UNIVERSITÀ
DEGLI STUDI
DI TORINO

ALMA UNIVERSITAS
TAURINENSIS

Founded in 1404

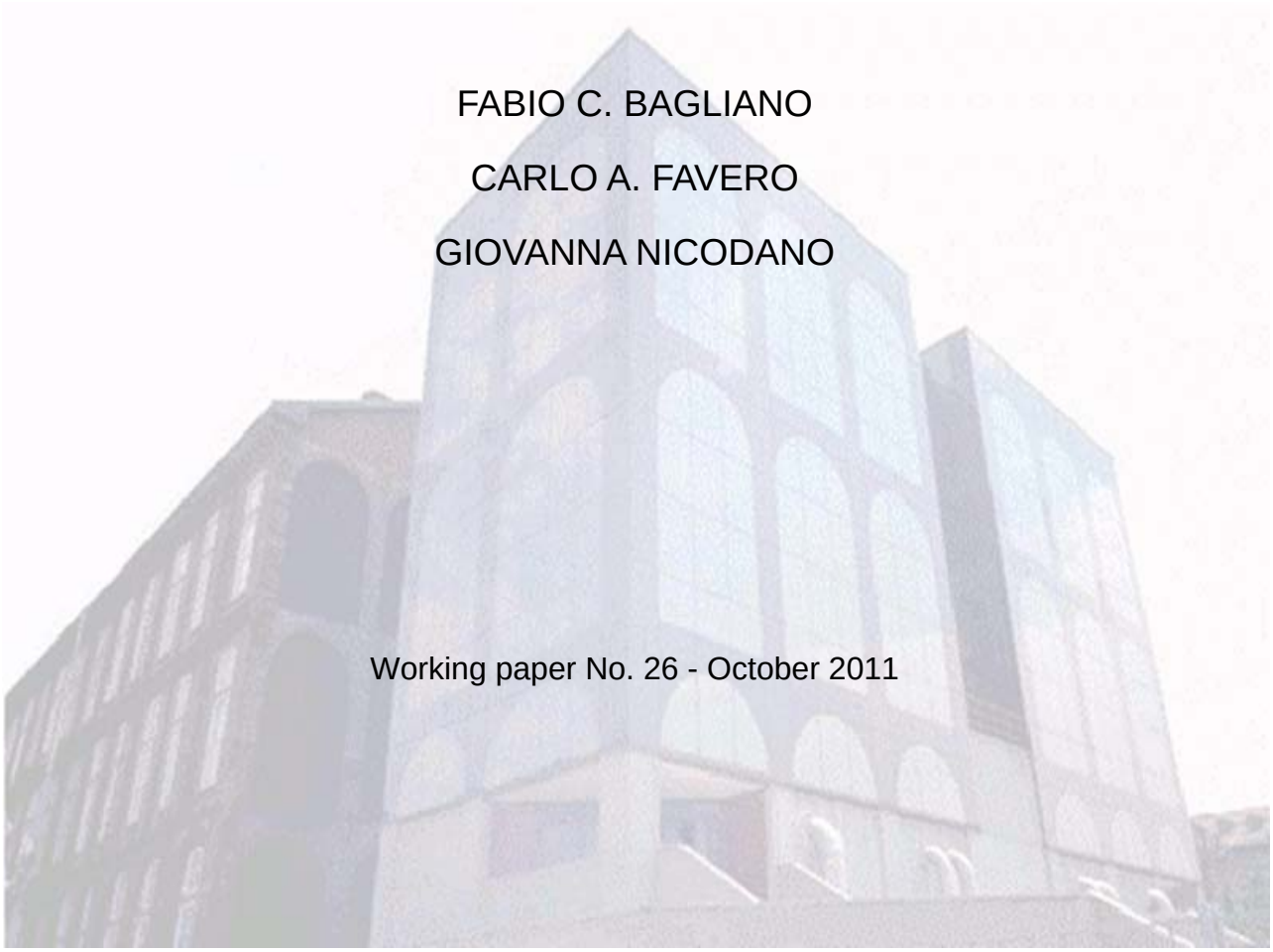
DEPARTMENT OF ECONOMICS AND
PUBLIC FINANCE “G. PRATO”
WORKING PAPER SERIES

INSIDER TRADING, TRADED VOLUME AND RETURNS

FABIO C. BAGLIANO

CARLO A. FAVERO

GIOVANNA NICODANO



Working paper No. 26 - October 2011

Insider trading, traded volume and returns*

Fabio C. Bagliano [a] Carlo A. Favero [b]
Giovanna Nicodano [c]

[a] Università di Torino and CeRP (Collegio Carlo Alberto)

[b] IGIER - Università Bocconi and CEPR

[c] Università di Torino, Collegio Carlo Alberto, and ECGI

August 2011

Abstract

Several models predict that both market liquidity and trading volume generated by less informed traders do not increase when there is insider trading. Available empirical evidence is mixed and still relatively small, because of the inherent difficulty to identify insider trading events. Our econometric work, based on 19 suspect insider trading events drawn from the non-public file of the Italian supervisory authority, provides further insight on these key implications of stock market models. The second purpose of this paper is to assess whether insider trading changes the distribution of volume and returns in a way that can be used by supervisory authorities in order to detect its presence through statistical methods.

JEL classification: G14, G18
Keywords: asymmetric information, insider trading, abnormal returns, traded volume

*Corresponding author: G. Nicodano (giovanna.nicodano@unito.it). We are indebted to Utpal Bhattacharya, Arturo Bris, Nadia Linciano, Alfredo Macchiati and Giovanni Siciliano and to participants at the workshop "Market Abuses: Law, Economics, and Regulation" (Università Bocconi) and at the "IV Workshop in Quantitative Finance" (ICER, Torino) for useful suggestions, to CoNSoB for providing us with the investigation file, to Borsa Italiana and Maurizio Murgia for supplying stock market data, to Diego Bonsignore and Enrica Marasso for research assistance. We gratefully acknowledge financial support from Centro Paolo Baffi, CoNSoB and MURST Cofin. This paper is a revised version of a 2001 working paper draft.

1 Introduction

This paper studies trading volume, returns and liquidity when there is insider trading. Several models, which follow the seminal analysis in Kyle (1985), predict that the insiders' presence in a stock market is associated with price run-ups (downs) when the insiders' news are good (bad). Moreover, trading volume generated by less informed traders should not increase as the insider's desire to sell or buy implies a higher than average probability of losing money for the trading counterpart. For the same reason the market becomes less liquid because market makers broaden the bid-ask spread so as to cover higher anticipated losses to the insider.

The empirical evidence concerning the occurrence of these effects is relatively small, because of the inherent difficulty to identify insider trading events even when it is not illegal. Indeed, an insider avoids diluting the value of private information by taking actions that would reveal it to other market participants too quickly. For instance the insider may rely on several brokers so as to hide the size of her overall trade to each of them. She may distribute her trades over time so as to prevent generating a burst in the order flow, which would be interpreted unambiguously by other market participants.

Given this strategy of hiding behind other traders' trades, data on insider trading are costly to find. Such data are gathered by stock market authorities when it is banned by the law, but illegal insider trading files are often non-public. One detailed analysis is provided by Cornell and Sirri (1992) confirming the existence of a price run-up, while challenging the view that liquidity and uninformed trading volume do not increase. This evidence refers to one case only, however. The large sample of prosecuted cases used by Meulbroek (1992) also confirms the price run-up occurring in the days when insiders are in the market, but outsiders' abnormal volume is equal across insider trading days and other days. Fishe and Robe (2004) analyze a recent court case involving 116 publicly traded companies, confirming the outsiders' volume puzzle while arguing that market depth falls. Our econometric work is based on 19 suspect insider trading events occurred in the 1990s, drawn from the non-public file of the Italian supervisory authority, CoNSoB. To preview the results, we also find a price run-up, together with an increase in liquidity when insiders trade.

The assessment of returns and volume during illegal insider trading days is also useful for regulatory enforcement. Estimates of abnormal returns can be used by courts for proving the "materiality" of inside information. This is related to the sum of abnormal returns (CAR) over the days in which the inside information was available up to and including the announcement date. If CAR is statistically different from zero, then the information traded on by

insiders was able to affect prices - in other words, it was material. Courts also rely on CAR for deciding on the penalty of the defendant ("disgorgement"), when the law mandates a penalty proportional to insider trading profits. These are estimated as the product of CAR during the holding period times the quantity purchased or sold by the insider (Mitchell and Netter, 1994).

Last but not least, the detection of illegal insider trading is not straightforward as the insider's strategy consists in hiding behind other traders' trades. Statistical detection can rely on abnormal price and volume movements, but these are also observed in conjuction with public announcements which need not always be associated with insider trading activity. We propose two ways to identify insider trading, that rely on a change in the time series pattern of returns and volume when there is insider trading. According to the model of He and Wang (1995), insider trading has persistent effects which are discernible "long" before the announcement dates, whereas announcements without insider trading affect volume and returns only in the days immediately preceding and following the information release. Moreover, insider trading could be distinguished from public information because news have a marked effect on returns and none on traded volume when there is homogeneous information in the market before the news and the updating method is the same across investors (Kandel and Pearson, 1995). Thus the first method studies whether insider trading increases the autocorrelation of returns and volume, whereas the second method focuses on the differential reaction of volume and returns to announcements.

Corporate insiders disclose their legal trading in the US and a few other countries to the stock market authority, which makes this information available to the public. There is a growing literature studying whether these trades help predict future returns and the associated corporate insiders' abormal trading profits (Seyhun, 1988; Zaman, 1988; Lakonishok and Lee, 2001). We prefer using investigation data, since the private information content of these official trades is still debated (Cohen et al., 2011; Eckbo and Smith, 1998; Jeng, Metrick and Zeckhauser, 2003). However, the empirical analysis by Cao et al. (2005) confirms that market depth increases while directors and officers trade based on the expiration of lock up provisions after IPOs.

This paper is organised as follows. In the next section we describe the behaviour of volume and returns around public announcements with and without insider trading, and review previous empirical work on US data. In section 3 we describe the non-public investigation file and our sample, contrasting its characteristics with Meulbroek's sample. Section 4 presents empirical results. Concluding comments follow.

2 The behavior of returns, volume and liquidity: some previous results

The pattern of volume and returns in a stock market depends on traders' preferences, on the initial distribution of information across market participants and on the way they process news.

If there is homogeneous information, the short-run time-series behaviour of expected returns is influenced by volume (or turnover), which is in turn determined by orders placed for liquidity reasons. Volume reduces the autocorrelation of returns because risk-averse speculators and dealers accept to bear larger risk - which is associated to larger liquidity orders - by increasing the required return. If liquidity orders are i.i.d., conditional on low liquidity orders yesterday (and therefore low required returns), high liquidity orders (and therefore high required returns) tomorrow are expected (Campbell, Grossman and Wang, 1993).[1]

Consider now the possibility that some public announcement takes place. If there is homogeneous information before the announcement there is no motive for trade among agents who similarly update their forecasts. There can be a marked price variation - if some information was unexpected - but there should be no abnormal trading at the announcement date, because there is no a priori reason for orders related to liquidity motives to become more frequent around announcements (Kandel and Pearson, 1995). Homogeneous information among market participants is likely when future announcements refer to macroeconomic events. Indeed Jain (1988) finds a strong price effect of certain macroeconomic news, whereas there is no significant reaction in turnover. As far as firm-relevant events are concerned, Kandel and Pearson (1995) also show that excess volume is concentrated on dates {-1,0,+1}. Abnormal trading and excess absolute returns are also found by Morse (1981) in those same days only[2]. Event studies focussing on take-overs find a more marked effect prior to announcement dates, namely a price run-up during 10

[1] To capture the interaction between voume and the (first-order) autocorrelation in returns, they estimate the following equation:

$$r_{t+1} = \alpha + (\gamma_1 V_t + \gamma_2 V_t^2)\, r_t + \varepsilon_t$$

where r is daily aggregate return and V is daily aggregate detrended log turnover. They find $\gamma_1 < 0$ and statistically significant as expected, and no strong evidence for nonlinearities (captured by the squared-volume term). This relationship also holds for individual stock return, with the aggregate turnover figure as a measure of volume V.

[2] Penman (1982) finds some excess returns in day -3 as well. However, he uses a different approach in that he estimates normal expected returns with a specific parametric model, namely the CAPM.

to 20 days preceding the announcement (Jarrell and Poulsen, 1989). However Gupta and Misra (1989) argue that a large part of the excess return is due to other kinds of publicly available information, such as rumours in the press. When companies which were not subject to rumours are examined, there is no excess return but in the day prior to the announcement. Hence, there is little or no evidence of abnormal behaviour preceding day -1 for in samples of US company announcements, once rumours in the press are accounted for.

When there is insider trading in the market, the asset price approaches the value implied by the inside information over time so that there should be no price surprise upon the announcement if insider trading is unregulated.[3] Orders placed by insiders push up total trading volume while orders placed for liquidity reasons should not change (Kyle, 1985; Foster and Viswanathan, 1996; Back Cao Willard, 2000)[4]. The bid-ask spread charged by risk-neutral market-makers widens (Glosten and Milgrom, 1985), as they expect to lose when they fill the orders placed by insiders, and need to gain more from less informed traders. As a consequence market liquidity falls.

It would be wrong to conclude that all abnormal trading occurring before or after public information is due to insider trading. When speculators have different signals with equal precision, a public announcement generates volume of trade because investors correct their previous forecasts with different intensity (Grundy and McNichols, 1990). Excess volume is concentrated just prior to and after the announcement because differently informed speculators bet on the outcome of the news release and close their positions just afterwards. "New public information mainly generates trade in the current period." On the contrary, "new private information not only generates trading in the current period, but also generates trading in future periods. This implies that when there is private information, independent arrival of new information can generate serially correlated volume" (He and Wang, 1995, p.957-958). High volume is not always a symptom of new information arrival to market participants, whereas high volume and large price changes are. Indeed, high volume of trade may not be accompanied by large price changes, when information is already in the economy and it is being revealed through prices by the speculators' trades. When new exogenous information arrives,

[3]In the Kyle (1985) model, the insider is risk-neutral. While risk-neutrality is not in general interesting for stock markets (since prices include a risk-premium) an insider often enjoys highly precise information on the content of the announcement, which makes him behave as if he was risk-neutral.

[4]Volume may change if outsiders, endowed with well defined preferences, choose investment in stocks anticipating future insider trading. If risk sharing gains exceed adverse selection losses, volume may increase (Buffa, 2004). If the opposite holds, it falls (Buffa and Nicodano, 2008).

on the contrary, there is an abrupt change in the investors' perception of the stock's underlying value- and high volume is associated with large absolute price changes.

Cumulative abnormal returns and abnormal trading volume for individual stocks are indeed found during days of illegal insider trading well before the announcement date after controlling for news in the press. Insider trading, and the associated abnormal volume and price run-up, typically takes place 6 (median) to 13 (mean) days before the public announcement (Meulbroek, 1992). A similar evidence is presented by Cornell and Sirri (1992). Both are consistent with the insight according to which new private information generates a persistent effect on volume and returns.[5] However, the increase in both outsiders' volume and liquidity - highlighted by Cornell and Sirri (1992)- is inconsistent with a key implication of adverse selection models. Fishe and Robe (2004) confirm the outsiders' volume puzzle, yet they argue that quoted depth falls in both specialist's and dealers' market.[6] Below we provide further evidence based on a sample of stock traded at the main Italian exchange.

3 Consob investigations

The Stock Exchange Authority - upon receiving an insider trading alert - gathers preliminary information on transactions performed and intermediaries involved. Then it reports the case to the judicial authority with or without a recommendation to further the enquiry. Our file of CoNSoB investigations includes all insider trading events occurred from 1991, when the law was first enacted, and filed to courts before July 1999 with recommendation to enquire.

The non-public file indicates whether each episode involves insider trading, manipulation or both. In Table I insider trading investigations are 58, while market manipulations are 18. The number of suspect insider traders is 311. The list of suspects includes funds, banks, foreign intermediaries, group holding companies, individual companies as well as investors with (member of the board, manager..) or without connections with the issuer of the traded

[5] It is also consistent with the effects of the introduction of binding restrictions on insider trading effected in the Amsterdam Stock Exchange in 1987. Trading volume fell and the price run-up was smaller when insiders were not allowed to trade (Kabir and Vermaelen, 1996).

[6] The specialist also increases the spread. Fishe and Robe's experiment refers to 2-trading days advance knowledge of a column to be published in Business Week, rather than inside information on a company's future announcement.

stock. Indeed, the ultimate insider trader may still be unknown to the market authority during the investigation[7]. This is typical in cases involving foreign intermediaries, that will reveal the identity of the person placing the order only if requested by courts. Suspect insiders may thus outnumber the ultimate insider traders, which may explain why the number of insiders per episodes (5.36) is much higher than Meulbroek's (2.5). The total number of companies involved in the deals (and not necessarily in the trading) is 111. Each insider trading episode may involve more than one company, for instance during a merger.

Table II lists the type of corporate event involved. In the vast majority of episodes (76%), the information concerns corporate control transactions such as trades of control blocks in the company or its parent, stock issues or conversions, mergers, restructuring. This figure is similar to Meulbroek's (79%). Her sample includes many cases of hostile take-overs while in Italy these were rare because corporate control was highly concentrated during the sample years.

Records provide information on the trades performed by each insider (or intermediary), the date, volume and cost. Table III reports profits gained or losses avoided by insiders, as estimated by CoNSoB. These figures are not based on abnormal returns. They are set equal to the difference between amount paid by the suspects for buying shares and the amount received for selling them on the basis of actual transaction data. When stock market data record only some purchases (or sales) before the announcement, CoNSoB assumes that the missing closing transaction was performed on the announcement date by the insider. In the case of insiders' sales before a liquidation event, the estimated gain is set equal to the receipts from the sales -which can be very large. When we exclude (include) the liquidation events, the per-episode mean profit is equal to 1464.7 (5044) millions lira, with many cases involving small gains.

In our econometric analysis we focus on all events which took place after December 1994. We drop previous observations because major market reforms were implemented in the early nineties,[8] altering the time-series of

[7]This may hold during litigation, as the identification of ultimate insiders was difficult for the stock market authority due to its limited investigation powers. Linciano (2003) analyzes the effectiveness of insider trading regulation in Italy. A 1998 amendment of the law required prosecutors to prove that insiders actually used price-sensitive non-public information.

[8]In 1991 there were changes in securities regulation, prohibiting off-exchange trading and dealers. In 1992 a block market began operations. Between 1991 and 1994 there was a gradual transition from a call auction to a continuous screen-based auction, followed in 1994 by a gradual change to cash settlement and the opening of trading in stock index futures. These reforms appear to have altered the returns - volume relationship for large

returns and trading volume. Stocks trading either outside the main marketplace or too infrequently are dropped, thus remaining with 23 events listed in Table IV. These events involve 22 stocks, which are non-voting in 5 cases. The types of companies range from small caps to both large private group-affiliated firms and privatising companies, with widely different turnover ratios. Table IV also reports the mean and median number of insider trading days (19.4; 9), which is far higher than the estimate for the US (3.2;2), while news days (2.3; 1) are not dissimilar (0.7;0). Insiders in Italy also begin trading much earlier (39.3;17) than in the US (13.2; 6). This difference can be ascribed to SEC investigation method, if it focuses attention on the two weeks preceding announcements only. Alternatively, it may be that timely reporting requirements are enforced more strictly in the US, thus allowing less time for insider trading.

4 Empirical Analysis

We collect "news" on these episodes, consisting of articles in the financial daily *Il Sole-24 Ore* concerning the content of the future announcement. We searched for the names of the company in the year preceding and following the episode, and kept track of the dates of all articles referring to the future event (losses, tender) - irrespective of the precision of the information. Daily data on prices, volume, turnover, the market index and aggregate lira trade volume have been provided by Borsa Italiana.

4.1 Specification and estimation method

We estimate three equations for each episode (indexed by $i = 1..I$), one for return (R_i), one for number of shares traded (V_i), and one for stock illiquidity

liquid companies (Majnoni and Massa, 1996) and increased volatility of excess returns for less liquid stocks (Impenna *et al.*, 1995).

($ILLIQ_i$) with the following specifications:

$$\begin{aligned} R_{it} &= \alpha_i + \beta_i R_{mt} + (\rho_{1i} + \rho_{2i} INSIDE_{it}) R_{it-1} + \gamma_i ANN_{it} + \delta_i INSIDE_{it} \\ &\quad + \sum_j \mu_{ji} NEWS_{jit} + \varepsilon_{it} \qquad (1) \\ V_{it} &= \alpha_i + \beta_i V_{mt} + (\rho_{1i} + \rho_{2i} INSIDE_{it}) V_{it-1} + \gamma_i ANN_{it} + \delta_i INSIDE_{it} \\ &\quad + \sum_j \mu_{ji} NEWS_{jit} + \eta_{it} \qquad (2) \\ ILLIQ_{it} &= \alpha_i + \beta_i ILLIQ_{mt} + (\rho_{1i} + \rho_{2i} INSIDE_{it}) ILLIQ_{it-1} + \gamma_i ANN_{it} \\ &\quad + \delta_i INSIDE_{it} + \sum_j \mu_{ji} NEWS_{jit} + \xi_{it} \qquad (3) \end{aligned}$$

The first control in equation (1), R_{mt}, is the return on a market index, which in our case is the *MIBTEL* index. The regressor V_{mt} in equation (2) is the total value of traded shares divided by a "market price" P_{mt} obtained as $P_{mt} = (1 + R_{mt}) P_{mt-1}$, with $P_{m0} = 100$. Illiquidity in equation (3), $ILLIQ_{it}$, is measured as the ratio of absolute return to trading volume. This is a proxy for the price impact suggested by Amihud (2002) and supported by Hasbrouck (2009), which shows strong correlation with conventional measures of illiquidity. Since the price impact in several models (e.g. Kyle, 1985) is defined as absolute return over uninformed volume, we also run the regression with this definition of $ILLIQ$. The dummy variables $INSIDE$, ANN and $NEWS_j$ respectively indicate the days when insider trade occurred, as reported in the investigation file, and when the announcement and the news are released. $NEWS$ refer to newspaper articles concerning the inside information, as in Meulbroek (1992). Since their precision varies, we insert one dummy $NEWS_j$ for each article in order to allow for different impacts. In the first two equations we also insert the lagged dependent variable - also interacted with the $INSIDE$ dummy - so as to check whether there is a significant change in the first-order autocorrelation of the series, as suggested in section 2.[9]

We run the three regressions for each stock separately. The initial date is 150 days before the first news or insider trade, and the final date is the announcement day except when no quotation is available on that day, which occurs in two cases in our sample. OLS estimates show no correlation of residuals, and coefficients' standard errors are corrected for heteroskedasticity when detected by appropriate specification tests.

[9] We also allowed for dependence of returns on contemporaneous volume as in Campbell, Grossman and Wang (1993), but the regressor itself has no statistical power. Since the other results are unaltered, we do not report them.

Table V reports the mean and median coefficient estimates on the ANN, $INSIDE$, and lagged dependent variables for equations (1) and (2). To allow comparability across stocks, the estimated effects of the ANN and $INSIDE$ variables on volumes are expressed as percentage of the average volume traded in the stock over the estimation period. Since our sample is small, we cannot construct meaningful cross-sectional standard errors and we report the number of statistically significant cases. The individual coefficients are reported also in the last four columns of Table IV. Insider trades have a statistically significant effect in 13 regressions out of 21 both on returns and on volumes; in 20 on either returns, or volume or both. When the coefficient of insiders' trades in the returns equation is statistically significant, which occurs in 15 cases, it is possible to compute insiders' excess profits which can then be used to determine disgorgement, as explained below in section 5. News and announcement days have a statistical significant impact on both returns and volume in several episodes. The return autocorrelation parameter is statistically significant in four cases: while it is generally accepted that returns are predictable over longer horizons, it is unusual to find this result in daily data for individual stock returns. Volume is predictable, consistent with the presumption - outlined in section 2 - that private and inside information get incorporated slowly in asset prices through trading.

Table VI reports estimates for equation (3). The coefficient associated with insider trading dates, δ, is negative and statistically significant in 16 cases out of 21, suggesting that market liquidity increases when there is insider trading. This supports the finding by Cornell and Sirri (1992) based on only one court case.

4.2 Insider trades, run ups and volume

Consider the price run-up, averaged across episodes, associated with inside information:

$$APR = \frac{\sum_i (\gamma_i + n_i \, \delta_i + \sum_j \mu_{ji})}{I} \tag{4}$$

where I is the number of insider trading episodes and n_i denotes the number of days with insiders' trades in each episode i. This measure is obtained as the sum of three components: announcement, insider trading, and news.

The impact of insider trading on daily returns, averaged across episodes (computed as $\frac{1}{I}\sum_i \delta_i$ and reported in Table V), is equal to 1.1%. Meulbroek's (1992) estimates are higher (3%, see her Table V, p.1679); however the median number of trading days in her sample (2) is smaller than in ours (19.4) suggesting that cumulatively insider trading is more visible on the Milan exchange than in the US stock markets (6.85).

The relative size of the announcement component can be related to the intensity of insider trading. Indeed inside information is incorporated into prices by the time its public announcement occurs, if insider trading is unrestricted (Kyle, 1985), in which case there should be no abnormal behaviour on announcement dates.[10] This is precisely what happens on the Bolsa Mexicana to stocks which are traded only by local citizens, as unrestricted insider trading takes place in advance of public disclosure (Bhattacharya, Daouk, Jorgenson and Kehr, 2000). Our results show average abnormal returns on announcement dates (9.67% in absolute value, as reported in Table V) which are smaller than in the US (18.50%) but larger than in Mexico (very close to 0%). The ratio of the price run-up associated with insider trading days relative to the price run-up at announcement dates, know as "price accuracy" (PA, Meulbroek, 1992):

$$PA = \frac{1}{I} \sum_{i} \frac{n\delta_i}{\gamma_i} \tag{5}$$

is infinite in Mexico, intermediate in Italy (222%, when attention is restricted to statistically significant estimates) and moderate in the US (47.56%). This result may be due to stricter enforcement of insider trading regulation and/or of disclosure requirements in the US. Indeed the US have a longer tradition than Italy of prosecution of insider trading, as the law was instituted in 1934 rather than 1991 and the first enforcement (prosecution in court) took place in 1961 instead of 1996 (Bhattacharya and Daouk, 2002).[11]

The mean abnormal volume on insider trading days in our sample is 1.563, that is volume is 156.3% higher than usual (0.93 in Meulbroek). In section 2 we report that there is no significant reaction to macroeconomic announcements in the US (Jain, 1988) which is consistent with absence of private information among investors since everyone would like to trade in the same direction. In our sample there is an almost seven-fold increase in volume on announcement dates, consistent with the presumption that investors who bought (sold) on both private and inside information sell (buy) to the newly informed ones after the announcement.

Finally, the average daily quantity traded by insiders significantly increases in the number of trading days available before the announcement. It is therefore not the case in our sample that insiders choose to trade more (and become more visible) when time is shorter. There is also a positive relation with average turnover in "normal" days, suggesting that insiders trade more

[10] A similar pattern emerges also when there is an abstain-or-disclose rule for corporate insiders' trading (Huddart, Hughes and Levine, 2001).

[11] This suggests to experiment this ratio as a metric for the effectiveness of insider trading regulation in a cross-country study.

when higher liquidity provides them with better camouflage.

5 Enforcing insider trading regulation

5.1 Disgorgement

Courts can rely on estimated Cumulative Abnormal Returns (CAR) for deciding on the penalty of the defendant ("disgorgement"), when the law mandates a penalty proportional to insider trading profits. These are estimated as the product of CAR during the holding period times the quantity purchased or sold by the insider (Mitchell and Netter, 1994). Abnormal returns to insider trading are in turn computed as the difference between the actual returns and an estimate of the portion of returns which is associated to factors different from the inside information.

The estimate of abnormal returns is usually based on a simple "market model", with a market return as the sole regressor (Mitchell and Netter, 1994). In Table V news and announcement-day dummies have a statistical significant impact on both returns and volume in most episodes. Therefore the estimate of abnormal returns based on a simple "market model" yields biased results in general. In other words, the abnormal return is often set equal to:

$$AR_{it} = \widehat{\alpha}_i \tag{6}$$

where $\widehat{\alpha}$ is estimated from the "market model":

$$R_{it} = \alpha_i + \beta_i R_{mt} + e_i \tag{7}$$

According to our analysis, the specification for returns should include also dummy variables for both news and announcement days, and the abnormal return should then be computed as:

$$AR_{it} = \widehat{\alpha}_i + (\widehat{\rho}_{2i} INSIDE_{it}) R_{it-1} + \widehat{\delta}_i INSIDE_{it} \tag{8}$$

using the parameter estimates from equation (1). Equation (7) thus provides biased estimates of abnormal returns.

5.2 Materiality of Information

Estimates of abnormal returns can also be used by courts for proving the "materiality" of inside information. This is usually related to the sum of abnormal returns over the days in which the inside information was available up to and including the announcement date, when the specification adopted

is a simple market model (Mitchell and Netter, 1994). If CAR is statistically different from zero, then the information traded on by insiders was able to affect prices - in other words, it was material.

Given our specification, materiality should be linked to the statistical significance of:

$$\hat{\alpha}_i + (\hat{\rho}_{2i} INSIDE_{it}) R_{it-1} + \hat{\gamma}_i ANN_{it} + \hat{\delta}_i INSIDE_{it} + \sum_j \hat{\mu}_{ji} NEWS_{jit} \quad (9)$$

In our sample inside information appears as material in all episodes. Indeed, the announcement effect on returns is below statistical significance in five cases, but in those cases the coefficient of the dummy associated with either insider trading or news or both are statistically significant. It follows that the inside information is able to significantly alter prices, which implies materiality.

5.3 Detection of insider trading with abnormal time series behavior

Section 2 argues that insider trading is associated with abnormal patterns of individual volume and returns and that, a priori, these can be distinguished from pure news and announcements effects because the former appear and persist before release dates while the latter closely surround the release time. Moreover, the effect of announcements and news on traded volume is negligible compared to that on absolute returns, if there is no private information and the method for updating information is similar across investors. Figure 1 shows that both news and insider trading usually significantly affect both returns and volume, suggesting that information was not homogeneously distributed prior to the announcement.

We cannot also detect any systematic ordering in the ratio of absolute return to absolute volume changes between news and insiders' dates, while we expected the former to be lower. There is, however, some clustering of points around the horizontal axis for the case of news, suggesting less asymmetric information before news release rather than before announcements. Figure 1 and Figure 2 together show that the response of prices and volumes to public and private information is not markedly different in our sample.

We also checked whether the serial dependence of volume (and returns) is increased by insider trading. However the latter does not change in a systematic way the autocorrelation parameter, as shown by the high number of insignificant estimates of the coefficient ρ_{2i} in Table V. These results rule out the possibility to refine along these lines existing detection methods.

6 Summary of results and concluding comments

Our econometric results confirm the robustness of the specification for returns used by Meulbroek (1992), with the return on the stock index, the announcement day dummy and the news date dummies being statistically significant explanatory variables. This implies that abnormal returns are estimated with systematic errors if a pure market model is used. Further specifications for returns can be investigated in future work following the large debate on multi-factor analysis.

On the basis of our estimates, inside information can be shown to be "material" in all episodes occurred at the Milan exchange in the 1990s and considered worth of further judicial investigation by the stock market authority. Moreover, reliable measures of "disgorgement" can be constructed in fifteen cases out of twenty-one on the basis of a statistically-significant estimate of the coefficient associated with insider trades.

The comparison between our sample and Meulbroek's suggests that insider trading is more pervasive in Italy than in the US. Indeed, the mean number of insider trading days is far higher in Italy than in the US, while that of news days is not dissimilar. Our estimates of abnormal returns on the announcement date also indicate that the "price surprise" in Italy is smaller than in the US. Conversely, the average price run-up during insider trading days is larger in Italy than in the US.

In our sample, insider trading does not change the time-series behaviour of volume and returns in a way that can be used by supervisory authorities in order to refine existing detection methods. Our results indicate that it is not possible to devise an alert system based on the changing pattern of returns autocorrelation, because estimates of the correlation parameter on insider trading dates are too unstable and imprecise. Moreover, in our sample there is also no detectable difference between abnormal return response to news and to insiders' trades, suggesting that there was differential information prior to the announcement. However, further insight could be gained by contrasting the current sample with another matched by size and announcement type. We expect the suspect sample to feature higher abnormal volume at the announcement date than the matched one, because of asymmetric information prior to the announcement. Moreover, the suspect sample should show both higher "price accuracy" and abnormal volume over the interval from 15 days to two days prior to the announcement, as private information is incorporated into prices.

Finally, the small size of our sample prevents formal testing of micro-

structural theories of insider trading. However, our evidence confirms both the price run-up and the increase in liquidity found by Cornell and Sirri (1992). While these results challenge conventional wisdom based on adverse selection models with risk neutral pricing, they should not be interpreted as evidence that regulation is detrimental to the stock market because it slows down the revelation of information. Indeed, insider trading reduces other investors' welfare even when it enhances price informativeness, provided that its positive effects on investment (Leland, 1992) and risk sharing (Bhattacharya and Nicodano, 2001) are offset by ousiders' trading losses.

References

[1] Amihud Y., Illiquidity and Stock Returns: Cross Section and Time-Series Effects, *Journal of Financial Markets*, 5, 2002, 31-56

[2] Back K., Cao H. and G.A. Willard, Imperfect Competition among Informed Traders, *Journal of Finance*, 55, 2000, 2117-2155

[3] Bhattacharya U., H. Daouk, The World Price of Insider Trading, *Journal of Finance*, 57(1), 2002, 75-108

[4] Bhattacharya U., H. Daouk, B. Jorgenson and C. Kehr, When an event is not an event: the curious case of an emerging market, *Journal of Financial Economics*, 55, 2000, 69-101

[5] Bhattacharya S. and G. Nicodano, Insider Trading, Investment and Liquidity: A Welfare Analysis, *Journal of Finance*, 56(3), 2001, 1141-1156

[6] Buffa A., Strategic Insider Trading with Imperfect Information: A Trading Volume Analysis, *Rivista di Politica Economica,* 2004, 101-143

[7] Buffa A., and G. Nicodano, Should Insider Trading Be Prohibited When Share Repurchases Are Allowed?, *Review of Finance,* 12(4), 2008 735-765

[8] Cao C., Casares Field L., and G. Hanka, Does Insider Trading Impair Market Liquidity? Evidence from IPO Lockup Expirations,

Journal of Financial and Quantitative Analysis, 78, 2005, 1073-1109

[9] Campbell J., Grossman S. and J. Wang, Trading Volume and the Serial Correlation in Stock Returns, *Quarterly Journal of Economics*, 1993, 108, 905-940

[10] Cohen L., Mallay C., L. Pomorski, Decoding Inside Information, working paper, 2011

[11] Cornell B. and E. Sirri, The reaction of investors and stock prices to insider trading, *Journal of Finance*, 47(3), 1992, 1031-1059

[12] Eckbo Espen B. and David C. Smith, The Conditional Performance of Insider Trades, *Journal of Finance*, 53(2), 1998, 467-498

[13] Fishe R. P.H. and M. A. Robe, The Impact of Illegal Insider Trading in Dealer and Specialist Market: Evidence from a Natural Experiment, *Journal of Financial Economics*, 71, 2004, 461-488

[14] Foster F.D. and S. Viswanathan, Strategic Trading when Agents' Forecasts the Forecasts of Others, *Journal of Finance*, 51, 1996, 1437-1478

[15] Glosten L. and P. Milgrom, Bid, Ask and Transaction Prices in a Specialist Market with Heterogenously Informed Traders, *Journal of Financial Economics*, 1985, 14, 71-100

[16] Grundy B.D. and M. McNichols, Trade and the Revelation of Information through Prices and Direct Disclosure, *Review of Financial Studies*, 2(4), 1990,495-592

[17] Gupta A. And L. Misra, Public Information and Pre-Announcement trading in Takeover Stocks, *Journal of Economics and Business*, 41, 1989, 225-233

[18] Hasbrouck J., Trading Costs and Returns for US Equities: Estimating Effective Costs from Daily Data, *Journal of Finance*, 64(3), 2009, 1445-1477

[19] He H. and J. Wang, Differential Information and the Dynamic Behavior of Stock Trading Volume, *Review of Financial Studies*, 8(4), 1995, 919-972

[20] Huddart S., Hughes J.S. and C. B. Levine, Public Disclosure and Dissimulation of Insider Trades, *Econometrica*, 69(3), 2001, 665-681

[21] Impenna C., P. Maggio and F. Panetta, Innovazioni strutturali nel mercato azionario: gli effetti della contrattazione continua, Banca d'Italia, Temi di discussione, 248, 1995

[22] Jain P.C., Response of Hourly Stock Prices and Trading Volume to Economic News, *Journal of Business*, 1988, 61(2), 219-231

[23] Jarrell G. and Poulsen A., Stock Trading before the Announcement of Tender Offers: insider trading or market anticipation?, *Journal of Law, Economics and Organization*, 5, 1989, 225-248

[24] Jeng Leslie A., Metrick Andrew and Richard Zeckhauser, Estimating the Returns to Insider Trading: A Performance- Evaluation Perspective, *Review of Economics and Statistics*, 85(2), 2003, 453-471

[25] Kabir R. and T. Vermaelen, Insider Trading and the Stock Market: Evidence from the Amsterdam Stock Exchange, *European Economic Review*, 40, 1996, 1591-1603

[26] Kandel E. and N.D. Pearson, Differential Interpretation of Public Signals and Trade in Speculative Markets, *Journal of Political Economy*, 103(4), 1995, 831-872

[27] Kyle A., Continuous Auctions and Insider Trading, *Econometrica*, 53(6), 1985, 1315-1336

[28] Lakonishok J. and I. Lee, Are Insiders' Trades Informative?, *Review of Financial Studies*, 14(1), 2001, 35-67

[29] Leland H., Insider Trading: Should it be Prohibited?, *Journal of Political Economy*, 100(4), 1992, 859-887

[30] Linciano N., The Effectiveness of Insider Trading Regulation in Italy. Evidence from Stock Price Run-Ups around Announcements of Corporate Control Transactions, *European Journal of Law and Economics*, 16, 2003, 199-218

[31] Majnoni G., and M. Massa, Share prices and Trading Volume: Indications of Stock Exchange Efficiency, Banca d'Italia, Temi di discussione, 263, 1996

[32] Meulbroek L.K., An Empirical Analysis of Illegal Insider Trading, *Journal of Finance*, 47(5), 1992, 1661-1701

[33] Michaeli R. and J.L.Vila, Trading Volume with Private Valuation: Evidence from the Ex-Dividend Day, *Review of Financial Studies*, 9(2), 1996, 471-509

[34] Mitchell M.L. and J.M. Netter, The Role of Financial Economics in Securities Fraud Cases: Applications at the Securities and Exchange Commission, *Business Lawyer*, 49, 1994, 545-590

[35] Morse D., Price and Trading Volume Reaction Surrounding Earnings Announcements: A Closer Examination, *Journal of Accounting Research*, 19(2), 1981, 375-383

[36] Penman S.H., Insider Trading and the Dissemination of Firms' Forecast Information, *Journal of Business*, 1982,55(4), 479-503

[37] Seyhun N., The Information Content of Aggregate Insider Trading, *Journal of Business,*. 61, 1988, 1-24

[38] Wang J., A Model of Competitive Stock Trading Volume, *Journal of Political Economy*, 102(1), 1994, 127-168

[39] Zaman M.A., Market Efficiency and Insider Trading: New Evidence, *Journal of Business*, 61(1), 1988, 25-44

Table I – CoNSoB Investigation activity (1991-7/1999).

This table reports the number of both insider trading and market manipulation episodes, which were investigated and filed to courts before July 1999 by CoNSoB. They are listed by the year in which the violation occurred. Insider trading events are reported in the first row, followed by the number of suspect insiders and by the number of companies involved. Market manipulation episodes are listed in the last row.
The suspect insiders sometimes are unknown (typically in cases involving foreign intermediaries), in which case the numbers refer to intermediaries used by insiders. Each insider trading episode may involve more than one company (e.g. in case of a merger).

	91	92	93	94	95	96	97	98	99	TOTAL
# InsiderTrading	**5**	**9**	**10**	**11**	**4**	**8**	**6**	**3**	**2**	**58**
# Insider traders	**15**	**21**	**44**	**50**	**28**	**63**	**64**	**10**	**16**	**311**
# Companies	**11**	**20**	**21**	**19**	**8**	**13**	**10**	**6**	**3**	**111**
# Manipulation	**0**	**0**	**0**	**3**	**4**	**3**	**7**	**1**	**0**	**18**

TABLE II- Type of inside information.

This table reports the type of inside information associated with the episodes investigated. Corporate control transactions are highlighted in bold.

Stock Conversion	**4**
Stock Issue	**2**
Control Block Transaction/Tender Offer	**25**
Sale/acquisition of another company	**3**
Friendly Merger	**8**
Restructuring	**2**
Losses	3
(Near) Liquidation	5
Others	6
TOTAL	58

Table III- Profit gained (loss avoided) by insiders.

This table reports the year of the violation, the number of insider trading episodes, the total profits per year as well as the mean, minimum and maximum profit per year.
Profits reported in this table are estimated by CoNsoB. These are the insider's holding period gains, calculated from actual buy and sell prices when available. If the insider's position is still open after the public announcement, CoNsoB assumes that the insider closed it at the first price prevailing after the announcement.

In the case of liquidation, the estimated gain is set equal to the amount of sales. When liquidation events occur in a given year, we report the statistics including these cases in parentheses. Figures are in thousand euro.

	#	Total	Mean	Min	Max
1991	**5**	**371.3**	**74.1**	**6.7**	**222.6**
1992	**9**	**1594.8**	**177.2**	**11.9**	**1084.6**
1993	**8(10)**	**3782.5 (40300.7)**	**472.8 (5037.6)**	**5.2**	**2685.6 (22724.1)**
1994	**11**	**15590.1**	**1417.4**	**5.7**	**7746.9**
1995	**3**	**1357.2**	**447.8**	**14.5**	**1239.5**
1996	**6(7)**	**8234.9 (41029.9)**	**1372.5 (5861.3)**	**27.4**	**5061.3 (32795)**
1997	**5(6)**	**10061.1 (57576)**	**2012.4 (9596)**	**82.2**	**6713.9 (47514)**
1998	**3**	**1053.1**	**350.1**	**49.6**	**619.7**
1999	**2**	**965.8**	**482.9**	**242.7**	**723**

TABLE IV

This table describes our sample. The first column reports letters instead of company names, which is allowed only after January 1998. The following columns report the types of traded stock (voting, V, or non-voting, NV); the type of inside information; the number of days with insider trading, with news, with insider trading on news dates; the number of days between the first trade and the announcement date (t=0), as well as the time between the first news in the press and the announcement. The next column shows whether there was a suspension of trade on a news date or at the announcement date (t=0) etc. Turnover is computed as average traded volume over market capitalization during the first thirty days of the sample. A turnover of 55.5 means that 0.0558 of market cap was traded on average. The sign (♦) in the first column denotes that the episode featured both insider trading and market manipulation. The sign § in the third column denotes that there was insider trading on the announcement date as well.

The last four columns summarise the estimates of the effect of announcement and of insiders' trades on returns on the quantity traded, once market movements and news in the press are allowed for. Details on the specification can be found in table V. A star denotes statistical significance at 5% level, and a double star at 1%.

STOCK		**INFORMATION on**	**TRADE DAYS**	**NEWS**	**TRADE & NEWS**	**1st TRADE -ANN**	**1st NEWS –ANN**	**NO TRADE ON**	**TURNOVER (‰)**	**ANN on Returns**	**ANN on Volume**	**Insider on Return**	**Insider on Volume**
A(♦)	V	Block	9	1	0	50	1		55.8	0.046**	5.80**	0.019**	1.170**
B	NV	Block	6	1	0	40	1		44.8	0.093**	-1.08	0.026**	2.533*
C	V	Block	52	1	0	138	1	News and 0	2.94	NA	NA	0.002	0.588**
D	V	Losses	3	2	0	2	40		14.2	0.297	34.70**	-0.011	7.905**
E	V	Liquid	96	9	2	187	289	0	24.4	NA	NA	-0.006*	1.073**
F	V	Acq/Sale	8§	1	0	17	54		2.6	0.036**	2.85**	0.009**	0.924**
G (♦)	V	Block	10§	0	-	28	-		5.3	0.026	3.56**	0.008*	1.348**
H	V	Tender	18	**1**	0	46	**2**	News and –1	100.1	0.182**	17.23**	0.006*	0.932**
I	V	Block	1	2	1	20	17	Many days	2.8	0.068**	4.52**	0.045**	2.500**
J	V	Merger	10	0	0	10	0	-1	113	0.190**	14.25**	0.010	1.013**
K	V	Block	31§	4	2	31	49	Many days	39.3	0.0002	-2.87**	0.008*	2.870**
L	V	Sale	14	1	0	161	182		137.7	0.068**	3.12**	0.012	1.978**
M	NV	Sale	6	1	0	8	182		317.5	0.028	3.65**	-0.012	4.157*
N(♦)	V	Merger	32	0	-	41	-		52	0.066**	14.78**	0.005*	0.974**
O	V	Merger	1	1	0	1	46		339.5	0.047**	3.09**	0.023**	1.492**
P	V	Losses	3§	1	1	2	1		460.9	0.100**	4.81**	0.026**	0.536**
Q	NV	Convers	9§	3	1	14	132		451.8	0.163**	6.97**	0.013*	1.055*
R	V	Liquid	64	1	0	84	16	Many days	260				
S	V	Tender (Auction)	2	3	0	0	126		709.8				
T	V	Tender	1	2	0	2	145		117	0.189**	-0.47	0.028**	-0.207
U	NV	Convers	13	12	0	12	141		399.4	-0.0002	0.92**	0.0001	0.015
V	NV	Convers	2	Idem	0	5	Idem		246.7	0.001*	0.90	0.007**	-0.169
Z	V	Tender	3	2	0	6	156		22.8	0.240**	12.65**	0.012**	0.133**
Mean			19.4	2.3		39.3	79.1		175.3	0.097	6.809	0.011	1.563
Median			9	1		17	47.5		106.5	0.068	3.648	0.009	1.055

TABLE V - Econometric Estimates of Returns and Volume

This table reports estimates of the equations:

$$R_{it} = \alpha_i + \beta_i R_{mt} + (\rho_{1i} + \rho_{2i} INSIDE_{it}) R_{it-1} + \gamma_i ANN_{it} + \delta_i INSIDE_{it} + \Sigma_j \mu_{ji} NEWS_{jit} + \varepsilon_{it}$$

$$V_{it} = \alpha_i + \beta_i V_{mt} + (\rho_{1i} + \rho_{2i} INSIDE_{it}) V_{it-1} + \gamma_i ANN_{it} + \delta_i INSIDE_{it} + \Sigma_j \mu_{ji} NEWS_{jit} + \eta_{it}$$

The dependent variables are stock return and traded volume, and the regressors are the return of a market index (R_{mt}), aggregate trading volume (V_{mt}) the lagged dependent variable, and dummy variables identifying announcement (ANN , news (NEWS) and insider trading (INSIDE) dates. Regressions are performed on each stock individually. The initial date is 150 days before first NEWS or INSIDE date, and the final date is the announcement day, except when no quotation is available on that day.

The numbers below are the mean and the median of estimated parameters in our sample.

	Estimated coefficient:	γ	δ	ρ_1	ρ_2
Equation For Returns	**Mean**	9.67%	1.10%	0.066	0.415
	Median	6.80%	0.90%	0.079	0.436
	n. of coeff. stat. signif (5%)	14 (out of 19)	15 (out of 21)	5 (out of 21)	2 (out of 19)
Equation For Volumes	**Mean**	680.9%	156.3%	0.307	-0.337
	Median	364.8%	105.5%	0.084	-0.110
	n. of coeff. stat. signif (5%)	16 (out of 19)	18 (out of 21)	20 (out of 21)	6 (out of 19)

TABLE VI - Preliminary Econometric Estimates of Illiquidity

This table reports estimates of the equations:

$$ILLIQ_{it} = \alpha_i + \beta_i\, ILLIQ_{mt} + \gamma_i\, ANN_{it} + \delta_i\, INSIDE_{it} + \Sigma_j\, \mu_{ji}\, NEWS_{jit} + \xi_{it}$$

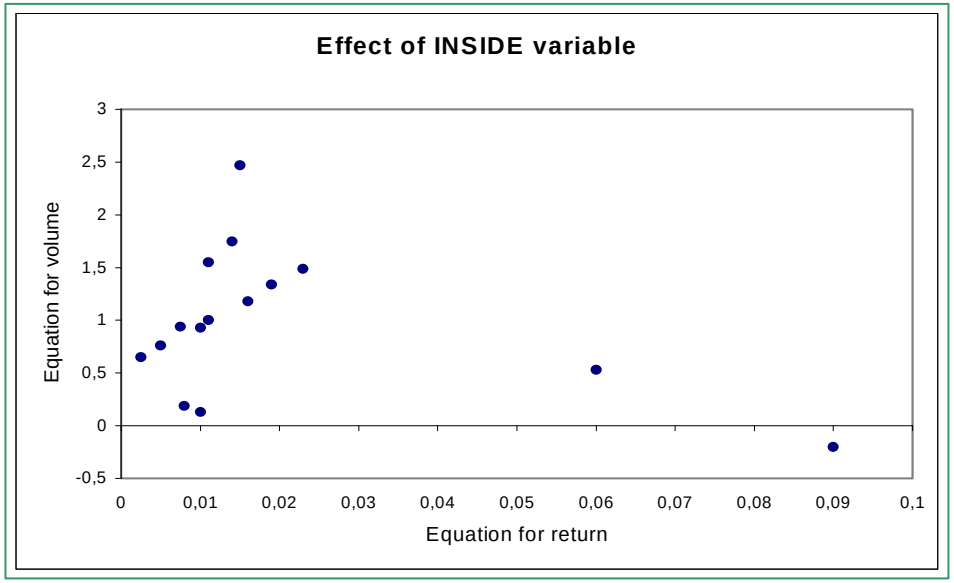
The dependent variable is the illiquidity index, computed as absolute return over lira volume, and the regressors are the illiquidity of a market index ($ILLIQ_{mt}$), dummy variables identifying announcement (ANN) , news (NEWS) and insider trading (INSIDE) dates. Regressions are performed on each stock individually. The initial date is 150 days before first NEWS or TRADE, and the final date is ANN except when no quotation is available on that day.

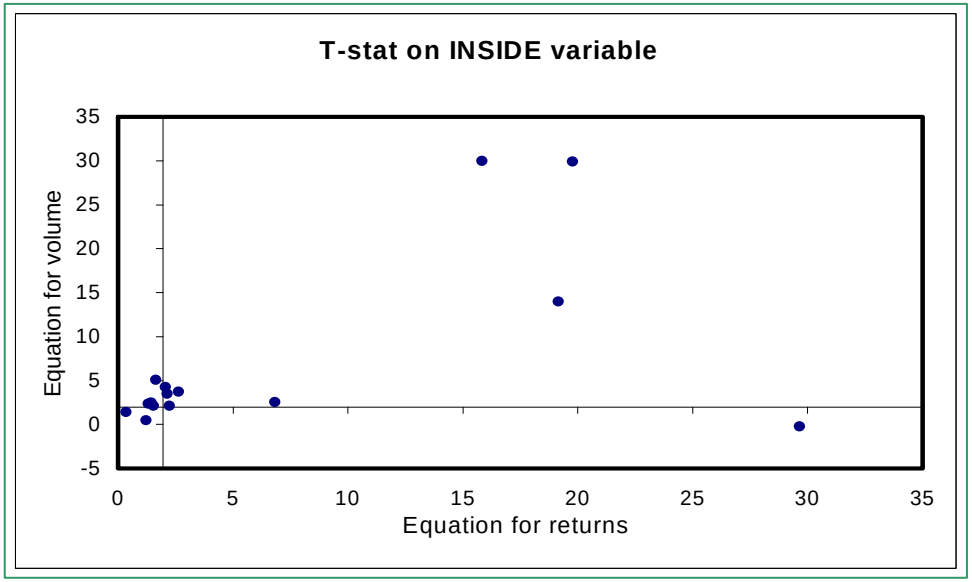
δ Stat significance=17 over 21.

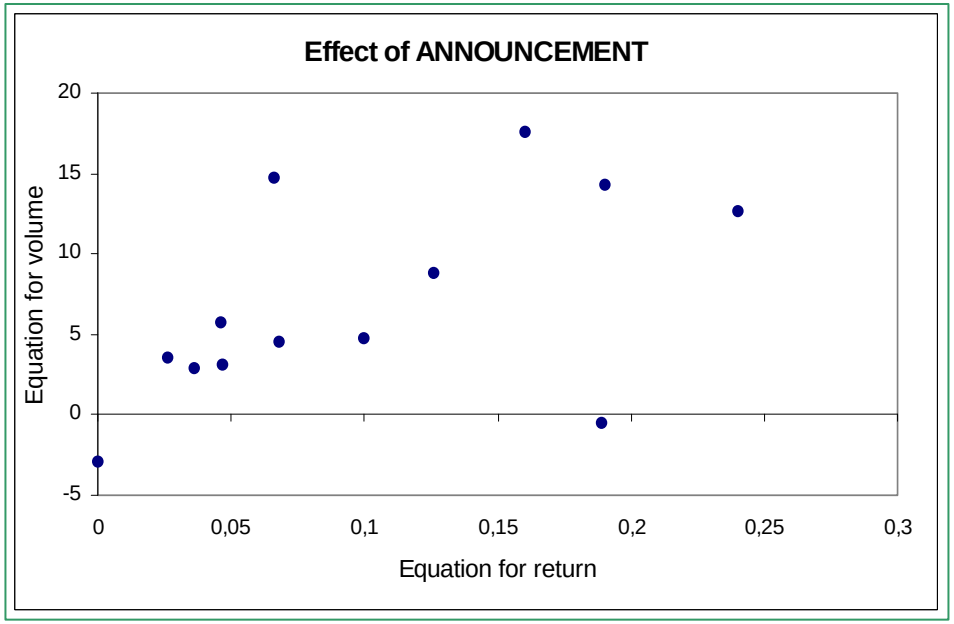
Stock		β	δ	R2
A	583	0,397	**-3,76584**	0,01438
		(2,144)	(-8,592003)	
B	306	0,057	-2,13584	0,008334
		(1,333)	(-0,898585)	
C	248	0,001	**-0,139295**	0,019986
		(1,394)	(-5,311693)	
D	459	0,000007	**-0,000106**	0,145717
		(4,305)	(-5,400036)	
E	249	0,00047	**-0,01616**	0,03090
		(1,91648)	(-2,66309)	
F	225	0,003282	**-0,244098**	0,026871
		(1,867560)	(-4,207917)	
G	494	0.002911	**-0.083898**	0,040992
		(2,469844)	(-4,943895)	
H	164	0,008649	**-0,205498**	0,096481
		(3,303580)	(-3,446374)	
I	279	0,000193	**-0,006054**	0,075788
		(4,118913)	(-3,562585)	
J	180	0,012689	**-0,697772**	0,059079
		(2,017889)	(-4,181595)	
K	832	0,001770	**-0,290423**	0,004690
		(1,173058)	(-6,934810)	
L	784	0,003813	-0,214456	0,004915
		(1,428970)	(-1,546508)	
M	545	0,001745	**-0,125359**	0,016522
		(1,610476)	(-7,660177)	
N	973	0,000163	-0,006092	0,044218
		(5,511757)	(-1,211728)	
O	426	0,000115	**0,003010**	0,031986
		(2,389938)	(2,150867)	
P	318	0,000455	-0,001792	0,242015
		(7,114185)	(-1,619524)	
Q	386	-0,001119	0,024327	0,010284
		(-3,069988)	(1,316077)	
T	614	0,0000826	**-0,000294**	0,165617
		(9,680032)	(-8,474283)	
U	593	0,018630	**-0,624006**	0,010787
		(1,877727)	(-2,190123)	
V	613	0,000256	**-0,000502**	0,091398
		(6,905695)	(-6,685908)	
Z	624	0,025429	**-1,113959**	0,034318
		(3,109336)	(-7,261023)	

Figure 1 - Effect of insider trading and announcements on returns and volumes

The left-hand side panels report the point estimates of δ_i (upper) and of γ_i (lower) in the return and volume equations. The right-hand side panels report the t-statistics associated with estimates of δ_i (upper) and of γ_i (lower). Points to the right of the vertical axis represent statistically significant estimates in the return equation. Points above the horizontal axis represent statistically significant estimates in the volume equation.







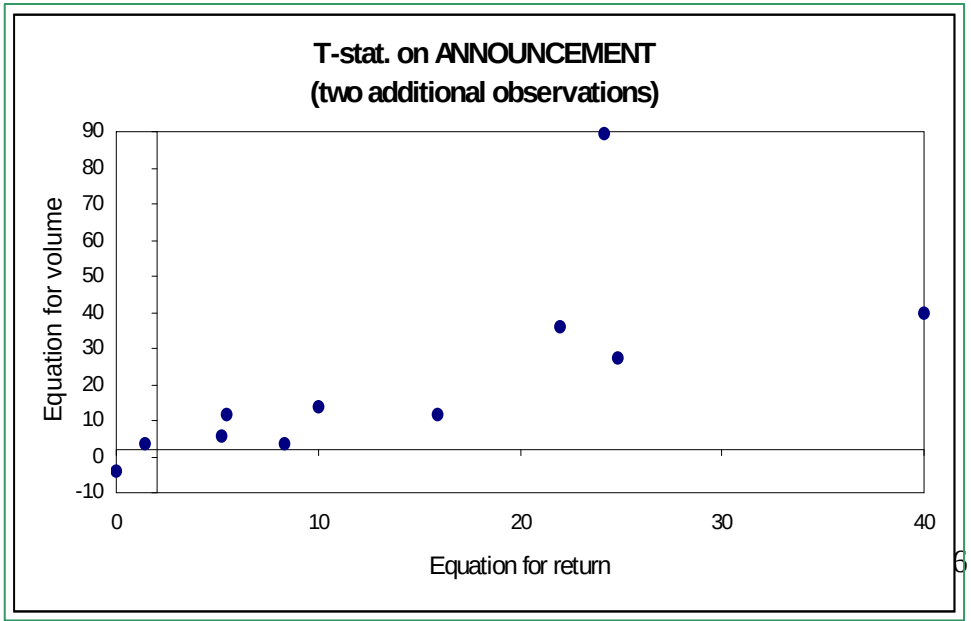
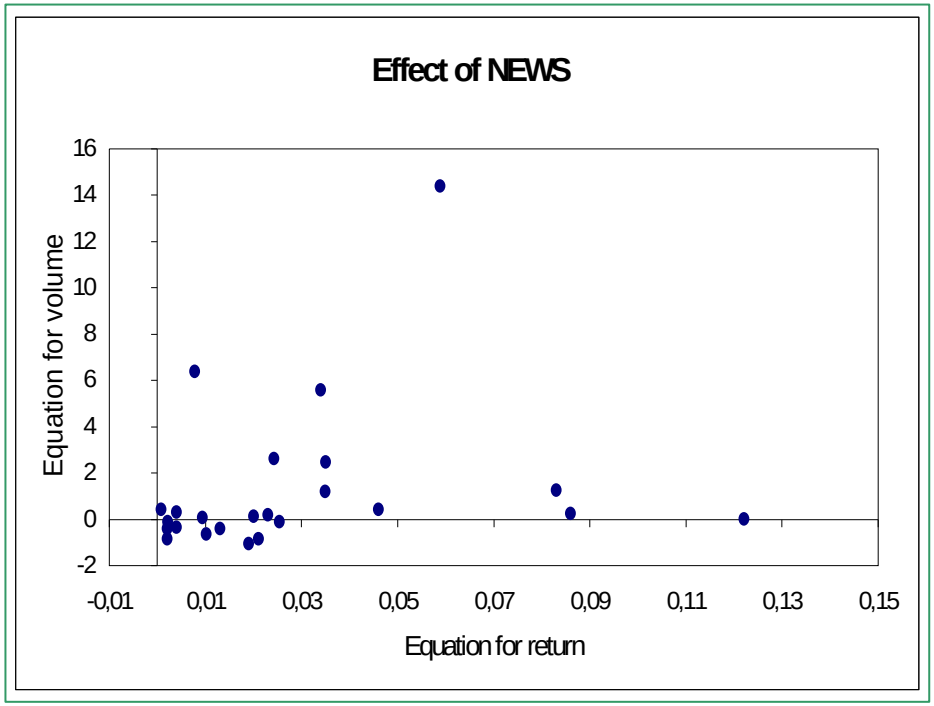
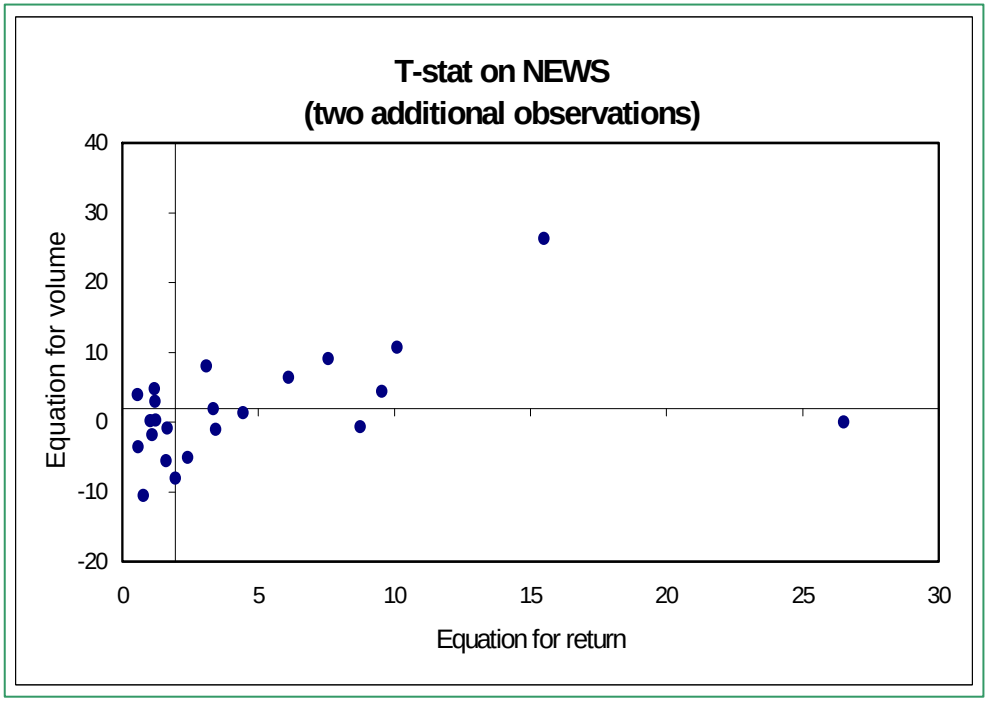


Figure 2- Effects of news on returns and volumes

This table represents the point estimates of μ_{ij} in the return and volume equations (left-hand side) and to the T-statistics associated to them (right-hand side). Points to the right of the vertical axis represent statistically significant estimates in the return equation. Points above the horizontal axis represent statistically significant estimates in the volume equation.





DEPARTMENT OF ECONOMICS AND PUBLIC FINANCE “G. PRATO”
UNIVERSITY OF TORINO
Corso Unione Sovietica 218 bis - 10134 Torino (ITALY)
Phone: +39 011 6706128 - Fax: +39 011 6706062
Web page: http://eco83.econ.unito.it/prato/