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ESSAYS IN MARKET MANIPULATION AND INSIDER TRADING

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Essays in Market Manipulation and Insider Trading

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Chapter 1

Intraday Cross-Markets Manipulation: the Italian Cases on Stocks

1. Introduction

The aim of this research is to test empirically some of the main economic propositions and regulatory issues concerning stock market manipulation. In particular, the analyses refer to trade-based manipulation strategies carried out during a single trading day, and which typically last just for a few minutes.

This paper is based on a unique dataset on stock market manipulation cases enforced by Consob, the Italian securities regulator, during the last fifteen years.

The kind of manipulative strategies examined here is called "price positioning" by CESR, the European network of securities regulators, which falls within the trade-based manipulation strategies (Allen and Gale, 1992). These manipulative strategies are based on actual trades and not on spreading false information, or on carrying out fictitious trades (such as pre-arranged trades or wash sales): therefore, the manipulator opens, but probably only apparently (Jarrow, 1992), a risky position in the market, often, as in the sample examined, to gain from positions already opened in related markets.

In "price positioning" schemes the manipulator is not interested in sending false or misleading signals to other market participants, as typically happens in pump & dump schemes, but just in fixing the price at a desired level, which is useful for closing positions opened in other markets or for matching some other manipulator's interests. According to CESR, possible examples of price positioning strategies are given by (a) the company which tries to sustain the price pattern of its stocks, (b) the market maker that quotes excessive bid-ask spreads, (c) the investor who trades on one market to improperly fix the stock price on a related market, and (d) the fund manager who alters the last price of the stocks in the portfolio fund so as to increase its value, corners and abusive squeezes.

The mentioned examples of price positioning can last many days, weeks or even months, while the dataset examined here is only focused on cases which last at most one day, typically for a few minutes.

The relevance of this paper should be understood in light of the lack of empirical evidence in this field. While securities regulation deals with the issues of market manipulation from a very late stage (Garber, 2000), and while microeconomic theory found its first sound building blocks in the 90's, only very recently have a few papers tested what the theories predict and looked at to what extent securities regulation is going in the right direction. Three dataset on market manipulation actually enforced by the authorities have been examined, all related to US markets: that of pump & dump schemes from January 1990 to October 2001 (Aggarwal and Wu, 2006), that of stock pools in the late 20's (Mahoney, 1999, and Jiang, Mahoney and Mei, 2005) and that of corners in commodity and stock markets (Allen, Litov and Mei, 2004).

According to these studies, it seems that today the risk of trade-based manipulation is not so relevant. Aggarwal and Wu (2006) show that from 1990 to 2001 the US SEC enforced only 3 cases on the NYSE, while most of the 142 enforced cases occurred on the OTC Bulletin Board and Pink Sheets markets. Allen, Litov and Mei (2004) examine cases of corners on the NYSE and they found only 13 cases, the last one took place in 1928. Jiang, Mahoney and Mei (2005) show that the famous cases of stock pools, which are similar to pump & dump schemes, actually did not cause serious damages to investors, so they explicitly conclude challenging the need of establishing an authority responsible for detecting and enforcing market manipulation, as happened in the US during the 30's and everywhere in the world later on. Finally, also a field experiment with racetrack betting run by Camerer (1998) shows that it should not be possible to systematically manipulate the market.

This view coincides with the position of several scholars of the Chicago law school (Fischel and Ross, 1991) who claim that the enforcement costs are excessively high compared to the benefits for the integrity of the market (i.e. a market free of the risk of insider trading and market manipulation), which, on the opposite side, regulators and several economists believe necessary to enhance market confidence, the trust investors need when they decide to enter into the market.

Matching the latter view, this research shows the noticeable results of a wide and recent experience of enforcing market manipulation in a primary European stock exchange, where several cases of market manipulation have been detected in very liquid stocks. It is shown that even though these cases last just for a few minutes, they could produce serious consequences for investors and market efficiency not only on the day when the manipulative action takes place, but also in subsequent days.

Returns, turnover and volatility have been examined at daily frequency with OLS and GARCH(1,1) models over a sample of 66 cases.

Using dummy variables in time series OLS regressions, it has been shown that market manipulation has a significant impact on returns in 48% of the sample cases (2.58% in absolute terms, st. dev. 2.46%). This effect increases up to 71% if returns are based on the specific manipulated auction prices (4.36%, st. dev 3.67%). As to the impact on volumes, it is significant in 47% of the cases. Further dummies show similar significant effects also in the three subsequent days both on returns and volumes. As to the impact on volatility, GARCH(1,1) models exhibit significant effects in 13% of the sample cases, and in higher percentages in the three subsequent days.

Revealing pictures on returns and volatilities dynamics around the manipulative day have been found through event-studies using both OLS and GARCH(1,1) models. That on returns shows that in the manipulative day a significant effect occurs, which is followed by a relevant (but less significant) bounce back effect. So, returns exhibit some degree of persistence of the shock generated by the manipulative action in the subsequent days.

Very interesting is the event study on the conditional standard deviation based on GARCH(1,1) models and OLS models designed with similar specification and standard deviations computed at different lengths (at 5, 20 and 60 days). All the models indicate that after the manipulative day there is a significant increase in the day-after forecasted volatility. The bounce back effect makes the shock persistent in the subsequent day, dying out at a low rate during approximately further 5 days. The shock computed through OLS models shows stronger persistency. It is absorbed in approximately 10 days if standard deviation is computed at 5 days, and more than 20 days if it is computed at 20 or 60 days.

All these effects seem strong enough to conclude that trade-based manipulation can not be neglected even if it refers to the type of “price positioning” strategies, which are those strategies not intended to deceive or mislead other investors, and even if this type of manipulation occurs in very low scale, namely when it concerns one-day strategies and last for just a few minutes.

A further group of issues refers to the conditions which make more likely the occurrence of intra-day price positioning strategies. In particular, it seems important to test if liquidity, volatility and market microstructure rules matter. As to liquidity, previous empirical studies seem to suggest that market manipulation is not an issue in liquid markets. Concerning volatility, Hart (1977) shows that trade based manipulation is easier if the economy is dynamically unstable, while Jarrow (1992) suggests the importance of momentum in the price pattern. As to market microstructure rules, regulators often say that these are the best tool for preventing trade-based manipulation (FESCO, 2001).

This research shows that many cases of market manipulation enforced in Italy refer to very liquid stocks. This evidence does not imply that liquidity is not a relevant mean in combating market manipulation, but it highlights that market manipulation strategies can not be fully stopped by high liquidity since there are many investors with endowment enough to successfully alter the price pattern of very liquid stock for a few determinant minutes or seconds during the trading day.

As to volatility, the mentioned event studies demonstrate that, before the occurrence of market manipulation of the price positioning type, returns and volatility do not exhibit momentum or unstable patterns. Nevertheless, the sample shows that many cases of market manipulation occur at the beginning or at the end of the trading day, which are typically the more volatile phases during the trading day (Goodhart and O’Hara, 1995).

As to market microstructure rules, it seems important to point out that, as a matter of facts, three out of the six types of price positioning schemes which have been enforced by Consob can not be put in place nowadays (at least with the same simplicity), due to the improvement of related microstructure rules.

Nevertheless, it is important to underline that there are at least three reasons that can make intra-day price positioning manipulation strategies a relevant issue in today’s stock markets. First, thanks to technological developments and new regulatory set ups investors can have direct access to the market through the internet, so professional intermediaries are not always able to filter or dampen abusive orders, as in the past. Second, the increasing number of trading venues, encouraged in the EU by the new Mifid directive, should multiply the non-synchronous trading among securities, and that could increase situations where people try to manipulate the price of related securities or markets. Third, the speedy development of derivatives and structured products increases the interrelation between securities and markets, and therefore it creates again the mentioned situations.

In other words, notwithstanding the relevance of the increase of market liquidity, of more appropriate market microstructure rules and of more advanced disclosure requirements in order to reduce the scope for trade-based manipulation, these strategies should remain a risk in modern stock markets that could be significantly reduced only if adequate detection systems are developed, as Consob and other regulators do by using the recent availability of high frequency data (Minenna, 2003a, CESR, 2007b).

Regulators, exchanges, intermediaries, asset management companies, hedge funds, issuers and other operators are increasingly involved in this area either for surveillance or compliance purposes. Regulators and exchanges are interested in detecting market manipulation for institutional issues, while intermediaries and institutional investors are interested in preventing their dishonest customers, managers or traders from being induced into manipulation schemes, which dilute their reputations.

In this respect, here a detection strategy has been analysed using value-at-risk (VaR) violations, based on the estimated conditional standard deviations through both the GARCH(1,1) and OLS models above mentioned. Actual returns have been compared for each stock with the next-day predicted oscillation band at standard confidence levels (99%, 95%, 90%). The exercise shows that 50% of the sample cases can be identified looking at violations that occur on log returns in the three subsequent days at 95% confidence level. These results can be improved working on the underlying models and on the interrelation among variables.

This paper is organised as follows. Section 2 summarises the literature on market manipulation, Section 3 reports a review of the empirical studies, Section 4 outlines the Italian case, Section 5 illustrates some examples of price positioning schemes, Section 6 exhibits time series analyses, Section 7 shows event studies, Section 8 examines VaR violations, and Section 9 provides a short summary.

2. Economic theories on trade-based manipulation

Market manipulation can be defined as an improper action intended to modify the price pattern of a financial instrument that would otherwise arise without this action (the counterfactual), or, as legal scholars say, that would otherwise arise from the free and proper interplay of market forces (see Chapter 2).

This definition implies that 1) market manipulation is ultimately intended to modify the price pattern (and not just volume or other market variables), 2) the actor's intention characterises his manipulative identity, 3) it is necessary to consider the "proper" or legal behaviour of players (since market-makers and company managers too are legally working in order to modify the price).

As many kinds of actions could suit this definition, a fundamental issue is that of identifying which strategies actually constitute market manipulation. Considering that prices mostly depend on information and on market orders, manipulative strategies are usually based on two means: (a) on the distortion of the public information set, or (b) on the subtle use of market orders and trades, which, in turn, are part of the public information set. Therefore a standard classification of market manipulation is that proposed by Allen and Gale (1992) which, following the US Securities and Exchange Act (1933), distinguishes information-based from trade-based manipulation. A third residual family is that of action-based manipulation.

Interestingly, the recent EU Market Abuse Directive (2003), which bans insider trading and market manipulation, almost follows the same categorisation but introduces a further distinction of trade-based manipulation: a) misleading transactions, and b) price positioning; in the former case the manipulator wants to send false signals to other market participants so as to take advantage of their reactions (misleading transactions), in the latter case the manipulator wants to fix the price at a desired abnormal level without caring about sending false signals (price positioning).

Examples of misleading transactions are trend creations, pump & dump, trash & cash, opening a position and closing it immediately after its public disclosure, manipulative bubbles, pools, etc. Examples of price positioning are the creation of a floor in the price pattern, excessive bid-ask spread, trading on one market to improperly position the price of a financial instrument on a related market, corner, abusive squeeze, colluding in the aftermarket of an IPO, and contract-based manipulation, etc.

The EU Market Abuse Directive classification is useful because it allows a link between trade-based manipulation strategies on the financial econometrics results concerning the informational content of prices (misleading transactions) and on abnormal prices (price positioning).

The economic literature on market manipulation focuses on the conditions under which self-financing market manipulation can occur, and on the effects market manipulation produces on stock market efficiency. Results have policy implications on the enforcement costs of market manipulation and eventually on the need to establish an authority responsible for investigating and prosecuting market manipulation cases.

When dealing with trade-based manipulation, economists have to leave the standard assumption that investors are price-takers to embrace the less explored one, where some investors are price-makers (other than market makers). This is the case of the so called large investors, those who move prices when they trade, because they usually trade huge quantity of shares, which can not be executed in the market without generating a relevant price change.

As for misleading transactions, pump & dump schemes, trend creation and manipulative bubbles, they can be implemented by creating a false trend in the price pattern: thanks to the basic rule of the anonymity of the trades, the manipulator can induce other investors into the belief that insiders are buying shares. He can persuade them to follow the trend, producing herding. Once the trend is established, the manipulator can successfully sell the shares slowly over time without producing a negative impact on the prices.

The basic issue is the, so called, “unravelling problem”. Can a trading strategy be profitable if it is based on two actions, the first consists of buying shares at an increasing price in order to establish a positive trend, and the second consists of selling the shares without producing a symmetric reduction in the price pattern? As long as the two actions produce symmetric effects on prices, the trading strategy does not appear, ex ante, profitable. This answer has been given by several economists, Mill (1921), and legal scholars, Fischel and Ross (1991). Nevertheless, recently, the strategy has been examined very carefully by micro economists, reaching opposite results within different sets of assumptions. The seminal work is that of Hart (1977), which has been subsequently extended by Jarrow (1992), Allen and Gale (1992), Vitale (2000) and Aggarwal and Wu (2006). Also the paper of Allen and Gorton (1992) falls within this field (see Chapter 2).

As for price positioning**,** once it is recognised that a large trader is price-maker and that he can bring the price to a desired level for a few instants or for a longer period, many possible manipulation strategies can be used by him. In price positioning schemes the manipulator is not interested in sending false or misleading signals to other market participants, even though sometimes his action produces this effect. In other words he is not interested in deceiving other investors or in creating herd effects. Price positioning schemes have been examined by Jarrow (1994), Kumar and Seppi (1992), Gerard and Nanda (1993) and Hillion and Suominen (2004).

Jarrow (1994) argues that in the presence of derivatives several manipulation strategies can be implemented by abusing the lack of synchronicity in the price adjustments of derivatives and their underlying assets. For instance, if the stock price systematically follows with a lag that of the related stock future, the manipulator, immediately after having opened a position on the underlying stock can buy the stock future producing an increase in the price patterns of both the stock future and the underlying stock, so that he can successfully liquidate both positions.

Kumar and Seppi (1992) look at the strategy of punching the future market cash settled price: a uniformed large trader can expect positive profit by establishing a position in the future, and then trading on the spot market to manipulate the spot price used to value the cash settlement price at delivery. Also Gerard and Nanda (1993) focused on the interrelationship among markets and, in particular, among primary and secondary markets. They confirmed that manipulations arose because of the difference between the price setting mechanisms of the two markets.

Hillion and Suominen (2004) suggest that brokers (agent) might manipulate the closing price (marking the close) in order to avoid being negatively judged by their customers (principal), who may be disappointed by the differences between the closing price, which is the price they see at the end of the day, and the price of the orders executed by their brokers during the day. Therefore, a broker could engage in market manipulation strategy by pushing the last price toward the average price of the contracts he has already executed on behalf of the customer.

A relevant characteristic of price positioning is the bounce-back effect which follows the manipulative action. Since the manipulative action fixes the price at an abnormal level, when the action stops prices immediately bounce back to the previous equilibrium levels. This occurs in other manipulation schemes too, but over a longer period.

As for those price positioning cases which last just a few minutes (such as those examined in this research), they produce significant price changes but these price changes typically disappear within a short time period, without significantly misleading other market participants. The question is, should those manipulation strategies be banned? In other words, are enforcement costs disproportionately higher than the benefit of cleaning the market from this kind of abuses? Furthermore, is it really possible to implement price positioning strategies in liquid stocks? What is actually the effect of this strategy in the price pattern? These questions will be examined in Sections 6-8.

3. The empirical literature

As mentioned in Section I, only a few recent empirical studies examined cases of market manipulation: the paper of Aggarwal and Wu (2006) on the recent experience in the US stock exchanges, that of Mahoney (1999) and Jiang, Mahoney and Mei (2004) on stock pools (which are closed in nature to pump & dump schemes) in the late 20’s in the US, and that of Allen, Litov and Mei (2004) on corners in the US stock and commodities markets.

Aggarwal and Wu (2006) examined 51 of the collected 142 cases of stock market manipulation enforced by the US SEC from January 1990 to October 2001. These cases are focused on pump & dump strategy in illiquid markets. Only 17% of the cases occurred in the three most important stock markets, NYSE, AMEX and NASDAQ. As for the price direction of the manipulative action, in the US, 84.5% of cases refer to price increases while less than 1% of cases refer to price decreases. Stabilization accounts for 2%. From January 2000 to October 2001, about 39% of all manipulation cases involved the use of Internet to spread false rumors. Following the US SEC press releases, the authors knew only the initial and final dates of the manipulative action for each stock. This period is called the manipulation period and it lasts on average 308 days (median 202 days, st. dev. 332 days, maximum 1,373 days, minimum 2 days). So, they define the pre-manipulation and post-manipulation period the year before and after, respectively, the manipulation period.

Table 1. Aggarwal – Wu (2006) Summary statistics for the manipulated stocks

This table reports summary statistics for the manipulated stocks. Panels A to C report the sample mean, standard deviation, skewness and kurtosis coefficients for daily returns and turnover, for the manipulation period, the 1-year pre- and post- manipulation periods, respectively. The data for return and turnover is panel and volatility is cross-sectional. In Panel D: we report statistics on the length of the manipulation period. The overall sample period is from January 1990 to December 2001.

	Mean	*Standard deviation*	*Skewness*	*Kurtosis*
A – Manipulation period				
Return	*.0274*	*.8933*	*60.66*	*3,939*
Turnover	*.0385*	*.2227*	*11.88*	*422.0*
Volatility	*.5730*	*1.6091*	*3.117*	*19.23*
B – Pre-manipulation period				
Return	*.0169*	*.4880*	*52.93*	*3,433*
Turnover	*.0079*	*.0421*	*37.91*	*1,576*
Volatility	*.2431*	*.4564*	*3.787*	*18.22*
C – Post-manipulation period				
Return	*-.0031*	*.1417*	*8.640*	*189.1*
Turnover	*.0368*	*.2018*	*25.07*	*178.3*
Volatility	*.1189*	*.1322*	*2.779*	*12.71*

If we look at the mean values, returns, turnovers and volatilities increase during the manipulation periods compared to the pre-manipulation periods. In the post-manipulation periods returns and volatilities bounce back to values lower than pre-manipulation period, while turnovers exhibit persistency at the values of the manipulation period.

In order to test their theories the authors run cross-section regressions based on the comparison between the manipulated stocks values (on returns, turnovers and volatilities), and a benchmark built for each manipulated stock on an equally weighted portfolio of 10 stocks, which were in the same size decile of all Center for Research in Security Prices (CRSP) stocks, and which were the closest in estimated betas to that of the manipulated stock. The sample is given by a total of 102 observations: 51 manipulated stocks and 51 benchmark portfolios. The following regressions have been run for the manipulation period, the pre-manipulation period, and the post-manipulation period (where M is a dummy for manipulated stocks). Results are shown in Table 2.

$$\text{Return} = \alpha_0 + \alpha_1 * M + u$$
$$\text{Turnover} = \alpha_0 + \alpha_1 * M + u$$
$$\text{Volatility} = \alpha_0 + \alpha_1 * M + u$$

Table 2. Aggarwal – Wu (2006) Liquidity, Return and Volatility of Manipulated Stocks

This table reports the results for regressing the average daily turnover, return, and volatility over the manipulation, pre-, and post manipulation periods on a constant and a dummy variable equal to one for the stock that was manipulated. For nonmanipulated stocks, we use the average turnover, return, and volatility for the same period as the manipulated stock. The results are based on matching the manipulated stock with a portfolio of 10 stocks in CRSP within the same size decile of the manipulated stock and with betas that are the closest to that of the manipulated stock. The sample has 51 stocks, and the sample period is from January 1990 to December 2001.

	Manipulation period	Pre-manipulation period	Post-manipulation period
A. Liquidity			
α_0	.00514	.00900*	.00539*
	(.01075)	(.00339)	(.00125)
α_1	.055166*	-.00197	.00342
	(.01586)	(.00538)	(.00182)
R^2	10.91%	.24%	4.65%
B. Return			
α_0	-.00080	.00171	.00087
	(.01106)	(.00327)	(.00086)
α_1	.06111*	.00966	-.00093
	(.01631)	(.00506)	(.00122)
R^2	16.32%	5.91%	.77%
C. Volatility			
α_0	.00346	.012376	.01008
	(.01207)	(.03109)	(.00982)
α_1	.11972*	.15638*	.08792*
	(.01795)	(.04817)	(.01398)
R^2	38.51%	15.37%	34.50%

***: 1% significance level; *: 5% significance level. All are one-tailed tests.*

As shown in Panel A, in the manipulation period, liquidity is significantly higher for the manipulated stocks than the benchmarks. Panel B reveals that during the manipulation period the manipulated stocks average daily returns are 6.11% higher than for the benchmarks, and this difference is statistically significant. During the post-manipulation period, average daily returns are not statistically different from those of the benchmarks. This is the bounce-back effect. Panel C reports the volatility, which is computed as the average the standard deviation for the ten benchmark stocks in the portfolio. For all the three periods, volatility is higher for manipulated stocks, and the coefficients are statistically significant. This indicates that manipulation is more likely to happen in volatile stocks. The authors' commented "*These results are interesting in their own right since they establish some basic facts about stock market manipulation in the United States*".

In addition Aggarwal and Wu test some of the predictions of their theoretical model, which has been mentioned in Section 2. Pump & dump schemes are characterised by 4 periods. In time 0, the market is in equilibrium. In time 1, the manipulator enters into the market, pushing the price up (pump). This price change constitutes a signal for other investors (information seekers) who are misled into thinking that the price change is due to insiders. In time 2, the price continues to increase because information seekers are following the trend. During time 2 the manipulator closes his position by selling the stock and exploiting a profit (dump). In time 3, the price decreases because information seekers understand that no positive information is going to be released.

The authors link their theory to their sample as follows: time 0, is the pre-manipulation period, time 1 is the first half of the manipulation period; time 2, is the second half of the manipulation period; time 3, is the post manipulation period. So, they break the manipulation period in two equal sub-periods, because they do not have information about the exact days in which the manipulators actually traded. Therefore they assume that manipulators enter into the market in the first half of the manipulation period while in the second half there is a herding effect due to the reaction of information seekers, and during the second half manipulators close their positions.

The first prediction of their model is that price at time 1 is higher than the price at time 0 and the price at time 2 is higher than the price at time 1. This prediction is confirmed by data and graphical analysis. The second prediction is that returns are higher when there are more information seekers in the market concerned. In other words the amount of trading is increasing in the number of information seekers. Therefore, the authors use the overall level of trading for a manipulated stock as a measure of the level of presence of information seekers. Consequently, they classify manipulated stocks into two groups, one with higher average turnover in the second period and one with low average turnover during that period. The two groups of stocks are formed on the basis of whether the average turnover for the stock is higher or lower than the median average turnover. They then test whether the cumulative return between time 2 (end of the manipulation period) and time 1 (midpoint of the manipulation period) is significantly higher for the high-turnover group than for the low-turnover group. Results show that there is some evidence supporting prediction 2. The authors' comment is "*What is interesting about this result is the extent to which volume matters for returns. Consistent with the model, a large number of active traders is necessary for high returns to the manipulator. (…) in the more general market microstructure literature, the evidence on the relation between volume and the direction of the returns is mixed (see Lee and Swaminathan 2000). Thus this finding is useful in understanding manipulation*".

The third prediction is that returns are increasing in the dispersion in the value of the stock. Therefore the authors sort manipulated stocks by their average daily volatility over the manipulation period and form two groups of stocks based on whether the average volatility for the stock is higher or lower than the median average volatility. They then estimate the difference in average cumulative returns between these groups and test for its statistical significance. Both t-statistics are positive, and the test is significant. The greater the dispersion in the stock value, the greater the returns to the manipulator.

Jiang, Mahoney and Mei [2005] extend the Mahoney (1999) sample to 55 stock pools occurring from 1927 to 1929. These works are relevant because they refer to the famous cases of stock pools, that "*consisted of agreements, often written, among a group of traders to delegate authority to a single manager to trade in a specific stock for a specific period of time, and then to share in the resulting profits or losses. After a lengthy investigation, the Senate Banking and Currency Committee (1934) concluded that pools represented attempts to manipulate the prices of the chosen stocks*".

Their results are summarised as follows. The stocks which were subjected to manipulative schemes are comparable to their associated industry portfolios on measures of size, but are more volatile and liquid. During pools, stocks experience abnormally high trading volumes and returns, but both effects are quite small on average, around 12% and 5%, respectively. Therefore the authors conclude that "*Outside the limited context of penny stocks and other illiquid markets, the evidence of profitable trade-based manipulation is anecdotal*". In addition, during pools also average volatility and liquidity increase. A strong cross-sectional relationship between abnormal turnover and return around the first days of pool formation was detected. Finally, the positive abnormal returns do not reverse neither in the short run nor in the long run, after controlling for several variables. In other words, there was no bounce back effect. In summary, while the pattern of stock price and trading volume could be consistent with market manipulation, there is no evidence that the stock pools' trades drove prices to artificially high levels. Therefore, they conclude that public investors were not harmed by pool operations.

Allen, Litov and Mei (2004) examine 13 attempts of stock corners occurred in the NYSE from 1863 to 1928. Corners are defined as "*a market condition brought about intentionally - though sometimes accidentally – when virtually all of the purchasable, or floating, supply of a company's stock is held by an individual, or group, who are thus able to dictate the price when settlement is called*". Using time series analyses they conclude that market corners tend to increase market volatility and have an adverse price impact on other assets. The presence of large investors makes it extremely risky for short sellers to trade against mispricing in the stock market. This creates severe limits to arbitrage in the stock market that impede market efficiency. Therefore, the authors believe that regulators and exchanges need to ensure that corners do not take place since they are accompanied by severe price distortions.

4. The Italian Cases

Stock market manipulation was banned in Italy in 1991. Table 3 shows the distribution of the 151 cases, which were subject to Consob enforcement activities from 1991 to 2005. Table 3 distinguishes information-based, trade-based manipulation and mixed cases. Each case refers to one security. Also more that one case could be due to the same manipulative event. Each event was enforced by Consob sending a file to the public prosecutor. In the period examined Consob could not directly give administrative sanctions, but the courts prosecuted several cases.

Table 3: Distribution of market manipulation cases

Year	Total cases	Information-based	Trade-based	Mixed cases
1992	6	6	0	0
1993	0	0	0	0
1994	6	3	1	2
1995	9	1	8	0
1996	5	1	4	0
1997	37	1	34	2
1998	10	0	7	3
1999	5	0	2	3
2000	8	0	6	2
2001	12	2	9	1
2002	33	1	22	10
2003	8	1	7	0
2004	8	7	0	1
2005	4	1	2	1
Total	*151*	*24*	*102*	*25*

Mixed cases refer to 22 cases of pump & dump, 2 cases of price stabilisation and 1 case of concealing ownership.

Compared with the cases enforced in the US on the NYSE, AMEX and the Nasdaq markets during the same period, Table 3 represents a significant number of cases. This difference could hardly be due to the minor liquidity or efficiency of the Italian Stock Exchange, since many cases occurred in liquid stocks. According to the FESE (2000), in January 2000 the Italian Stock Exchange was ranked the third largest market in Europe as to turnover in the electronic order book transactions.

Interestingly, all the trade-based manipulation cases have been detected after 1994, where the Italian Stock Exchange moved from an outcry to a computerised system. This suggests the relevance of IT tools in detecting trade-based manipulation.

Table 4 illustrates the types of manipulation strategies and their related price directions. Manipulation strategies are more often intended to increase prices than to deflate them. This happens especially for information-based, stabilisation and pump & dump schemes. A large proportion of strategies, aimed at deflating prices, are those of price positioning and relationship among financial instruments. The former is the only one significantly skewed in that direction.

Table 4: Market manipulation strategies and price direction

Manipulation strategies	Total cases	Inflate	Deflate
Information-based manipulation	24	24	0
Trade-based manipulation			
a) Misleading transactions			
- Pump & dump - Trash & cash	41	31	10
- Concealing ownership	1	0	1
b) Price positioning			
- Pure price positioning	23	7	16
- Relationships among stocks or markets	55	32	23
- Price stabilisation	6	6	0
- Squeeze	1	1	0
Total cases	*151*	*101*	*50*
%	*100%*	*67%*	*33%*
Sub-total Misleading transactions	*42*	*31*	*11*
Sub-total Price positioning	*85*	*46*	*39*

Table 5 indicates how many days market manipulation cases lasted. Notice that these statistics refer precisely to the period during which manipulators acted. Therefore, looking at pump & dump, these data are more accurate than those shown by Aggrawal and Wu, since they had to infer the precise period during which manipulators acted.

Table 5 – Average length of market manipulation schemes (days)

Manipulation strategies	Total cases	Inflate	Deflate
Information-based manipulation	28	28	-
Trade-based manipulation			
a) Misleading transactions			
- Pump & dump - Trash & cash	33	33	8
- Concealing ownership	124	-	124
b) Price positioning			
- Pure price positioning	1	1	1
- Relationships among stocks or markets	1	1	1
- Price stabilisation	329	329	-
- Squeeze	82	82	-
Total cases	*27*	*14*	*4*

Quite interestingly, cases of pure price positioning and manipulation based on the relationship among stock or market have a very short life, 1 day, both for inflate and deflate strategies.

Finally, Table 6 outlines the types of people involved in market manipulation. The relevance of professional people who engage in market manipulation is evident. Not only insiders, but also brokers and fund managers. This can be due to the particular skills which are needed to manipulate stock markets. A parallel explanation, provided for by Aggrawal and Wu, who have found similar results in the US stock markets (see Chapter 2), is that several manipulation strategies require manipulators to behave as they were insiders, in such a way to convince other market participants to mimic their moves, producing herding.

Table 6: Types of people involved in manipulation cases

Year	Total cases	Insiders	Intermediaries	Fund managers	Relevant shareholders	Others
1992	6	0	0	0	6	0
1993	0	0	0	0	0	0
1994	6	6	0	0	0	0
1995	9	1	8	0	0	0
1996	5	1	3	0	0	1
1997	37	0	34	0	2	1
1998	10	0	5	2	3	0
1999	5	0	1	0	3	1
2000	8	0	3	3	2	0
2001	12	2	2	6	1	1
2002	33	1	1	19	2	10
2003	8	2	0	4	1	1
2004	8	0	1	0	0	7
2005	4	0	0	0	2	2
Total	*151*	*13*	*58*	*34*	*22*	*24*
%	*100%*	*9%*	*38%*	*23%*	*15%*	*16%*

[Insiders: issuers, member of the board, controlling shareholders; Relevant shareholders: those with relevant stake (greater 2% of issued shares), raiders; Others: journalists, financial analysts, lawyers, others]

5. Intra-day price positioning schemes: examples and issues

Considering the significant number of price positioning cases enforced by Consob and the fact that the liquidity and market microstructure of the Italian Stock Exchange are very well ranked, it seems that price positioning schemes should deserve a proper attention. The Italian experience can actually be a symptom of a much more widespread phenomenon, which could characterise many other developed markets in the world. In fact, as it is shown in the following Sections, the major problem of enforcing price positioning cases is that they are very difficult to detect, since they have a very short life span and produce significant, but not dramatic, changes in the price pattern.

Therefore, this empirical analysis focuses on price positioning cases and, in particular, on those cases which last up to one day, more typically a few minutes. As already mentioned, in price positioning schemes the manipulator is not interested in sending signals to other market participants, even though sometimes his action produces this effect. In these schemes manipulators are interested in moving the price toward a desired level, so that they can profit because of other positions already opened on correlated markets, securities or derivatives.

What seems necessary to succeed in these strategies is to have enough market power to move the price in the relevant period. Due to the high liquidity of stocks, it could be thought that just a few entities have this power. Actually this is not the case, since very often in order to succeed the manipulative actions need to alter the price just for a very short time. Of course many entities have resources capable of reaching this goal, even in very liquid stocks.

In addition, it should be emphasised that in these strategies manipulators typically act very quickly, in order to avoid other investors' reactions. For instance, to manipulate electronic call auctions they insert or delete orders in the last few seconds before the auction ends. Whereas to manipulate the continuous trading sessions in order driven markets, they typically concentrate their orders in a very short period after having carefully examined the book depth.

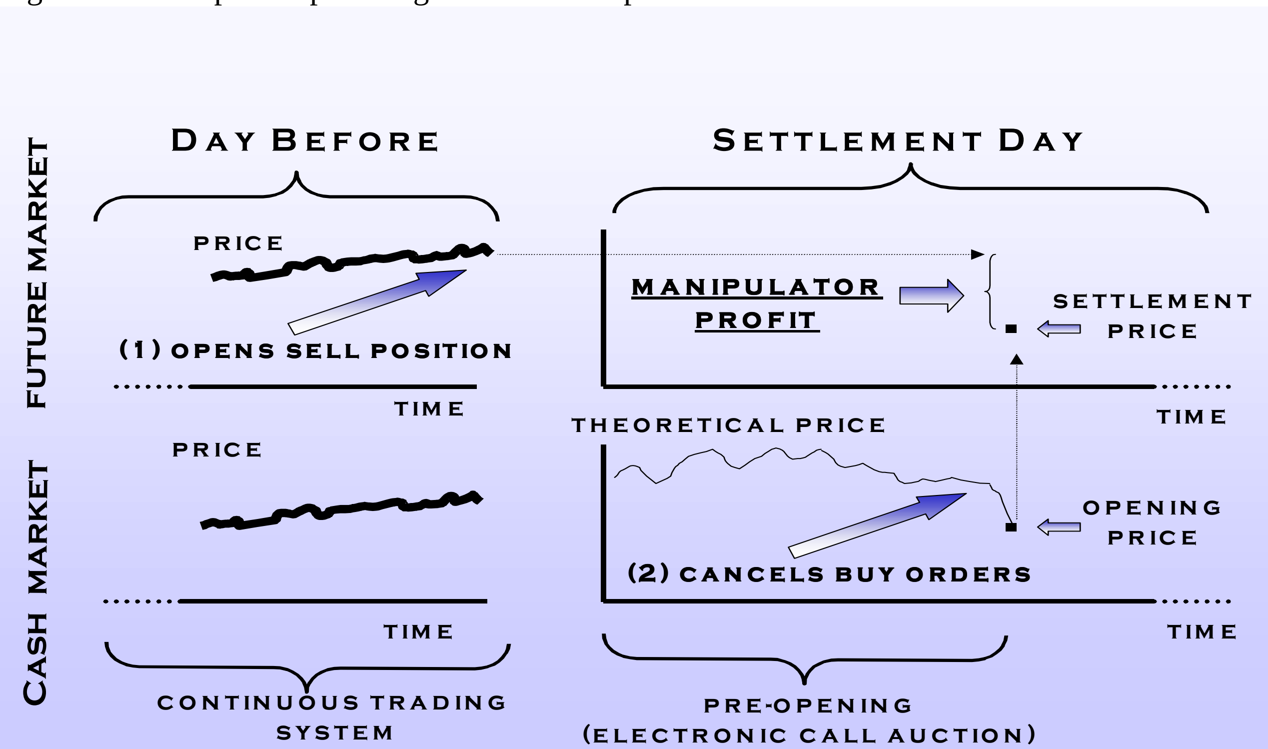
Since after the manipulative action prices typically bounce back to previous equilibrium levels, resources invested to manipulate the price often result in a loss for the manipulator. What is crucial to succeed in the full strategy is that this loss be lower than the gain achieved in a position opened in related securities or markets (Jarrow, 1994). It seems that this condition is not difficult to meet in modern financial markets due to the various interrelations between markets, the different speed of price movements and lack of perfect synchronicities.

At the same time, this means that the best way to reduce the scope of those kinds of trade-based manipulations are to increase market liquidity, to improve market microstructure rules (Salini, 2001) and, finally, to build *ad hoc* detection systems (Minenna, 2003a).

To understand the meaning of price positioning schemes, consider the following two examples shown on Figures 1 and 2, both linked to very liquid securities.

Example 1 refers to the strategy named "punching the settlement price" (Kumar and Seppi, 1992). In the morning of the settlement day of the stock future - which is cash settled depending on the stock index (MIB30) value at the end of the opening auction, which, in turn, is computed as the weighted average of the opening auctions of the underlying stocks - just a few seconds before the auction end, the theoretical prices of these opening auctions fell, on average, from +6% to –2%, compared to the previous day last prices.

Figure 1 – Example of "punching the settlement price"

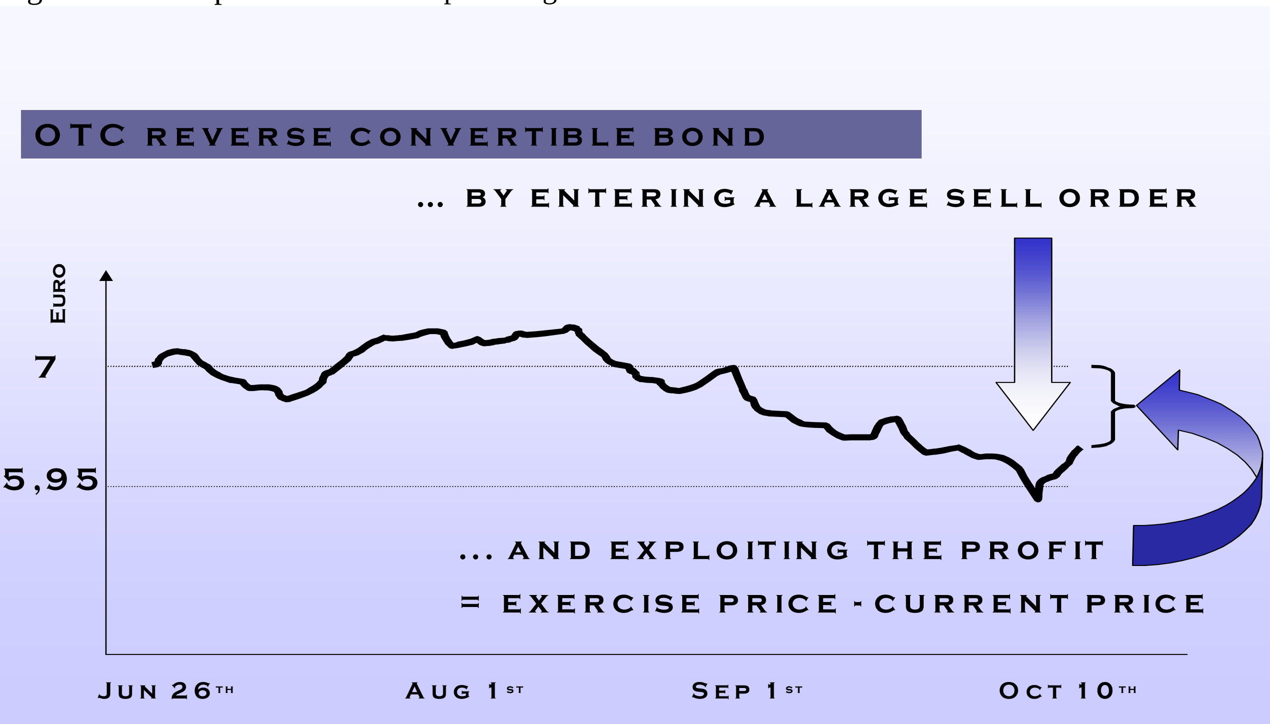


After an investigation, it was proved that this price change was caused by a trader, working for a primary foreign bank. After having opened a sell position in the stock index future the day before the settlement day, he wanted to reduce the settlement price of the index future. To do so he manipulated the opening auctions of the most important underlying stocks, he entered very large amounts of buy orders at the beginning of those auctions, and then, after other investors balanced his orders with other sell orders, so that an equilibrium was reached, he deleted his buy orders a few seconds before the end of the auction. Therefore other investors had no time to adjust their orders, and the opening prices of the auctions collapsed and, automatically, the future settlement price too. As expected, after the opening auction the price bounced back to higher level (not reported in the Figure 1).

Example 2 refers to a case of manipulation of the underlying stock of a structured bond: a reverse convertible bond issued by a bank to retail investors. This kind of bond is called "structured" because retail investors buy a bond and, at the same time, sell a put option to the bank written on a specific stock. Retail investors are attracted from the high immediate return deriving from the premium of the embedded put option. Usually the bank covers the risk associated with the put option, selling it to a specialised intermediaries, that is often the engineer of the reverse convertible bond.

In the example, the put option would have been in the money at the expiration date if two conditions were satisfied: if the price of the underlying stock was lower than € 7.00 (the exercise price) and if before the expiration date at least one market contract had been closed at a price lower than or equal to € 5.95 (the knock-in barrier). Since the day before the expiration date only the first condition was met, the specialised intermediary, who bought the put option, decided to manipulate the underlying stock pushing down its price, as shown in Figure 2. After the manipulative action the price bounced back to higher level.

Figure 2 – Example of "Relationships among stocks or markets"



According to the previous Sections, several interesting issues are related to intra-day price positioning strategies.

First, since price positioning looks like a shock in the market equilibrium, it would be interesting to measure the effects that it produces on return, volume and volatility and how long these effects last. Particular emphasis should deserve the exam of the effects on the value-at-risk (VaR), due to its relevance in risk management and banks' behaviours. All these analyses are important also for valuing the need of enforcing market manipulation, as several economists and legal scholars suggesting that enforcement costs are disproportionately higher than the benefit deriving from preserving market integrity.

A second group of questions refers to the conditions which make more likely the occurrence of intra-day price positioning strategies. In particular, it seems important to test if liquidity, volatility and market microstructure rules matter. As to liquidity, previous empirical studies seem to suggest that market manipulation is not an issue in liquid market. Concerning volatility, Hart (1977) shows that manipulation is possible if the economy is dynamically unstable. As to market microstructure rules, regulators often say that these are the best tools for preventing trade-based manipulation (FESCO, 2001).

Third, detection systems could be improved on the basis of the achieved results. Not only are exchanges and authorities interested in this field, but also brokers, asset management companies and hedge funds are increasingly involved in this activity in order to save the their reputation. Consob has recently developed a detection system based on a probabilistic approach which is producing very interesting results (Minenna, 2003a; Consob *Annual Report*, 2006).

6. Time series analysis

The sample is based on 66 cases of intra-day price positioning manipulation actions occurred in the Italian Stock Exchange from March 1997 to July 2003.

Table 7 shows details of the sample: strategy description, the number of cases, and related events, types of prices which were manipulated ("day" prices are prices other than opening and last prices), and directions of the manipulative actions.

Notice that most of the differences between cases and events is due to the manipulation strategies indicated in the first two rows of Table 7. The relevance of the 28 cases related to the first event should be taken into account when examining the results exhibited in this and in the following Sections.

Following other research on the Italian stock exchange (Bagliano, Favero, Nicodano, 2001), a first set of OLS regressions have been run on time series for returns and volumes separately.

The model for returns is

$$Ri = c(1) + c(2)\,Rm + c(3)\,Ri(-1) + c(4)\,M + u \qquad (1)$$

where Ri is the daily stock i log return, Rm is the daily market index log return (Mibtel) and M is a dummy for the manipulative day.

The model has been examined using four types of returns (Ri) related to the following prices:

- the opening price (which is the price of the opening auction)
- the reference price (which is the weighted average price of the last 10% of all day trades)
- the last price
- the official prices (which is the weighted average price of all day trades).

Table 7 – Sample details

Description of the manipulation strategy	**Cases**	**Events**	**Manipulated prices**	**Direction**
A trader managing a firm's proprietary desk, after having opened a position on the stock future, manipulates the last price of the underlying stocks, so as to later close the position of the stock future at higher prices (according to the exchange's rule, transactions on the stock futures end 30 minutes after that on the underlying stocks).	28	1	Last (28)	Inflate (28)
A trader managing a firm's proprietary desk, manipulates the opening price of the underlying stocks of the stock future in order to punch its settlement price (see Figure 1).	3	1	Opening (3)	Deflate (3)
A firm manipulates the stock price in order to gain in the position held on a related reverse convertible bond (see Figure 2).	6	5	Opening (2) Day (4)	Deflate (6)
An asset manager manipulates the continuous trading phase in order to carry out a pre-arranged trade at an anomalous price among two managed funds, so as to increase the value of one fund at the expense of the other, where the asset manager receives lower fees.	14	14	Day (14) Last (5)	Deflate (14)
A firm manipulates the opening price of the stock in order to gain from the position opened in the related odd-lots market.	9	9	Opening (9)	Deflate (9)
In the last day of the quarter an asset manager manipulates the last price of stocks in the portfolio funds in order increase the value of the fund and increase his performance fees, which were calculated on basis of the end of quarter value of the fund.	6	6	Last (6)	Inflate (6)
Totals	*66*	*36*	*Opening (14)* *Day (18)* *Last (39)*	*Inflate (34)* *Deflate (32)*

Due to the characteristics of intra-day price positioning, it is important to take into account the meaning of these different returns. For instance, since the manipulative action can take place in different periods during the day, it would not be meaningful to examine the opening returns in the manipulation day if the manipulative action occurs after the opening auction.

The market index (Rm) considered is the Mibtel, which is calculated every minute during the day. The Rm opening value has been used only when Ri refers to the opening price. In all the other cases Rm is the return based on the last index value (this creates some non-synchronous trading problems). Finally, notice that stock returns are adjusted to consider changes in the number of shares issued, but both stock and index returns do not take into account dividends.

The model for volume has the following specification:

$$Vi = c(1) + c(2)\ Vm + c(3)\ Vi(-1) + c(4)\ Vi(-2) + c(5)\ Vi(-3) + c(6)\ Vi(-4) + c(7)\ Vi(-5) + c(8)\ M + u \quad (2)$$

where Vi is the daily stock i log change of the number of shares traded, Vm is the daily log change of the volume traded in all Italian stocks and M is a dummy for the manipulative day.

Similar regressions have been run using the number of contracts (F) instead of the number of shares (V). Thus, F is a measure of trade frequency.

$$Fi = c(1) + c(2)\ Vm + c(3)\ Fi(-1) + c(4)\ Fi(-2) + c(5)\ Fi(-3) + c(6)\ Fi(-4) + c(7)\ Fi(-5) + c(8)\ M + u \qquad (3)$$

In all the listed models the number of lags have been optimised depending on the significance of their coefficients. Actually, models (2) and (3) never have more than 4 lags.

Almost all the series start 250 days before the manipulative day and all stop in the manipulative day. So, there are 251 observations.

In order to examine the effects of market manipulation after it occurs, for each regression a twin regression has been run adding three dummies (Post1, Post2, Post3) for the three days subsequent to the manipulative day. Therefore, there are 254 observations.

Table 8 shows the results of models (1), (2) and (3) for the dummies M, Post1, Post2, Post3. Coefficient standard errors have been corrected for heteroskedasticity only when detected using the White test.

Before commenting on the results, it seems important to emphasise that cases where dummies do not exhibit significant coefficients actually do not imply that in these cases manipulation did not occur, since all the cases examined are cases where market manipulation were proved (or, at least, cases where Consob and the Courts believed so) and where the damages for the markets and for other investors could have been very significant. For instance, consider the case where a manipulator moves the stock price by just a (not significant) tick and the related call option becomes in the money. Even if this action does not produce (*ex post*) a significant price change, it produces remarkable welfare consequences. In principle, significant changes should be valued *ex ante*, because the meaning of market manipulation is based on the concept of counterfactual: what would have happened if the manipulative action did not occur (see Section 2). Therefore, if we find statistically significant coefficients, we should interpret these findings as evidences of more serious market damages, also because prices are relevant information for investors.

Table 8 – OLS results

Dependent Variable **log returns or changes based on**	***Dummy***	**Sample**	**Number of significant coefficients (10%)**	**%**	**Number of significant coefficient with expected sign**	**%**
Official Price	**M**	**66**	**32**	**48%**	**13**	**41%**
Official Price	Post1	66	32	48%	NA	NA
Official Price	Post2	66	21	32%	NA	NA
Official Price	Post3	66	43	50%	NA	NA
Reference Price	**M**	**66**	**30**	**45%**	**18**	**60%**
Reference Price	Post1	66	28	42%	NA	NA
Reference Price	Post2	66	22	33%	NA	NA
Reference Price	Post3	66	23	35%	NA	NA
Last Price	**M**	**64**	**24**	**38%**	**11**	**46%**
Last Price	Post1	64	22	34%	NA	NA
Last Price	Post2	64	20	31%	NA	NA
Last Price	Post3	64	21	33%	NA	NA
Opening Price	**M**	**14**	**10**	**71%**	**9**	**90%**
Opening Price	Post1	NA	NA	NA	NA	NA
Opening Price	Post2	NA	NA	NA	NA	NA
Opening Price	Post3	NA	NA	NA	NA	NA

Dependent Variable **log returns or changes based on**	***Dummy***	**Sample**	**Number of significant coefficients (10%)**	**%**	**Number of significant coefficient with expected sign**	**%**
Volume	**M**	**66**	**31**	**47%**	**21 (>0)**	**68%**
Volume	Post1	66	21	32%	NA	NA
Volume	Post2	66	13	20%	NA	NA
Volume	Post3	66	14	21%	NA	NA
Trade Frequency	**M**	**66**	**16**	**24%**	**13 (>0)**	**81%**
Trade Frequency	Post1	66	12	18%	NA	NA
Trade Frequency	Post2	66	11	17%	NA	NA
Trade Frequency	Post3	66	12	18%	NA	NA

Overall, Table 8 shows a high percentage of significant coefficients in the manipulative days (M) and also in the subsequent three days (Post1, Post2, Post3). Nevertheless it should be taken into account that, working with daily data, there should be a lot of noise, as the R^2 show (the R^2 of returns based on official prices has mean 0.23, st. dev. 0.12, min 0.02, max 0.44). It is possible that dummies can be significant due to causes other than market manipulation. Anyway, notice that M dummies are more frequently significant than Post dummies.

Also notice that Table 8 reports only significant coefficients at 10%, but most of these coefficients are significant also at 5%. For instance, dummies related to the manipulative day (M) in the model that refer to returns based on official prices are significant at 5% in 31 cases out of the 32 at 10%. This can also be relevant when considering the implementation of detection systems.

As to returns, dummies related to the manipulative day (M) are often significant, from 38% to 71% of cases, depending on the kind of prices concerned.

Returns based on the opening auction score the highest percentage of significant coefficients and the highest percentage of significant coefficients with the expected signs. This is probably due to the fact that regressions have been run only when market manipulation occurred in the opening auctions, otherwise the estimation would not make sense. Therefore only 14 cases have been examined. In other words, the estimations are conditioned on the occurrence of manipulation in the opening auction.

Returns based on the official price seem more affected by market manipulation than those based on reference prices and last prices. One of the reasons for this could be because the former is calculated by taking into account the opening price while the latter are calculated many hours after the opening action.

Quite surprisingly, the coefficient signs are not always those expected. This effect could be due to the bounce back effect, or the increase of intra-day volatility, both caused by market manipulation.

As to changes in daily volume and in daily frequency of trades, they too often look significantly affected by market manipulation, especially the former.

Table 9 provides further statistics only for significant coefficients of dummies M. Table 10 gives the same information in absolute values (so as to avoid the problems of the different directions of the manipulative action).

Table 9 – OLS results

Dependent Variable log returns or changes based on	*Dummy*	Number of significant coefficients	Coefficient estimates mean	Coefficient estimates st. dev.	Coefficient estimates max	Coefficient estimates min
Official Price	M	32	-2,10%	2,89%	3,60%	-10,12%
Reference price	M	30	- 0,15%	3,51%	5,57%	-10,18%
Last price	M	24	-1,12%	3,54%	5,37%	9,79%
Opening price	M	10	-4,31%	3,52%	0,24%	-9,46%
Volume	M	31	97,55%	142,83%	495,62%	-58,19%
Trade frequency	M	16	39,31%	50,23%	133,19%	-24,59%

Table 10 – OLS results

Dependent Variable log returns or changes based on	*Dummy*	Number of significant coefficients (out of 66)	Coefficient estimates mean Abs. Val.	Coefficient estimates st. dev. Abs. Val.	Coefficient estimates max Abs. Val.	Coefficient estimates min Abs. Val.
Official Price	M	32	2,58%	2,46%	10,12%	0,48%
Reference price	M	30	2,60%	2,86%	10,18%	0,25%
Last price	M	24	3,87%	3,45%	9,79%	0,25%
Opening price	M	10	4,36%	3,67%	9,46%	0,24%
Volume	M	31	117,08%	126,76%	495,62%	9,87%
Trade frequency	M	16	47,05%	42,55%	133,19%	7,90%

Considering that these data refer to daily changes, Table 9 exhibits the very important changes caused by the manipulative actions both for returns and for volume and trade frequency.

Comparing tables 9 and 10, returns based on last prices and reference prices are those which have opposite signs more often, while returns based on official prices and opening price are more skewed toward negative values. This fact is linked to the analysis of expected signs shown in Table 8. Opening prices seem more frequently subject to deflating manipulative actions. As to official prices, they also often have negative signs. But it is not easy to find the reason why, considering reference and last prices show both signs, and opening auctions (which are those more skewed toward negative sign) accounts for just 10 cases. As mentioned above, possible reasons could be found in the bounce back effect and in the increase of intra-day volatility and will be examined further in following Sections.

To estimate the impact on volatility and to further examine the implications on Value at Risk, a similar exercise has been run starting from returns based on official prices using GARCH instead of OLS. The official price seems to be the variable which should perform better in our context, since it has more information content, showing the effect the manipulation produced during the whole of the manipulative day and not just in a shorter period. In fact, while last prices are typically more informative in forecasting next day prices, they should not fully absorb what happened before the end of the day. Therefore, since investors are more and more looking at intraday prices and since market manipulation strategies that we are examining have mostly an intraday life, it seems more appropriate to work with official prices.

In particular, four basic GARCH(1,1) specifications have been examined, depending on the position of dummies variables: in the mean equation (Model A), in the variance equation (Model B), in both mean and variance equations (model C) and, finally, in a OLS regressions of

GARCH(1,1) residuals (Model D) where also Post1, Post2, Post3 dummies are included. All models assume normally distributed error terms.

Model A

$Ri = c(1) + c(2)\ Rm + c(3)\ Ri(-1) + c(4)\ M + u\sigma$ (4)

$\sigma^2 i = c(5) + c(6)\ u^2(-1) + c(7)\ \sigma^2 i(-1)$ (5)

Model B

$Ri = c(1) + c(2)\ Rm + c(3)\ Ri(-1) + u\sigma$ (5)

$\sigma^2 i = c(4) + c(5)\ M + c(6)\ u^2(-1) + c(7)\ \sigma^2 i(-1)$ (6)

Model C

$Ri = c(1) + c(2)\ Rm + c(3)\ Ri(-1) + c(4)\ M + u\sigma$ (7)

$\sigma^2 i = c(5) + c(6)\ M + c(7)\ u^2(-1) + c(8)\ \sigma^2 i(-1)$ (8)

Model D (2 steps)

$Ri = c(1) + c(2)\ Rm + c(3)\ Ri(-1) + u\sigma$ (9)

$\sigma^2 i = c(4) + c(5)\ u^2(-1) + c(6)\ \sigma^2 i(-1)$ (10)

$u = c(9) + c(10)\ M + c(11)\ Post1 + c(12)\ Post2 + c(13)\ Post3 + e$ (11)

Table 11a summarises the main findings for significant coefficients at 10%, but notice that almost all these coefficients are actually also significant at a 5% level, except those which refer to dummy Post3. All coefficient estimates are expressed in absolute terms.

Table 11a - GARCH(1,1) results (variance equations in shadowed rows)

Dependent Variable log returns based on official prices	***Dummy***	**Number of significant coefficients at 10% (out of 66)**	**Coefficient estimates Mean Abs. Val.**	**Coefficient estimates st. dev. Abs. Val.**	**Coefficient estimates Max Abs. Val.**	**Coefficient estimates Min Abs. Val.**
Model A mean equation	M	8	2,85%	2,39%	7,45%	0,78%
Model B variance equation	M	10	0,16%	0,28%	0,74%	0,01%
Model C mean equation	M	6	1,33%	0,80%	2,03%	0,02%
Model C variance equation	M	4	0,02%	0,01%	0,04%	0,01%
Model D OLS mean equation	M	9	5,32%	3,23%	10,00%	1,81%
Model D OLS mean equation	Post1	7	5,24%	3,01%	9,67%	2,44%
Model D OLS mean equation	Post2	1	2,70%	-	2,70%	2,70%
Model D OLS mean equation	Post3	11	2,71%	0,65%	4,15%	1,83%

As for the mean equation, GARCH Models A, C and D produce more selective results compared to the OLS' shown in Table 8 (notice that Model D exhibits higher coefficient estimates while Model C provides very low values).

Model D also gives interesting pieces of information on the bounce back effect, which seems to have almost the same strength as the manipulative effect.

As for the variance equation, GARCH Models B and C (shadowed rows) produce significant results in the same percentages of the mean equations.

Finally, the variance equation has been estimated also using OLS (instead of MLE) in the following Model E:

Model E (2 steps)

$$Ri = c(1) + c(2)\ Rm + c(3)\ Ri(-1) + u\sigma \quad (12)$$

$$\sigma^2 i = c(4) + c(5)\ u^2(-1) + c(6)\ \sigma^2 i(-1) + c(7)\ M + c(8)\ Post1 + c(9)\ Post2 + c(10)\ Post3 + e \quad (13)$$

where $\sigma^2 i$ has been computed rolling at 5, 20 and 60 days. Table 11b shows the number of significant coefficients of the four dummies and their absolute values.

Table 11b – Variance equation estimated with OLS

Dependent Variable $\sigma^2 i$ (based on log returns on official prices) at different length	***Dummy***	**Number of significant coefficients at 10% (out of 66)**	**Coefficient estimates Mean Abs. Val.**	**Coefficient estimates st. dev. Abs. Val.**	**Coefficient estimates Max Abs. Val.**	**Coefficient estimates Min Abs. Val.**
5 days	M	2	0,03%	0,03%	0,06%	0,01%
5 days	Post1	4	0,04%	0,05%	0,11%	0,01%
5 days	Post2	4	0,05%	0,03%	0,08%	0,01%
5 days	Post3	5	0,10%	0,08%	0,20%	0,02%
20days	M	0	-	-	-	-
20days	Post1	1	0,04%	-	0,04%	0,04%
20days	Post2	2	0,00%	0,00%	0,00%	0,00%
20days	Post3	2	0,00%	0,00%	0,01%	0,00%
60days	M	0	-	-	-	-
60days	Post1	2	0,01%	0,01%	0,02%	0,00%
60days	Post2	1	0,01%	-	0,01%	0,01%
60days	Post3	2	0,00%	0,00%	0,00%	0,00%

It appears that the variance equation estimated in OLS Model E shown in Table 11b does not capture the manipulative action compared to the GARCH models in Table 11a. Table 11b shows that when $\sigma^2 i$ is computed at 5 days, Model E performs better. Coefficients c(5) and c(6) (not reported in the table) are always significant at 1%. Nevertheless, when $\sigma^2 i$ is computed at 5 days the sum of their estimates is always greater than 1, so exhibiting non-stationarity in variance.

7. Event Studies

An event study has been run using the returns based on official prices. The exercise has been performed using both OLS and GARCH(1,1) estimations. Since the manipulation days are characterised by negative returns in most of the cases examined, the event study has been focused on these cases (53 cases using OLS and 52 cases using GARCH(1,1) estimations).

The OLS model specification is that given in equation (12). Each case has been adjusted according to the criteria and the results already shown in Section 6.

$$Ri = c(1) + c(2)\ Rm + c(3)\ Ri(-1) + u \quad (12)$$

The GARCH(1,1) specification for the mean equation is that of Model D above (see equation 9). Each case has been adjusted according to the criteria and the results already found in Section 6.

$$Ri = c(1) + c(2)\ Rm + c(3)\ Ri(-1) + u\sigma \quad (9)$$
$$\sigma^2 i = c(4) + c(5)\ u^2(-1) + c(6)\ \sigma^2 i(-1) \quad (10)$$

Notice that instead of distinguishing in a standard way the estimation window (from -250 to -21 days before the manipulation day) from the event window (from -20 to +20 days around the manipulation day), the length of the estimation window lasts from –250 to +20 days around the event day. In this way potential abnormal returns (AR) are here calculated as the residuals of regressions (12) and (9) from –20 days before the event to +20 days after the event. This approach has been followed because it should be taken into account that, as the R^2 of the regressions is quite low (mean 22%, st. dev 12%, max 41%, min 2%), it would not be without consequences using the resulting coefficients in the event window as if the regressions had very high R^2. On the other side, according to Campbell, Lo MacKinley (1997), the approach here followed could have the problem of parameters estimations being affected by event-related returns, so that both the normal and abnormal returns would reflect the impact of the event. In Appendix 1 it is shown that the estimations of parameters are not significantly affected by event-related returns.

Figures 3 and 4 show the potential abnormal returns (AR) using OLS and GARCH(1, 1) models.

Figure 3 –AR using OLS (one st. dev. reported). 53 cases.

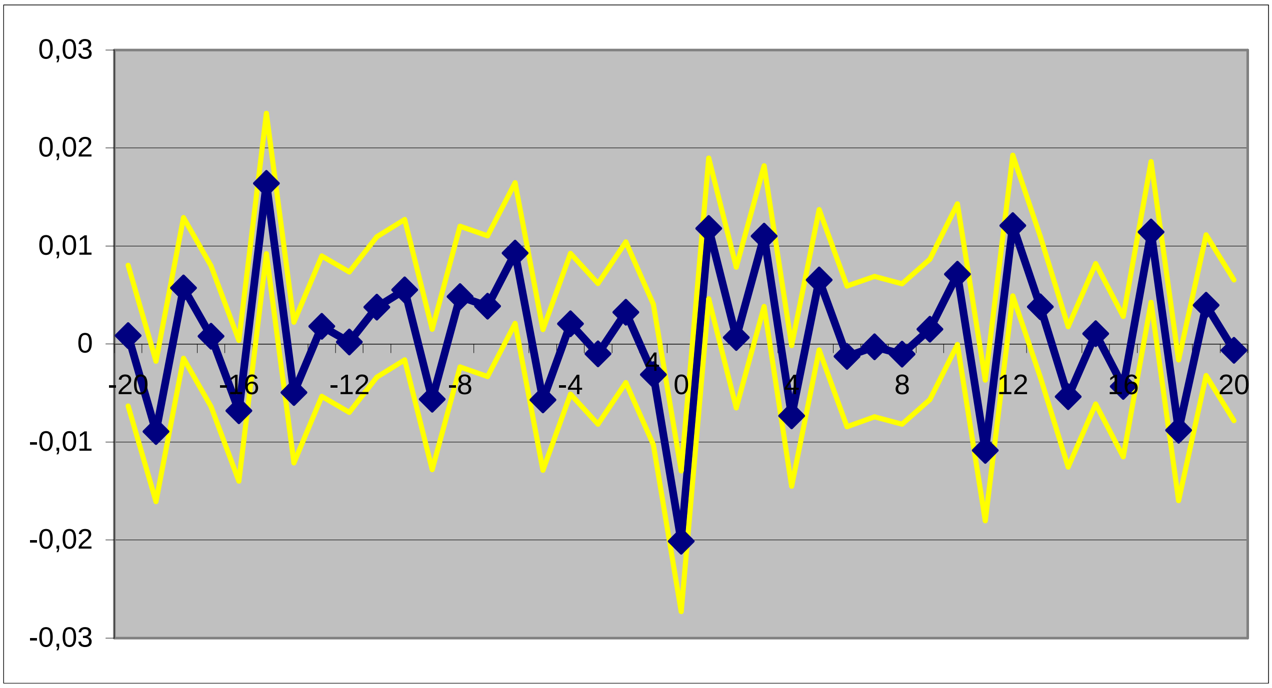
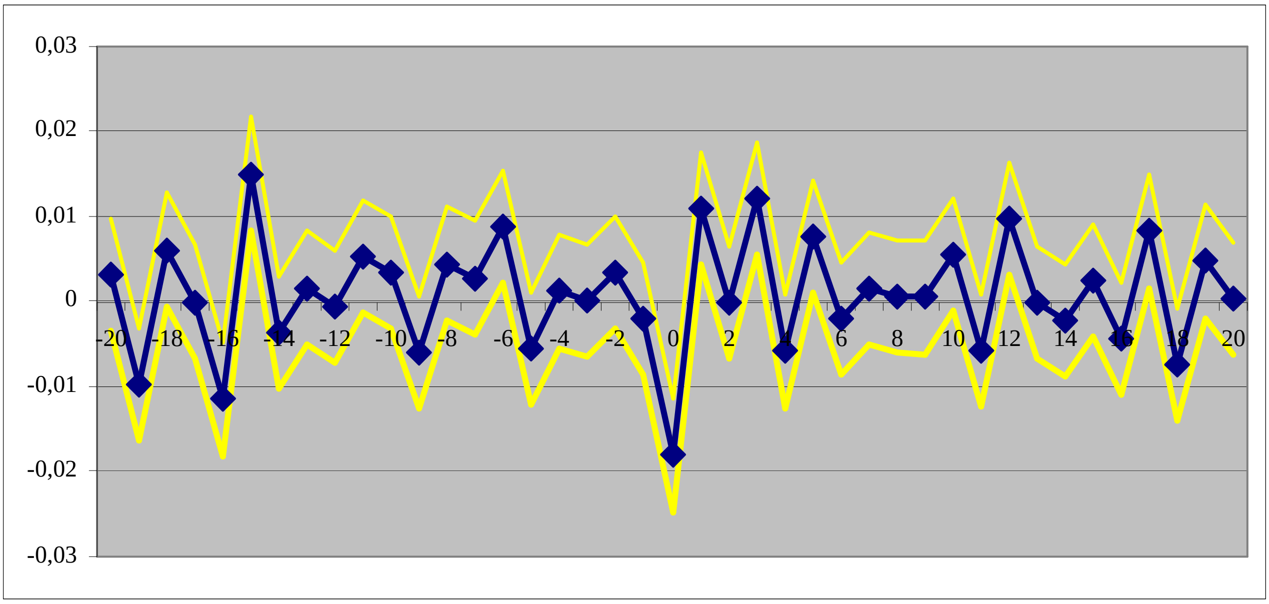


Figure 4 –AR using GARCH (1, 1) (one st. dev. reported).



Both models show that in the manipulation day there is a significant negative abnormal return which is followed by a positive (but not significant) return the day after. The latter constitutes the bounce back effect.

Figures 5 and 6 show the cumulative abnormal returns.

Figure 5. CAR using OLS (one st. dev. reported).

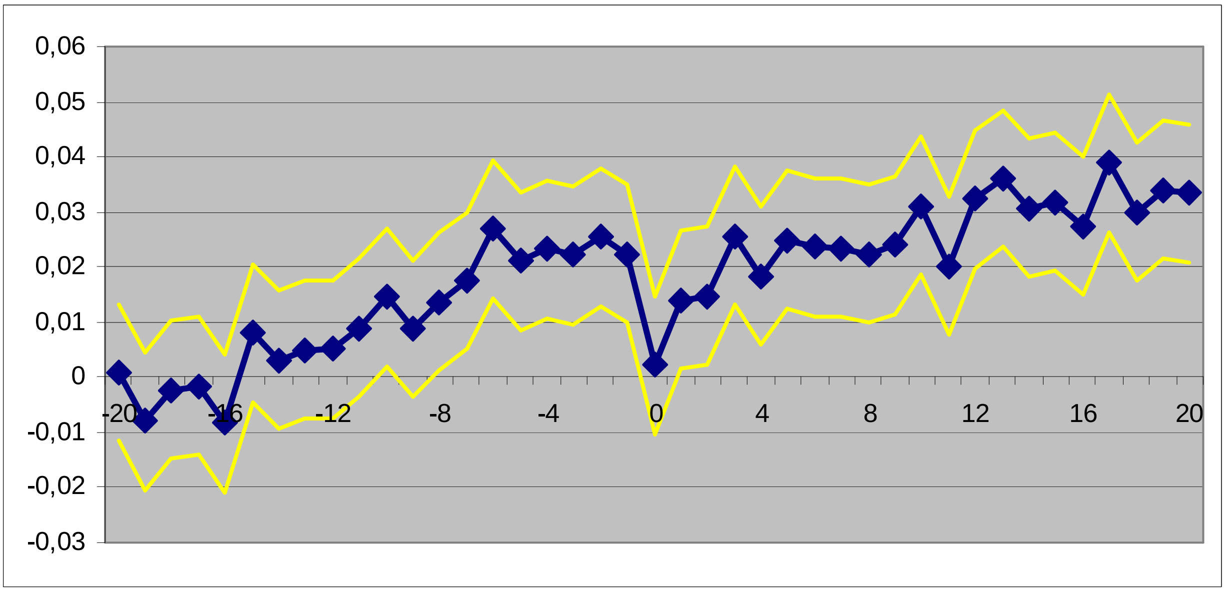
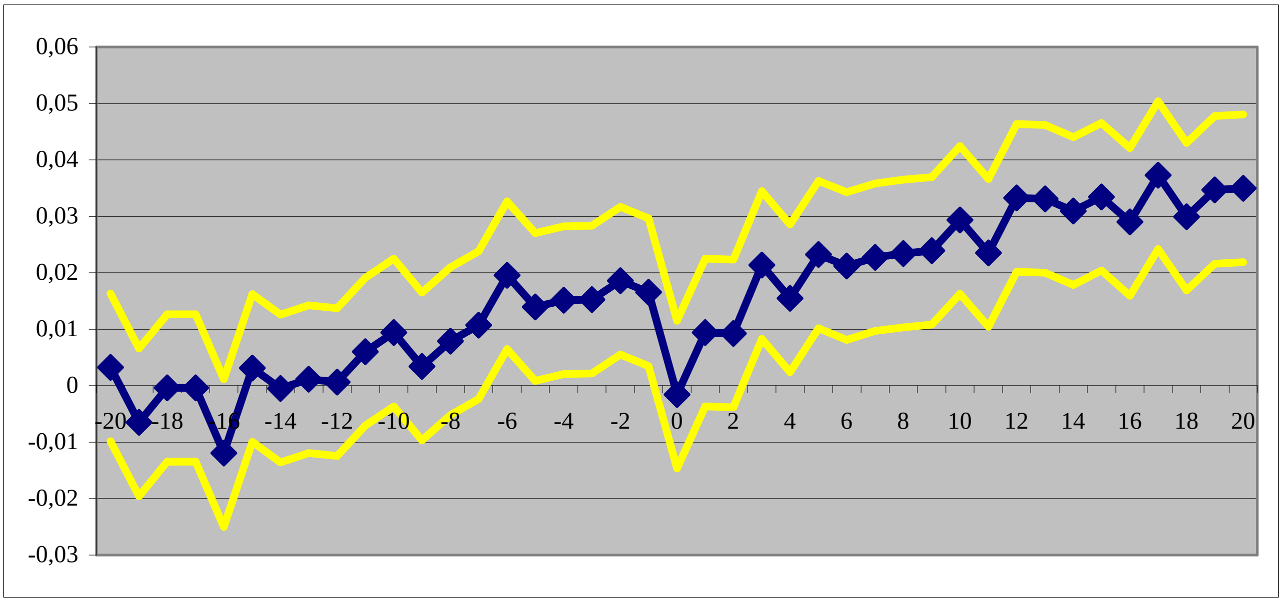


Figure 6 –CAR using GARCH (1, 1) (one st. dev. reported).



Again, both models exhibit the relevance of the manipulative action and of the bounce back effect, which, however, does not seem to have the same strength as the manipulative action.

Figures 3 to 6 above show signs of persistency of the manipulative actions on returns. Among the possible explanation, this could probably be caused by the impact on VaR: the increase in volatility generated by the manipulative action can induce traders to automatically close positions opened on the same security, and their selling pressure can slow down the bounce back effect.

The CAR series also shows a positive trend (see Table 12). Interestingly the following regression (14) gives significant values for the manipulative actions results (notice that AR data are based on the OLS model; very similar results are obtained if AR data are based on the GARCH(1,1) model).

$$AR = c(1) + c(2)\ AR(-1) + c(3)\ M + c(4)\ Post1 + c(5)\ Post2 + c(6)\ Post3 + u \quad (14)$$

Table 12- OLS regression of AR (produced by the OLS model).

Explanatory variables / R^2	**Coefficient**	**Coefficient estimates mean**	**Coefficient estimates st. dev.**	**Coefficient t-statistics**	**Prob.**
	c(1)	0.002	0.001	1.779	0.084
AR(-1)	c(2)	-0.588	0.133	-4.426	0.000
M	c(3)	-0.023	0.005	-4.514	0.000
Post1	c(4)	-0.002	0.006	-0.267	0.791
Post2	c(5)	0.006	0.005	1.132	0.266
Post3	c(6)	0.010	0.005	1.908	0.069
R^2	0.57				

Therefore the manipulative action seems relevant, amounting to a daily change of -2,3% and showing signs of persistency in the subsequent day.

Figures 3b and 5b show the OLS AR and CAR using standardised residuals on the basis of the standard deviation calculated over the period from –20 to –1, that is a period not affected by the manipulative action. Table 12b gives the results of an OLS regression of the potential AR on a constant, the last lag and the four dummies.

Figure 3b –AR using OLS with standardised residuals (one st. dev. reported). 53 cases.

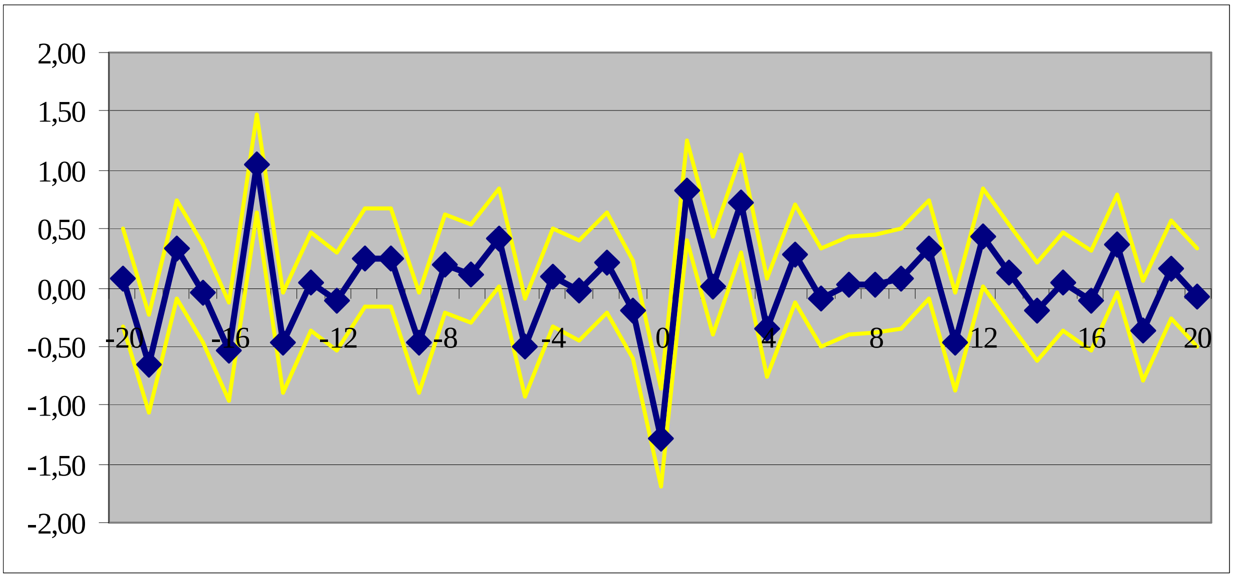


Figure 5b. CAR using OLS with standardised residuals (one st. dev. reported).

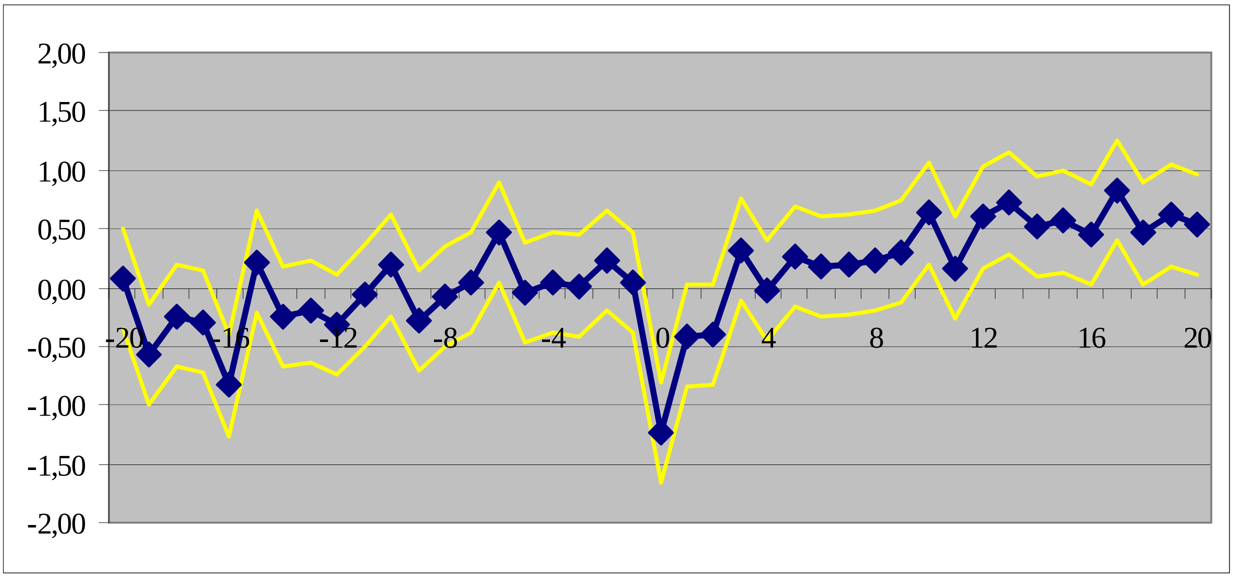


Table 12b- OLS regression of AR (produced by the OLS model using standardised residuals).

Explanatory variables / R^2	**Coefficient**	**Coefficient estimates mean**	**Coefficient estimates st. dev.**	**Coefficient t-statistics**	**Prob.**
	c(1)	0.025	0.046	0.563	0.595
AR(-1)	c(2)	-0.582	0.129	-4.505	0.000
M	c(3)	-1.413	0.283	-4.989	0.000
Post1	c(4)	-0.056	0.329	-0.172	0.865
Post2	c(5)	0.468	0.300	1.562	0.127
Post3	c(6)	0.702	0.281	2.491	0.018
R^2	0.63				

Looking at volatility, in order to value the impact of market manipulation Figures 7 and Table 13 show the average conditional standard deviation of all the 64 cases (both with positive and negative AR in the manipulative day) estimated using GARCH(1,1) model as specified in equations (9)-(10).

Figure 7 – GARCH Conditional st. dev. (sample with positive and negative cases; 64 cases)

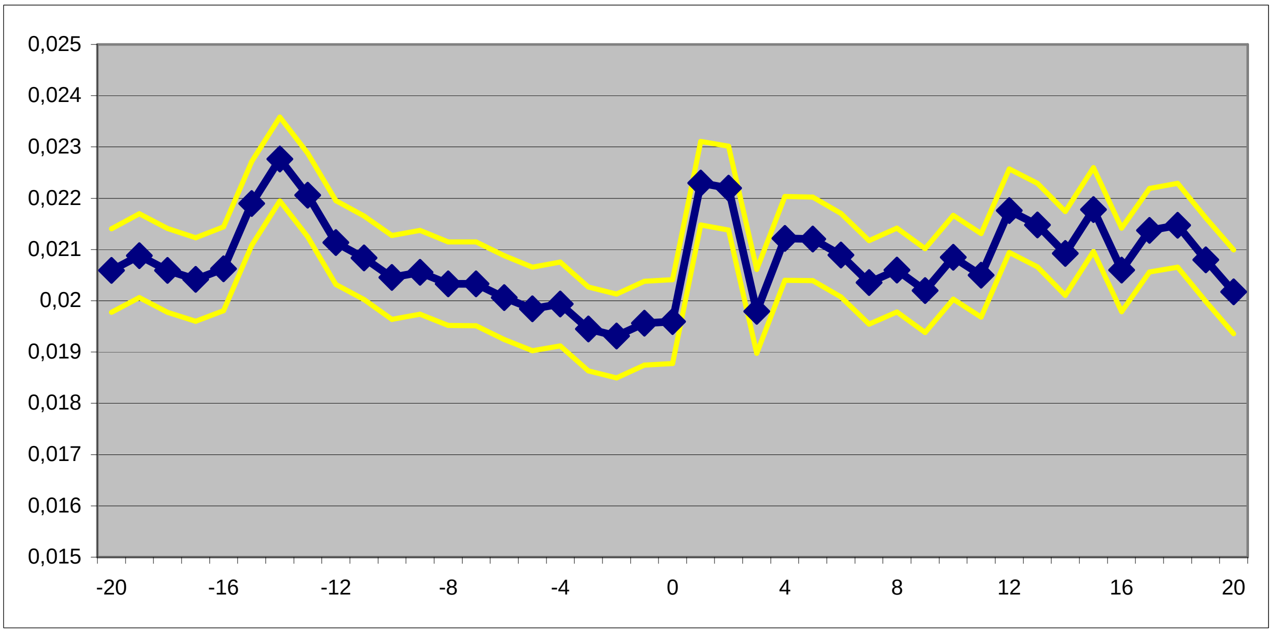


Table 13

day	conditional st. dev.	annual basis	% change
-5	1,98%	31,50%	-1,10%
-4	1,99%	31,65%	0,48%
-3	1,95%	30,88%	-2,44%
-2	1,93%	30,66%	-0,72%
-1	1,96%	31,06%	1,30%
0	1,96%	31,11%	0,16%
1	2,23%	35,39%	13,78%
2	2,22%	35,23%	-0,44%
3	1,98%	31,42%	-10,82%
4	2,12%	33,68%	7,19%
5	2,12%	33,66%	-0,05%

The manipulative action (in t = 0) has a very strong effect not only on the forecasted day-after (t = 1) volatility, but also later. It shows persistency in t = 2, probably due to the bounce back effect (in t = 1). According to the GARCH structure, the jump in volatility bounces back slowly during the following days.

Figures 8 and Table 14 show the same results in the 52 cases (only those with negative AR in the manipulative day) estimated using GARCH(1,1) model as specified in equations (9)-(10).

Figure 8 – Volatility. GARCH Conditional st. dev. (sample with negative cases; 52 cases)

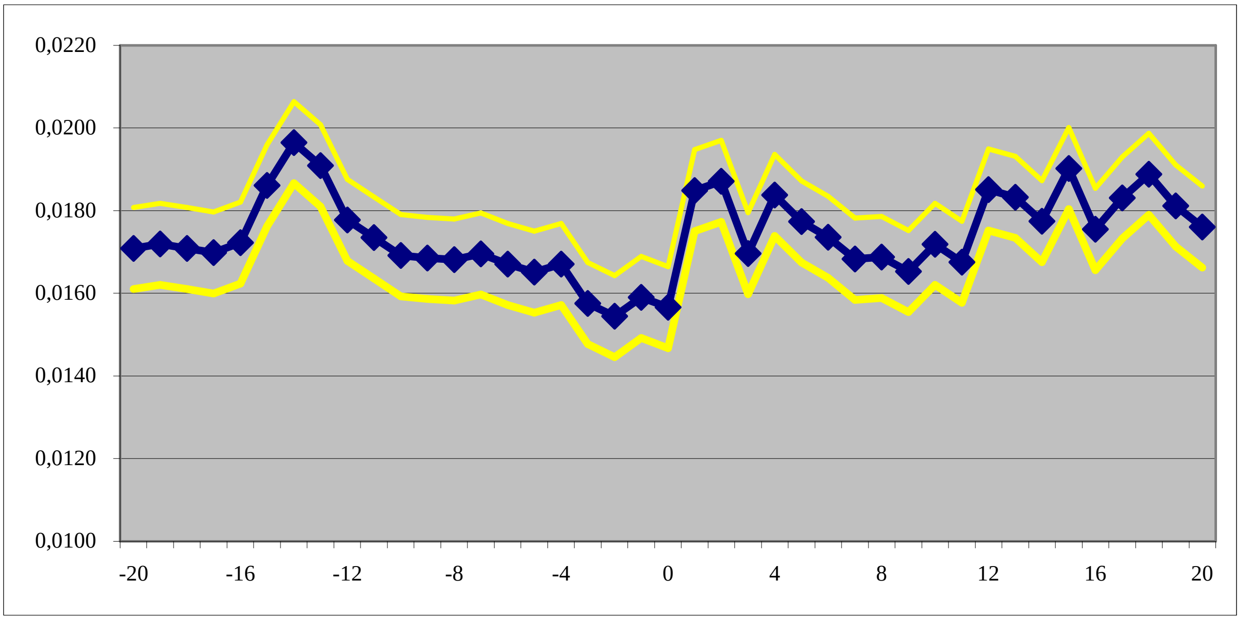


Table 14

day	conditional st. dev.	annual basis	% change
-5	1,65%	26,22%	-1,12%
-4	1,67%	26,52%	1,13%
-3	1,58%	25,02%	-5,66%
-2	1,54%	24,52%	-1,99%
-1	1,59%	25,25%	2,97%
0	1,57%	24,86%	-1,54%
1	1,85%	29,35%	18,07%
2	1,87%	29,71%	1,20%
3	1,70%	26,93%	-9,34%
4	1,84%	29,17%	8,31%
5	1,77%	28,15%	-3,48%

The dynamics look very similar to those of the general case. The manipulative action (in t = 0) produces an 18% increase in the estimated day-after (t = 1) volatility (stronger than that of the general case), and shows persistency in t = 2 due to the bounce back effect (in t = 1). Later volatility bounces back slowly to the values preceding the shock.

Graphs 9, 10, 11 show volatility at several lengths (5, 20 and 60 days) estimated as the standard deviation of the residuals of the OLS regression of equation (12) in Model E already presented.

$$Ri = c(1) + c(2)\ Rm + c(3)\ Ri(-1) + u\sigma \qquad (12)$$

All the graphs exhibit a relevant shift in volatility after the manipulative action occurs. This change in volatility shows persistency even if volatility is estimated at 5 days.

Figure 9 – Volatility (st. dev.). OLS estimates at 5 days (one st. dev. reported)

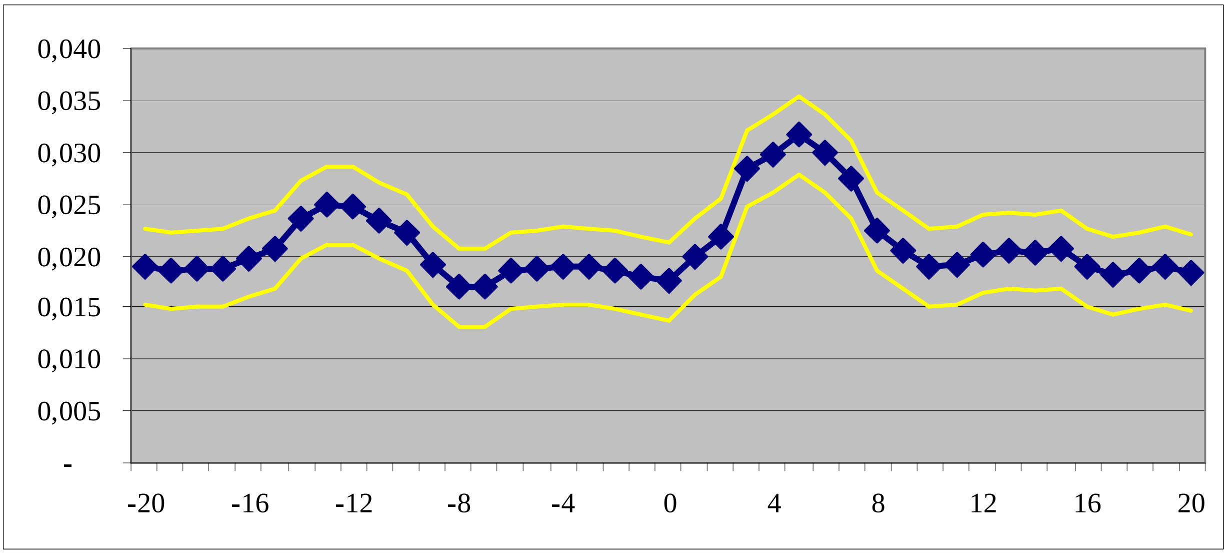


Figure 10 – Volatility (st. dev.). OLS estimates at 20 days (one st. dev. reported)

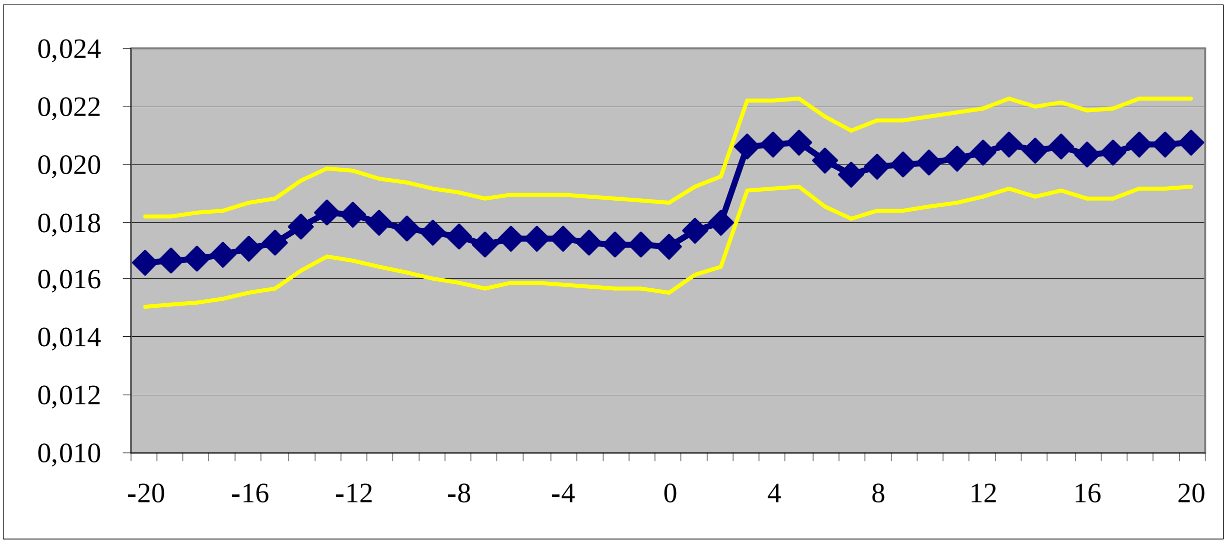
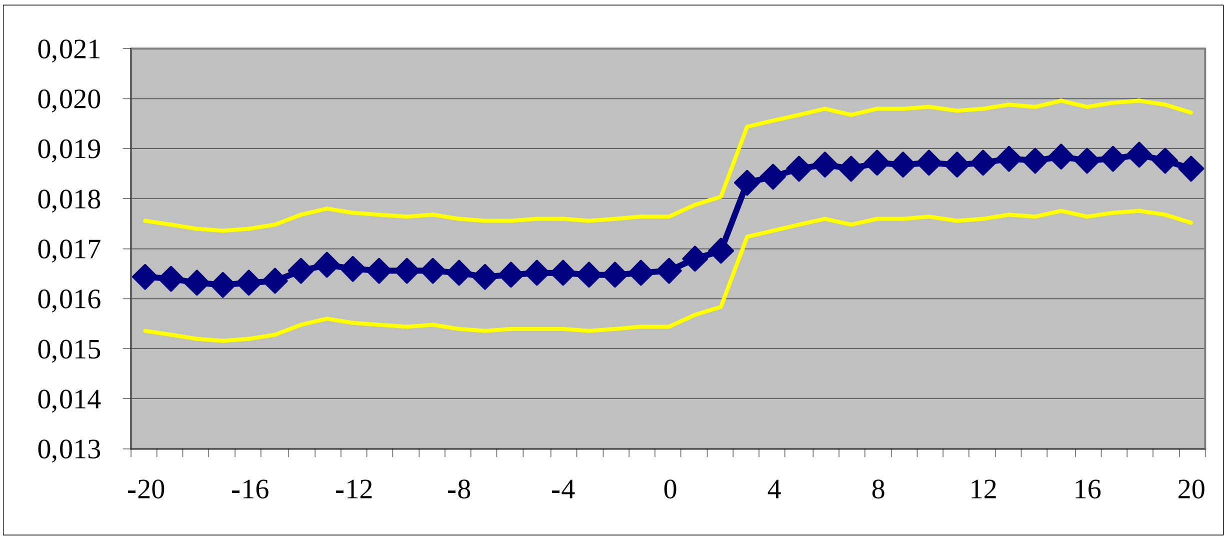


Figure 11 – Volatility (st. dev.). OLS estimates at 60 days (one st. dev. reported)



8. VaR violations

VaR refers to the portfolio's worst outcome that is likely to occur at a given confidence level. For instance, at the end of the trading day it is possible to compute the VaR for long or short positions opened on a specific stock or portfolio, so that the VaR gives at a given confidence level (typically at 99%, 95% or 90%) what would be the next day's (or days') maximum or minimum value of the opened positions. GARCH models are quite common in financial literature for computing VaR because of their outstanding performance in estimating volatility (Angelidis and Degiannakis, 2007).

In studying the impact of events on stock behavior it is interesting to compare the event day stock return with the VaR predicted for that day and computed for different levels of significance: if the return on the manipulative day is lower (higher) than the calculated lower (higher) value of VaR then it is possible to conclude that the manipulative action had an impact on the stock. Furthermore this VaR "violation" could prove a useful tool in order to detect market manipulation for surveillance purposes. In practice, regulators (or other interested parties) could start further investigations on intra-day data once a VaR violation has been detected on a single stock.

The model specification here adopted is a simple GARCH(1,1), as the Model D already introduced in Section 6, where error terms are assumed normally distributed.

$$Ri = c(1) + c(2)\ Rm + c(3)\ Ri(-1) + u\sigma \qquad (9)$$
$$\sigma^2 i = c(4) + c(5)\ u^2(-1) + c(6)\ \sigma^2 i(-1) \qquad (10)$$

Table 15 shows the VaR violations detected at 99%, 95% and 90% confidence levels for all the 64 cases of market manipulation from day –5 to day +5. Notice that Table 15 can indicate also more than one violation for the same case.

Table 15 – VaR violations (GARCH(1,1))

Confidence levels	99%	99%	95%	95%	90%	90%
% of violations per stock mean (st. dev) over the period -20 +20	3,43% (3,16%)	1,94% (2,50%)	8,12% (4,97%)	4,95% (4,17%)	12,30% (6,41%)	9,70% (6,01%)
Day	Positive	Negative	Positive	Negative	Positive	Negative
-5	0	4	0	16	2	20
-4	2	0	2	1	2	3
-3	0	1	3	1	6	3
-2	0	1	3	1	6	4
-1	1	0	2	1	2	2
0	1	4	1	6	2	15
1	3	0	11	3	19	4
2	1	1	7	2	15	3
3	6	1	15	1	19	1
4	1	0	2	4	4	7
5	1	0	4	0	10	1

The first row shows the stock means and standard deviations (in brackets) for violations detected over the period from day –20 to day +20 (41 days). If the GARCH(1,1) model works effectively we should expect that the percentages of violations per stock are quite close to the corresponding confidence level of the VaR. Anyway, taking into account that the event window is affected by the manipulative action, these percentages are expected to be slightly higher than the corresponding confidence levels. Overall, considering that 41 observations are not enough for definitive answers, it seems that the model exhibits a good performance, but it could be improved. In particular, it should be taken into account that the VaR has been built assuming that the forecasted conditional mean is zero, while actually the event study in Section 7 shows significant signs of autocorrelation in the data (Figure 6).

Coming back to the results shown in Table 15, it seems that the number of VaR violations on the manipulative day is not particularly high, even at 90% confidence level, where 17 out of 64 cases have been detected. Quite interestingly, in the immediate following days several violations occur, apparently on the opposite sign. 19 violations are detected on day 1, a further 15 on day 2 and again 19 on day 3.

Table 16 illustrates at different levels of confidence the number of cases (and not just violations) which have been detected in positive or negative VaR violations at least once from day 0 to day 3 or shorter sub-periods.

Table 16 – VaR Violations: detected cases (GARCH(1,1))

Confidence levels	99%	99%	99%	95%	95%	95%	90%	90%	90%
Days	Positive	Negative	Total	Positive	Negative	Total	Positive	Negative	Total
0	1	4	5	1	6	7	2	15	17
0-1	4	4	7	12	9	20	20	18	35
0-1-2	5	5	9	16	11	24	28	20	41
0-1-2-3	10	5	14	24	11	32	34	20	46

Therefore a significant percentage of cases can be detected at 95% level looking at violations that occur in the 3 subsequent days (50%, 32 out of 64), and a higher percentage at 90% level (72%). An optimal detection strategy, in terms of confidence levels and number of days, should also take into account the cost associated with the further efforts required to better examine intra-day data and to finally establish to start formal investigations. Anyway, it seems that VaR violations could constitute a useful detection tool that could also be linked to examine other market variables, as in Minenna (2003a).

The same analyses have been carried out using the volatility estimated with OLS at different lengths. Tables 17, 18, 19 show VaR violations, while Tables 20, 21, 22 show the cases detected.

Table 17 – VaR violations. (OLS 5days)

Confidence levels	99%	99%	95%	95%	90%	90%
% of violations per stock mean (st. dev) over the period -20 +20	3,93% (3,12%)	2,29% (2,41%)	8,27% (4,51%)	5,41% (4,09%)	12,61% (5,31%)	9,11% (5,24%)
Day	Positive	Negative	Positive	Negative	Positive	Negative
-5	1	4	1	17	4	22
-4	3	0	3	2	5	3
-3	0	1	4	2	4	3
-2	2	2	5	3	10	5
-1	1	1	1	2	3	5
0	1	5	1	9	4	17
1	8	0	16	3	20	5
2	0	1	7	2	12	3
3	5	0	11	1	18	1
4	2	0	3	1	4	4
5	0	1	2	1	7	1

Table 18 – VaR violations. (OLS 20days)

Confidence levels	99%	99%	95%	95%	90%	90%
% of violations per stock mean (st. dev) over the period -20 +20	4,08% (2,88%)	1,64% (2,85%)	9,15% (4,56%)	5,14% (4,58%)	14,06% (5,81%)	8,84% (5,31%)
Day	Positive	Negative	Positive	Negative	Positive	Negative
-5	0	1	1	10	2	21
-4	2	0	2	2	5	2
-3	0	1	6	1	6	3
-2	1	1	2	1	4	4
-1	1	0	2	1	3	2
0	1	4	1	10	6	13
1	4	0	13	3	20	5
2	1	1	7	1	16	3
3	3	0	10	0	20	0
4	1	0	3	2	5	5
5	2	0	9	1	16	1

Table 19 – VaR violations. (OLS 60days)

Confidence levels	99%	99%	95%	95%	90%	90%
% of violations per stock mean (st. dev) over the period -20 +20	4,04% (3,84%)	1,87% (3,30%)	9,07% (6,65%)	4,50% (4,35%)	13,87% (8,70%)	9,11% (5,52%)
Day	Positive	Negative	Positive	Negative	Positive	Negative
-5	1	3	2	11	5	18
-4	2	0	6	0	7	3
-3	1	1	4	1	7	3
-2	0	1	2	1	6	5
-1	2	0	3	1	3	2
0	1	4	2	9	4	13
1	4	2	12	3	20	4
2	3	1	9	2	11	3
3	3	0	14	0	17	0
4	4	0	3	2	5	6
5	0	0	7	0	11	0

Table 20 – VaR Violations: detected cases (OLS 5 days)

Confidence levels	99%	99%	99%	95%	95%	95%	90%	90%	90%
Days	Positive	Negative	Total	Positive	Negative	Total	Positive	Negative	Total
0	1	5	6	1	9	10	4	17	21
0-1	9	5	14	17	11	25	22	21	37
0-1-2	9	6	15	21	12	30	27	23	42
0-1-2-3	13	6	19	26	13	35	34	23	48

Table 21 – VaR Violations: detected cases (OLS 20 days)

Confidence levels	99%	99%	99%	95%	95%	95%	90%	90%	90%
Days	Positive	Negative	Total	Positive	Negative	Total	Positive	Negative	Total
0	1	4	5	1	10	11	6	13	19
0-1	5	4	8	14	12	21	29	17	35
0-1-2	6	5	10	18	13	26	30	20	42
0-1-2-3	9	5	13	25	13	33	38	20	49

Table 22 – VaR Violations: detected cases (OLS 60 days)

Confidence levels	99%	99%	99%	95%	95%	95%	90%	90%	90%
Days	Positive	Negative	Total	Positive	Negative	Total	Positive	Negative	Total
0	1	4	5	2	9	11	4	13	17
0-1	5	6	9	13	11	20	22	16	33
0-1-2	7	7	12	18	12	24	26	18	37
0-1-2-3	10	7	15	26	12	32	34	18	45

Summarising, the detection of manipulative cases, through the examination of VaR violations based on the volatility estimated using OLS at 5 days, seems to perform better than those based on other OLS estimates and also slightly better than those based on GARCH(1,1), also taking into account the ability of the underlying models in explaining data.

A possible explanation of why OLS model at 5 days performs better than GARCH(1,1) could be due to the fact that the former is less adaptive. Table 23 reflects the differences between data in Table 17 (OLS 5 days) and data in Table 15 (GARCH(1,1).

Table 23 – VaR violations. Differences between Table 17 and Table 15 (OLS 5days – GARCH(1,1))

Confidence levels	99%	99%	95%	95%	90%	90%
% of violations per stock mean (st. dev) over the period –20 +20	0,50% (-0,04%)	0,35% (-0,09%)	0,15% (-0,46%)	0,47% (-0,08%)	0,31% (-0,99%)	-0,59% (0,77%)
Day	Positive	Negative	Positive	Negative	Positive	Negative
-5	1	0	1	1	2	2
-4	1	0	1	1	3	0
-3	0	0	1	1	-2	0
-2	2	1	2	2	4	1
-1	0	1	-1	1	1	3
0	0	1	0	3	2	4
1	5	0	5	0	1	1
2	-1	0	0	0	-3	0
3	-1	-1	-4	-1	-1	-2
4	1	0	1	-3	0	-3
5	-1	1	-2	1	-3	0

The first row shows that GARCH(1,1) model performs better over the whole –20 +20 period, finding on average less violations with higher precision. This is confirmed during the period from day –5 to day –1., where most of the differences are positive. Also in day 0 the OLS model detects more violations, but it is in day 1 where it detects much more violations compared to the GARCH(1,1) model, probably because the latter is able to adapt the forecasted conditional volatility so as not to be surprised by the bounce-back effect.

Finally, notice that from day 2 to day 5 the GARCH(1,1) model detects more violations, probably because the OLS model overestimates volatility after the shocks due to the manipulative action and/or because actual volatility dies out slower than the speed predicted by the GARCH(1,1) model.

9. Conclusions

After many decades the economic and regulatory debates on market manipulation have been enriched by a the first few empirical research on this field, all based on the US markets. These studies clearly back the view that trade-based manipulation should not be an issue in modern stock markets and, therefore, it could be deregulated in several extensions. This is because, on one hand, liquidity, microstructure rules and appropriate regulation are antidotes strong enough to reduce the scope of market manipulation and, on the other hand, the enforcement of market manipulation is characterised by relevant costs and risks due to the difficulties of distinguishing market manipulation from pure speculative trades.

On the contrary this research, which relies on a unique database of cases enforced in a primary European stock market, shows that trade-based manipulation is, and probably will be, an issue in modern stock markets and that it can not be successfully faced without the development adequate detection systems. The lack of such systems could explain the poor evidences of trade-based manipulation cases enforced in mayor US markets reported in the mentioned studies.

Actually, notwithstanding the relevance of liquidity and microstructure rules, this research shows that trade-based manipulation can not be neglected even if it refers to the type of "price positioning" strategies, which are those strategies not intended to deceive or mislead other investors, and even if this type of manipulation occurs in very low scale, namely when it concerns one-day strategies and last for just a few minutes during the day.

In fact, focusing with OLS and GARCH models on a sample of price positioning cases which last for a few hours or minutes, often on very liquid stocks, it has been shown that returns, volumes and volatilities are significantly affected not only in the manipulated day but also in the subsequent days. In particular, the effects on volatility are very strong and long-lasting.

Therefore, an effective detection system has been suggested using violations of value-at-risk oscillation bands. Approximately 50% of the sample cases can be identified looking at violations that occur on log returns in the three subsequent days at 95% confidence level. This result can be improved working on the underlying models and on the interrelation among variables.

Appendix 1 - Analysis of the parameters stability

The event study exercises have been executed computing potential abnormal returns (AR) as the residual of the OLS or GARCH estimates along the all sample at disposal, from day –250 to day +20, instead of distinguishing in a standard way the estimation period (from -250 to -21 days before the manipulation day) from the event period (from -20 to +20 days around the manipulation day). This approach has been followed because, as the R^2 of the regressions is quite low (mean 0,23, st. dev 0,12, max 0,45, min 1,71), it does not seem appropriate to use the resulting coefficients in the event window as if the regressions had very high R^2, as is implicitly assumed in event study analysis.

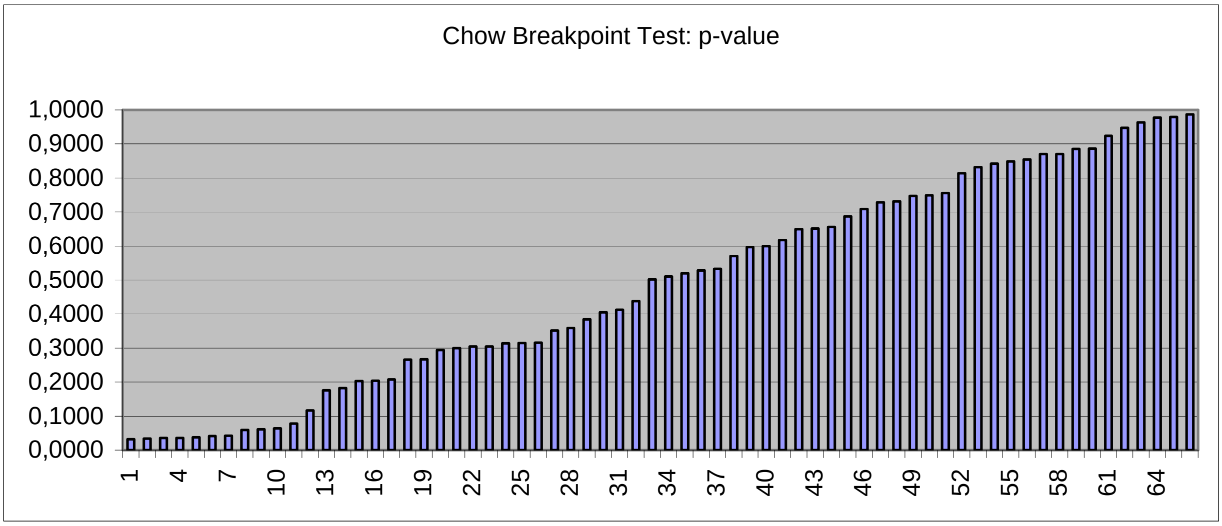
In other words, the approach here followed assumes that coefficients do not change significantly if, instead of using the full sample from day -250 to day +20, we had considered the sample from day –250 to day –20, as is usual in event study analysis. This assumption seems appropriate because the manipulative event should not be anticipated by any relevant change before its occurrence (from day –20 to day –1)[1] and because, even if coefficients' estimates carried out using the full sample are somewhat biased, we should expect that these biases are not significant since the sample is very long (270 days) compared to the number of observations actually affected by the manipulative action (approximately 3-5 days, according to the above analyses). In order to check if our assumption is reliable the following analysis has been carried out.

As to the OLS model

$$Ri = c(1) + c(2)\, Rm + c(3)\, Ri(-1) + u \qquad (12)$$

it has been run the Chow Breakpoint Test using day –20 as relevant date. The null hypothesis is that the coefficients estimated in the two different samples (before and after day –20) are equal. Figure 12 shows the results for all the 66 cases examined.

Figure 12 - P-values of the Chow Breakpoint Tests

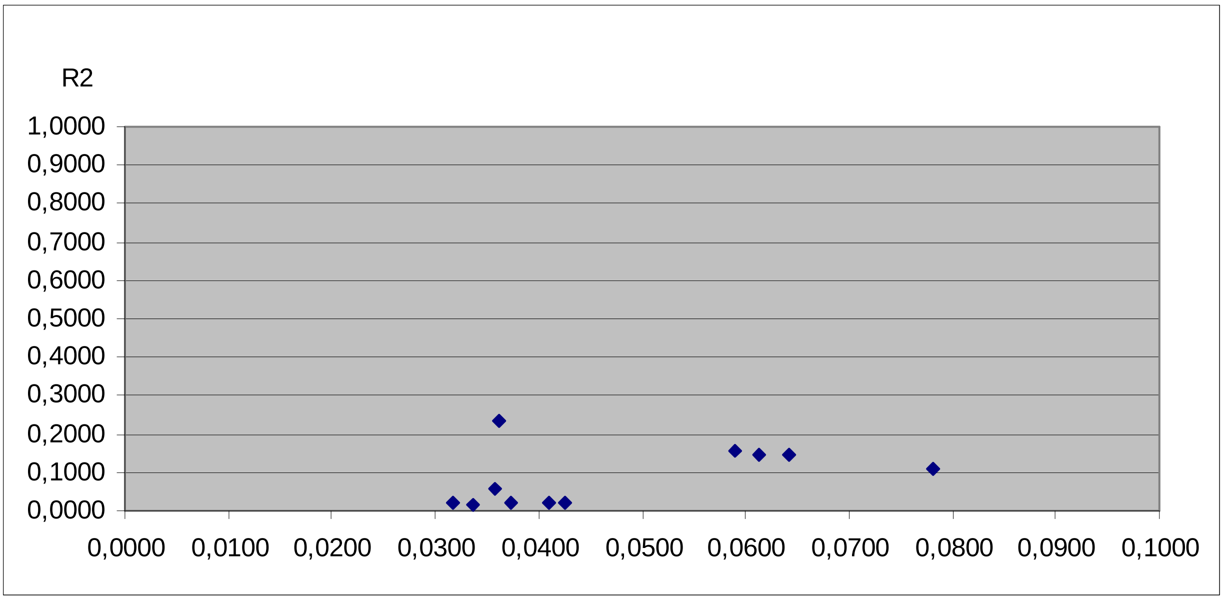


Overall, since the average p-value is 0,49 (st. dev. 0,31), it seems the assumption that coefficients do not change significantly before and after day -20 is reasonable.

[1] In a similar event study analysing the impact of terrorism on financial markets (Chesney and Reshetar, 2007) the estimation window ends the day before the event.

Anyway the null hypothesis is rejected at 10% in 11 cases, apparently due to the following reasons: in 3 cases to the 9/11 effect, in 2 cases to other shocks preceding day –20, in 2 cases to the manipulative action, and in 4 cases to the same problem affecting a stock. Figure 13 shows the R^2 of the 11 cases. Being very low, this should lead to preferring the approach adopted here instead of the standard one, where it is implicitly assumed that R^2 values are close to 1.

Figure 13 - R^2 of cases with p-value < 10%.



Finally, notice that the sign differences between the coefficient estimates according to the two samples are balanced: as to the coefficients which link stock returns to the market ones (beta, or c(2) in eq. (12)), the coefficients estimated using the full sample are in 5 cases greater than those estimated using the sample up to day –20, while in 6 cases the coefficient estimates are lower.

Looking at the GARCH(1,1) model

$$Ri = c(1) + c(2)\ Rm + c(3)\ Ri(-1) + u\sigma \quad (9)$$
$$\sigma^2 i = c(4) + c(5)\ u^2(-1) + c(6)\ \sigma^2 i(-1) \quad (10)$$

we can apply to the mean equation the results already found with OLS, because the MLE estimates carried out in GARCH models are very close to the OLS' estimates. In addition Figure 14 and 15 exhibit the distribution of the differences between the coefficients' estimates using the all sample and those using a sample up to day –20.

It seems that on average c(2) estimates are lower using the full sample instead of the shorter one, while the differences in c(3) estimates are quite balanced.

As for the variance equation, Figures 16 and 17 show the differences referred to coefficients c(5) and c(6), while figure 18 illustrates their combined distribution and Table 24 summarises main statistics.

Figure 14 – Coefficient c(2), differences between the values estimated using the full sample and the sample up to day –20.

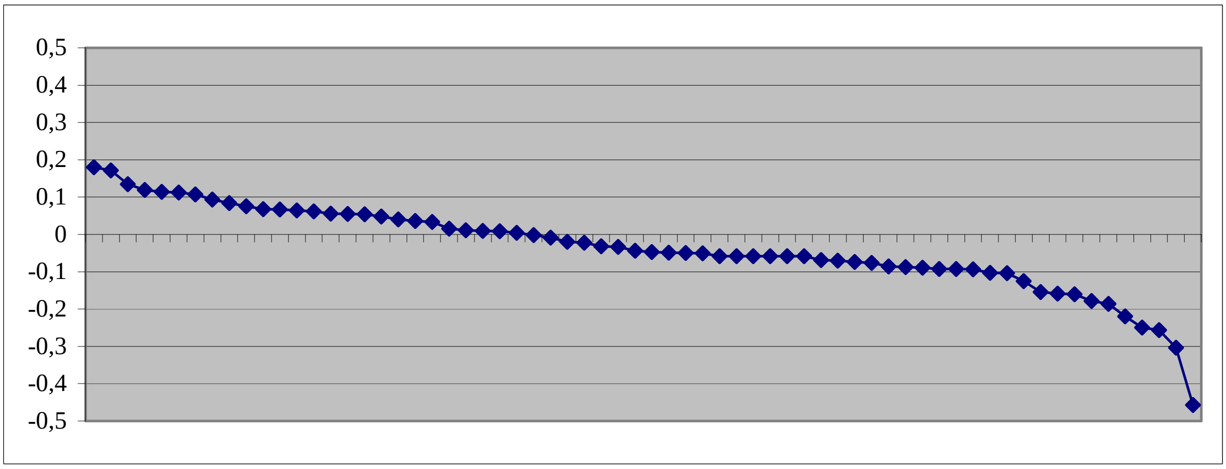


Figure 15 – Coefficient c(3), differences between the values estimated using the full sample and the sample up to day –20.

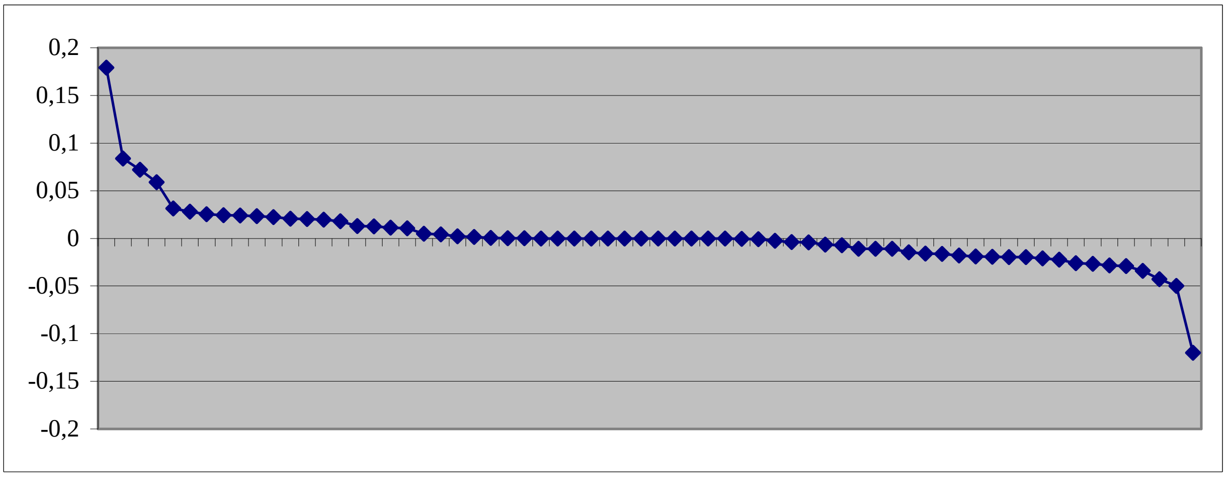


Figure 16 – Coefficient c(5), differences between the values estimated using the full sample and the sample up to day –20.

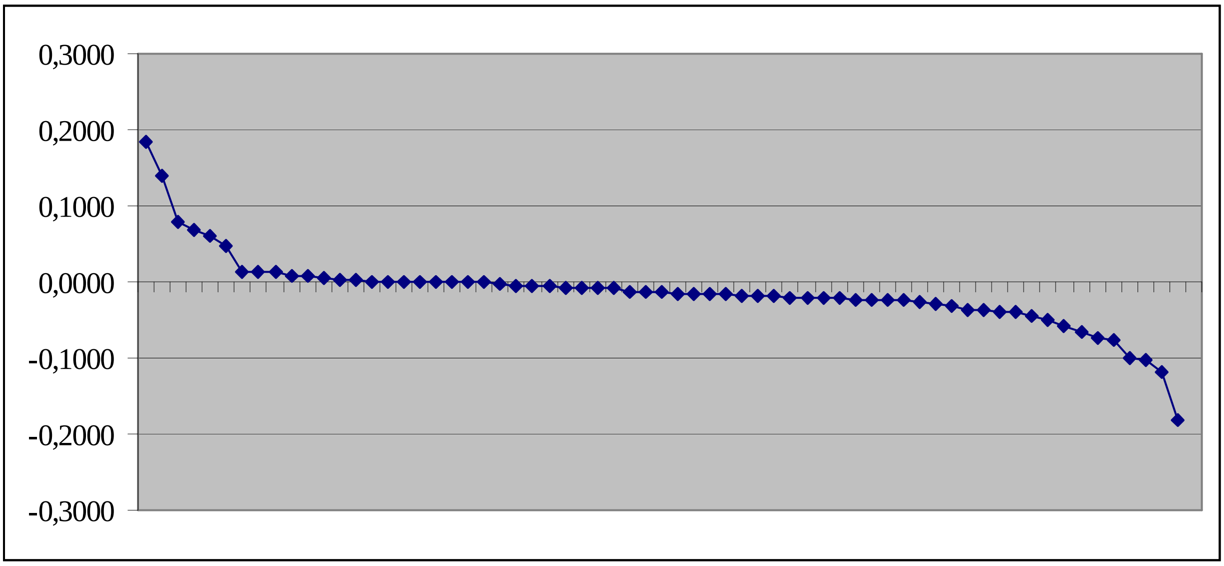


Figure 17 – Coefficient c(6), differences between the values estimated using the full sample and the sample up to day –20.

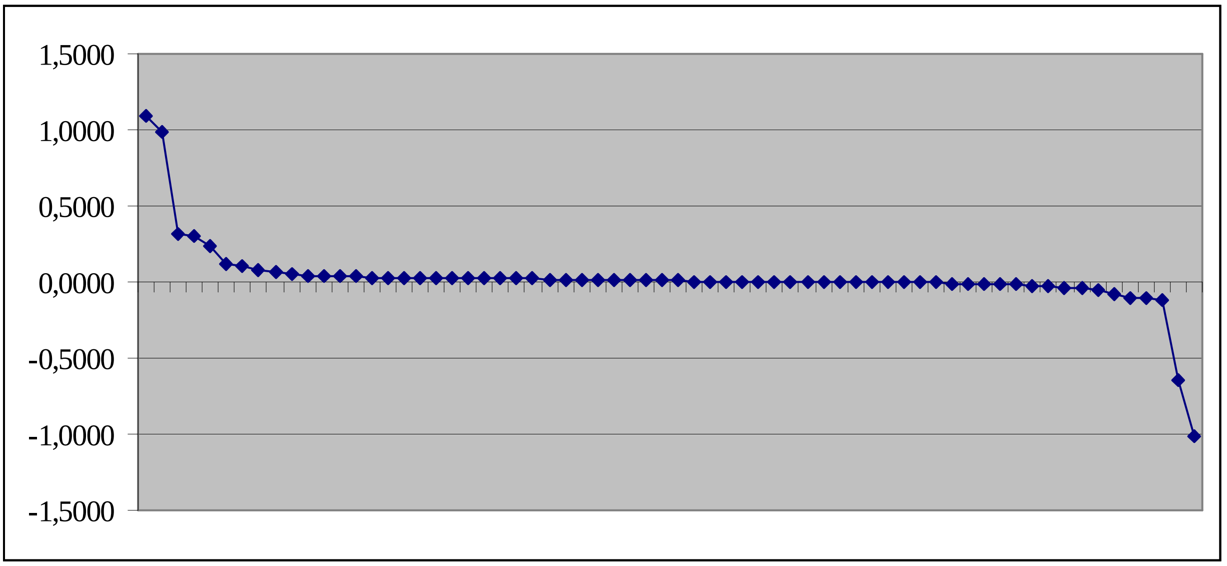


Figure 18. Coefficients c(5) and c(6), differences between the values estimated using the full sample and the sample up to day –20.

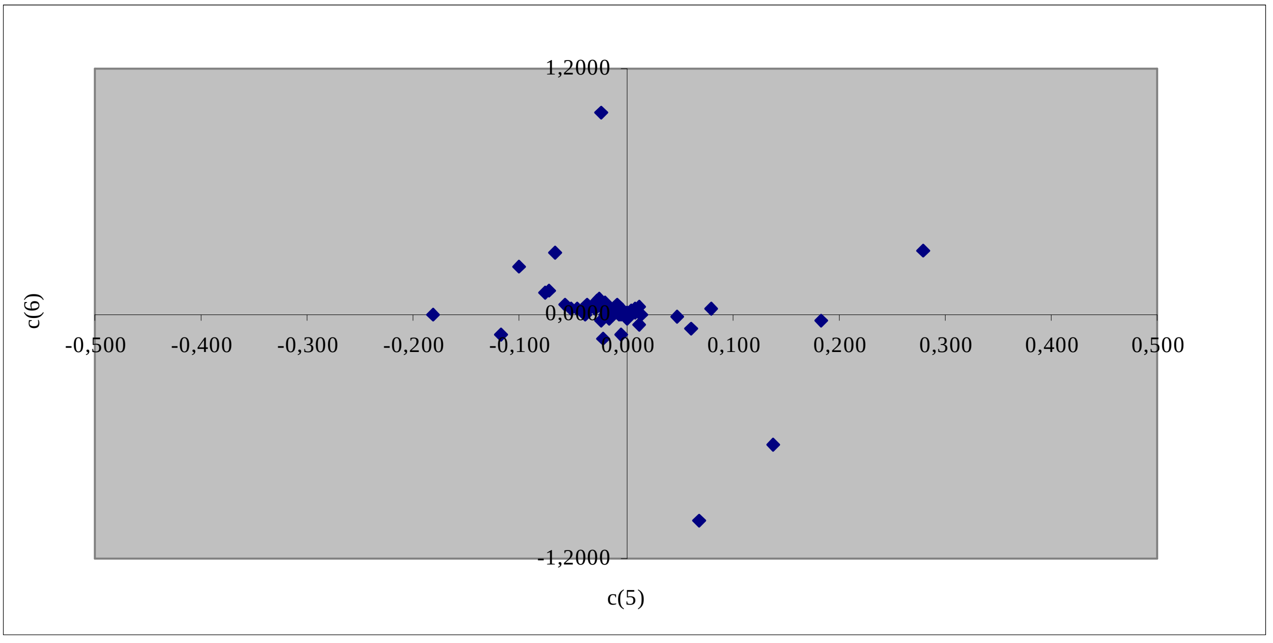


Table 24 - Statistics

	c(2)	c(3)	c(5)	c(6)
Mean	-0,0351	0,0025	-0,0070	0,0079
st. dev.	0,1158	0,0350	0,0615	0,2074
Kurtosis	1,8689	11,5546	8,8408	17,3618

Overall, it seems that the differences among GARCH(1,1) coefficients are quite balanced and not so relevant, except for a few cases that could deserve further analyses.

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Chapter 2

Stock Market Manipulation: a Review

1. Introduction

This paper is intended to test a general definition of market manipulation, similar to that provided by The New Palgrave Dictionary (1992), and to survey the main theoretical and empirical studies in economics that can help the legal and regulatory debate on market manipulation, so as to identify the difficulties around a general law and economic approach.

Before starting, two issues are worth mentioning; the relationship between insider trading and market manipulation and the way market manipulation can be prevented.

In several respects market manipulation is linked to insider trading. Both actions are seen as abuses and, despite controversial debates in the literature, both are banned all over the world (with the relevant exception of spot currency markets), since they are believed to ultimately reduce market confidence, putting at risk the existence of the market.

The literature on market manipulation is less developed than that on insider trading. At this stage, two remarks on the differences between the two behaviour could be helpful in understanding the literature on market manipulation that will be presented. First, several, but not all, market manipulation strategies can be seen as a form of insider trading, since the manipulator is like a monopolist, being the only one who knows everything about the source of the manipulated price, caused by his action. Therefore he can abuse the information he generated, strategically trading around the release of that information. Second, in several, but not all, market manipulation strategies the manipulator tries to behave in a way that can be perceived by other investors as that of an insider, so he can enjoy the herding effect caused by misled investors. In other words, the manipulator pretends to be an insider.

As for prevention, legal scholars believe that most of securities regulation can be interpreted as a way of preventing and avoiding market manipulation. This seems particularly true when considering market manipulation schemes related to the dissemination of false or misleading information. While, when considering those manipulative strategies based on trades entered into the market two relevant variables matter: liquidity and market microstructure rules.

The higher the liquidity of the market, the higher the cost of building up market manipulation strategies. Nevertheless, it should be taken into account that in modern capital market, characterised by the direct access of investors, it is easier for manipulators to enter manipulative orders into the market that could produce significant price changes for a few minutes or seconds, so gaining from the positions already opened in other related markets or securities.

Looking at market microstructure, it is possible to show that several refinements of the rules have significantly reduced the scope for market manipulation strategies. Nevertheless the multiplication of the trading venues around the world, the increasing correlations among markets and securities, reinforced by the development of structured financial products, do not fully ensure markets from the risk of manipulative actions, notwithstanding the extraordinary results achieved during the last decades. Therefore it seems that the development of *ad hoc* detection and surveillance systems and the strengthening of the authorities' enforcement actions is necessary to better ensure investors' market confidence.

Finally notice that market manipulation issues are significantly related to those on bubbles, which have come under further scrutiny from economists, especially after the exuberance of the 1990s (Hunter, Kaufman and Pomerleano, 2003, Ryan and Zingales, 2005, Cochrane, 2005). Manipulative pump & dump schemes could be positioned at the beginning of a bubble and could explain how a bubble is generated in the market.

The paper is organised as follows. Section 2 presents a simple but general definition of market manipulation. Section 3 outlines a reference classification of market manipulation following the EU market abuse directive. Section 4 sketches the difficulties of finding a general definition. Section 5 and Section 6 present a review of theoretical and empirical works. Section 6 concludes.

2. Defining market manipulation

The basic issue of market manipulation is its definition. Practitioners, economists and legal scholars have been debating market manipulation since the first rules of organised exchanged were established. Everybody seems to agree on its relevance. Practitioners are concerned because of the risk of incurring significant losses when manipulators enter into the market. Economists claim that market manipulation distorts the system of prices, which is crucial for allocation efficiency. As mentioned, legal scholars believe that most of securities regulation can be interpreted as a way of preventing and avoiding market manipulation (Loss 1988, Fischel and Ross, 1991). Regulators fear that manipulators undermine market confidence. Thus, IOSCO's Objectives and Principles of Securities Regulation (IOSCO, 2003) states as its first principle that "*Investors should be protected from misleading, manipulative or fraudulent practices*".

All this appears strong enough to expect that market manipulation has been carefully defined. Actually this is not the case. The concept looks clear and intuitive but the definition and its boundaries are still under discussion.

Testing a definition

Market manipulation could be defined as an improper action intended to modify the price pattern of a financial instrument that would otherwise arise without this action (the counterfactual) or, as legal scholars say, that would otherwise arise from the free and proper interplay of market forces[2].

This definition implies that 1) market manipulation is based on an action, 2) the actor's intention characterises his manipulative identity, and 3) market manipulation is finally intended to modify the securities price patterns. Lastly notice that there would be a wide scope for applying econometric tools in order to estimate the counterfactual.

[2] This definition is very close to that shown in the New Palgrave Dictionary (1992): "*The title refers to activities whose objective is to alter prices in financial markets through the use of techniques that result in 'unnatural' market prices, often through the use of wash sales or reporting fictional or apparent market prices*".

The manipulative action

The manipulative action is intrinsically linked to its means, that allow to reach the goal, that of modifying the price pattern. Since the price pattern mostly depends on information and orders to trade, the action is typically based on spreading false or misleading information or on entering manipulative orders into the market.

However, since, more generally, prices depend on supply and demand, other successful means could be adopted. The traditional example is that of frequent movements of (empty) boats in the harbour, which give the public a (false) impression of an increasing supply of a commodity, which should reduce the price.

The standard categorisation of market manipulation in the economic literature is that proposed by Allen and Gale (1992), which, adds to the Securities Exchange Act (1934) distinction between information-based and action-based manipulation, a third category named trade-based manipulation. As the authors explain: "*The kinds of manipulation the Act [Securities Exchange Act (1934)] effectively outlawed fall naturally into two categories. The first can be described as action-based manipulation: that is, manipulation based on actions that change the actual or perceived value of the asset.(…) The second category can be described as information-based manipulation, that is, manipulation based on releasing false information or spreading false rumours (…). However, there is a third category of manipulation that is much more difficult to eradicate. We refer to this third category as trade-based manipulation. It occurs when a trader attempts to manipulate a stock simply by buying and then selling, without taking any publicly observable actions to alter the value of the firm or releasing false information to change the price*".

In principle, the action could consist of an inaction if the person involved is under the legal duty to act, such as listed companies, managers, market makers or relevant shareholders, etc.

It should be emphasised that the action should be seen as "improper" (in a wide sense and not necessarily in legal terms), otherwise also a management action which is rightly intended to maximise the company value would fit the definition of market manipulation. In this respect interesting insights are shown by Chatterjea, Cherian and Jarrow (1993), who claim that corporate finance theorems can be explained within a market manipulation framework. Additionally, also the ordinary market maker activity could otherwise fall within the definition of market manipulation.

As for the "improper" management behaviour, Allen and Gale (1992) believe that fall within the action-based manipulation category also those, apparently legitimate, company decisions which are intended to modify the price pattern but are actually taken in order to allow the management to gain from positions specifically opened in the market to profit from this action. They say: "*For example, in 1901 the managers of American Steel and Wire Company shorted the firm's stock and the closed its steel mills. When the closure was announced, the stock price fell from around $60 to around $40 per share. The managers then covered their short positions and reopened the mills, at which point the stock price rose to its previous level*". This behaviour is actually close to insider trading, but can be deemed as manipulative because the company's decision was "false", being strongly affected by the managers' intention to profit from the positions opened in the stock market.

Close to these strategies are the cases of earning manipulation and of stock-option manipulation. In the first case, managers are interested in shifting earning across years in order, for instance, to ensure their bonuses for the subsequent year. As for the recent cases of stock option manipulation through backdating of grant dates, this is actually more like fraud than market manipulation.

The intent and the (self-financing) manipulative strategy

The intent poses several relevant questions both to information-based and trade-based manipulation.

As for trade-based manipulation, does the proposed definition imply that external observers, such as other market participants, regulators and economists, can never detect and/or prove market manipulation, as it is impossible on one side to distinguish between ordinary speculative trades and manipulative ones and, on the other side, to be positioned in the mind of the traders concerned?

The positive answer is that of the Chicago law school (Fischel and Ross, 1991), who claims that these difficulties disproportionally increase the costs of enforcing market manipulation. They say that the risk of making mistakes in detecting and enforcing market manipulation is too high, and it is better to avoid the introduction of the market manipulation ban. More recently, Avgouleas (2005) advocates deregulation for those trades which are less likely to be due to market manipulation, namely those trades "*that (a) are not directed by insiders, (b) do not involved concealed efforts to control the market and (c) do not raise concerns that relevant trades are subsidized by other positions or contracts*".

Notice that this view is strongly related to the technical difficulties of detecting market manipulation, which is actually more an economic than a legal issue. Therefore, it be stated that improvements in detecting market manipulation would limit the scope of this view.

The negative answer is that from regulators. The US SEC argues that circumstances surrounding the manipulative action can demonstrate the manipulative intent. In this respect it is helpful to consider not only the manipulative action but also the wider manipulative strategy. Actually, a manipulative strategy is based on several actions, which are perfectly matched over time to allow profit gains. Recently, the EU market abuse - two words intended to mean both insider trading and market manipulation schemes - directive (2003/6/EC) and its implementing directive (2004/123/EC) and guidance (CESR, 2005) provide operators with a list of these circumstances (see Appendix Tables 1 and 2).

For instance, even the subtle case of pump & dump schemes – where the manipulator just buys, sets a trend in the price pattern and then sell – could be detected looking at the way orders to trades are entered into the market when the manipulator buys: ordinary speculation typically requires maximising the number of shares bought by minimising the orders' price impact, while pump & dump typically requires maximising the orders' price impact for a given endowment.

Nevertheless, some forms of market manipulation are tolerated by jurisdictions, also because of the difficulties in distinguishing between ordinary and manipulative trades. This is, for instance, the case of the safe harbours allowed in the London Metal Exchange, or allowed by other regulators in equity markets to intermediaries that provide liquidity according to a contract with the company, or, again, allowed to issuers which carry out buy-back programmes or to intermediary syndicates during offerings. In all of these cases, several conditions must be complied with in order to enjoy the safe harbours.

Other, less explored, questions on the manipulative intent refer to its very final end. These questions often arise in information-based schemes. Should market manipulation be confined to cases where the manipulator's intent is exclusively to gain through the price change caused by his action? Or could it be extended also to those cases where the price change is just an intermediate goal, or it is not due to this intention even though it is caused by a manipulative way, such as by spreading false information?

These questions should probably find a positive answer, but there are some quite intriguing situations. Such as the cases where the false statement is crucial not only to create a price change but also to send a message to other people or to the public. As stated by IOSCO (2000), "*In some jurisdictions, dissemination of false or misleading information constitutes a separate offence prosecuted under laws not specifically directed at manipulation*", so it seems that these strategies are somewhat different from pure market manipulation.

Note that also economic literature on market manipulation is not yet considering these cases, focusing only on those schemes where manipulators strategically trade before, and after, releasing false information. More generally, economic literature examines cases of self-financing manipulation strategies, because it is rightly more concerned about strategies where the a speculator could systematically win in the market. Nevertheless, according to the above proposed definition, market manipulation could arise, for instance, also if the speculator decides to modify the price pattern just in order to reduce its expected losses (even though the whole manipulation strategy is not self-financing).

A final important remark refers to the legal definition of market manipulation, that often does not requires the intent as a necessary element of market manipulation, holding sufficient the effects produced by the manipulative action. So, effect-based definitions are preferred to intent-based definitions. This is because of the enormous difficulties in proving manipulative intent. Therefore, since effect-based definitions could have a wider scope than intent-based definition (not all the actions that produce relevant price changes can be seen as manipulative) laws typically adopt other techniques to overcome this problem.

For instance, the EU regulation on market abuse presents two solutions. First, the external observer should look carefully at the effects of the action concerned (and not at the trader's intention). In particular, the observer should look at the modified price pattern, if he detects (according to economic and statistical tools) misleading or abnormal price changes, then he should try to find if there were legitimate reasons, or accepted market practices that could motivate these changes. If he finds them, then he can archive the case, if he does not, he has good reasons to continue his investigation, being the findings strong enough to infer (or to prove) the manipulative intent. Second, since, as already shown, it is helpful to consider a market manipulation strategy as the sum of the market manipulation action and of "other circumstances" which surround that action, and since these circumstances are typically interrelated to each other, they could be crucial for an external observer in understanding the reason why the alleged market manipulation action occurred and eventually to prove market manipulation.

Modifying the price pattern

An open issue is that of the relevant variables that characterise the manipulative action. Is it just the price pattern or also market volume, market makers' reactions, volatility, other investors beliefs, authorities' decisions that show the object of market manipulation?

The answer of the proposed definition is that all the other mentioned variables matter as long as they produce, in turn, an impact on the price patterns (which of course includes also volatility). Most importantly, this also seems to be the implied answer given by economic literature, which, considering only self-financing manipulation strategies, does not value any other action which does not ultimately have an impact on prices.

Several legal definitions of market manipulation seem to favour a wider scope. According to the US SEC, "*Manipulation is intentional interference with the free forces of supply and demand for a security, often designed to deceive or defraud investors through controlling or artificially affecting the price of securities or market activity*" (IOSCO, 2000). The recent EU directive on market abuse focuses on those orders to trade which "*give, or are likely to give, false or misleading signals as to the supply of, demand for or price of financial instruments*" and on that dissemination of information "*which gives, or is likely to give, false or misleading signals as to financial instruments*".

The counterfactual

Another issue is that of the minimum price change which is required to value an action as manipulative. In this respect it seems that even a very small change could constitute market manipulation. This is because even the manipulation of a simple price tick could be enough to cause extraordinary shift in investors' wealth. Consider, for instance, a stock option that becomes in-the-money due to a manipulative order.

Therefore, in empirical analyses, when considering the price impact of manipulative actions, it is not appropriate to conclude that there was actually no market manipulation if *ex post* the price change was not significantly different from ordinary price changes. On the contrary, analyses should be run *ex ante*, so that any attempt of intentionally modifying the price pattern, even by a tick, could be valued as market manipulation.

Finally, it should be noted that market manipulation, requiring an analysis of the counterfactual, provides a wide scope to apply economic and quantitative tools.

3. A reference categorisation

Given the wide variety of market manipulations strategies, several categorisations can be outlined. In the economic literature there is just one categorisation attempt, that of Cherian and Jarrow (1995). But (since they classify information-based manipulation as a form of trade-based manipulation) here it seems better to follow the recent EU market abuse directive (2003), which distinguishes market manipulation on the basis of the means, between information-based and trade-based manipulation, and then to classify trade-based manipulation into two forms a) misleading transactions and b) price positioning.

In misleading transaction strategies the manipulator wants to send false signals to other market participants, so as to take advantage of their reactions. In price positioning strategies the manipulator wants to fix the price at a desired abnormal level, being reckless about sending false signals or not. The manipulator just abuses its market power. Finally, a further category of trade-based manipulation brings in those cases which are mixed with information based manipulation.

Examples of information-based manipulation schemes are quite obvious. They refer to the source that spread or release the false or misleading information, typically listed companies, managers, financial analysts, journalists, gurus, relevant shareholders. Due to the development of the Internet, also not so qualified people are able to spread information which can have impact on the price pattern, and, therefore, are able to manipulate the market.

Examples of trade-based manipulation are more sophisticated. Table 3 in the Appendix describes many schemes put forward by the market abuse directive. Here there is a short list of some schemes, distinguishing between misleading transactions and price positioning manipulation strategies:

a) misleading transactions: trend creation, pump & dump, trash & cash, opening a position and closing it immediately after its public disclosure, bubbles, pools;
b) price positioning: creation of a floor in the price pattern, excessive bid-ask spread, trading on one market to improperly position the price of a financial instrument on a related market, corner, abusive squeeze, colluding in the aftermarket of an IPO, contract-based manipulation.

Particularly interesting is the distinction of trade-based manipulation between misleading transactions and price positioning, because it allows us to link trade-based manipulation strategies to the financial econometrics results on the informational content of prices (misleading transactions schemes) and on abnormal prices (price positioning schemes).

Anyway, this classification is just indicative since more complex examples of stock market manipulation strategies can fall within all the three mentioned classes.

4. The difficulties of finding a general definition

The main underlying reasons for the difficulties in finding a reliable definition of market manipulation are probably four: a) the great variety of market manipulation strategies, b) the existing differences in market microstructure around the world, c) the "impossibility" that the law could express a satisfying definition, and d) the very recent contribution of microeconomic theory.

a) The great variety of market manipulation strategies

As mentioned, market manipulation strategies are very wide in forms and species basically because people can have many different reasons to manipulate market prices. Among the possible classifications of market manipulation other than that in Section 3, Table 4 in the Appendix exhibits that produced by IOSCO (2000) which distinguishes between market manipulation methods and objectives.

b) Differences in market microstructure

A second reason that can explain the difficulties of dealing with a proper definition of market manipulation is linked to the variety of microstructure rules that exchanges have in place around the world. The more different these rules are, the more difficult it is to find a definition of trade-based manipulation that can fit all cases. In fact, every method of manipulating the price is strongly related to the price formation process established by the individual exchange.

A major distinction in stock exchanges is between outcry and electronic trading systems. The latter, which is prevalent, usually employs two kind of auctions, the continuous trading one, where there is a sequence of prices, with each price immediately determined as the consequence of matching two orders with opposite signs, and the call-auction or batch-auction, where a single price is formed at the end of an auction which lasts for a pre-determined period[3], during which time

[3] Notice that in order to deter market manipulation the electronic call-auction end is not predetermined, but stochastic, in several exchanges.

market participants can enter their orders, if few conditions are met. During the call-auction market participants can continuously monitor the "theoretical" price, i.e. the price that would be formed if the auction ended in that specific instant. According to the rule of the exchange, call-auctions typically take place at the beginning and, more recently, also at the end of the trading day.

c) The definitions of market manipulation provided by the law

As mentioned in Section 3, the definitions of trade-based manipulation provided by the law very rarely refer to the manipulation intent of the agent, otherwise it would be almost impossible to probe it. Fischel and Ross (1991) emphasise this issue arguing that the judge should be positioned into the mind of the alleged manipulator to distinguish manipulative trades from those which come from ordinary speculative trading strategies.

Legal definitions of trade-based manipulation usually avoid expressing the intent of the manipulator, opting in favour for quite abstract concepts, such as "artificial" prices, which do not find a similar concept within the financial-economic literature.

Interestingly, as mentioned above, the approach of the European market abuse directive is anchored to effect-based (and not intent-based) definitions where trade-based manipulations are those which produce "misleading" or "abnormal" prices, which, in addition, are not caused by legitimate reasons or which are not due to accepted market practices. This approach can probably bridge law and financial-economics concepts since misleading prices could be interpreted as a partition of those prices which, according to economic studies, have an informative content, while abnormal prices match quite well those prices defined in the financial economic literature.

d) Microeconomic analyses

A final explanation for finding a proper definition for market manipulation is that most microeconomic analyses have been produced very recently. Table 1 lists the definitions of market manipulation given by several economists.

Table 1 – Definitions of market manipulation

Authors	**Definitions**
	General manipulation strategies
Vila (1989)	*In this paper an agent is said to manipulate price when this agent affects the price by his action and perceives that he does so.*
The New Palgrave Dictionary (1992)	*The title refers to activities whose objective is to alter prices in financial markets through the use of techniques that result in 'unnatural' market prices, often through the use of wash sales or reporting fictional or apparent market prices.*
Allen and Gale (1992)	*The kinds of manipulation the Act [Securities Exchange Act (1934)] effectively outlawed fall naturally into two categories. The first can be described as action-based manipulation: that is, manipulation based on actions that change the actual or perceived value of the asset.(…) The second category can be described as information-based manipulation, that is, manipulation based on releasing false information or spreading false rumours (…). However, there is a third category of manipulation that is much more difficult to eradicate. We refer to this third category as trade-based manipulation. It occurs when a trader attempts to manipulate a stock simply by buying and then selling, without taking any publicly observable actions to alter the value of the firm or releasing false information to change the price.*
Cherian and Jarrow (1995)	*Roughly speaking, market manipulation occurs when an individual (or a group of individuals) trades a firm's shares in a manner such that the share price is influenced to his advantage.*

Avgouleas (2005)	*Behaviour effected through any one, or a combination of any one of the following: misrepresentations and other false statements or concealments, artificial transactions, and trading schemes, which are made or structured in such a way as to induce other market participants to engage in the trading of financial investments or the exercise of rights in financial investments. Relevant trading must be in such a direction or the exercise of rights must be effected in such a way, as to either lead the price of these investments to an artificial level, and/or enable the perpetrators of the behaviour to materialise, from interests held in the specific or related investments, financial gains that would not be possible, in the absence of such behaviour.*
Information-based manipulation	
Vila (1989)	*The case of agent spreading of false rumours about a company or committing criminal act against a company. The manipulator profits by 'shorting' the stock, i.e. selling the stock without having it and buying the stock after the decline of the stock price.*
Benabou – Laroque (1992)	*Many types of insiders have both the ability and the incentives to manipulate public information and asset prices through strategically distorted announcement or forecasts.*
Trade-based manipulation	
a) Trend creation – Bubbles – Pump & Dump – Pools	
Hart (1977)	*In this paper we shall be able to obtain general conditions under which intervention by speculator is profitable. Our analysis is based on the simplifying assumption that there is a single speculator and a large number of nonspeculator. The speculator will be regarded as a skilled professional who understand the way in which other trader in the market behave, at least in the aggregate, and who is therefore able to act like a monopolist. All other traders will be assumed price-takers and will be lumped together under the general heading of nonspeculators. (…) We shall be interested in whether, given that the economy is initially in a stationary state, the speculator can manipulate the market from the nonspeculators.*
Vila (1989)	*Before taking over a company, a potential raider usually tries to acquire stocks on the open market. Rational investors closely watch the volume of individual stocks trading and usually, active buying sour rumours of a takeover. This in turns raises the price of the stock. Therefore the supply curve for stocks will not be fully elastic and the monopolist/raider will not acquire all the shares in the open market.*
Jarrow (1992) Gastineau – Jarrow (1991)	*Jarrow (…) defines market-manipulation trading strategy as a dynamic trading position in financial securities that moves securities prices and that satisfies 3 conditions:* *1) the large trader's wealth after liquidation of the position is expected to be grater than the amount of wealth required to initiate the position* *2) the trade is not an arbitrage opportunity that would also be available to small investors (price-takers)* *3) there is no chance of loss to the trading strategy or, more precisely, in the absence of information that suggests a trading strategy will yield a positive, risk-adjusted return on liquidation, the trader undertakes it anyway, expecting to profit from advantages related to size and intertemporal differences in market impact.*
Allen and Gorton (1992)	*It is possible for an uninformed trader to buy a stock, drive the price up and then sell the stock at the higher price, thereby earning a profit? In this paper we show that this type of trade-based manipulation is possible under very natural conditions and develop an example where there is an equilibrium amount of manipulation.*
Camerer (1998)	*For present purposes, define market manipulation to mean trading against one's information or preferences, to create price movements that will lure other investors and ultimately allow later profit. (…) Markets in which some investors try to infer information of others from price signals might be vulnerable to market manipulation of this sort. Manipulators could make uninformative trades that might seem to convey information, but are actually made to deliberately mislead uniformed traders (for the purpose of later profit).*
Aggarwal and Wu (2006)	*Manipulation can occur in a variety of ways, from actions taken by insiders that influence the stock price (e.g., accounting and earnings manipulation such as in the Enron case) to the release of false information or rumors in Internet chat rooms.*

	Moreover, it is well known that large block trades can influence prices. For example, by purchasing a large amount of stock, a trader can drive the price up. If the trader can then sell shares and if the price does not adjust to the sales, then the trader can profit. Of course, we should expect that such a strategy would not work. Selling shares will depress the stock price, so that, on average, the trader buys at higher prices and sells at lower prices. This is the unraveling problem and would seem to rule out the possibility of trade-based manipulation.
Eren – Ozsoylev (2006)	*One of the most well-known manipulation schemes is the hype and dump manipulation, also referred to as pump and dump. In this scheme, the manipulator artificially inflates the asset price through promotion in order to sell at the inflated price, or deflates the asset price through false hype in order to buy at the deflated price. This practice is illegal under U.S. securities law, yet it is common.*
b) Price positioning – contract based – market power	
Kumar and Seppi (1992)	*Can uninformed investors profitably manipulate security prices by strategically trading? This question has long intrigued economists and the general public. For economists, since Keynes and Friedman the issue of interest has been whether such manipulation can arise as an equilibrium phenomenon in the presence of rational market makers and other traders. Prima facie, it might appear that manipulation requires a divergence between a security's price and its "value" which other market participants ought to recognise and profitably counteract, thereby offsetting any incipient manipulation. We show here that this is incorrect (…) profitable manipulation occurs in our model under a surprisingly week set of assumptions. (…) For example, after establishing a "long" futures position, the settlement price can be artificially bid up by buying in the spot market. This is called "punching the settlement price". If the futures position is larger that the spot position, the net expected gain (i.e., profit on futures less loss on the spot) is positive.*
Gerard - Nanda (1993)	*We investigate the potential for manipulation due to the interaction between secondary market trading prior to a seasoned equity offering (SO) and the pricing of the offering. Informed traders acting strategically may attempt to manipulate offering prices by selling shares prior to the SO, and profit subsequently from lower prices in the offering.*
Jarrow (1994)	*If prices of one market systematically lag prices in the other, an opportunity for manipulation exists.*
Hillion and Suominen (2004)	*In our model, a broker's execution quality depends on his ability to search out additional traders in the market, to accommodate his customer's order. The customer does not know her broker's ability, but tries to estimate this from the prices that she observes: her execution price and the closing price. The broker, in turn, tries to influence the customer's learning about his ability, by exerting effort when executing the order and by manipulating the closing price. In the case of a customer's sell order, for instance, a low execution price, as compared with the closing price, is an indication of low broker ability. Because the broker's future commission depends on the customer's estimate of his ability, the broker, in this case, manipulates the closing price downwards by selling shares at the close.*

Overall, it seems that most economists are not so interested in what market manipulation is. The literature is focused on the equilibrium conditions which allow particular types of manipulation strategies to occur and on the effects manipulation produces on market efficiency.

5. Economic theories

The following paragraphs summarise the economic literature according to the reference categorisation. Economic analysis focuses on the conditions under which market manipulation can occur and on the effects market manipulation produces on stock market efficiency. Results have policy implications on the enforcement costs of market manipulation and eventually on the need of establishing an authority responsible for detecting and enforcing market manipulation.

5.1. Information-based manipulation

Making money by disseminating false or misleading information could be quite an easy job. This practice has been observed many times during the last few centuries. What looks fundamental to succeed in this game is to be credible enough to convince other market participants about the truthfulness of the disseminated information.

According to the economic studies on credibility and reputation, the issue is to what extent it is possible for a credible person to succeed in the game without losing reputation. The benchmark answer is that if the manipulator lies, he loses almost immediately his reputation and, therefore, he loses the possibility of succeeding a second time. Market discipline works efficiently enough to disincentive information-based manipulation.

On the other hand, recent microeconomic research argues that several conditions can put this conclusion at risk. First, information is not always verifiable ex post. Therefore market discipline can not work properly, because no one can eventually say if the manipulator lied or not. Second, since people can make honest mistakes, also the manipulator can be thought to have honestly made an erroneous assertion. Consequently, he can save his reputation.

This is the position of Benabou and Laroque (1992), who examine if and under what conditions information-based manipulation carried out by corporate officers, financial journalists, financial analysts or gurus is consistent with equilibrium. They show that the market learning process does not work efficiently, hence there is scope for manipulation even in the long run.

Van Bommel (2003) shows that spreading positive (negative) false rumour after opening a long (short) position could be an optimal manipulative strategy. "*The extent to which the rumour can move the stock price depends on the number of followers and the amount that each invest. The model can explain stock-price overreaction, excess volatility and negative autocorrelation of stock prices and are consistent with empirical rumour studies who find that before publication of a rumour, stocks experience an on average significant price increase*". Therefore, it explains why rumours are so widespread in financial markets.

Eren and Ozsoylev (2006) consider the case where information-based manipulation is successful within a pump (or hype) & dump scheme, showing how information-based and trade-based manipulation can overlap. They argue that a hype and dump manipulation carried out by a single informed trader, who knows the risky asset payoff with certainty, is attained in equilibrium if there is at least one naive trader in the market and the cost of being suited of dishonest rumor-mongering and that of being detected by sophisticated traders is high enough. "*On the welfare side, we show that informed trader increases her trading profit by hyping and dumping at the expense of naive traders. On the asset pricing side, we find that market depth and trading volume increase with hype and dump while market efficiency decreases*".

In micro models the manipulator is often considered as a monopolist or an insider, because he is the only one who knows the information source (himself), the content and the diffusion time of the piece of information he is going to disseminate. Of course, other persons (outsiders) can intervene in the game after the manipulator spreads the false information.

According to Cherian and Jarrow (1995) many strategic information-based models, such as those of Kyle (1985) and Easley H'Hara (1987) fall within the information-based manipulation category since the monopolistic informed trader's (named "manipulator") trading strategy tends to make prices less informationally-revealing, thus enabling him to extract higher monopolistic information rents from the rest of the market. In the former model, the monopolistic informed trader submits orders which increase with noise trading, in the latter model he strategically chooses between small market orders and large block orders.

Anyway, it seems that the conduct examined in these models should hardly be seen as manipulative, because they are not so intended to modify the price pattern, but to prevent market makers or other investors learning what is the inside information, i.e. the trader full order. Furthermore, this conduct is not based on false information but on false (or, better, not fully revealing) trades.

An interesting issue is to understand what happens when, after the release of false information, another credible entity expresses an opposite view. And, in particular, what happens when this entity is a listed company, which, for instance, replies in order to address the public information set after the effects produced by the manipulator's action. Since it is difficult to establish in a short period who is saying the truth, it would be interesting to understand what is the market reaction and, therefore, if the manipulator can still expect a profit.

Securities regulation prevents the risk of market manipulation by imposing several checks before and after the release of relevant information. Typically, periodic results published by listed companies are checked and monitored by auditors and regulators. Recently, also reports and research on listed companies disseminated by financial analysts (either independents or working for intermediaries), rating agencies and journalists should comply with rules set out by the law, and not only with those rules set out by self-regulatory bodies.

In general, the risk of information-based manipulation increases depending on the reputation of the source that spreads the false information, but the development of the Internet has increased the importance of unqualified sources.

5.2. Trade-based manipulation

Market manipulation strategies not based on the spreading of false or misleading information can be defined as trade-based manipulation. Nevertheless, as above mentioned (Eren and Ozsoylev, 2006) this kind of manipulation can also be mixed with the information-based genre.

There are several types of trade-based manipulation schemes. According to the reference categorisation in Section 3, a way of distinguishing among these strategies is to consider, on one side, all the schemes where the manipulator is interested in sending a false signal to other market participants in order of provoking their reactions and then successfully closing the strategy when the stock prices reach the expected levels, and, in the other side, all the schemes where the manipulator is just interested in fixing or positioning the price at a certain level which allows him to obtain some other profit or benefit irrespective of the reactions of other market participants.

Note that in order to analyse these strategies, economists have to leave the standard assumption that investors are price-takers to embrace the less explored one, where some investors are price-makers. This is the case of large investors, those who move prices when trading; they usually trade huge quantity of shares, which can not be executed in the market without generating a price change. Of course large investors could also trade as small investors (price-takers) when they decide to dilute their orders over time.

As Jarrow (1992) highlights: *"A large trader is one whose trades change prices. To differentiate information traders from manipulator, we assume that large trader has no information. His trades move prices only because of size or because the "other side" of the market believe (with some probability) that the large trader is informed".*

Very interesting is the third condition of the Jarrow's proposed definition, as reported in Section 4: *"market-manipulation trading strategy as a dynamic trading position in financial securities that moves securities prices and that satisfy 3 conditions: 1) the large trader's wealth after liquidation of the position is expected to be grater than the amount of wealth required to initiate the position; 2) the trade is not an arbitrage opportunity that would also be available to small investors (price-takers; 3) there is no chance of loss to the trading strategy or, more precisely, in the absence of information that suggests a trading strategy will yield a positive, risk-adjusted return on liquidation, the trader undertakes it anyway, expecting to profit from advantages related to size and intertemporal differences in market impact".*

Notice that Jarrow's definition, as others in the literature, refers to the case of self-financing manipulation strategies, but, actually, serious market manipulation occurs even when the strategy is not self-financed, but produces a better pay-off for the manipulator compared to that without manipulative action.

Vila (1989) explains why economic literature only recently considered market manipulation: *"Until the last ten years, perfect competition was a standard assumption in financial economics. Indeed, the stock markets and the futures markets, among others, were often given as textbooks examples of the Walrasian paradigm".* In other words, as long as investors are assumed price-takers, the case of trade-based manipulation can not arise.

Sections 5.2.1 and 5.2.2 deal with the two forms of trade-based manipulation.

5.2.1- Misleading transactions

Pump & dump schemes, trend creation and manipulative bubbles can be implemented by setting a false trend in the price pattern: thanks to the basic rule of the anonymity of the trades, the manipulator can induce other investors into the belief that insiders are trading. He can persuade them to follow the trend, producing herding. Once the trend is established, the manipulator can successfully close the position slowly over time, without producing a negative impact on the prices.

The basic issue is the, so called, "unravelling problem": can a trading strategy be profitable if it is based on two actions, the first one consists of buying shares at increasing prices in order to establish a positive trend and the second one consists in selling the shares without producing a symmetric reduction in the price pattern? As long as the two actions produce symmetric effects on prices, the trading strategy does not appear, ex ante, profitable.

Allen and Gale (1992) stated: *"The argument is simple. When a trader tries to buy a stock, he drives up the price. When he tries to sell it, he drives down the price. Thus, any attempt to manipulate the price of a stock simply by buying and selling requires the trader to "buy high" and "sell low". This is the reverse of what is required to make a profit".*

This answer has been given by several economists, such Mill (1921), and legal scholars, such Fischel and Ross (1991). Nevertheless, recently, the mentioned strategy has been examined very carefully by micro economists, reaching opposite results within different sets of assumptions. Also practitioners and regulators believe that these manipulation schemes can be observed in the markets (see Appendix).

The seminal work is that of Hart (1977), which has been subsequently extended by Jarrow (1992), Allen and Gale (1992), Vitale (2000) and Aggarwal and Wu (2006). Also the paper of Allen and Gorton (1992) falls within this field.

Hart (1977) argues that, in the presence of investors who trade on rule of thumb, it makes sense for manipulators, defined as large informed investors, to destabilise prices. Hart shows in a deterministic setting that if the stationary equilibrium is unstable or demand functions are non-linear and satisfy some conditions, manipulators can trade profitably. Under special conditions market manipulation is also possible even when the economy is stable.

Jarrow (1992) extends Hart's analyses to a stochastic setting and he reaches similar results. He shows that if prices have a momentum, manipulation can be profitable, since an increase in price pattern caused by the manipulator's trades at one date tends to increase prices at future dates. The author examines the necessary and sufficient conditions of the price process that allow a large trader who trades strategically, i.e. the manipulator, to profit without risk, in other words creating arbitrage opportunities. He defines these strategic trades as market manipulation strategies.

He shows that the existence of these trading strategies depends on the sensitivity of the equilibrium price process to the history, namely the past sequence, of the manipulator's holdings (and not to his current holdings). Otherwise market manipulation is not possible. What is crucial is the time asymmetry in the sensitivity of price changes to the large trader's trades. Only this asymmetry creates manipulation opportunities.

Since Hart (1977) and Jarrow (1992) analysed market manipulation in the context of dynamic models of asset markets, so assuming the investors' demand function as exogenous, Allen and Gale (1992) argue that it is not clear whether and under what conditions manipulation is consistent with rationality. Allen and Gale (1992) examine market manipulation taking into account the investors' expected utility-maximising behaviour and show that in a rational expectation framework, where all agents maximise expected utility, it is possible for a manipulator to profit provided that investors are misled (i.e., provided that investors attach a positive probabilities to the fact that manipulator's trades are actually insiders' trades). Asymmetric information is crucial: traders are uncertain whether a large trader who buys the stock does so because he knows it is undervalued or because he intends to manipulate the price. Therefore, Allen and Gale (1992) demonstrate that market manipulation is possible even if there is no momentum in the price process or if the price process is stable.

Aggrawal and Wu (2006) extend the Allen and Gale (1992) results including in their framework information seekers, i.e., those investors who trade following price signals. In this way Aggrawal and Wu (2006) include the point made by Jarrow (1992) on price momentum in the Allen and Gale (1992)'s framework, since information seekers behaviour produce momentum in the price process.

The implications of Aggrawal and Wu (2006) analyses on market efficiency and securities regulation are very interesting. Information seekers usually improve market efficiency as their trades, following informed trades, moves market prices quickly towards fundamental values. But when there are manipulators in the market information seekers reduce market efficiency because they follow the false signals sent by manipulators.

In addition, since information seekers compete for shares, increasing the number of information seekers will increase the manipulators' profit, thereby making market manipulation more likely. Furthermore, increasing the number of information seekers make arbitrage activities more difficult, so worsening market efficiency. Consequently they argue that "*the need for government regulation is acute. In particular, enforcement of anti-manipulation rules can improve market efficiency by restoring the effectiveness of arbitrage activities*".

Allen and Gorton (1992) overcome the unravelling problem by looking at the behaviour of liquidity traders, those who trade for exogenous reasons. While in the standard microstructure models (like those of Glosten and Milgrom or Kyle) with asymmetric information it "*is assumed equally likely that liquidity traders are buyers or sellers*" Allen and Gorton argue that this is not realistic, since typically liquidity traders do not have pressing needs to buy securities as they do when they sell. Therefore, this "*natural asymmetry between liquidity purchases and liquidity sales leads to an asymmetry in price responses. If liquidity sales are more likely than illiquidity purchases, there is less information in a sale than in a purchase because it is less likely the trader is informed.* Consequently market maker's adjust bid-ask spread at a lower speed in response to a sale than to a buy order. In turn, this asymmetry of price elasticities make profitable market manipulation strategies, overcoming the unravelling problem: a manipulator can buy stocks causing a large effect on prices and then sell them producing a lower effect.

Finally, Allen and Gorton (1992) found another asymmetry that allows the existence of successful market manipulation schemes. They note that in microstructure models sellers and buyers are assumed equally likely to be informed, while actually this is not the case since short sale constraints make easier to exploit good news than bad news. Again, if market makers attach different probabilities to these two situations, there are opportunities for profitable manipulation.

Vitale (2000) bases his argument on the market makers learning process, showing that an uninformed speculator can profit from submitting huge noise orders to the market makers so that they are not able to properly distinguish liquidity traders from informed traders. Simultaneously the uninformed speculator gains an informational advantage, being the only one who knows the actual sources of the huge noise orders; he can then extract fundamental information from market makers quotes and then exploit this informational advantage in the subsequent periods. Vitale highlights that this manipulative strategy is possible if profits coming from the informational advantage are higher than the costs of sending misleading orders to the dealers. Correspondingly, the solution of the trade-off determines the optimal volume of speculative noise trading.

In addition, he notes that Lyons (1995) empirically found that in foreign exchanges a large component of the order flow of a dealer does not contain information. Therefore, since in foreign exchange market trades mostly occur between specialised investors, Vitale says that these findings could be evidence of market manipulation attempts.

Mei, Wu and Zhou (2004) show that manipulators can take advantage of investors' behavioural biases such as the "dispositional effect": people are less willing to sell loser stocks than to sell winner stocks. Therefore the manipulator can overcome the unravelling problem in pump & dump schemes if the speed of price decline when the manipulator sells is slower than that of price rise when the manipulator buys.

Fishman and Hagerty (1995) argue that, without advocating asymmetries, another group of trade-based strategies can take place if regulation sets out trade disclosure, as typically happens to managers' trades or to shareholders who own a relevant company's stake, such as 2% or 5% of the outstanding shares. These people can manipulate the price abusing of the information content of the mandatory disclosure, even if they actually do not possess any private information. For instance, a manager can buy stocks and immediately sell them after the price has increased due to the public disclosure.

In conclusion, notice there are two other ways of solving the unravelling problem which can be found by looking at the orders' execution time. First, looking at the asymmetric price responses associated to the way orders to trade are entered into the market. Since microstructure rules allow investors (and manipulators) to minimise or maximise the impact of the orders on prices, depending on the need of immediacy requested. Therefore, manipulators can alternate the two types of orders in such a way to overcome the unravelling problem. Second, by looking at the different time length during which the positions are opened or closed, diluting the order's quantity over time can actually reduce the price impact.

While all the above studies refer to market manipulation strategies which are carried out only on one stock, Gerard and Nanda (1993) paper concerns the interrelationship of primary market and secondary markets in seasoned equity offering (shortly SO). They show that market manipulation could explain both the significant issue discount and the significant negative excess return prior to the issue date, both found in empirical literature. They suggest that the latter could be due to manipulators who short sell stock in the secondary market in order to induce a higher issue discount, which, in turn, allows them to close successfully the strategy buying the shares in the SO. This scheme can be seen as a form of trash & cash, i.e. the opposite of pump & dump schemes. The strategic game is profitable if the manipulator can recoup his secondary market losses through share purchases at a reduced price in the SO.

5.2.2. Price positioning

Once it is recognised that a large trader is a price-maker and that he can bring the price to a desired level for a few instants or for a longer period, many manipulation strategies are possible for him. In price positioning schemes the manipulator is not interested in sending false or misleading signals to other market participants, even though sometimes his action produces this effect. In other words, he is not interested in deceiving other investors or in creating herd effects. Typically, in these schemes manipulators gain from manipulating a security because of other positions already opened in related markets or, more generally, because of the existence of already signed contracts. Consider, for instance, a trader, who, after having opened a position on a call option, trades on the underlying asset in order to bring the price to such a level that makes the position on the call option profitable. Similar strategies can be carried out by abusing the relationship between the same security traded in different market venues, or by abusing of the relationship between different securities which are strongly correlated.

Here is the definition given by CESR (Appendix Table 2): "*Trading on one market to improperly position the price of a financial instrument on a related market. This practice involves undertaking trading in one market with a view to improperly influencing the price of the same or a related financial instrument in another market. Examples might be conducting trades in an equity to position the price of its derivative traded on another market at a distorted level or trading in the underlying product of a commodity derivative to distort the price of the derivative contract. (Transactions to take legitimate advantage of differences in the prices of financial instruments or underlying products as traded in different locations would not constitute manipulation.)*".

These kind of cases has been examined by Jarrow (1990), Kumar and Seppi (1992) and, again, Gerard and Nanda (1993).

Jarrow (1990) argues that in the presence of derivatives several manipulation strategies can be implemented by abusing the lack of synchronicity in the price adjustments of derivatives and their underlying assets. For instance, if the stock price systematically follows with a lag the price of its related stock future, the manipulator, immediately after having opened a position on the underlying stock, can buy the stock future producing an increase in the price patterns of both the stock future and the underlying stock, so that he can successfully liquidate both the positions (see Chapter 3). This strategy can also be interpreted as a "self front-running", making clear, once again, the relationship between market manipulation and insider trading. Finally, notice that the manipulator is not interested in misleading other market by establishing a trend. He is just using his market power to move the stock future price path.

Kumar and Seppi (1992) refer to the case of punching the future market cash settled price. A uniformed large trader can expect positive profit by establishing a future position and then trading on the spot market to manipulate the spot price used to compute the cash settlement price at delivery. Among the conditions which are necessary to succeed, the future position should be greater than that on the spot market. They also show it is crucial that manipulative trades should be believed with some probabilities with those of other informed trader. Notice that the "cash settlement" acts as an infinite liquid market and that the strategy can be extended to option markets.

Also the Gerard and Nanda (1993) paper, already shown in Section 5.2.1., focuses on the relationships among markets and, in particular, among primary and secondary markets. They confirm that manipulations arise because of the difference between the price setting mechanisms of the two markets.

Hillion and Suominen (2004) suggest that brokers (agents) could manipulate the closing price (marking the close) in order to avoid being negatively judged by their customers (principal), who would be disappointed by strong differences between the closing price, which is the most important price they observe at the end of the day, and the price of the orders executed by their brokers during the day. Therefore, a broker could engage in a market manipulation strategy by pushing the last price toward the average price of the contracts he has already carried out on behalf of the customer.

Also price stabilisation practices can fall within the price positioning type. Often, managers or main shareholders do not like that the company shares lose value or be too volatile. Hence the company could engage in price stabilisation practices in a way that can be seen as excessive compared to the rules of the market concerned. Price stabilisation could be interpreted as a form of market manipulation because the company is interested in moving the price towards a desired level. This price level could be far from the fundamental value, or from that arising from the free interplay of market forces.

Therefore the trades of companies on their own stocks are often strictly regulated and in some jurisdictions admitted only if aimed at enhancing liquidity. In other countries, since it is not easy to distinguish between the activity of price stabilisation and that of providing liquidity, companies can enjoy a safe harbour to trade on their own stock if they meet several predetermined conditions.

Another situations that can motivate price positioning manipulation schemes on equity markets are contracts linked to the stock values at predefined periods. Therefore parties of the contract could be interested in manipulating the stock during these periods. Structured bonds and swaps are good examples of such contracts. These types of price positioning schemes are also known as contract-based manipulation.

Finally, examples of price positioning are the classic cases of market power, such as corners or squeezes, which occur more frequently in futures on commodity indexes. These manipulative strategies are very important, so that it is not particularly difficult to detect them when they take place. Nevertheless it seems difficult to prove in Court, since defendants can successfully argue that similar situations can also derive from exceptional market conditions. The literature on corners and squeezes is quite rich (Pirrong, 1996). Due to the particular characteristics of the markets where these manipulations typically arise, we are not examining this literature here, since we are more interested in stock markets. Nevertheless, cases of squeezes sometimes are detected also in stock exchanges, especially in less liquid stocks. Small cases of corners and squeezes also occur in derivative stock markets, for instance covered warrants, where the market maker has a lot of power, being at the same time issuer and market maker in a market designed for retail investors, so that other market professionals and arbitrageurs can not enter.

A significant characteristic of price positioning is the bounce back effect, which follows the market manipulation period. It appears the logical consequence of a manipulative action, which aim at fixing the price at an abnormal level. So, when the manipulative action stops, prices bounce back to the previous equilibrium levels.

Since price positioning can produce significant price changes and those price changes often disappear in a short time period, even within a few seconds, and therefore they do not seem to significantly mislead other market participants, the question is if these manipulation strategies should be banned or not. In other words, are enforcement costs disproportionately higher than the benefit of cleaning the market from this kind of abuse?

Avgouleas (2005) proposed a deregulation of those trades which are less likely to be manipulative, defined as those trades which a) are not directed by insiders, that typically are interested in price changes, b) do not involve concealed efforts to control the market and c) do not raise concern that they are linked to other positions or contracts.

The reason for deregulation is that even if these trades are intended to manipulate price, it is very difficult and costly to distinguish them from innocent speculation. So, there is a risk of mistakes, because it is difficult to understand the traders' intent.

On the other hand, it seems that what is actually difficult is the detection of these cases. Often, once detected these cases show very clearly the trader's intent because, typically, these schemes have very strong connections with several circumstances that prove the manipulative intent. Additionally, manipulators tend to repeat many times their successful strategy, so revealing their nature. Actually, manipulative schemes very often show inconsistencies with ordinary speculative investment strategies.

In conclusion, there are several situations that can induce professional investors to engage in price positioning and, consequently, there is a risk that this type of market manipulation occurs. Interestingly, this kind of market manipulation could also take place in very liquid stocks, since a few seconds is sufficient to manipulate the price successfully.

6. Empirical studies

Only a few recent studies examined cases of market manipulation: the paper of Aggarwal and Wu (2006) on the recent experience in the US stock exchanges, that of Mahoney (1999) and Jiang, Mahoney and Mei (2004) on stock pools (which are similar to pump & dump schemes) in the late 20's in the US, and that of Allen, Litov and Mei (2004) on corners in stock exchanges.

Two other empirical analyses focused on a single (non-equity) case: Jordan and Jordan (1996) examined the Salomon Brothers' market corner of a Treasury note auction in May 1991, while Merrick, Naik, and Yadav (2005) show a case of manipulation involving a delivery squeeze on the bond futures contract traded in London.

An interesting experimental study has been carried out by Camerer (1998) on manipulation of racetrack betting, which is close in nature to a particular kind of manipulation of call auctions. His attempts at manipulating the bets failed, so he concludes that it is difficult to systematically manipulate the market.

Finally, it should be emphasised that a significant group of studies found evidence of regularities in financial markets, which suggested that those anomalies could have been generated by market manipulations, even though there is not legal proof for those allegations.

The paper of Hilion and Suominen (2004) falls into this kind of empirical analyses. They suspected that last prices in the Paris Bourse could have been systematically manipulated by brokers to prevent that their customers being disappointed by the significant differences between the price of the contracts executed on their behalf during the day and the last price of the day, which is the price reported in newspapers and typically read by brokers' customers.

Still on the last prices, Felixson and Pelli (1999) believe that there was a systematic market manipulation in the Finnish stock market. Khwaja and Mian (2003) analyze a unique data set containing daily firm-level trades of every broker of the stock exchange in Pakistan over a 32-month period. They argue that brokers manipulated the market engaging in pump & dump schemes by abusing their customers' orders.

Aggarwal, Purnanandam, Wu (2006) found evidence of market manipulation in the high level of IPO underpricings during the Internet bubble of the late 1990s based on the allocation practices of underwriters.

Interestingly, Frieder and Zittrain (2006) and Hanke and Hauser (2006) show the potential effectiveness of pump & dump schemes based on e-mail and other internet messages. Frieder and Zittrain (2006) report that approximately 730 million spam e-mails are sent every week, 15% of which refer to stocks. They analyse 75,000 unsolicited e-mails sent between January 2004 and July 2005 and found that a spammer (manipulator) who bought shares the day before started an e-mail campaign and then sold them the day after had made a 4.9% return. Misled investors typically lose 5.25% in two days. Hanke and Hauser (2006) show that stock spam e-mails have a significant impact on returns, volatility, intra-day spread and trading volume. In particular, they show that trading volume in spammed stocks is significantly higher on and around spam days. Frieder and Zittrain (2006) also found similar evidence: on a day when no spam is detected, the likelihood of a recommended stock being the most actively traded stock that day is 8%. However, on days when there is spam and a recommendation, the probability of a recommended stock of being the single most actively traded stock is 81%.

In conclusion, to test effectively the theory predictions it seems better to look at actual data set of market manipulation cases. Therefore the papers by Aggarwal and Wu (2006), Mahoney (1999), Jiang, Mahoney and Mei (2004) and Allen, Litov and Mei (2004) are illustrated in depth in the following Sections. Finally, the Camerer's (1998) experiment is presented.

6.1. Aggarwal – Wu (2006)

Aggarwal and Wu examined recent cases enforced by the US SEC from January 1990 to October 2000. They collected 142 cases of stock market manipulation, most related to pump & dump schemes.

As Table 2 shows, only 17% of the cases occurred in the three most important stock markets, NYSE, AMEX and NASDAQ. While the other 83% refer to markets considered relatively inefficient, in the sense that they are small and illiquid: 48% in OTC markets (such as OTC Bulletin Board and Pink Sheets) and 35% in regional exchanges or in unidentified markets.

Table 2. Aggarwal – Wu [2006] Distribution of Manipulation Cases

This table reports the distribution of manipulation cases in various markets from 1990 to 2001. 'Nasdaq' denotes NASDAQ National Market System. 'SmallCap' denotes NASDAQ Small Capitalization Market. 'OTC' includes both the OTC Bulletin Board and the Pink Sheets. 'Other' denotes cases that occur on other regional markets (Pacific Stock Exchange, Vancouver Stock Exchange, Boston Stock Exchange, Alberta Stock Exchange) and those that cannot be classified to a particular market.

Year	NYSE	AMEX	Nasdaq	Nasdaq Small Cap	Regional	OTC	Unknown	*Total*
1990	3	0	2	0	4	11	5	*25*
1991	0	1	0	0	1	0	2	*4*
1992	0	0	2	0	0	3	7	*12*
1993	0	0	0	0	0	2	0	*2*
1994	0	0	0	0	0	1	0	*1*
1995	0	0	8	0	0	0	1	*9*
1996	0	0	0	0	1	0	1	*2*
1997	0	0	0	0	0	5	6	*11*
1998	0	0	1	0	0	4	2	*7*
1999	0	0	1	0	0	5	5	*11*
2000	0	2	0	1	0	19	6	*28*
2001	0	1	3	1	0	18	7	*30*
Total	*3*	*4*	*17*	*2*	*6*	*68*	*42*	*142*
Total %	*2.11*	*2.82*	*11.97*	*1.41*	*4.23*	*47.89*	*29.58*	*100*

As they note, these figures show a relevant result that backs the need for regulating market manipulation and, in particular, that sustains of the need for preventative measures: "*the markets in which manipulation is more likely to occur also have the feature that there are much lower disclosure requirements for their listed firms, and the firms are subject to much less stringent securities regulations and rules. These are precisely the markets in which asymmetric information problems are likely to be the most severe. Thus we argue that the lack of disclosure requirements and regulatory oversight allows manipulators to operate with ease*".

Table 3 shows interesting insights deriving from the distribution of the types of parties involved in market manipulation cases.

Table 3. Aggarwal – Wu [2006] Types of People Involved in Manipulation Cases

This table reports the occurrence of 'potentially informed' people who are involved in manipulation cases from 1990 to 2001. 'Insider' denotes corporate executives and directors. 'Shareholder' denotes large shareholders with 5% or more ownership in the manipulated stock. Note that more than one type of person may be involved in any case.

Year	Brokers	Corporate insiders	Market Makers	Underwriters	Relevant shareholders	*Total*
1990	17	9	0	6	3	*25*
1991	3	3	0	1	1	*4*
1992	11	2	2	2	0	*12*
1993	2	0	0	0	0	*2*
1994	1	1	0	0	1	*1*
1995	8	8	7	0	7	*9*
1996	1	2	0	0	2	*2*
1997	10	10	1	0	8	*11*
1998	5	3	0	0	3	*7*
1999	7	5	1	1	7	*11*
2000	12	8	2	5	6	*28*
2001	14	17	1	0	7	*30*
Total	*91*	*68*	*14*	*15*	*45*	*142*
Total %	*64*	*48*	*10*	*11*	*31*	-

According to the theory on trade-based manipulation of the kind of misleading transaction (see Section 3.2.1), manipulators pretend to act like insiders. Therefore the authors say *"that a key to successful manipulation is the pooling of the manipulator with the truthful informed party. Hence, the manipulator needs either to be informed or to be able to credibly pose as being informed. There are many ways to do this. For example, one way to credibly pose as an informed party is to be an insider. Others such as brokers, underwriters, market makers, or large shareholders can also credibly pose as informed investors"*.

As to the price impact of the manipulative action, in their sample 84.5% of cases refer to price increases while less than 1% of cases refer to price decreases. Price stabilization accounts for 2%. Finally, from January 2000 to October 2001, about 39% of all manipulation cases involved the use of the Internet in spreading false rumors.

Aggarwal and Wu focused their research on a sample of 51 manipulated stocks. According to the US SEC press releases, they knew only the dates for when the manipulation started and ended. This period is named the "manipulation period". It lasts on average 308 days (median 202 days, standard deviation 332 days, maximum 1,373 days, minimum 2 days). Summary statistics of the stocks during the manipulation period and the year before (pre-manipulation period) and after (post-manipulation period) are reported in Table 4.

Table 4. Aggarwal – Wu [2006] Summary statistics for the manipulated stocks

This table reports summary statistics for the manipulated stocks. Panels A to C report the sample mean, standard deviation, skewness and kurtosis coe cients for daily returns and turnover, for the manipulation period, the 1-year pre- and post- manipulation periods, respectively. The data for return and turnover is panel and volatility is cross-sectional. In Panel D: we report statistics on the length of the manipulation period. The overall sample period is from January 1990 to December 2001.

	Mean	*Standard deviation*	*Skewness*	*Kurtosis*
A – Manipulation period				
Return	*.0274*	*.8933*	*60.66*	*3,939*
Turnover	*.0385*	*.2227*	*11.88*	*422.0*
Volatility	*.5730*	*1.6091*	*3.117*	*19.23*
B – Pre-manipulation period				
Return	*.0169*	*.4880*	*52.93*	*3,433*

Turnover	*.0079*	*.0421*	*37.91*	*1,576*
Volatility	*.2431*	*.4564*	*3.787*	*18.22*
C – Post-manipulation period				
Return	*-.0031*	*.1417*	*8.640*	*189.1*
Turnover	*.0368*	*.2018*	*25.07*	*178.3*
Volatility	*.1189*	*.1322*	*2.779*	*12.71*

Looking at the mean values, returns, turnovers and volatilities increase during the manipulation periods compared to the pre-manipulation periods. In the post-manipulation periods returns and volatilities bounce back to values lower than pre-manipulation period, while turnovers exhibit persistency at the values of the manipulation period.

In order to test their theories the authors ran cross-sectional regressions based on the comparison between the manipulated stocks values (on returns, turnovers and volatilities) and a benchmark, built, for each manipulated stock, on an equally weighted portfolio of 10 stocks, which were in the same size decile of all Center for Research in Security Prices stocks and which were the closest in estimated betas to that of the manipulated stock. The sample is given by a total of 102 observations: 51 manipulated stocks and 51 benchmark portfolios. The following regressions ran for the manipulation period, the pre-manipulation period, and the post-manipulation period (where M is a dummy for manipulated stocks). Results are shown in Table 5.

Return = $\alpha_0 + \alpha_1 * M + u$
Turnover = $\alpha_0 + \alpha_1 * M + u$
Volatility = $\alpha_0 + \alpha_1 * M + u$

Table 5. Aggarwal – Wu [2006] Liquidity, Return and Volatility of Manipulated Stocks

This table reports the results for regressing the average daily turnover, return, and volatility over the manipulation, pre-, and post manipulation periods on a constant and a dummy variable equal to one for the stock that was manipulated. For nonmanipulated stocks, we use the average turnover, return, and volatility for the same period as the manipulated stock. The results are based on matching the manipulated stock with a portfolio of 10 stocks in CRSP within the same size decile of the manipulated stock and with betas that are the closest to that of the manipulated stock. The sample has 51 stocks, and the sample period is from January 1990 to December 2001.

	Manipulation period	Pre-manipulation period	Post-manipulation period
A. Liquidity			
α_0	.00514	.00900*	.00539*
	(.01075)	(.00339)	(.00125)
α_1	.055166*	-.00197	.00342
	(.01586)	(.00538)	(.00182)
R^2	10.91%	.24%	4.65%
B. Return			
α_0	-.00080	.00171	.00087
	(.01106)	(.00327)	(.00086)
α_1	.06111*	.00966	-.00093
	(.01631)	(.00506)	(.00122)
R^2	16.32%	5.91%	.77%
C. Volatility			
α_0	.00346	.012376	.01008
	(.01207)	(.03109)	(.00982)
α_1	.11972*	.15638*	.08792*
	(.01795)	(.04817)	(.01398)
R^2	38.51%	15.37%	34.50%

***: 1% significance level; *: 5% significance level. All are one-tailed tests.*

As shown in Panel A, in the manipulation period, liquidity is significantly higher for the manipulated stocks than the benchmarks. Panel B reveals that during the manipulation period the manipulated stocks average daily returns are 6.11% higher than for the benchmarks, and this difference is statistically significant. During the post-manipulation period, average daily returns are not statistically different from those of the benchmarks. This is the bounce-back effect. Panel C reports the volatility, which is computed as the average the standard deviation for the ten benchmark stocks in the portfolio. For all the three periods, volatility is higher for manipulated stocks, and the coefficients are statistically significant. This indicates that manipulation is more likely to happen in volatile stocks. The authors' commented "*These results are interesting in their own right since they establish some basic facts about stock market manipulation in the United States"*.

In addition Aggarwal and Wu test some of the predictions of their theoretical model, which has been mentioned in Section 2. Pump & dump schemes are characterised by 4 periods. In time 0, the market is in equilibrium. In time 1, the manipulator enters into the market, pushing the price up (pump). This price change constitutes a signal for other investors (information seekers) who are misled into thinking that the price change is due to insiders. In time 2, the price continues to increase because information seekers are following the trend. During time 2 the manipulator closes his position by selling the stock and exploiting a profit (dump). In time 3, the price decreases because information seekers understand that no positive information is going to be released.

The authors link their theory to their sample as follows: time 0, is the pre-manipulation period, time 1 is the first half of the manipulation period; time 2, is the second half of the manipulation period; time 3, is the post manipulation period. So, they break the manipulation period in two equal sub-periods, because they do not have information about the exact days in which the manipulators actually traded. Therefore they assume that manipulators enter into the market in the first half of the manipulation period while in the second half there is a herding effect due to the reaction of information seekers, and during the second half manipulators close their positions.

The first prediction of their model is that price at time 1 is higher than the price at time 0 and the price at time 2 is higher than the price at time 1. This prediction is confirmed by data and graphical analysis.

The second prediction is that returns are higher when there are more information seekers in the market concerned. In other words the amount of trading is increasing in the number of information seekers. Therefore, the authors use the overall level of trading for a manipulated stock as a measure of the level of presence of information seekers. Consequently, they classify manipulated stocks into two groups, one with higher average turnover in the second period and one with low average turnover during that period. The two groups of stocks are formed on the basis of whether the average turnover for the stock is higher or lower than the median average turnover. They then test whether the cumulative return between time 2 (end of the manipulation period) and time 1 (midpoint of the manipulation period) is significantly higher for the high-turnover group than for the low-turnover group. Results show that there is some evidence supporting prediction 2. The authors' comment is "*What is interesting about this result is the extent to which volume matters for returns. Consistent with the model, a large number of active traders is necessary for high returns to the manipulator. (…) in the more general market microstructure literature, the evidence on the relation between volume and the direction of the returns is mixed (see Lee and Swaminathan 2000). Thus this finding is useful in understanding manipulation*".

The third prediction is that returns are increasing in the dispersion in the value of the stock. Therefore the authors sort manipulated stocks by their average daily volatility over the manipulation period and form two groups of stocks based on whether the average volatility for the stock is higher or lower than the median average volatility. They then estimate the difference in average cumulative returns between these groups and test for its statistical significance. Both t-statistics are positive, and the test is significant. The greater the dispersion in the stock value, the greater the returns to the manipulator.

6.2. Mahoney (1999), Jiang, Mahoney and Mei (2005)

Jiang, Mahoney and Mei [2005] extend the Mahoney (1999) sample to 55 stock pools occurred from 1927 to 1929. These works are relevant because they refer to the famous cases of stock pools, that "*consisted of agreements, often written, among a group of traders to delegate authority to a single manager to trade in a specific stock for a specific period of time, and then to share in the resulting profits or losses. After a lengthy investigation, the Senate Banking and Currency Committee (1934) concluded that pools represented attempts to manipulate the prices of the chosen stocks*". Stock pools created bubbles in the stock exchange, which when burst, among others, brought recession, which, in turn, led policy makers to establishing the US SEC, an authority responsible for enforcing market manipulations. Their results are summarised as follows.

The stocks which have been subject to manipulative schemes are comparable to their associated industry portfolios on measures of size, but are more volatile and liquid. During pools stocks experience abnormally high trading volumes and returns, but both effects are quite small on average, around 12% and 5%, respectively. Therefore the authors conclude that "*Outside the limited context of penny stocks and other illiquid markets, the evidence of profitable trade-based manipulation is anecdotal*". In addition, within pools also average volatility and liquidity increase. A strong cross-sectional relationship was detected between abnormal turnover and return around the first days of a pool's formation.

Finally, the positive abnormal returns do not reverse, both in the short run and in the long run, after controlling for several variables. In other words, there was no bounce back effect. In summary, while the pattern of stock price and trading volume could be consistent with market manipulation, there is no evidence that the stock pools' trades drove prices to artificially high levels. Therefore, they conclude that public investors were not harmed by pool operations.

Several reasons lead the authors to believe that stock pools could be better understood in a insider trading framework than in a market manipulation one, according to those who suspect that brokers organised pools in order to signal to their (misled) customers that there were undervalued stocks that could be bought. Finally the authors say: "*This finding is notable because Congress devoted substantial resources to uncovering evidence of manipulation on the New York Stock Exchange during the late 1920s. It therefore appears, contrary to received wisdom, that manipulation was not common on the NYSE during that period. This suggests that the size, liquidity, and disclosure standards in that market, although modest by current standards, were sufficient to protect investors against manipulation. This contrasts with the relatively small and illiquid markets that account for the majority of manipulation cases brought by the SEC (Aggarwal and Wu, 2003). It also contrasts with futures markets, in which the supply of the underlying deliverable commodity or financial instrument can be cornered, causing severe price distortions (Merrick, Naik and Yadav, 2003). Our results suggest, then, that enforcement resources can be focused on discrete segments of the securities markets. (…) Given investigators' efforts to find cases of manipulation on the New York Stock Exchange during the 1920s, these findings suggest that manipulation was not a substantial problem*".

6.3. Allen, Litov and Mei (2004)

Allen, Litov and Mei (2004) examine 13 attempts of stock corners occurred in the NYSE from 1863 to 1928. Corners are defined as "*a market condition brought about intentionally - though sometimes accidentally – when virtually all of the purchasable, or floating, supply of a company's stock is held by an individual, or group, who are thus able to dictate the price when settlement is called*". Using time series analyses they conclude that market corners tend to increase market volatility and have an adverse price impact on other assets. The presence of large investors makes it extremely risky for short sellers to trade against mispricing in the stock market. This creates severe limits to arbitrage in the stock markets, which impedes market efficiency. Therefore, the authors believe that regulators and exchanges need to ensure that corners do not take place since they are accompanied by severe price distortions.

6.4. Camerer (1998).

Camerer ran a field experiment, which falls within the schemes of trade-based manipulation, where the manipulator sends false signals to other market participants (misleading transactions). The main purpose of his research relates to two questions: 1) can (asset) market be manipulated? 2) In which way prices in centralised asset markets reflect the aggregated information held by traders?

The experiment is based on real (observed) attempts at manipulating pari-mutuel markets (i.e. bets on horse races, where the winners proportionally share the bets lost by other bettors). Beginning approximately 30 minutes before the start of the race, people can bet on a specific horse at a displayed "price" which is function of the ratio between the bets that have been submitted on that specific horse and the total bets on the race. The bets are submitted (or deleted) using a computerised system.

Note that the bettors who bet well before the start of the race on a specific horse do not know the odds they will receive in case of a win, so "*it is hard to imagine why a rational bettor would bet early, since they do not know the price they will getting*", but this is close in meaning to orders at market price entered well before the end of call-auctions. Actually, most of the bets are submitted in the last few minutes, as in the stock market call-auctions. Every minute the betting totals (in $) are updated and displayed. So bettors can understand immediately (1-2 minutes later) the impact of their bets on the betting total.

The experiment (manipulation scheme) is based 1) on the submission of huge temporary bets 20-25 minutes before the start of the race and 2) on the cancellation of the bets 8-11 minutes before the start of the race. The experiment has been repeated 50 times. Each experiment including a bet on a specific horse was matched with a (controlled) bet on a horse of the same race.

The author says that in theory the manipulation scheme should have effect if 4 conditions hold:

1) the ignorance of the cancellation: bettors must not realise that bets can be cancelled at all, or if they know that this is possible (as it seems they know) they must think that most bets will not be cancelled, otherwise they should not pay attention to the displayed bets until the few last minutes; actually cancellations seem rare because total bets rarely fall over time;
2) visibility: bet totals should be displayed;
3) reaction: traders must react to changes in perceived odds; the author defines 3 types of bettors:

a. “opinion bettors” (shortly OB, or also called “private-information investors”): they have an opinion about the chances of each horse and do not infer superior information from odds; they compare the odds with their opinion and accordingly they enter into the market; therefore, when the manipulator enters transitory bets that reduce the odds, then marginal opinion bettors should leave the market; the opposite when the manipulator cancels his bets;
b. “partial rational expectations bettors” (PREB): they believe that bet totals contain information and also believe that other bettors do not fully adjust to the information (for instance, they believe that there are many opinion bettors); odds do not fully reflect all available information (specialised newspaper predictions or trends in the bets); therefore when the manipulator enters into the market and the odds go down PREB follow the trend entering into the market, the opposite when the manipulator cancels his bets, but – “if there is asymmetry” (see point 4) - the author thinks that the reaction would be less important, so that the net effect at the end of the auction would be that there are more PREB that enter into the market than exit from the market;
c. “full rational expectations bettors” (FREB) believe that the displayed bet totals contain information but that bet totals at any point in time fully reflect available information (so there is not herd effect); the author assumes that these investors bet their money in the same proportion as the proportions already in the bet pool; therefore the authors expects that when the manipulator enters into the market the odds go down and the FREB would enter into the market in order to keep their money in the bet in a specific horse in the same proportion of the money invested by all the bettors in that bet; the opposite when the manipulator cancels his bet; due to asymmetry, when the manipulator cancels his bet the net effect would be positive;

4) asymmetry: there must be an asymmetry between bettors reactions to the odds when the bet is placed and when the bet is cancelled, otherwise there would not be a net effect of manipulation[4].

The 50 experiments have been analysed in an event-study where there are three events: a) the moment when the temporary bet (manipulated) is made, b) the moment when the bet is cancelled and c) when the race starts. Results are as follows:

- event a) there is a significant effect on the odds: they drop; but after the event they continue to increase quite steadily as in the controlled sample, this could mean that the temporary bets (manipulated bets) do not draw much money toward the (manipulated) bet horse (actually it can be observed that “*after the temporary bets are made other bettors begin to bet slightly less on the temporary-bet horse compared to the control*”);
- event b) there is an effect on the odds: they go up quickly and then they go up at a higher rate compared to the controlled sample) and
- event c) there is no effect (in comparison with the controlled sample the odds are in line).

So, the author concludes that it should not be possible to manipulate stock markets.

Another analysis is based on the comparison of the change in the odds (more bets - i.e. money - are entered on a specific horse the lower the odds):

- the changes (which can be seen as returns) in the period that starts just before the temporary-bet are entered and ends at the beginning of the race show no differences with the controlled sample, also in terms of variance;
- the changes (returns) in the period that starts just after the temporary-bet is entered and ends just before the temporary-bet is cancelled show a higher change for the controlled sample, hence

[4] Actually, investors’ reactions could be stronger when bets are entered than when bets are deleted due to the fact that in percentage terms, compared to the total bets in the market, the bets entered are more than bets deleted.

“*this means that most bettors who are betting in this time period are some mixture of opinion bettors and full rational expectation bettors*”, in other terms there is no herd effect on the temporary-bet horse after the temporary-bet is entered.

The author’s conclusions are the following:

- pari-mutuel racetrack odds can not be systematically manipulated with a sample of 50 $500 bets on randomly chosen temporary-bet horses;
- a possibility is that bettors react oppositely to the bet and its cancellation and the two effect roughly cancel each other out (violating the asymmetry condition assumed in the theory);
- another possibility is that markets can be manipulated under some identifiable conditions, for instance, when the horse is at its first race (like in IPO);
- the results are important because the information aggregation in pari-mutuel betting markets are generally considered surprisingly efficient (Thaler – Ziemba, 1998) and because they show that the possibility that large investors can systematically manipulate the market should not be so relevant as suspected.

Probably, the latter indication on the efficiency of this market can explain why the manipulation attempts failed. Since typically in very liquid and efficient markets there is a huge order-flow which enters during the last minutes of the auction, the manipulative temporary bets entered 20-25 minutes before the start of the race, as well as the cancellation of the bets 8-11 minutes before the start of the race, should not have significant information content. As shown in Chapter 1, examples of successful manipulation of very liquid stocks in the Italian Stock Exchange required manipulators to cancel their order in the last minute before the end of the auction, otherwise other investors would have had time to react and to bring the price to its equilibrium.

7. Conclusions

This paper shows the economic debate on stock market manipulation. Very few papers examine the issues relating to the its definition and categorisation. Most of the analyses focuses on the subset of self-financing manipulation strategies, because this issue is close to the important topics of the stabilising or destabilising effects of speculation, and of the possibility that a speculator could systematically win in the market due to his market power, as sometimes suspiciously feared by journalists and practitioners.

The theoretical analysis devotes particular attention to the case of pump & dump schemes, which can also be named manipulative bubbles. A few but important works have been produced on cross-market manipulation strategies. Also information-based manipulation has been considered with care. All these studies – which have been developed after the 90’s – demonstrate that market manipulation is an issue because it is possible to build successful strategies in equilibrium and because these strategies have a negative effect on market efficiency.

Those studies overturned the previous belief, according to which trade-based manipulation cannot exist in competitive markets due to arbitrage considerations, and any information-based manipulation would be almost immediately punished because of the speed of the investors’ learning process.

At the beginning of this century a first set of empirical works examined actual cases of stock market manipulation enforced by US authorities. Those studies confirmed that market manipulation produces relevant negative effects on market efficiency. Nevertheless, since they also show that the samples examined refer to very old cases occurred at the beginning of the last century or to cases occurred in extremely illiquid markets, they suggest that market manipulation is not an issue in modern liquid and efficient capital markets. High standard of regulation and transparency would stop any serious attempt at market manipulation, while the increasing liquidity would make trade-based manipulation very expensive.

This conclusion could be significantly misled by the sample examined. As shown in Chapter I, sophisticated detection systems could identify more subtle cases of trade-based manipulation as those cross-markets or contract-based which can take place even in very liquid stocks at intra-day frequencies.

Appendix

Table 1 – Level 2 implementing measures (2004/123/EC) of the EU market abuse directive

Article 4 *For the purposes of applying Article 6(2) of Directive 2003/6/EC, (…) the following non-exhaustive signals, which should not necessarily be deemed in themselves to constitute market manipulation, are taken into account when transactions or orders to trade are examined by market participants and competent authorities:* *(a) the extent to which orders to trade given or transactions undertaken represent a significant proportion of the daily volume of transactions in the relevant financial instrument on the regulated market concerned, in particular when these activities lead to a significant change in the price of the financial instrument;* *(b) the extent to which orders to trade given or transactions undertaken by persons with a significant buying or selling position in a financial instrument lead to significant changes in the price of the financial instrument or related derivative or underlying asset admitted to trading on a regulated market;* *(c) whether transactions undertaken lead to no change in beneficial ownership of a financial instrument admitted to trading on a regulated market;* *(d) the extent to which orders to trade given or transactions undertaken include position reversals in a short period and represent a significant proportion of the daily volume of transactions in the relevant financial instrument on the regulated market concerned, and might be associated with significant changes in the price of a financial instrument admitted to trading on a regulated market;* *(e) the extent to which orders to trade given or transactions undertaken are concentrated within a short time span in the trading session and lead to a price change which is subsequently reversed;* *(f) the extent to which orders to trade given change the representation of the best bid or offer prices in a financial instrument admitted to trading on a regulated market, or more generally the representation of the order book available to market participants, and are removed before they are executed;* *(g) the extent to which orders to trade are given or transactions are undertaken at or around a specific time when reference prices, settlement prices and valuations are calculated and lead to price changes which have an effect on such prices and valuations.*
Article 5 *For the purposes of applying point 2(a) of Article 1 of Directive 2003/6/EC, and without prejudice to the examples set out in the second paragraph of point 2 thereof, (…) the following non-exhaustive signals, which should not necessarily be deemed in themselves to constitute market manipulation, are taken into account when transactions or orders to trade are examined by market participants and competent authorities:* *(a) whether orders to trade given or transactions undertaken by persons are preceded or followed by dissemination of false or misleading information by the same persons or persons linked to them;* *(b) whether orders to trade are given or transactions are undertaken by persons before or after the same persons or persons linked to them produce or disseminate research or investment recommendations which are erroneous or biased or demonstrably influenced by material interest.*

Table 2 – CESR (2005) – Level 3 guidance of the EU market abuse directive

5.8 Possible Signals of Insider Dealing or Market Manipulation *a) An unusual concentration of transactions in a particular security (for example, with one or more institutional investors known to be affiliated with the issuer or a party with a particular interest in the issuer such as a bidder/potential bidder);* *b) An unusual repetition of a transaction among a small number of clients over a certain period of time* *c) Unusual concentration of transactions and/or orders with only one client; or with the different securities accounts of one client; or with a limited number of clients (especially if the clients are related to one another).* *5.9 Possible Signals of Insider Dealing* *(…)* *5.10 Possible signals of Market Manipulation* *(a) Transactions with no other apparent justification than to increase/decrease the price of or to increase the volume of trading in a financial instrument. Particular attention might be given to orders of this kind which result in the execution of transactions near to a reference point during the trading day – e.g. near the close;* *(b) The client submits orders which, because of their size in relation to the market in that security, will clearly have a significant impact on the supply of or demand for or the price or value of the security. Again, particular attention might be given to orders of this kind which result in the execution of transactions near to a reference point during the trading day – e.g. near the close;* *(c) Transactions which appear to have the purpose of increasing the price of a financial instrument during the days preceding the issue of a related derivative/convertible;* *(d) Transactions which appear to have the purpose of maintaining the price of a financial instrument during the days preceding the issue of a related derivative/convertible when the market trend is downward;* *(e) Transactions which appear to be seeking to modify the valuation of a position while not decreasing/increasing the size of that position;* *(f) Transactions which appear to be seeking to increase/decrease the weighted average price of the day or of a period during the session;* *(g) Transactions which appear to be seeking to set a market price when the liquidity of the financial instrument is not sufficient to fix a price within the session (unless the rules or regulation of the regulated market explicitly allow such operations);* *(h) Transactions which appear to be seeking to bypass the trading safeguards of the market (e.g. as regards volume limits; bid/offer spread parameters; etc);* *(i) When a transaction is to be concluded/executed, changing the bid-ask prices (as computed by the trading system) when this spread is a factor in the determination of the price of that transaction;* *(j) Entering significant orders in the central order book of the trading system a few minutes before the price determination phase of the auction and cancelling these orders a few seconds before the order book is frozen for computing the auction price so that the theoretical opening price might look higher or lower than it otherwise would do;* *(k) Transactions which appear to be seeking to maintain the price of the underlying financial instrument below the strike price of a related derivative at expiration date;* *(l) Transactions which appear to be aimed at modifying the price of the underlying financial instrument so that it crosses over the strike price of a related derivative at expiration date;* *(m) Transactions which appear to be seeking to modify the settlement price of a financial instrument when this price is used as a reference/determinant in the calculation of margins requirements.*

Table 3 – CESR (2005) Examples of market manipulation

***Dissemination of false and misleading information*.**
This type of market manipulation involves dissemination of false and misleading information without necessarily undertaking any accompanying transaction. This could include creating a misleading impression by failure properly to disclose a price sensitive piece of information which should be disclosed. For example, an issuer with information which would meet the Directive definition of 'inside information' fails properly to disclose that information and the result that the public is likely to be misled.
(a) <u>Spreading false/misleading information through the media</u>. This involves behaviour such as posting information on an internet bulletin board or issuing a press release which contains false or misleading statements about a company whose shares are admitted to trading on a regulated market. The person spreading the information knows that it is false or misleading and is disseminating the information in order to create a false or misleading impression. Spreading false/misleading information through an officially recognised channel for disseminating information to users of a regulated market is particularly serious as it is important that market participants are able to rely on information dissemination via such official channels.
(b) <u>Other behaviour designed to spread false/misleading information</u>. This type of market manipulation would cover a course of conduct designed to give false and misleading impression through means other than the media. An example might be the movement of physical commodity stocks to create a misleading impression as to the supply or demand for a commodity or the deliverable into a commodity futures contract.
False or misleading transactions
a) <u>Wash trades</u>. This is the practice of entering into arrangements for the sale or purchase of a financial instrument where there is no change in beneficial interests or market risk or where the transfer of beneficial interest or market risk is only between parties who are acting in concert or collusion.
b) <u>Painting the tape</u>. This practice involves engaging in a transaction or series of transactions which are shown on a public display facility to give the impression of activity or price movement in a financial instrument.
c) <u>Improper matched orders</u>. These are transactions where both buy and sell orders are entered at or nearly at the same time, with the same price and quantity by different but colluding parties, unless the transactions are legitimate trades carried out in conformity with the rules of the relevant trading platform (e.g. crossing trades).
d) <u>Placing orders with no intention of executing them</u>. This involves the entering of orders, especially into electronic trading systems, which are higher/lower than the previous bid/offer. The intention is not to execute the order but to give a misleading impression that there is demand for or supply of the financial instrument at that price. The orders are then withdrawn from the market before they are executed. (A variant on this type of market manipulation is to place a small order to move the bid/offer price of the financial instrument and being prepared for that order to be executed if it cannot be withdrawn in time.)
Price positioning
a) <u>Marking the close</u>. This practice involves deliberately buying or selling securities or derivatives contracts at the close of the market in an effort to alter the closing price of the security or derivatives contract. This practice may take place on any individual trading day but is particularly associated with dates such as future/option expiry dates or quarterly/annual portfolio or index reference/valuation points.
b) <u>Colluding in the after market of an Initial Public Offer</u>. This practice is particularly associated with Initial Public Offers of securities immediately after trading in the security begins. Parties which have been allocated stock in the primary offering collude to purchase further tranches of stock when trading begins in order to force the price of the security to an artificial level and generate interest from other investors – at which point they sell their holdings.
c) <u>Abusive squeeze</u>. This involves a party or parties with a significant influence over the supply of, or demand for, or delivery mechanisms for a financial instrument and/or the underlying product of a derivative contract exploiting a dominant position in order materially to distort the price at which others have to deliver, take delivery or defer delivery of the instrument/product in order to satisfy their obligations. (It should be noted that the proper interaction of supply and demand can and often does lead to market tightness but that this is not of itself market manipulation. Nor does having a significant influence over the supply of, demand for, or delivery mechanisms for an investment/product by itself constitute market manipulation.)
d) <u>Creation of a floor in the price pattern</u>. This practice is usually carried out by issuers or other entities

which control them, and involves transactions or orders to trade employed in such a way that obstacles are created to the share prices falling below a certain level, mainly in order to avoid negative consequences for their share or credit ratings. This needs to be distinguished from legitimate trading in shares as part of "buy-back" programmes or the stabilisation of financial instruments.
e) Excessive bid-ask spreads. This conduct is carried out by intermediaries which have market power – such as specialists or market makers acting in cooperation – in such a way intentionally to move the bid-ask spread to and/or to maintain it at artificial levels and far from fair values, by abusing of their market power, i.e. the absence of other competitors.
f) Trading on one market to improperly position the price of a financial instrument on a related market. This practice involves undertaking trading in one market with a view to improperly influencing the price of the same or a related financial instrument in another market. Examples might be conducting trades in an equity to position the price of its derivative traded on another market at a distorted level or trading in the underlying product of a commodity derivative to distort the price of the derivative contract. (Transactions to take legitimate advantage of differences in the prices of financial instruments or underlying products as traded in different locations would not constitute manipulation.)
Transactions involving fictitious devices/deception (Mixed cases of information and trade-based manipulation)
a) Concealing ownership. This is a transaction or series of transactions which is designed to conceal the ownership of a financial instrument via the breach of disclosure requirements through the holding of the instrument in the name of a colluding party (or parties). The disclosures are misleading in respect of the true underlying holding of the instrument. (This practice does not cover cases where there are legitimate reasons for financial instruments to be held in the name of a party other than the beneficial owner – e.g. nominee holdings. Nor do all failures to make a required disclosure necessarily constitute market manipulation.)
b) Dissemination of false or misleading market information through media, including the internet, or by any other means (in some jurisdictions this is known as 'scalping'). This is done with the intention of moving the price of a security, a derivative contract or the underlying asset in a direction that is favourable to the position held or a transaction planned by the person disseminating the information.
c) Pump and dump. This practice involves taking a long position in a security and then undertaking further buying activity and/or disseminating misleading positive information about the security with a view to increasing the price of the security. Other market participants are misled by the resulting effect on price and are attracted into purchasing the security. The manipulator then sells out at the inflated price.
d) 'Trash and cash'. This is the opposite of pump and dump. A party will take a short position in a security; undertake further selling activity and/or spread misleading negative information about the security with the purpose of driving down its price. The manipulator then closes their position after the price has fallen.
e) Opening a position and closing it immediately after its public disclosure. This practice is typically carried out by portfolio managers and other large investors whose investment decisions are usually valued by market participants as relevant signals of future price dynamics. The canonical unfair conduct consists in closing the position previously acquired immediately after having publicly disclosed it putting emphasis on the long holding period of the investment. However, making a report or disclosure will not, in itself, give rise to a false or misleading impression if it was made in the way specified by any applicable legal or regulatory requirement and was expressly required or permitted by such a requirement.

Table 4 - IOSCO (2000)

Methods of market manipulation
Engaging in a series of transactions that are reported on a public display facility to give the impression of activity or price movement in a security (painting the tape)
Improper transactions in which there is no genuine change in actual ownership of the security or derivative contract (wash sales)
Transactions where both buy and sell orders are entered at the same time, with the same price and quantity by different but colluding parties (improper matched orders)
Increasing the bid for a security or derivative to increase its price (advancing the bid)
Buying activity at increasingly higher prices. Securities are sold in the market (often to retail customers) at the higher prices (pumping and dumping)
Buying or selling securities or derivatives contracts at the close of the market in an effort to alter the closing

price of the security or derivatives contract (marking the close)
Securing such control of the bid or demand-side of both the derivative and the underlying asset that leads to a dominant position. This position can be exploited to manipulate the price of the derivative and/or the asset (corner). As regards derivatives, in a corner, a market participant or group of participants accumulates a controlling position in an asset in the cash, derivative and other markets. The market participant or group of participants then requires those holding short positions to settle their obligations under the terms of their contracts, either by making delivery or by purchasing the asset from the manipulator or by offsetting in the derivatives market opposite the manipulator at prices distorted by the manipulator
Taking advantage of a shortage in an asset by controlling the demand-side and exploiting market congestion during such shortages in such a way as to create artificial prices (squeeze)
***Objectives of market manipulation**. The objective of manipulative conduct will normally be to make money either directly through transactions, or by other means. Some examples of how this motive is achieved include:*
Influencing the price or value of a security or a derivative contract, so that the manipulator can: buy at a lower price, sell at a higher price, influence takeover bids, or other large transactions, or combat competitive transactions
Influencing the price of a derivative contract or the underlying asset
Influencing the price of a security underlying an index
Influencing the subscription price in public or non-public offerings
Influencing the price/conversion ratio in connection with merger of companies
Influencing the price of a security in connection with take-over offers
Influencing someone to subscribe for, purchase, or sell assets or rights to assets, or to abstain from doing so
Influencing the accounts/balance sheet of institutional investors
Influencing the limit for triggering forced sale by creditors
Influencing the impression of financial advice or placements

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Chapter 3

The Lead-Lag Relationship Between the Spot Index and the Futures Contract for the MIB30 Italian Stock Index at High Frequency Data: Can Self-Financing Manipulation Strategies Succeed?

1. Introduction

This exercise tries to model empirically the temporal relationship between price movements of the FIB30 futures contract and its underlying asset, the MIB30 stock index. Analyses have been performed using intra-daily data at 1 minute frequency. The purpose is twofold a) to test the efficient information hypothesis, under which there should not be cross autocorrelation linkages between financial instruments b) to examine if it is possible to exploit these cross autocorrelation in forecasting activity.

Similar analyses have been performed by Brooks, Rew and Ritson (2001), who have investigated the mentioned relation in the UK equity market at 10 minutes frequency. Departures from this study are mentioned.

A related issue refer to the possibility to manipulate the index or the futures contract by trading on the market, for instance implementing strategies intended to create a trend in the intra-daily price pattern.

The paper is organised as follows: Section 2 summarizes the theoretical and empirical literature on the relationship between equity futures contracts and the underlying index, Section 3 shows the dataset, Section 4 illustrates the methodologies adopted and their results, Section 5 synthesizes main findings and possible extensions.

2. The literature on the theoretical relationship between spot and future markets

Under the information efficiency paradigm spot and future contract should be perfectly and contemporaneously correlated and not cross-correlated through time, otherwise arbitrage opportunities would abound. According to Hull (1997, p. 59)

$$F_t = S_t \, e^{(r-d)\,(T-t)} \qquad (1)$$

where F_t and S_t are respectively the futures contract and the spot index values at time t, while r is the continuously compounded risk-free rate of return, d is the continuously compounded dividend yield and T is the maturity date for the future contract.

or in logs (Campbell, Lo, MacKinley, 1997)

$$f_t = s_t + (r-d)\,(T-t) \qquad (2)$$

where $f_t = \ln(F_t)$ and $s_t = \ln(S_t)$.

Along the paper the upper case letters are used to denote the levels of the series and lower-case letters are used to denote their logs.

Relationship (1) reflects the so called cost of carry (COC) strategy, i.e. the arbitrage opportunity of shifting from derivative to underline financial instruments and vice versa ("Cash and Carry" or "Reverse Cash and Carry"). Therefore under equation (1) or (2) past values of futures contracts and spot indexes should not matter: under the efficient information hypothesis lagged values should not be statistically significant.

Nevertheless some forms of auto-correlations are usually detected in financial markets at some lags and still cross-autocorrelation have been found. This raises the question of the existence of a leading role of a specific financial instrument.

In the context of the relationship among futures contracts and underling spot indexes, wide evidences on the leading role played by futures contracts have been found in a intra-daily domain in US markets by Kawaller, Koch, Koch (1987), Stoll, Whaley (1990), Chan (1992), Ghosh (1993) and in UK markets by Abhyankar (1995 and 1998) and Brooks, Rew and Ritson (2001).

Bi-directional causality has been supported by Tang, Mak and Choi (1992) in Hong Kong markets. Differently, Wahab and Lashgari (1993) did not find any lead-lag relationship in the UK at daily frequencies. Tables 1 compares samples and methodologies of the mentioned studies.

Table 1 – Previous empirical studies

Authors	Period	Markets	Data Frequency	Significant Lags	Methodology
Kawaller, Koch, Koch	1987- 1988	US	1 minute	From 25 to 45 minutes	Three stage OLS
Stoll, Whaley	1990	US	5 minutes	5 minutes	ARMA
Ghosh	1988	US	15 minutes	15 minutes	VECM
Abhyankar (1995)	1986-1990	UK			AR(2), EGARCH(1,1)
Abhyankar (1998)	1992	UK	1 minute	From 5 to 15 minutes	EGARCH(1,1)
Brooks, Rew, Ritson	1996-1997	UK	10 minutes	At least 10 minutes	ECM

Finally it should be stressed that many of these research do not find arbitrage opportunities once transaction costs are taken into account. This result is important to sustain the efficiency of these markets.

Two main reasons are usually advocated to explain the leading role of futures markets: *a)* the higher operational efficiency of future markets, due to the easy way of carrying out transactions compared to the cost of trading many spot financial instruments (rapid execution, liquidity, leveraged position, low margins) and *b)* the fact that futures markets are the main source of market-wide information, while the cash market is the main source of firm-specific information (see Goodhart, O'Hara, 1995). A third reason could be the consequent higher liquidity which allows futures price to better absorb and reflect information.

3. Data

In order to explore the nature of the relationship in the Italian Derivative Equity Market (IDEM) managed by Borsa Italiana Spa where the FIB30 future contract on the MIB30 index are traded, we start by using a small sample: ten working days (from 2nd to 15th January 2004) at one minute frequency for both MIB30 and FIB30, gathering 4.582 observations. As shown in Table 1, this sample makes this exercise more comparable with those of Kawaller, Koch and Koch (1987) and Abhyankar (1998).

MIB30 is a value weighted index constituted by the 30 more important equity financial instrument (shortly blue chips) traded on the MTA (the Italian equity cash market managed by Borsa Italiana Spa) selected and updated every six months on the basis of several factors, notably market capitalisation and market liquidity.

FIB30 futures contracts are traded every day on the nearest three delivery days. The delivery days are the third Friday of March, June, September and December. Therefore along the mentioned sample period there were three contracts traded and expiring, respectively, on March, June and September 2004. The FIB30 contract here selected is the one with nearest delivery date, namely 19th March 2004. This choice is recurrent in the literature, mainly because the nearest the expiration date the higher the liquidity is.

As to MIB30 the one minute observations are computed by SIA (which is a Borsa Italiana Spa subsidiary) on the basis of the last contract signed on each of the 30 underlying securities. Therefore data referred to minute 10:15 expresses the value of MIB30 based on the last contracts signed on the underlying blue chips from 10:14:00 to 10:14:59.

As to FIB30 the one minute observations have been selected using the above mentioned criteria from the database which gather all the prices of all contracts signed on the FIB30. In this case the burden of computation is surely higher and for this cost the selected sample has been confined within 10 days.

In each day the data of the selected sample start at minute 9:10 (i.e. last price of the minute going from 9:10:00 to 9:10:59) and end at minute 17:24. This period coincides with the continuous electronic auctions that take place on the underlying blue chips.

Actually, the trading period on the blue chips starts at 8:00 with a electronic call auction which lasts until 9:00. A further call auction takes place after the continuous one from 17:25 to 17:40. During both electronic call auctions the automatic system computes and shows to market participants the so called “theoretical” price, which is the price of the auction if the auction stopped at that instant of time. In addition a further continuous auction starts again in a different trading venue (Trading After Hours, TAH) from 18:00 until 20:00 under strict specific regulatory conditions and with a significant lower liquidity.

As to the FIB30, market trading starts at 9:00 and finishes at 17:40.

Different trading periods between FIB30 and MIB30 produce necessarily some incompleteness in the dataset. This incompleteness characterises also previous studies. Anyway a more complete sample could produce other inefficiencies, such as the existence of regularly and irregularly spaced values or the existence of prices selected from different kind of auctions. Finally, it should be mentioned that on 13th January data stop at 11:16 due to a lack in the Consob database on FIB30 contracts.

The sample is based on transaction prices instead of on bid-ask spread, which is adopted by several researches on intra-daily frequencies (Dacorogna, Muller, Nagler, Olsen, Pictet, 1993) in order to avoid the problems of negative autocorrelation induced by trading over the two sides (bid-ask bounce).

This choice is basically due to the available data on MIB30 index. Nevertheless it should be stressed that a) futures and cash Italian markets are order driven and not quote driven markets and b) the financial instruments we are dealing with are extremely liquid and many contracts are signed during a minute, therefore the bid-ask spread is very small and usually coincides with the tick size. Hence we should not expect relevant changes in working with transaction data instead of with bid-ask spread. This choice is consistent with other studies such as Kawaller, Koch and Koch (1987).

4. Econometric analyses, methodologies and results

In order to explore the characteristics of the Italian markets, data samples over the mentioned period have also been prepared for 3 blue chips composing the MIB30 (all belonging to the telecommunications industry: STMicroelectronics, TIM, Telecom Italia. Table 2 and Table 3 show the main descriptive statistics on log-prices and returns.

Table 2 (log-prices)

	FIB30	MIB30	ST	Telecom Italia	TIM
Mean	10.21825	10.21452	3.115311	0.928676	1.506494
Std. Dev.	0.005334	0.005509	0.023321	0.027545	0.021928
Skewness	-0.58553	-0.42878	-0.28860	-0.77487	-0.05558
Kurtosis	3.320033	3.015544	1.560768	2.640477	2.141970

Table 3 (returns)[5]

	FIB30	MIB30	ST	Telecom Italia	TIM
Mean	6.12E-06	6.36E-06	1.34E-05	2.16E-05	1.84E-05
Std. Dev.	0.000333	0.000390	0.000808	0.001388	0.001503
Skewness	-1.71199	-0.97888	-6.09978	0.018296	0.022869
Kurtosis	84.02279	47.25948	195.5277	2.679689	2.489936
Significant autocorrelation (sign; lags)	No	Negative 1 lag	No	Negative 1 lag	Negative 1 lag
Significant partial autocorrelation (sign; lags)[6]	No	Negative 1 lag	No	Negative 5 lags	Negative 5 lags

Return series show very relevant excess of kurtosis as widely illustrated in the literature. Negative autocorrelation is detected by correlogram at 1 lag for the MIB30 returns while FIB30 returns do not exhibit autocorrelation at any lags. Underlying blue chips returns show signs of partial negative autocorrelation up to 5 minute lags. Note that STMicroelectronics, which is the more liquid blue chips, does not exhibit autocorrelation. Augmented Dickey-Fuller tests show that unit roots can't be rejected for log-prices while they can be rejected for returns[7] (therefore returns are stationary variables).

[5] Note that returns have been multiplied by a factor of 1.000.
[6] Using Ljung-Box test at 25 lags.
[7] Tests have been performed including intercept and 5 legs for log-values (results do not change even including just 1 lag).

In order to detect lead-lag relationships between MIB30 and FIB30 the following methodologies have been adopted: unrestricted VAR, State Space model and VEC.

According to Gosh (1993) the market efficiency paradigm implies that spot and futures prices should never drift too far apart, suggesting that a cointegrating relationship should exist. Following Brooks, Rew and Ritson (2001) in order to find the cointegrating relationship between FIB30 and MIB30 values (in levels) it could be performed the Dickey-Fuller test which shows that regressing

$$s_t = \gamma_0 + \gamma_1 f_t + z_t \qquad (3)$$

estimated residuals z_t are stationary (correlogram shows significant positive partial autocorrelation up to lag 10) according to ADF test using a specification with 10 lags, intercept and trend. Therefore the two series look as cointegrated. As expected there is a strong relationship between MIB30 and FIB30: the slop coefficient is almost 1.

Table 4

Coefficient	Estimated values	t-stat
γ_0	0,30	-22,84
γ_1	1,03	799,27
Residuals	Estimated value	ADF on residuals
z_t	0,16	-8,20

Adopting the Engle – Granger two step methodology I run the following 2 equations VECM

$$\Delta s_t = \theta_0 + \delta z_{t-1} + \Sigma_i \beta_I \Delta s_{t-I} + \Sigma_j \alpha_j \Delta f_{t-j} + \varepsilon_t \qquad (4)$$

$$\Delta f_t = \theta_0 + \delta z_{t-1} + \Sigma_i \beta_I \Delta f_{t-I} + \Sigma_j \alpha_j \Delta s_{t-j} + \varepsilon_t \qquad (5)$$

The optimum number of lags selected using SBIC is 6 (26,63011), see results on Table 5.

Table 5

VECM Lags	SBIC
-4	-26,6200
-5	-26,6257
-6	-26,6286
-7	-26,6271
-8	-26,6230
-10	-26,6156

Tables 6 and 7 summarise the results of the VECM

Table 6 - Dependent variable: MIB30 returns (see equation 4). R^2 = 0,1192

Coefficient	Coefficient values	t-ratio
θ_0	5,70E-06	1,05
δ	-0,051	-3,62
β_{-1}	-0,381	-17,43
Last significant β: β_{-5}	-0,043	-2,00
α_{-1}	0,349	10,40
Last significant α: α_{-5}	0,008	3,41

Comparing with Brooks, Rew and Ritson (2001) results, the main difference is in the sign of β_{-1} (they do not show R^2 and other relevant lags).

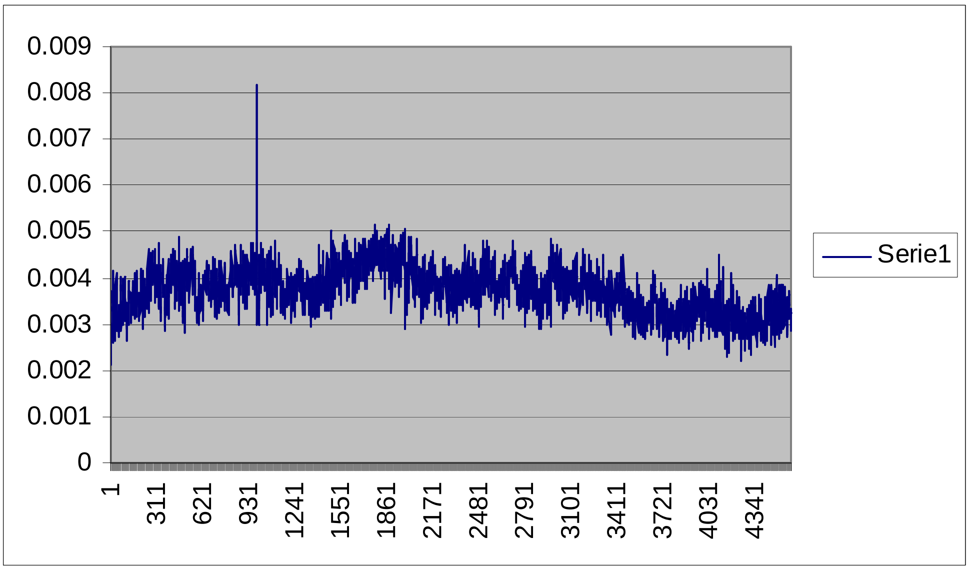
Hence data exhibit that: 1) cointegrating equation is significant: market is adjusting toward the long run equilibrium; 2) future market leads spot index; 3) there exists a negative autoregressive components; 4) the intercept is not significant.

Table 7 - Dependent variable: FIB30 returns (see equation 5). R^2 = 0,0524

Coefficient	Coefficient values	t-ratio
θ_0	6,21E-06	1,28
δ	0,066	5,25
β_{-1}	-0,144	-6,82
Last significant β: β_{-6}	-0,085	-4,59
α_{-1}	0,162	8,34
Last significant α: α_{-5}	0,064	3,90

Hence data exhibit that: 1) cointegrating equation is significant: the positive sign would mean that after departure from long run equilibrium traders buy the future and sell the cash (sign of Cash & Carry?); 2) future market is affected by spot index past values; 3) there exists a negative autoregressive components; the intercept is not significant.

Brooks, Rew and Ritson (2001) examined also a VECM where the long run equilibrium is defined by the cost of carry as indicated in equation (2) instead of equation (3). Here it is not analysed this model because in our sample - which goes from 2nd to 15th January 2004 - the two equations coincide considering that 1) the dividend yield was zero, 2) interest rates and time decay are almost constant because the period is very short. To better show this point next picture show the difference between FIB30 and MIB30 values (in levels) along the data sample.



In order to implement a benchmark for comparison to the VECM model, it has been checked the best ARMA model (see equation 6) following the SBIC criteria both for MIB30 and FIB30 returns series.

$\Delta x_t = \alpha_0 + \Sigma_i \alpha_I \Delta x_{t-I} + \Sigma_j \beta_j u_{t-j} + u_t$ (6)

The lower SBIC is given by AR(1) models both for MIB30 and FIB30 returns. More exactly the SBIC values for MIB30 returns on simple AR models at different length lag are the following:

Table 8

Lag length	SBIC for MIB30 returns	SBIC for FIB30 returns
AR(1)	-12,892	-13,172
AR(2)	-12,891	-13,170
AR(3)	-12,891	-13,169
AR(4)	-12,889	-13,168
AR(5)	-12,888	-13,166
AR(6)	-12,887	-13,164

Introducing MA terms the SBIC values increase at any lag. Also Brooks, Rew and Ritson (2001) find AR(1) model as the best ARMA model for index returns (while they did not run regressions for the futures contract). Therefore our AR(1) regressions produce the following estimates.

Table 9 - Dependent variable: MIB30 returns. R^2 = 0,0341

Coefficient	*Coefficient values*	t-ratio
α_0	5,66E-06	1,30
α_{-1}	-0,184	-12,71

Table 10 - Dependent variable: FIB30 returns. R^2 = 0,0016

Coefficient	Coefficient values	t-ratio
α_0	6,37E-06	1,29
α_{-1}	-0,040	-2,76

The following unrestricted VAR equations have been run on returns:

$\Delta s_t = \theta_0 + \Sigma_i \theta_I \Delta s_{t-I} + \Sigma_j \phi_j \Delta f_{t-j} + v_t$ (6)

$\Delta f_t = \theta_0 + \Sigma_i \theta_I \Delta f_{t-I} + \Sigma_j \phi_j \Delta s_{t-j} + v_t$ (7)

The optimum number of lags selected using SBIC is 7, see some results on Table 11.

Table 11

VAR Lags	SBIC
-5	-26,6079
-7	**-26,6150**
-8	-26,6128
-9	-26,6118
-10	-26,6080
-15	-26,5910

Tables 12 and 13 summarise the results of the unrestricted VAR.

Table 12 - Dependent variable: MIB30 returns (see equation 6). R^2 = 0,1182

Coefficient	Coefficient values	t-ratio
θ_0	5,67E-06	1,04
θ_{-1}	-0,427	-23,03
Last significant θ: θ_{-7}	-0,050	-2,72
ϕ_{-1}	0,397	19,05
Last significant ϕ: ϕ_{-7}	0,061	2,94

Hence data exhibit that: 1) there exists a negative autocorrelation component which is significant even at 7 lags (actually at 6^{th} lag it is not significant); 2) future contracts exercise a positive impact on the spot index even at 7 lags (actually at 6^{th} lag futures contracts are not significant); 3) the intercept is not significant.

Brooks, Rew and Ritson (2001) have found the optimal lag length equal to one, that means 10 minutes. Their analyses show similar results (negative autocorrelation, positive effect of future contracts, insignificant intercept). In addition they have also found that at 1 lag the autocorrelation coefficient is stronger than the future contract coefficient (θ_{-1}=0,176>ϕ_{-1}=0,136). They do not show R^2.

Table 13 - Dependent variable: FIB30 returns (see equation 7). R^2 = 0,0481

Coefficient	Coefficient values	t-ratio
θ_0	6,37E-06	1,32
θ_{-1}	-0,203	-10,94
Last significant θ: θ_{-7}	-0,046	-2,49
ϕ_{-1}	0,220	13,32
Last significant ϕ: ϕ_{-6}	0,098	5,18

Hence data exhibit that: 1) there exists a negative autocorrelation component which is significant even at 7 lags; 2) spot index exercises a positive impact on the future contracts even at 6 minute lags; 3) the intercept is not significant. Brooks, Rew and Ritson (2001) did not run this regression.

One step ahead forecasts are created for both series using the first 4000 observations and leaving the other 581 ones for out of sample forecasting.

Table 14 - FIB30 returns

	AR(1)	VAR	VECM
RMSE	0,000354	0,000512	0,000492
MAE	0,000227	0,000391	0,000331

Table 15 - MIB30 returns

	AR(1)	VAR	VECM
RMSE	0,000392	0,000421	0,000525
MAE	0,000285	0,000267	0,000396

Data show that VAR and VECM do not help more than a simple AR(1) model in forecasting both spot index and futures contracts. Brooks, Rew and Ritson (2001) found some improvements in forecasting the index using the VECM. Anyway they admit that this improvement is not very significant.

It seems that these results are strongly dependent on the sample and probably, more importantly, on the low value of the R^2, which is actually not shown by Brooks, Rew and Ritson (2001) and by other authors.

5. Conclusions

Data show that there exists a significant positive bi-directional relationship between MIB30 and FIB30. Actually the impact of FIB30 on MIB30 seems stronger. Strong negative autocorrelation in both series has been detected. This result could be due to fact that we have worked on transactions data and not to semi bid-ask spread quotes.

The above results contradict the efficient market hypothesis. Nevertheless it should be stresses that detected inefficiencies vanish after a few minutes and probably they can't be exploited if transactions costs are taken into account. This mean that arbitrageurs successfully clean the market.

Therefore the risk of systematic self-financing market manipulation strategies, such as trend creation (Jarrow, 1994), could be neglected because models show that R^2 is quite low. So even significant lag relationship could not produce systematic changes on dependent variables.

Nevertheless, we should pay attention to the double hypothesis indicated in the literature by Fama and others: the low R^2 could mean that the models examined do not catch the true underline stochastic process. Therefore it could still be possible to manipulate the market even though our R^2 is low.

Finally, since a significant lead-lag relationship exists, it can be abused. As a matter of facts, in Chapter 1 it has been shown that the cases occurred in Italy refer to situations where the manipulator modified the price pattern of the MIB30 underlying stocks in order to profit from positions opened in the future markets.

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