/ increases in their relative number of transactions, with respect to the average. For the median, the significance of the difference between the previous and later periods is measured by the non-parametric tests of Wilcoxon, median and Kruskal-Wallis. In brackets, the p-value are shown. Finally, the number of companies that experienced decreases and increases in the number of transactions relative to their median are given.

SAMPLE OF 11 ASSETS

	AVERAGE						MEDIUM							
Window	**Before**	**After**	**Diff.**	**t-test [p-value]**	**Falls**	**Rises**	**Before**	**After**	**Diff.**	**Wilcoxon Test**	**Median Test**	**K-W Test**	**Falls**	**Rises**
±5 days	0.414	0.147	-0.267	-8.07 [0.000]	10	1	0.420	0.149	-0.271	2.50 [0.012]	10.00 [0.001]	6.82 [0.009]	10	1
±10 days	0.328	0.163	-0.165	-4.84 [0.000]	8	3	0.305	0.163	-0.142	3.74 [0.000]	20.00 [0.000]	14.28 [0.000]	10	1
±15 days	0.305	0.155	-0.150	-6.11 [0.000]	9	2	0.268	0.148	-0.120	4.64 [0.000]	30.00 [0.000]	21.77 [0.000]	10	1
±20 days	0.320	0.154	-0.166	-7.46 [0.000]	11	0	0.292	0.150	-0.142	5.40 [0.000]	40.00 [0.000]	29.27 [0.000]	10	1
±30 days	0.316	0.152	-0.164	-9.82 [0.000]	11	0	0.307	0.150	-0.157	6.61 [0.000]	52.26 [0.000]	43.87 [0.000]	10	1
±40 days	0.303	0.149	-0.154	-10.95 [0.000]	11	0	0.275	0.148	-0.127	7.51 [0.000]	72.20 [0.000]	56.48 [0.000]	11	0
±50 days	0.307	0.141	-0.166	-13.19 [0.000]	11	0	0.290	0.137	-0.153	8.48 [0.000]	92.16 [0.000]	72.01 [0.000]	11	0
±60 days	0.332	0.139	-0.193	-13.92 [0.000]	11	0	0.320	0.134	-0.186	9.33 [0.000]	112.13 [0.000]	87.18 [0.000]	11	0

Table 3.1. Relative negotiated volume for the entire sample.

In the following table, the change in the average and the median in the relative negotiated volume are shown for different windows. Each window is centered on the event date and has the duration that appears in the first column. The second and third column show the average/median before and after the event date, given each duration. For the average, the difference is shown in 4th column and its significance is evaluated (5th column) by a t-tes (p-value in brackets). Finally, the 6ª and 7ª columns show, respectively, the number of companies that experienced decreases/ increases in their relative number of transactions, with respect to the average. For the median, the significance of the difference between the previous and later periods is measured by the non-parametric tests of Wilcoxon, median and Kruskal-Wallis. In brackets, the p-value are shown. Finally, the number of companies that experienced decreases and increases in the number of transactions relative to their median are given.

SAMPLE OF 18 ASSETS

	AVERAGE						MEDIAN							
Window	**Before**	**After**	**Diff.**	**t-test [p-valor]**	**Falls**	**Rises**	**Before**	**After**	**Diff.**	**Wilcoxon Test**	**Median Test**	**K-W Test**	**Falls**	**Rises**
±5 days	5092.52	934.85	-4160.67	-2.22 [0.056]	13	5	4722.63	608.62	-4114.01	2.08 [0.036]	3.60 [0.057]	4.81 [0.028]	12	6
±10 days	3656.49	2505.04	-1151.45	-0.77 [0.453]	12	6	1661.11	1809.90	148.79	0.71 [0.473]	0.00 [1.000]	0.57 [0.449]	12	6
±15 days	3231.39	2288.60	-942.79	-0.84 [0.406]	12	6	1304.58	1381.26	76.68	0.66 [0.507]	0.13 [0.715]	0.47 [0.493]	12	6
±20 days	3500.54	2630.17	-870.37	-0.83 [0.410]	14	4	2204.98	1339.45	-865.53	1.18 [0.239]	0.40 [0.527]	1.41 [0.234]	14	4
±30 days	3234.81	2744.32	-490.49	-0.63 [0.532]	13	5	2204.98	1356.30	-848.68	1.45 [0.145]	0.27 [0.605]	2.14 [0.143]	13	5
±40 days	2803.85	2374.71	-429.14	-0.71 [0.482]	14	4	1687.99	1333.55	-354.44	1.58 [0.113]	1.80 [0.179]	2.52 [0.112]	15	3
±50 days	2840.73	2414.86	-425.87	-0.74 [0.456]	14	4	1772.81	1213.22	-559.59	2.59 [0.009]	4.00 [0.045]	6.75 [0.009]	15	3
±60 days	2652.97	2437.91	-215.06	-0.43 [0.666]	13	5	1687.99	1199.62	-488.37	2.77 [0.005]	6.53 [0.010]	7.73 [0.005]	15	3

Table 3.2. Relative negotiated volume for the sub-sample.

In the following table, the change in the average and the median in the relative negotiated volume are shown for different windows. Each window is centered on the event date and has the duration that appears in the first column. The second and third column show the average/median before and after the event date, given each duration. For the average, the difference is shown in 4th column and its significance is evaluated (5th column) by a t-tes (p-value in brackets). Finally, the 6ª and 7ª columns show, respectively, the number of companies that experienced decreases/ increases in their relative number of transactions, with respect to the average. For the median, the significance of the difference between the previous and later periods is measured by the non-parametric tests of Wilcoxon, median and Kruskal-Wallis. In brackets, the p-value are shown. Finally, the number of companies that experienced decreases and increases in the number of transactions relative to their median are given.

SAMPLE OF 11 ASSETS

	AVERAGE						MEDIAN							
Window	**Before**	**After**	**Diff.**	**t-test [p-valor]**	**Falls**	**Rises**	**Before**	**After**	**Diff.**	**Wilcoxon Test**	**Median Test**	**K-W Test**	**Falls**	**Rises**
±5 days	4138.51	555.36	-3583.15	-8.07 [0.122]	8	3	1475.04	439.78	-1035.26	2.08 [0.036]	3.60 [0.057]	4.81 [0.028]	8	3
±10 days	2423.97	887.90	-1536.07	-4.84 [0.200]	8	3	957.78	813.42	-144.36	1.24 [0.212]	0.80 [0.371]	1.65 [0.198]	8	3
±15 days	1922.22	1055.38	-866.84	-6.11 [0.302]	8	3	995.97	799.40	-196.57	1.74 [0.081]	1.20 [0.273]	3.10 [0.078]	8	3
±20 days	2436.03	1645.38	-790.65	-7.46 [0.396]	9	2	1030.73	826.00	-204.73	1.85 [0.064]	3.60 [0.057]	3.48 [0.062]	9	2
±30 days	2337.45	1398.39	-939.06	-9.82 [0.155]	10	1	1376.55	725.19	-651.36	3.63 [0.000]	17.06 [0.000]	13.22 [0.000]	10	1
±40 days	1974.24	1137.17	-837.07	-10.95 [0.100]	10	1	1118.56	494.85	-623.71	4.60 [0.000]	20.00 [0.000]	21.24 [0.000]	11	0
±50 days	1859.16	1359.71	-499.45	-13.19 [0.304]	9	2	1088.07	434.94	-653.13	5.13 [0.000]	27.04 [0.000]	26.37 [0.000]	10	1
±60 days	1777.65	1516.83	-260.82	-13.92 [0.543]	8	3	1139.80	494.85	-644.95	5.08 [0.000]	26.13 [0.000]	25.87 [0.000]	10	1

In these tables, the results for the average and median for the two samples, are presented separately. The first and second columns show the mean values (average or median) of the aggregate (18 or 11 assets) for the different periods, before and after the change over, respectively. In the third column, the difference between the first two columns is presented. The fourth column shows the significance of this difference; for the average, a t-test is used and for the median, three non-parametric tests were employed: the Wilcoxon (U Mann-Whitney) test, the Chi-squared test for the median and the Kruskal-Wallis test. Finally, the last two columns show the number of stocks that have experienced either a rise or a fall in their relative number of transactions or relative volume negotiated for each period.

For the sample of 18 stocks, we observe in the number of relative transactions a very different kind of behavior between the average and the median. The two measurements only agree when they indicate a significant reduction in the number of transactions in the window that corresponds to the 5 days preceding and the 5 days following the entry of the stocks into the Fixing system. From this period on, important differences begin to appear between the two measures. Particularly in the larger windows, in which there is a change, from significant increases in the number of transactions for the average, to non-significant decreases in this variable for the median, (except for the 60-day window, which shows a significant decrease). The different behavior of these two measures could be due to extreme values on certain trading days. These extreme values could be the result of the splits carried out by some of the companies in the sample. The results found in the subsample of 11 assets that did not split their shares, seem to confirm this evidence. In this sub-sample, the difference observed between the average and the median is quite similar. There is a significant reduction in the number of transactions in every period considered. This result supports the evidence presented by Gómez Sala (1999) in his study of splits in the Spanish market. To be more specific, in comparing the two samples, we notice that among the companies that have either increased or decreased their transactions in any given period, the firms which increase their number of transactions, are generally those that had split their shares.

With regard to the relative negotiating volume, we also note a different sort of behavior between average and median values. In general, the averages have much greater values than the median, which could indicate the presence of extreme values. The non-normality observed in this variable, manifest in the leptokurtosis of the distribution, (in other words, thicker tails than those of the normal distribution), has been extensively debated in the literature. This fact can not be directly attributed to the splits, which the similar behavior observed between the two samples confirms. Once again, this result supports the findings of Gómez Sala (1999), in which no significant changes were seen in the trading volume of the assets that had been split.

For the sample of 18 stocks, the average volume negotiated only reduces significantly in the 5-day window. For the remaining periods, non-significant reductions of this variable are observed. On the other hand, the median shows significant decreases in the windows of 5, 50 and 60 days. The sample of 11 assets presents similar, if not more extreme results. Reductions are observed in the average volume in every single period, although none of them is significant. With regard to the median, the reductions become significant in almost all the windows (except in those of 10 and 15 days).

To reinforce the accuracy of the results obtained a second test is done. The new evaluation included two innovations. First, the logarithmic transformation was used for the variables examined in the study. This transformation has been widely promoted for the analysis of the negotiating activity, since it smoothens the behavior of the variables, as Ajinkya and Jain, (1989), among others, substantiate. Furthermore, this second test measures the significance of the differences between periods, in cross-section, which allows us to focus on the problem from other methodological perspective.

The test is based on the following expression, calculated for each asset:

$$D_j = \ln\left(\frac{\overline{V}_j}{\overline{V}_M}\right)_{t-before} - \ln\left(\frac{\overline{V}_j}{\overline{V}_M}\right)_{t-after} \qquad \textbf{(1)}$$

t=5,10,15,20,30,40,50,60 days.

where, *Dj, differentiates between the two periods, before and after the change in the variable under study (relative number of transactions or relative negotiating volume) for the asset j; Vj is the mean value of the variable under study, for the days t immediately preceding or following the event, for the asset j;* V_M *is the mean value of the variable under study for the days t preceding or following the event, for the market.*

Once this difference has been calculated for each asset and for every period, the significance of its average and its median is studied, in cross-section, for the two samples under consideration. In Tables 4.1 and 4.2. we present the results for the relative number of transactions and the relative volume negotiated, respectively, for the sample and sub-sample. The first two columns contain the number of companies that experience either a rise or a fall in activity between the former and the latter periods. The following four columns present the average and the median of the differences of the stocks and their significance (measured with a t-test for the average and the Wilcoxon test for the median).

The results are very similar to those obtained with the first test. For the number of transactions, and for the sample of 18 assets, we again observe a great difference in behaviour between the average and the median. On this aspect, both measurements show a significant reduction in the number of transactions in the 5-day window. For the sample of 11 assets, a similar behavior is observed between average and median. Once again, significant reductions are observed in the number of transactions for all the windows. Apart from a few exceptions, the companies whose negotiating levels increase or decrease in this test are precisely the same ones that did so in the previous test.

Table 4.1. Relative number of transactions.

For each of the stocks traded, the expression (1) has been calculated. The time intervals considered around the event date are presented in the first column. The second and third columns reflect, respectively, the number of stocks that experienced decreases and increases in the number of transactions in the post-event period. The remaining columns measure, respectively, the average, in cross-section, of the previously mentioned magnitude; its significance by the statistical test and its associate p-value (in brackets) with a t-test; the median of this magnitude and finally, its significance with the Wilcoxon non-parametric test (statistical and p-value in brackets).

	SAMPLE OF 18 ASSETS						SAMPLE OF 11 ASSETS					
Window	**Falls**	**Rises**	**Average**	**t-test [p-valor]**	**Median**	**Wilcoxon Test**	**Falls**	**Rises**	**Average**	**t-test [p-value]**	**Median**	**Wilcoxon Test**
±5 days	15	3	0.623	3.78 [0.001]	0.444	3.09 [0.002]	9	2	0.813	3.42 [0..006]	0.870	2.44 [0.014]
±10 days	9	9	0.108	0.50 [0.619]	0.006	0.61 [0.542]	8	3	0.547	2.90 [0.015]	0.567	2.00 [0.045]
±15 days	10	8	0.082	0.42 [0.681]	0.019	0.48 [0.632]	9	2	0.534	3.05 [0.012]	0.560	2.17 [0.029]
±20 days	11	7	0.143	0.78 [0.448]	0.197	1.04 [0.296]	10	1	0.613	5.20 [0.000]	0.531	2.80 [0.005]
±30 days	12	6	-0.069	-0.27 [0.790]	0.393	0.13 [0.896]	11	0	0.687	7.59 [0.000]	0.683	2.89 [0.004]
±40 days	12	6	-0.020	-0.08 [0.935]	0.508	0.08 [0.931]	11	0	0.705	10.29 [0.000]	0.682	2.89 [0.004]
±50 days	12	6	0.143	0.60 [0.554]	0.487	0.65 [0.513]	11	0	0.827	9.40 [0.000]	0.847	2.89 [0.004]
±60 days	12	6	0.262	1.09 [0.291]	0.672	1.00 [0.316]	11	0	0.951	10.11 [0.000]	0.934	2.89 [0.004]

(1) $D_j = \ln\left(\overline{V}_j \; \overline{V}_M^{-1}\right)_{before} - \ln\left(\overline{V}_j \; \overline{V}_M^{-1}\right)_{after}$; where, D_j represents the difference between the two periods, before and after the la variable of the study for the stock j; $\overline{V}_j$ is the average value of thee variable under study for the days t before or after the event for the stock j; $\overline{V}_M$ is the mean value of the variable under study for the days t before or after the event

Table 4.2. Relative negoting volume.

For each of the negotiated assets, the expression (1) has been calculated. The time intervals considered around the event date appear in the first column. The second and third columns reflect, respectively, the number of stocks that had decreases and increases in their number of transactions in the post-event period. The remaining columns measure, respectively, the average, in cross-section of the previously mentioned magnitude; the significance is evaluated by the statistical test and the associated p-value (in brackets), the medium of the magnitude by a t-test; and finally, the significance by the Wilcoxon non-parametric test (statistic and p-value in brackets).

	SAMPLE OF 18 ASSETS						SAMPLE OF 11 ASSETS					
Window	**Falls**	**Rises**	**Average**	**t-test [p-value]**	**Median**	**Wilcoxon Test**	**Falls**	**Rises**	**Average**	**t-test [p-value]**	**Median**	**Wilcoxon Test**
±5 days	13	5	1.142	3.27 [0.004]	1.063	2.65 [0.008]	8	3	1.098	2.60 [0.026]	1.151	2.09 [0.037]
±10 days	11	7	0.187	0.48 [0.639]	0.350	0.83 [0.408]	7	4	0.173	0.33 [0.744]	0.428	0.93 [0.350]
±15 days	11	7	0.356	1.05 [0.309]	0.217	1.35 [0.178]	8	3	0.287	0.64 [0.537]	0.536	1.11 [0.266]
±20 days	13	5	0.432	1.47 [0.159]	0.476	1.74 [0.081]	9	2	0.454	1.17 [0.268]	0.615	1.38 [0.168]
±30 days	12	6	0.333	1.36 [0.192]	0.604	1.26 [0.206]	9	2	0.686	2.24 [0.049]	0.671	1.91 [0.056]
±40 days	15	3	0.379	1.75 [0.098]	0.604	1.74 [0.081]	10	1	0.736	3.05 [0.012]	0.715	2.27 [0.023]
±50 days	15	3	0.541	2.83 [0.011]	0.583	2.48 [0.013]	10	1	0.777	3.52 [0.005]	0.616	2.71 [0.006]
±60 days	13	5	0.605	3.03 [0.007]	0.583	2.48 [0.013]	8	3	0.821	3.33 [0.007]	0.764	2.35 [0.018]

(1) $D_j = \ln\left(\overline{V}_j \ \overline{V}_M^{-1}\right)_{before} - \ln\left(\overline{V}_j \ \overline{V}_M^{-1}\right)_{after}$; where, D_j represents the difference between the periods before and after the variable under study for the stock j; $\overline{V}_j$ is the mean value of the variable under study for the days t preceding or following the event for the stock j; $\overline{V}_M$ is the mean value of the variable under study for the days t before or after the event

The results obtained for the negotiating volume are also similar to those of the first test, if not more conclusive, if we observe the great similarity between the average and the median. For both samples, (18 and 11 assets), significant reductions in volume are seen in the extreme windows (5, 40, 50 and 60 days).

In summary, with the use of these tests, a clear deterioration is observed in the negotiating level during the first days of the stock's entry into the new system, as measured not only by the relative number of transactions, but also by the relative negotiated volume. For the rest of the windows, and for the sample of 18 assets, no significant change is seen in the number of transactions between the two trading systems, although this result might well have been biased by the presence of stock splits during the latter period. In fact, the significant reduction in transactions found in the sample that excludes the splits seems to confirm this evidence. With regard to the volume, this variable behaves quite similarly in both samples. In addition to the previously mentioned significant decrease in the 5-day window, significant reductions in volume are also observed over longer periods.

By extension, the results reveal a decline in the average negotiating rate of the stocks that traded on the Fixing system (at least during the first days). This implies that it is, a priori, in clear contradiction with the prospective results predicted by the advocates of the system.

5. REPERCUSSIONS ON STOCK RETURNS AND VOLATILITY

In this section we shall attempt to analyze the impact that the change of trading system, from the continuous market to the Fixing system, has had on the returns and average volatility of the shares involved .

This effect is not obvious at first sight. On the one hand, the investors could interpret the change as a positive event, since the original aim was to concentrate the negotiating of these certificates and improve their liquidity. Furthermore, it is assumed that market microstructural improvements should be accompanied by an increase in the average returns of the shares. On the other hand, the stocks chosen for the Fixing system had been selected specifically because of their low negotiating activity and liquidity. The change of negotiating system could therefore be perceived by the investors as a negative indication from the market about a group of stocks that, comparatively speaking, offer less attractive prospects than other shares trading on the continuous market. Finally, both effects might well co-exist in a sort of trade-off, so that their individual effects on the asset returns are not clear at all.

Their effect on volatility seems more predictable. As the negotiating is limited to a specific interval, and these assets are less exposed to the fluctuations generally caused by the news releases about the companies trading on the market, it seems only natural to expect a decrease in their average volatility.

To measure the impact on return and volatility for the whole group of assets, an equally weighted portfolio is formed with the shares that changed system; the grouping of stocks that compose the sample in a portfolio is, as Maloney and McCormick (1982) point out, especially appropriate when the event date is the same for all the stocks in a sample. As approximation of the portfolio returns generated during the period under study, the average daily individual asset return (calculated logarithmically and adjusted for dividends, rights and splits) has been used.

An important factor is the existence of certain characteristics that are common to all the stocks that were subject to the system change: their scarce liquidity and their low negotiating level. The market price of any asset traded on a financial market is not independent of the contracting system to which it is subjected. The fact that a stock scarcely trades, has important repercussions on the level of its systematic risk and its expected return. Of course, this can be extended to any portfolio that is built by the aggregation of assets infrequently traded. The thin trading generates, according to Shanken (1987), auto-correlations and spurious cross-correlations that affect the risk and return models, such as the market model and its extensions, CAPM, APT, etc.

As a result it is not valid to use either the market model specification (or its extensions) to estimate the expected return or the abnormal return of this kind of stocks. It would produce a measurement error that would generate bias and inconsistency in the resulting estimates. This bias derives from the fact that the asset returns is associated with a lower negotiating level while the market index returns is associated with a higher relative negotiating level; it creates it a measurement error in the stock returns which is serially correlated with the market returns. Financial literature proposes several methods for correcting this problem, among the most popular being Dimson´s (1979) method of added coefficients, Scholes-Williams´ (1977) model and that of Cohen et al. (1983).

Given the auto-correlation and cross-correlations that arise from the thin trading, the evaluation of the portfolio returns might well be affected. This effect is taken into account by employing an alternative to the market model, which introduces a series of lags and leads of the market index as explanatory variables. In this way, the distortion produced by the infrequent trading is eliminated. This return model is quite similar in essence to the methodological concepts of Dimson (1979), and Scholes and Williams (1977), for correcting the estimates of systematic risk in the market model when a low negotiating volume is involved. It has already been employed in event studies like those carried out by Richardson et al. (1986), among others. The return model employed here, therefore, is:

$$R_t = \alpha + \beta_1 RM_t + \sum_{i=1}^{p} \beta_{i+1} RM_{t-i} + \sum_{j=1}^{q} \beta_{p+1+j} RM_{t+j} + \varepsilon_t \quad \textbf{(2)}$$

where,

R_t *is the portfolio returns, observed at the moment t*; α *is the mean return independent of the portfolio's systematic risk;* β_j *is the coefficient of sensitivity of the portfolio returns, given the market returns;* RM_t *is the return observed in the market portfolio (reflected by the IBEX35 index) at the moment t;* ε_t *is the random disturbance; p, the number of lags; and q*, *the number of leads.*

Four possible alternatives are considered for the modeling portfolio returns on specification (2):

i) Market model (Model I; p=0, q=0);

ii) Market model lagged by one period (Model II; p=1, q=0);

iii) Market model lagged by one period and leading by one period (Model III; p=1, q=1)

iv) Market model lagged by two periods and leading by two periods (Model IV; p=2, q=2).

The mathematical specifications of these models can be found in Annex 1.1.

On the other hand, it is usually assumed that the random error term from expression (2) verifies the assumptions of the classical linear model, that is, it is assumed that the disturbance term is serially uncorrelated with zero mean and constant variance. The estimate of this model by ordinary least squares could be defective if heteroskedasticity exists and the inference calculated on the resulting estimates might well be inexact, as Morgan and Morgan (1987) and Connolly and McMillan (1989), among others, have found. The precise specification of the error is important because, among other reasons, the risk premium imposed on a stock is a function of the conditional variance of the return.

A more accurate alternative to the previous specification is the modeling of the conditional variance of the return by means of the generalized autoregressive conditional heteroskedasticity models (GARCH models). The GARCH(p,q) model was outlined by Bollerslev (1986) as a generalization of the autoregressive conditional heteroskedasticity model proposed by Engle (1982). These kinds of models distinguish between the unconditional variance (that is constant and stationary) and the variance, that is conditioned by the set of available information, which is variable over time. An important characteristic of the GARCH(p,q) model is that it is considered as symmetric. In other words, the effect on the variance of the innovations or market shocks is independent of their sign; the evidence seems to indicate however, that the returns are usually more sensitive to news about unfavorable events than about favorable events. This fact has been taken into consideration in asymmetric volatility models, which are, in fact, generalizations of the GARCH model. Together with the GARCH(p,q), we can consider two asymmetric models: the EGARCH model, proposed by Nelson (1990), and the TGARCH model by Zakoïan (1994).

With regard to the modeling of the volatility of the series of financial data, the empirical evidence available supports the use of the GARCH family of models instead of other specifications. Lamoreaux and Lastrapes (1990) state that the GARCH(1,1) specification has proven to be the ideal representation of the volatility behaviour of several economic series. In the Spanish market, Alonso (1995), finds that the volatility of a portfolio returns is more accurately characterized from a symmetrical specification, as afforded by the modeling of two regimes (Hamilton, 1988) than with the asymmetrical specifications of several other models. Faced with this evidence, León and Mora (1998) determine that the specification that best approaches the volatility of the daily return of the IBEX35 is the TGARCH model, improving the asymmetric models and making them even better, in any of the cases, than the models based on symmetrical specifications do.

Faced this ambiguous evidence, we considered five possible specifications for modeling the behavior of the conditional variance: A simple linear regression model, a group of symmetrical models formed by the ARCH(1) and GARCH(1,1)[7] models and finally, a group of asymmetric models formed by the EGARCH(1,1) and TGARCH(1,1) models. The mathematical specifications of these models are outlined in Annex 1.2.

To identify the best return-volatility specification, we refer to methods based on information criteria, such as Schwartz´s Information Criteria (SIC). This criterion is based on the expression[8] $SIC=2*\ln(L_{ML})/T - K\ln(T)/T$, which was developed by

[7] The GARCH(1,1) model is the parsimonious representation of the ARCH model whit a great number of terms.
[8] Where $\mathbf{L_{ML}}$ is the value of the maximun likelihood function (given the distribution of the random disturbance term) valuated by the **K** parameters estimation and given a sample of **T** observations.

Schwartz (1978) and evaluates the reliability of a given model by the accuracy achieved and by penalizing the number of parameters employed to achieve it. Consequently, this criterion allows us to locate the most parsimonious model by choosing the one that has a greater SIC. This method has been employed in studies aimed at identifying the best specification, for both return and volatility, from a set of alternative models, such as those presented by León and Mora (1996), or Andrés (1999), among others.

The results obtained on the return and volatility models considered, evaluated by the SIC, are presented in Table 5. On analyzing the results, a sharp increase is observed in the likelihood function in all of the models that incorporate leads and lags in the independent variable as opposed to the simple market model. This increase being even greater in the case of Model II. We can therefore conclude that the best specification for the return, following the SIC method and for each of the four different ways of modeling the volatility that have been studied here, is obviously Model II, or the market model with a lag of one period.

Furthermore, for each of the return models, a sharp increase is again observed in the likelihood function that the models of heteroskedastic conditional variance provide when measured by the SIC, as compared to the simple lineal regression. This type of models, therefore, and more precisely the GARCH(1,1), seems to be the most appropriate specification for modeling the volatility. It can also be observed, by means of the direct comparison of the SIC magnitudes, that the best group of models is the symmetrical one (the SIC of the symmetrical models is, in all of the cases, greater than the SIC of the asymmetric models). Therefore, the structure of symmetrical volatility seems to have a greater descriptive capacity than the two asymmetric generalizations proposed. This result seems to contribute similar evidence to that presented by Alonso (1995), but it should be considered with caution, given the limited number of models compared. The decisive factor in the choice of a symmetrical model, like the GARCH(1,1), is the lack of significance[9] of

[9] Significance determined from the consistent estimates by computing the quasi-maximum likelihood covariances and standard errors using the methods described by Bollerslev and Wooldridge (1992).

the parameters that determine the sensitivity of the conditional variance to the asymmetry[10] factor. The estimates done by maximum likelihood, allow us to conclude, not only for the TGARCH model, but for the EGARCH model as well, the insensitivity of the volatility to the sign of the unexpected events in all of the cases studied. In Annex 2, the results of those estimates are presented.

Table 5: SIC Magnitudes.

In this table we show the value of the SIC expression for each of the proposed models. By columns, each of the proposed specifications for modeling the return behaviour (where p is the number of lags and q is the number of leads on the IBEX35 index returns in the original market model). By lines (reading across), each of the five models proposed for the study of the conditional volatility. According to the logic of the SIC approach, the model with the highest value is the best.

	Market Model (p=0; q=0)	***Model II (p=1; q=0)***	***Model III (p=1; q=1)***	***Model IV (p=2; q=2)***
OLS	*6.5390*	*6.6283*	*6.6074*	*6.5812*
ARCH(1)	*6.8348*	*6.9297*	*6.9177*	*6.8955*
GARCH(1,1)	*6.8397*	***6.9341***	*6.9166*	*6.8907*
TGARCH(1,1)	*6.8209*	*6.9150*	*6.8974*	*6.8725*
EGARCH(1,1)	*6.8341*	*6.9208*	*6.9035*	*6.8703*

SIC=2*ln(L_{ML})/T - K ln(T)/T, where L_{ML} is the value of the maximum likelihood function (given the distribution of the random disturbance term) evaluated by K parameter for a sample of T observations.

We therefore conclude that the best way to model the volatility of the portfolio returns is by the GARCH (1,1) specification; in this sense, the evidence for the series considered agrees with that of Lamoreaux and Lastrapes (1990).

Consequently, let us consider the return and volatility model defined by the market model lagged by one period and the GARCH (1,1) structure in the conditional variance of the random error term:

[10] The sensitivity of the conditional variance logarithm in the case of the EGARCH model.

$$
\begin{aligned}
&R_t = \alpha + \beta_1 RM_t + \beta_2\, RM_{t-1} + h_t^{1/2}\,\eta_t \\
&h_t = \mu + \xi_1\, \varepsilon_{t-1}^2 + \varphi_1\, h_{t-1} \\
&\varepsilon_t = h_t^{1/2}\,\eta_t\,;\ \ \eta_t\ \ i.i.d., E(\eta_t) = 0,\ E(\eta^2{}_t) = 1\ \ ;\ \varepsilon_t / \Omega_t \sim N(0, h_t)
\end{aligned}
\qquad \textbf{(3)}
$$

where, η_t *is a gaussian white noise process;* h_t *is the conditional variance (volatility);* μ is *the mean conditional variance;* ξ_1*, the sensitivity of the conditional variance to the arrival of news in the previous period;* φ_1 *is the sensitivity of the conditional variance to a lag; and* ε_t *is the random disturbance of the model.*

To this specification of the return and volatility of the portfolio, a series of binary variables are added in the equation for the mean. The purpose of this is to reflect the mean effect, during a given period of time, that the event could have on the average unexpected returns and the average accumulated abnormal returns[11]. The use of the dummy variable to measure and contrast the impact of a given event on the return provides, according to Karafiath (1988), similar results to those obtained with the traditional event study method but, from a methodological point of view, is more efficient than the traditional method. The resulting model is as follows:

$$
\begin{aligned}
&R_t = \alpha + \beta_1 RM_t + \beta_2\, RM_{t-1} + \gamma_1 D_{1(-j)} + \gamma_2 D_{2(j)} + h_t^{1/2}\,\eta_t \\
&h_t = \mu + \xi_1\, \varepsilon_{t-1}^2 + \varphi_1\, h_{t-1} \\
&\varepsilon_t = h_t^{1/2}\,\eta_t\,;\ \ \eta_t\ \ i.i.d., E(\eta_t) = 0,\ E(\eta^2{}_t) = 1\ \ ;\ \varepsilon_t / \Omega_t \sim N(0, h_t) \\
&j = 5,10,15,20,25,30,35,40,50,60,80,100,120\ \ days.
\end{aligned}
\qquad \textbf{(3.1.)}
$$

Where $D_{1(-j)}$ and $D_{2(j)}$ represent dummy variables associated with time intervals (expressed in days) of *j* durations. Therefore, taking the first day of July, (the event date) as a reference, different windows of identical duration *(j)* are arbitrarily chosen, both preceding and following the event date. The binary variables $D_{1(-j)}$ and $D_{2(j)}$ take a value of 1 during the periods *(-j)* and *(j)* respectively and of

[11] The study done on the average acummulate abnormal returns is not different from that of the average abnormal returns which is shown below.

zero during the remaining time interval. In total, 13 time intervals have been considered comprised of between 5 and 120 days.

The impact of the change in negotiating system on the volatility of the asset returns can be determined by measuring the impact on the average level of the conditional variance that the event could generate; therefore, following a methodology similar to the one previously employed, the binary variables $D_{1(-j)}$ and $D_{2(j)}$ are introduced into the structure of the conditional variance of the expression (3), analyzing the following system for each of the intervals j previously considered:

$$\begin{aligned}
&R_t = \alpha + \beta_1 RM_t + \beta_2 RM_{t-1} + h_t^{1/2}\eta_t \\
&h_t = \mu + \xi_1 \varepsilon_{t-1}^2 + \varphi_1 h_{t-1} + \gamma_1^* D_{1(-j)} + \gamma_2^* D_{2(j)} \qquad \textbf{(3.2.)} \\
&\varepsilon_t = h_t^{1/2}\eta_t ; \;\; \eta_t \;\; i.i.d., E(\eta_t) = 0, \; E(\eta^2{}_t) = 1 \;\; ; \;\; \varepsilon_t / \Omega_t \sim N(0, h_t)
\end{aligned}$$

Where γ_1^* and γ_2^* measure the sensitivity of the autonomous coefficient of the conditional variance in the time periods considered. The rest of the variables and parameters have previously been defined.

The most efficient way of doing the analysis is by estimating the effect jointly, on the return and the volatility, beginning with just one system that incorporates the binary variables previously defined. Consequently, they incorporate the variable dummy into the equation for the mean and the conditional variance, with which, the model that is finally considered is as follows[12]:

$$\begin{aligned}
&R_t = \alpha + \beta_1 RM_t + \beta_2 RM_{t-1} + \gamma_1 D_{1(-j)} + \gamma_2 D_{2(j)} + h_t^{1/2}\eta_t \\
&h_t = \mu + \xi_1 \varepsilon_{t-1}^2 + \varphi_1 h_{t-1} + \gamma_1^* D_{1(-j)} + \gamma_2^* D_{2(j)} \qquad \textbf{(4)} \\
&\varepsilon_t = h_t^{1/2}\eta_t ; \;\; \eta_t \;\; i.i.d., E(\eta_t) = 0, \; E(\eta^2{}_t) = 1 \;\; ; \;\; \varepsilon_t / \Omega_t \sim N(0, h_t)
\end{aligned}$$

---

[12] The models (3.1) and (3.2) were estimated separetly, and the results were not different from those of model (4), shown below.

Model (4) was estimated by maximum likelihood for the daily returns of the period from October 21st 1997 to December 31st 1998. As the aggregation of the individual returns to form the portfolio returns generates the well-known heteroskedasticity problem, the standard errors were determined from the variances and covariances matrix calculated by the quasi-maximum likelihood process described by Bollerslev and Wooldridge (1992). This method not only allows us to carry out an inference on the estimates that are consistent in the possible heteroskedasticity, but also in the possible absence of conditional normality in the residuals of the regression. The estimates carried out for each of the 13 time periods considered are presented in Tables 6.1. and 6.2.

The clear significance of the β_1 and β_2 coefficients can be observed for every time period considered, taken approximate values of 0.18 and 0.12 respectively. On the other hand, the coefficient of the mean return is not significantly different from zero. The coefficients of the conditional variance of the GARCH(1,1) structure are also significant. When we observe the γ_1 and γ_2 coefficients, it is clear that there was no extraordinary impact on the level of the mean portfolio returns ($\hat{\gamma}_1$ is negative and non-significant in any period) during any of the periods previous to the event date. In the period of approximately 15 days following the negotiating change, however, the mean portfolio returns suffered a systematic drop, measured by $\hat{\gamma}_2$, which is negative and significant. This fact continues for an additional period of approximately 15 days, from which point onwards, the drop in mean returns disappears and it is no longer significantly different from zero in any of the other time intervals considered. This fact seems to indicate a negative reaction by the market to the change in the trading system.

Table 6.1. Effect of the Fixing System on Returns and Volatility:
Estimation results.

Results of the estimates done for Model (4) by the maximum likelihood method (assuming conditionally normally distributed errors), given the different durations of time j that appear in the first column. The coefficients γ_i and γ_i^* ($i = 1,2;$) reflect the sensitivity of the portfolio returns and volatility in respect of the *dummy* variables $D_{1(-j)}$ and $D_{2(j)}$. They take the values 1 in the periods *(-j) and (j)* respectively and zero in the remaining time interval. For each interval the estimates of the parameters and the p-values (in brackets) under the robust covariance matrix estimator given by the method of Bollerslev-Wooldridge (1992) are given.

COEFFICIENTS	C	β_1	β_2	γ_1	γ_2	μ	ξ_1	φ_1	γ^*_1	γ^*_2
5 days	-0.000 [0.560]	0.212 [0.000]	0.145 [0.000]	-0.003 [0.095]	**-0.003** **[0.036]**	1.6E-05 [0.001]	0.369 [0.035]	0.335 [0.027]	-7.1E-06 [0.416]	**-4.9E-06** **[0.558]**
10 days	-0.000 [0.495]	0.187 [0.000]	0.122 [0.000]	-0.000 [0.593]	**-0.004** **[0.010]**	1.3E-05 [0.000]	0.645 [0.001]	0.2532 [0.027]	-4.9E-07 [0.968]	**3.E-06** **[0.719]**
15 days	-0.000 [0.677]	0.185 [0.000]	0.123 [0.000]	-0.001 [0.147]	**-0.002** **[0.198]**	1.5E-05 [0.000]	0.607 [0.002]	0.246 [0.040]	-3.6E-06 [0.628]	**-2.3E-06** **[0.838]**
20 days	-0.000 [0.521]	0.203 [0.000]	0.140 [0.000]	-0.000 [0.461]	**-0.001** **[0.329]**	1.9E-05 [0.000]	0.518 [0.007]	0.227 [0.086]	-8.6E-06 [0.192]	**-1.1E-06** **[0.921]**
25 days	-0.000 [0.729]	0.177 [0.000]	0.117 [0.000]	-0.000 [0.567]	**-0.001** **[0.177]**	1.4E-05 [0.000]	0.671 [0.000]	0.236 [0.027]	-7.3E-07 [0.913]	**6.2E-06** **[0.542]**
30 days	-1.2E-05 [0.973]	0.175 [0.000]	0.120 [0.000]	-0.000 [0.234]	**-0.002** **[0.055]**	1.6E-05 [0.000]	0.679 [0.000]	0.191 [0.029]	-3.E-06 [0.620]	**8.E-06** **[0.445]**
35 days	1.9E-05 [0.961]	0.175 [0.000]	0.122 [0.000]	-0.000 [0.328]	**-0.001** **[0.231]**	1.9E-05 [0.000]	0.627 [0.000]	0.174 [0.062]	-8.6E-06 [0.099]	**9.7E-06** **[0.404]**

$$R_t = \alpha + \beta_1 RM_t + \beta_2 RM_{t-1} + \gamma_1 D_{1(-j)} + \gamma_2 D_{2(j)} + h_t^{1/2}\eta_t$$

(4) $$h_t = \mu + \xi_1 \varepsilon_{t-1}^2 + \varphi_1 h_{t-1} + \gamma_1^* D_{1(-j)} + \gamma_2^* D_{2(j)}$$

$$\varepsilon_t = h_t^{1/2}\eta_t ; \quad \eta_t \ i.i.d., E(\eta_t) = 0, \ E(\eta^2{}_t) = 1 \quad ; \quad \varepsilon_t / \Omega_t \sim N(0, h_t)$$

where R_t shows the portfolio returns and RM_t shows the IBEX35 index returns for each observation at time *t*.

Table 6.2. Effect of the Fixing System on Return and Volatility: Estimation results.

Results of the estimates done for Model (4) by the maximum likelihood method (assuming conditionally normally distributed errors), given the different durations of time j that appear in the first column. The coefficients γ_i and γ_i^* ($i = 1,2;$) reflect the sensitivity of the portfolio returns and volatility in respect of the *dummy* variables $D_{1(-j)}$ and $D_{2(j)}$. They take the values 1 in the periods *(-j) and (j)* respectively and zero in the remaining time interval. For each interval the estimates of the parameters and the p-values (in brackets) under the robust covariance matrix estimator given by the method of Bollerslev-Wooldridge (1992) are given.

COEFFICIENTS	C	β_1	β_2	γ_1	γ_2	μ	ξ_1	φ_1	γ^*_1	γ^*_2
40 days	-1.5E-05 [0.967]	0.176 [0.000]	0.122 [0.000]	-0.000 [0.528]	**-0.001** **[0.107]**	1.8E-05 [0.000]	0.652 [0.000]	0.178 [0.054]	-7.3E-06 [0.179]	**6.8E-06** **[0.512]**
50 days	-4.3E-05 [0.914]	0.172 [0.00]	0.124 [0.000]	-0.000 [0.461]	**-0.001** **[0.344]**	1.8E-05 [0.000]	0.648 [0.000]	0.168 [0.0608]	-7.7E-06 [0.105]	**1.4E-05** **[0.226]**
60 days	-6.1E-05 [0.884]	0.179 [0.000]	0.130 [0.000]	-0.000 [0.387]	**-0.000** **[0.468]**	1.8E-05 [0.000]	0.617 [0.000]	0.142 [0.122]	-8.E-06 [0.097]	**2.4E-05** **[0.078]**
80 days	-1.6E-05 [0.972]	0.206 [0.000]	0.12 [0.000]	-0.000 [0.360]	**-0.001** **[0.152]**	1.5E-05 [0.000]	0.569 [0.001]	0.164 [0.112]	-4.0E-06 [0.348]	**2.8E-05** **[0.036]**
100 days	-0.000 [0.585]	0.199 [0.000]	0.128 [0.000]	-0.000 [0.825]	**-0.000** **[0.569]**	1.3E-05 [0.000]	0.603 [0.000]	0.158 [0.092]	-1.2E-06 [0.769]	**2.5E-05** **[0.026]**
120 days	-9.E-05 [0.897]	0.200 [0.000]	0.126 [0.000]	-0.000 [0.893]	**-0.000** **[0.380]**	1.5E-05 [0.003]	0.610 [0.001]	0.174 [0.081]	-3.9E-06 [0.465]	**1.5E-05** **[0.102]**

$$R_t = \alpha + \beta_1 RM_t + \beta_2 RM_{t-1} + \gamma_1 D_{1(-j)} + \gamma_2 D_{2(j)} + h_t^{1/2}\eta_t$$

(4) $$h_t = \mu + \xi_1 \varepsilon_{t-1}^2 + \varphi_1 h_{t-1} + \gamma_1^* D_{1(-j)} + \gamma_2^* D_{2(j)}$$

$$\varepsilon_t = h_t^{1/2}\eta_t;\quad \eta_t\ \ i.i.d., E(\eta_t)=0,\ E(\eta^2{}_t)=1\quad;\quad \varepsilon_t/\Omega_t \sim N(0,h_t)$$

where R_t shows the portfolio returns and RM_t shows the IBEX35 index returns for each observation at time *t*.

Observing the estimated coefficients γ_i^* associated with the dummy variables, the behaviour of the mean daily volatility could also be attributed to the change in the trading system. While γ_1^* estimates are negative and not significant in all the cases, the γ_2^* coefficients are positive in the majority of the cases and not significant in any, except for the periods of 80 and 100 days following the event, in which case they are positive and significant. Based on this evidence and on the methodology employed, we can conclude that the change in negotiating system did not significantly alter the level of daily conditional variance of the portfolio.

6. CONCLUSIONS

Our work has focused on evaluating the repercussions that the change in trading system, from the continuous market to the Fixing system, has had on the negotiation levels, returns and volatility of the stocks involved. The main objective of the study, therefore, was to evaluate the effects of the new trading system by comparing the expected results (which were the basis for the change) with the actual results observed, in the belief that any innovation or modification imposed on the market should be empirically evaluated. The evidence against the change can be summarized as follows:

1) Liquidity.

In contrast to the expected increase in this variable by the advocates of the Fixing system, this study has not found any indications of such an improvement during the time period examined. On the contrary, significant decreases are detected in the negotiating activity for the periods immediately following the change.

2) Asset Returns.

We have observed, for the group of stocks that were subjected to the negotiation change, an immediate and systematic reduction in the average return. This decrease is undoubtedly related to the deterioration of the liquidity, as previously commented, which can be interpreted as a clear penalization by the investors of the stocks that abandoned the continuous trading system.

3) Volatility

With regard to the expected reduction in volatility, no significant reductions have been observed in the level of the average volatility of the returns. On the contrary, in the longer time periods, an increment is actually observed in this variable. This evidence has been proven with the return-volatility model described of in this paper, that is to say, with the market model with a lag and volatility model based on the GARCH(1,1) specification. Nevertheless, an exploratory study of these results, employing the other alternative specifications referred to in this work, concluded in similar evidence.

Therefore, the fundamental conclusion of this study, (based on the methodology employed, and for the sample time period considered), is that the expectations of the advocates of the Fixing system, (which were the very motive for its implementation), have not been fulfilled.

It is reasonable to conjecture, at least for the time being, that the investors might have not perceived the Fixing system in the way as its promoters. In this way, they obviously might see the change as a penalization imposed on these shares by the market. That is to say, as a degradation or descent in category, making these assets less attractive. This evidence, therefore, could show a dependence between the possible success of the microstructural innovations that can be carried out in small markets (as the Spanish example is) and the correct interpretation by its investors of the causes that motivate such changes. If this is really the case, it would indicate the necessity for a greater information effort on behalf of the promoters of the new system to explain their true motives. Furthermore, the evidence observed in this specific case could hardly be an isolated irrepetible case and should therefore be considered in the case of any other innovation or alteration that is carried out in the future.

On the other hand, it is important to bear in mind that the imposition of the Fixing system supposes an important change in the trading system for the stocks involved. Both systems have their own special characteristics that are valued in different ways, according to the type of investor. So that what may be a clear advantage for one group of investors may well be an inconvenience for another. What is required, therefore, is a system that pleases the majority of the investors. In the case of the Fixing system in the Spanish market, it is possible that the change from a system that offered the possibility of executing purchase and sale orders immediately at any moment during a day's trading session to a new system in which trading is only permitted at two specific moments, has been a far too dramatic change for a certain group of investors. The results observed might well indicate the rejection by investors who were quite satisfied with the way in which the trading was previously done. This would again indicate the need for a greater effort, on behalf of the promoters of the Fixing system to explain the characteristics and possible advantages of the new negotiating system, on the one hand, and, on the other, the need for more careful planning in the case of implementing innovations that imply drastic changes.

Finally, we must point out that this negotiating system is totally new in Spanish market. Therefore, although initially it may not have generated the foreseen results, we shall have to wait until this system is totally consolidated to arrive at definite conclusions.

ANNEXES

Annex 1: Mathematical specifications of the retun and volatility models employed.

Annex 1.1: Specifications for portfolio returns.

Model	Specification
General Model	$R_t = \alpha + \beta_1 RM_t + \sum_{i=1}^{p} \beta_{i+1} RM_{t-i} + \sum_{j=1}^{q} \beta_{p+1+j} RM_{t+j} + \varepsilon_t$
Market Model (Model I) *(p=0, q=0)*	$R_t = \alpha + \beta_1 RM_t + \varepsilon_t$
Model II *(p=1; q=0)*	$R_t = \alpha + \beta_1 RM_t + \beta_2 RM_{t-1} + \varepsilon_t$
Model III *(p=1; q=1)*	$R_t = \alpha + \beta_1 RM_t + \beta_2 RM_{t-1} + \beta_3 RM_{t+1} + \varepsilon_t$
Model IV *(p=2; q=2)*	$R_t = \alpha + \beta_1 RM_t + \sum_{i=1}^{2} \beta_{i+1} RM_{t-i} + \sum_{j=1}^{2} \beta_{p+1+j} RM_{t+j} + \varepsilon_t$

Annex 1.2: Mathematical specificationes for volatility.

Model	Specification
ARCH(p) (*Engle, 1982*)	$Y_t = \alpha + \beta' X_t + h_t^{1/2} \eta_t$ $h_t = \mu + \sum_{i=1}^{p} \xi_i \varepsilon_{t-1}^2$ $\varepsilon_t = h_t^{1/2} \eta_t;\ \ \eta_t\ i.i.d., E(\eta_t) = 0,\ E(\eta^2{}_t) = 1\ ;\ \varepsilon_t / \Omega_t \sim N(0, h_t)$
GARCH(p,q) (*Bollerslev, 1986*)	$Y_t = \alpha + \beta' X_t + h_t^{1/2} \eta_t$ $h_t = \mu + \sum_{i=1}^{p} \xi_i \varepsilon_{t-1}^2 + \sum_{j=1}^{q} \varphi_j h_{t-j}$ $\varepsilon_t = h_t^{1/2} \eta_t;\ \ \eta_t\ i.i.d., E(\eta_t) = 0,\ E(\eta^2{}_t) = 1\ ;\ \varepsilon_t / \Omega_t \sim N(0, h_t)$
EGARCH(p,q) (*Nelson, 1990*)	$Y_t = \alpha + \beta' X_t + h_t^{1/2} \eta_t$ $\ln(h_t) = \mu + \sum_{i=1}^{p} (\xi_i \lvert \frac{\varepsilon_{t-i}}{(h_{t-1})^{1/2}} \rvert + \vartheta_i \lvert \frac{\varepsilon_{t-i}}{(h_{t-1})^{1/2}} \rvert) + \sum_{j=1}^{q} \varphi_j \ln(h_{t-j})$ $\varepsilon_t = h_t^{1/2} \eta_t;\ \ \eta_t\ i.i.d., E(\eta_t) = 0,\ E(\eta^2{}_t) = 1\ ;\ \varepsilon_t / \Omega_t \sim N(0, \ln(h_t))$
TGARCH(p,q) (*Zakoïan, 1994*)	$Y_t = \alpha + \beta' X_t + h_t^{1/2} \eta_t$ $h_t = \mu + \sum_{i=1}^{p} \xi_i \varepsilon_{t-1}^2 + \vartheta \varepsilon_{t-1}^2 D_{t-1} + \sum_{j=1}^{q} \varphi_j h_{t-j};$ $donde\ D_{t-1} = 1\ si\ \varepsilon_{t-1}^2 < 0;\ D_{t-1} = 0\ en\ otro\ caso.$ $\varepsilon_t = h_t^{1/2} \eta_t;\ \ \eta_t\ i.i.d., E(\eta_t) = 0,\ E(\eta^2{}_t) = 1\ ;\ \varepsilon_t / \Omega_t \sim N(0, h_t)$

Annex 2: Results of the estimates of the coefficients of the conditional variance given the different specifications for the mean: Estimates and significance.

In the following tables, the parameters estimated by maximum likelihood (assuming conditionally normally distributed errors) are shown. Among brackets, the p-values under the robust covariance matrix estimator given by the method of Bollerslev-Wooldridge (1992) are given.

Annex 2.1: Coefficients for the volatility in the Market Model.

Specification	μ	ξ_1	φ_1	ϑ
ARCH(1)	2.E-05 [0.000]	0.776 [0.000]	-	-
GARCH(1,1)	1.8E-05 [0.0002]	0.669 [0.003]	0.212 [0.082]	-
EGARCH(1,1)	-4.846 [0.000]	1.005 [0.000]	0.582 [0.000]	0.067 [0.610]
TGARCH(1,1)	1.9E-05 [0.000]	0.633 [0.012]	0.209 [0.080]	0.078 [0.850]

Annex 2.2: Coefficients for the volatility in Model II (market model laged by one period).

Specification	μ	ξ_1	φ_1	ϑ
ARCH(1)	2.7E-05 [0.000]	0.726 [0.000]	-	-
GARCH(1,1)	1.5E-05 [0.000]	0.689 [0.000]	0.220 [0.042]	-
EGARCH(1,1)	-3.757 [0.000]	0.826 [0.000]	0.683 [0.000]	0.135 [0.197]
TGARCH(1,1)	1.5E-05 [0.000]	0.690 [0.010]	0.220 [0.044]	-0.001 [0.997]

Annex 2: Results of the estimates of the coefficients of the conditional variance given the different specifications for the mean: Estimates and level of significance.

In the following tables, the parameters estimated by maximum likelihood (assuming conditionally normally distributed errors) are shown. Among brackets, the p-values under the robust covariance matrix estimator given by the method of Bollerslev-Wooldridge (1992) are given.

Annex 2.3: Coefficients for the volatility in the model III (market model lagged and leading by one period).

Specification	μ	ξ_1	φ_1	ϑ
ARCH(1)	2.7E-05 [0.000]	0.718 [0.0000]	-	-
GARCH(1,1)	1.5E-05 [0.000]	0.688 [0.000]	0.209 [0.051]	-
EGARCH(1,1)	-3.973 [0.000]	0.846 [0.000]	0.663 [0.000]	0.124 [0.243]
TGARCH(1,1)	1.6E-05 [0.000]	0.677 [0.009]	0.207 [0.055]	0.028 [0.997]

Annex 2.4: Coefficients for the volatility in the model IV (market model lagged and leading by two periods).

Specification	μ	ξ_1	φ_1	ϑ
ARCH(1)	2.5E-05 [0.000]	0.767 [0.000]	-	-
GARCH(1,1)	1.6E-05 [0.000]	0.732 [0.000]	0.174 [0.049]	-
EGARCH(1,1)	-4.048 [0.000]	0.847 [0.000]	0.655 [0.000]	0.115 [0.302]
TGARCH(1,1)	1.6E-05 [0.000]	0.671 [0.007]	0.207 [0.055]	0.170 [0.660]

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