

THE IMPACT OF INSIDER'S BEHAVIOR AND EARNINGS MANAGEMENT ON STOCK PRICES: AN EXPERIMENTAL STUDY

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Abstract. This paper designs a laboratory experiment to study the relation between earnings management and insider trading and their effects on the stock markets. The experiment simulates a market where one insider and three outsiders trade on the stocks of a company. We show that if the insider affects the stock price with her earnings announcements, then she will use this power and increase her capital gains. These earnings management practices not only induce price inefficiencies but also affect the profits of the other traders. We also show that the managerial stock-based compensation worsens these effects, seriously increasing stock prices and manager's profitability. We conclude that the lack of transparency in earnings management and the perverse incentives of the managerial compensation policies have an important role in generating price inefficiencies, bubbles and financial crises.

Keywords: Insider trading, earnings management, stock-based compensation, laboratory experiment, private information, market efficiency.

JEL Classification: C91, D82, G14.

Introduction

It is usually said that we are living in an information society but, paradoxically, investors have never been so uninformed. The current financial crisis has seriously increased investor distrust and thus the efficient functioning of the markets. An excessive assumption of risk by poorly aligned officers, abusive managerial compensation systems that encourage short-termism and earnings management to the detriment of the quality of information, officers who merely seek insider returns, which also amounts to an expropriation of shareholder wealth through practices of abusive use of insider information, and the ultimate expropriation by the majority shareholders –and all of this favored in many cases by a lack of a responsible performance of the audit function and of proper oversight– have all contributed to the current crisis (Van Geyt et al., 2013).

In this article we shed some light on the opportunistic behavior of the insiders who not only possess private information and use it in their trading, but also deliver this information to the market with clear incentives to profitably manipulate the information. For this purpose, and unlike most studies that use real data (e.g. Kang and

Kim, 2012 or Dhaoui, 2008) we conduct a laboratory experiment designed to show how an insider might behave if her actions are not properly supervised and penalized.

Experiments in finance have a long tradition in recent decades – see e.g., Plott and Sunder 1982, Forsythe and Lundholm 1990, Sunder 1992, Smith et al. 1998, Lei et al. 2001, Hommes et al. 2005, Bossaerts et al. 2007, Pouget 2007, Bossaerts and Plott 2008, Cipriani and Guarino 2008, Angerer et al. 2009, Anufriev and Panchenko 2009, Deaves et al. 2009. These articles, among others, deal with the basic topics of asset pricing, portfolio choice, asymmetric information, bubble formation, herding or coordination. This article is linked to this literature but our experimental design is completely different. We directly focus on a price function that depends not only on the excess of supply/demand but also on the difference between reported and real earnings, which we interpret as an informational surprise in a rational expectations setting. This naïve function confers to the insiders the power of influencing the price not only through their trading but also through their earnings figure reports.

We consider markets with one insider and three outsiders that trade on the stocks of a firm without knowing the final price at which their orders will be closed. The only information the traders have is the determinants of the price (price function) and the earnings figure reported by the insider (who knows the real earnings figure as well). The final payoff (after 40 rounds) depends on the final wealth the participants have on their dealings and investments (i.e. their portfolios are finally valued at the final stock price). We consider two alternative treatments: the baseline (T0), where all traders receive a dividend payout (a fixed amount per stock in their portfolios) every five periods; and a second treatment (T1), where insiders also receive a stock-based compensation depending on the increase of the stock price every five periods (see e.g. Schotter and Weigelt (1992), Cyert et al. 2002, Bergstressera and Philipponb 2006, or more recently, Kuhnen and Nielsen 2012, for studies about managerial compensation).

Our results show that under these basic assumptions insiders misreport earnings figures so as to drive the stock price for their own benefit: in treatment T0 to maximize capital gains and in T1 to maximize their bonuses. As a consequence, insiders' returns are higher than outsiders' returns but also insiders' returns significantly increase when the stock-based remuneration policy is implemented. Therefore, earnings management practices and stock-based compensation induce two serious inefficiencies to the market: they affect positively/negatively the insider/outsider return and they distort the stock price, which sharply increases under stock-based compensation schemes (Sutter et al., 2012, found a similar result with dividend payouts).

In the next section we detail the experimental design and the hypotheses underlying our simple market model. In Section 2 we present the experimental results and, finally, we identify the main conclusions.

1. Experiment

1.1. Setting

We consider 10 different markets where the stocks of a firm are sold. At the beginning of the experiment each subject i is assigned an initial endowment of stocks (x_{it}) and money (m_{it}). Particularly, they are initially endowed with 5 stocks and 100 experimental currency units (ECUs). The initial price of the firm's stocks (p_t) is 20 ECUs and thus subjects possess an initial wealth (w_{it}) of 200 ECUs. In addition, subjects are also assigned to a group (market) of four people and a type (insider or outsider). Particularly, we refer to the insider as subject $i = 1$ and to the outsiders as subjects $i = 2, 3, 4$. These assignments remain during the entire experiment.

In each market there are one insider and three outsiders. The insider knows privately the information about the growth rate of firm's earnings (r_t), which is randomly chosen (with equal probability) from the following set $\{-20, -10, 0, 10, 20\}$ in each period. For example, if value 20 is drawn we assume that the earnings have risen 20 per cent in the current period. In every period, the insider has to report on the firm's earnings to the other three subjects in the market. This message (\tilde{r}_t) must also be a value of the set $\{-20, -10, 0, 10, 20\}$, but this reported value does not necessarily have to be the true one. Then, all four subjects in the market simultaneously make a decision about their trading orders. For the sake of simplicity, we restrict the operations to three possible cases: "buying a single stock of the firm", "selling a single stock of the firm" or "neither buying nor selling stocks". When making this decision, subjects do not know the closing price that buyers will have to pay and sellers will receive. This price is computed through the following equation:

$$p_t = p_{t-1} + 2(d_t - s_t) + \frac{1}{10}(\tilde{r}_t - r_t) \quad (1)$$

where d_t is the demand (number of subjects in the same market that are willing to buy a stock) and s_t is the supply (number of subjects in the same market that are willing to sell a share), $d_t, s_t \in \{0, 1, 2, 3, 4\}$ with $d_t + s_t \leq 4$. Therefore, the price in period t is a function of its previous value, the excess of demand/supply and the surprises in the announced earnings with respect to the true ones. Therefore, three main assumptions are underlying the price formation. First, prices follow a dynamic structure, which in case the number of agents in the market was very large and if earnings surprises were unpredictable would approximate a random walk (market efficiency hypothesis). Second, competitive forces in the market lead the prices up/down in case of excess of demand/supply. In spite of this assumption, in our game the market is not competitive since each subject has a certain market power and may affect the price movement to some extent. Third, subjects' expected earnings under truth-reporting are unbiased and thus this expectation does not significantly deviate from r_t . Then, if we interpret r_t as the expected earnings and assume rational expectations, a positive/negative surprise in the reported earnings triggers the share prices upwards/downwards.

Note that for the price function in equation (1) price movements in every period ($p_t - p_{t-1}$) are integers in the range $[-12, 12]$. The upper/lower bound corresponds to

the situation where all subjects are willing to buy/sell, the real earnings experiment a 20% decrease/increase and the insider reports a 20% increase/decrease of the earnings (e.g., $p_t - p_{t-1} = 12$ where $d_t = 4$, $s_t = 0$, $\tilde{r}_t = 20$ and $r_t = -20$).

After having received the subject's trading orders, the price is computed and the orders are closed at the corresponding price. Borrowing money to buy a share is not allowed and thus if a subject cannot pay the price after having chosen "buy a new stock" the computer reminds her that she does not have enough money and she is forced not to trade in this period. In this case the new price is recomputed assuming the new demand. In the same line, a subject can only decide to "sell a stock" if she has at least one stock in her account. These restrictions to the transactions help to stabilize the price throughout the experiment, because subjects cannot continue buying (selling) during more than 5 consecutive periods (approximately) since they do not have enough money (stocks) with which to trade.

The experiment lasts 40 periods and in every period subjects accumulate their wealth (the ECUs and the market value of their current stocks). Furthermore every 5 periods (i.e. in periods 5, 10, 15, 20, 25, 30, 35 and 40) agents received a dividend (D_{it}) of 2 ECUs for every share possessed at the end of the corresponding period (once the transactions of the period have been closed).

We considered two alternative treatments and a between-subjects design. In the baseline treatment (T0) subjects only receive the dividend remuneration and the capital gains from their market operations that are incorporated to their wealth. In the other treatment (T1) we additionally implement a stock-based remuneration policy for the insiders, which consists of an extra bonus every 5 periods (i.e. at the same time as the dividend payout). This bonus is gained only if the share price has increased during the last 4 previous rounds and in this case the insider bonus (b_{it}) is 5 times the price increase within this period. Therefore, a bonus is computed as

$$b_{it} = \begin{cases} 5(p_t - p_{t-4}) & \text{if } p_t - p_{t-4} > 0, \\ 0 & \text{otherwise.} \end{cases} \quad (2)$$

The final payoff of subject i (π_i) is computed as the wealth possessed for this agent in period $t=40$ as

$$\pi_i = m_{it} + p_t x_{it} + D_{it} + b_{it}, \quad (3)$$

where $b_{it} = 0$ in treatment T0 and for every subject $i = 2,3,4$ in treatment T1.

1.2. Procedures

We conducted the experiment, which was programmed within the z-Tree toolbox (Fischbacher 2007), in the Laboratory for Research in Social and Economic Behavior (LINEEX), which is hosted at the University of Valencia. For each treatment we organized a session with 40 subjects and thus a total of 80 undergraduates from various disciplines participated in the experiment.

Before the start of each session, experimental subjects privately read the instructions and were then able to test their understanding of the instructions in five practice rounds

that did not affect the final payoff. For these practice rounds participants were assigned into groups of four and received a role in the group: insider (one in every group) or outsiders (the other three of the group). These groups and roles remained unchanged in the practice rounds and during the entire experiment as well. Their identities were never revealed. To ensure that the data is truly independent across groups, the participants were informed that they would only play against the same group during the entire experiment. They were also informed about their initial endowments (5 stocks and 100 ECUs) and the initial price of the stocks (20 ECUs), all the same in each market and for each subject. After the completion of the practice rounds, the participants had to answer several control questions. The software only started once all participants answered all control questions correctly. When the experiment started the subjects were assigned their initial endowments again and the stock price was initialized as well.

Within each group the game was played for 40 periods and each period had two steps. In the first step the insider of each group received a message about the firm earnings that was randomly drawn. In both treatments we used the same sequence of earnings to ensure the comparability of the results. The real value of the earnings was never revealed to the outsiders of the group although they might infer ex post guesses based on the final stock price at the end of each period (since real earnings are part of the final price). With this private information the insider decided on the reported earnings figure that was publicly announced. In the second step each participant in the market decided privately and submitted their decision about either selling, buying or not participating in the market. With all the submitted orders and the reported and real earnings, the price was formed and the orders were satisfied accordingly. The results of the decisions on subjects' wealth and its components (stocks and liquidity) were recorded in a table, as well as the stock prices, reported earnings and their own trading decisions. This information was continuously updated and available on the screen during the experiment.

At the end of the experiment the total wealth of the subjects (the stocks valued at the final price of the game and the money possessed at the end of the experiment) was converted into Euros at a known exchange rate (50 ECUs = 1 Euro). Payment took place privately and the participants had to leave the laboratory immediately once they were paid. The maximum, minimum and average payoff was 22.38 (31.92), 12.54 (8.46) and 16.23 (17.07) Euros in treatment T0 (T1), respectively. A session lasted on average two hours and a half.

1.3. Hypotheses

In this section we justify a set of conjectures that rise from the experimental design and its underlying incentives. We gather the hypotheses into two different categories: (i) Hypotheses related to the earnings management and insider trading practices, and (ii) hypotheses related the effects of stock-based compensation schemes. Below we describe the three main hypotheses in each category.

(i) Hypotheses related to the earnings management and insider trading practices:

In our framework insiders have access to private information about the firm performance and also have the privilege of disseminating the information to the market. Thus the first hypothesis under test is whether in this context insiders report the information truthfully. In this study we do not analyze either the ethics or the illegal considerations of misreporting (see Abdolmohammadi and Sultan 2002 for an experiment based on the ethical behavior of insider trading and Brandts and Charness 2003 for a sender-receiver experiment with punishment under misreporting). Our experimental design does not focus on these matters since the incentives come directly from the individual profitability and do not depend on moral considerations, possible controls or penalties on misreporting behavior or even collateral effects on reputation. All these questions might also be introduced in alternative treatments but this was not the focus of our study. In our experiment, however, insiders know that their misreporting may affect not only their own profitability but also that of their partners. In this case we wonder whether they behave honestly in this sense or they do not worry about such considerations and directly maximize their own profitability. We hypothesized this conjecture in H1.

H1: "Insiders systematically misreport information about earnings."

Assuming that H1 cannot be rejected, we go a step further and study whether manipulation is intended to affect market prices so insider's profits on their trading operations increase. For this purpose we revise the incentives' underlying equation (1). Given p_{t-1} and $d_t - s_t$, the best strategy for an insider that maximizes the profits in her trading operations is obtained by maximizing $|\tilde{r}_t - r_t|$ and thus reporting a 20% increase/decrease in earnings whenever earnings decrease/increase and, consequently, sell/buy an action when she expects an increase/decrease in the stock price. For example, the announcement of a 20% earnings increase when real earnings decrease has a positive effect on the stock price (it increases in 3 or 4 units when real earnings have fallen a 10% or 20%, respectively). This marginal effect compensates the two-unit reduction of the price due to the insider selling order. This effect, however, happens for a given value of p_{t-1} and $d_t - s_t$. Observe that the manipulation strategy of the insider might be offset by the behavior of the other investors that might decide to sell/buy on the basis of the announcement of the high/low earnings or the high/low stock prices in a particular period. Of course the final effect on the stock price depends on the strategies of all players and their beliefs about the expected behavior of their opponents. Nevertheless, we believe that with our experimental design it seems reasonable to test the hypothesis H2 about the information manipulation strategy of the insiders.

H2: "Earnings management practices are incentivized by the profitable insider trading operations. Then, insiders report high increases/decreases in earnings when earnings have decreased/increased and they intend to sell/buy stocks at a high/low price".

The hypotheses H1 and H2 highlight the fact that insiders not only use private information for making optimal trading decisions but also they manipulate the information for the sake of increasing the gains on their transactions. Note that these hypotheses sound reasonable in a stylized market where no controls or penalties on misreporting are considered. Nevertheless we try to illustrate how insiders behave in this scenario and the consequences of such behavior. Specifically, this insider strategic

behavior has negative externalities on others' profits, since outsiders decide about their trading based on false information and the insiders exploit their mistake-induced decisions profitably. These assessments lead to hypothesis H3.

H3: "Earnings management positively/negatively affects insiders'/outsiders' returns. Thus, in the case of earnings management, insiders' returns are higher than average outsiders' returns".

(ii) Hypotheses related to stock-based compensation schemes:

Our experiment also explores the insiders' behavior under the implementation of a stock-based remuneration policy and the effects of this type of manager's compensation on the market. For this purpose, in treatment T1 we consider a stock-based compensation policy in which the insider receives an extra bonus every five periods that depends on the increase of the stock price during the last four periods, including the period of the current payout but not that of the previous payment – see equation (2). In this context, the first hypothesis to be tested is precisely the treatment effect. This effect, however, has two important directions: The insiders' profitability and the firm value. The resulting hypotheses are stated in H4 and H5:

H4: "The stock-based remuneration policies positively affect insiders' returns (even without considering the bonus). Thus, insiders' returns are higher in the presence of this manager compensation scheme".

H5: "The stock-based remuneration policies positively affect firm value. Thus, share prices rise more in the presence of this manager compensation scheme".

Hypothesis H2 is based on the idea that the main source of insiders' profit comes from their trading. Nevertheless, their optimal strategy might not be the same if we include another alternative manager remuneration policy. For example, under our stock-based compensation scheme the strategy that maximizes bonuses consists of trying to increase the stock price (e.g., by reporting high earnings and buying stocks) until they get the bonus and doing the opposite strategy just when they have received it in order to maximize the next bonus. Therefore, for this particular stock-based compensation scheme the following hypothesis seems plausible:

H6: "Under stock-based compensation schemes earnings management is driven by bonus maximization. Particularly, our stock-based compensation policy makes insiders report increases/decreases on earnings before/immediately after getting the bonus."

2. Results

This section is divided into five parts. First, we present some summary statistics about the experiment. Then we test the hypotheses stated in the previous section by using panel regressions explaining the decision on insiders' reported earnings and the trading choice and the profits of both insiders and outsiders. Finally, we analyze the effects of stock-based compensation schemes on insiders' profitability and firm value.

2.1. Descriptive statistics

Table 1 displays some descriptive statistics at the group (market) level in T0 and T1. These data give an idea about the behavior of both insiders and outsiders during the experiment and, particularly, at the end of it. The data are disaggregated at the group level and the data for the three outsiders of every group are averaged.

First we comment on the statistics of T0, which are highlighted in bold in Table 1. Consistently with hypothesis H3, the insider's wealth is higher (599 ECUs) than the average wealth of the outsiders (549 ECUs) despite the fact that the average number of stocks for both subject types are the same (8). This fact gives a first intuition about the speculation source of the extra gains of the insider. On the other hand the stock price has sharply increased in all markets from 20 ECUs to 60 ECUs on average, as a consequence of the higher number of purchases than sales orders (530 and 413, respectively) and the messages about reported earnings, which accounts for misleading information 82% of the time (see hypothesis H1). It is also revealing that the majority of the messages (63%) correspond to the optimal manipulation strategies under hypothesis H2 (i.e. "20% earnings increase" and "20% earnings decrease").

Table 1. Descriptive statistics at the group (G) level in T1 and T0 (in bold)**

| | G 1 | G 2 | G 3 | G 4 | G 5 | G 6 | G 7 | G 8 | G 9 | G 10 | Total* |
|--|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|--------------|
| Insider's wealth at the end (with bonus) | 992 | 987 | 919 | 869 | 667 | 816 | 1011 | 555 | 1435 | 1446 | 970 |
| Insider's wealth at the end (without bonus) | 967 | 927 | 874 | 854 | 622 | 751 | 1011 | 555 | 1380 | 1376 | 932 |
| Outsider's average wealth at the end | 572 | 495 | 441 | 387 | 694 | 784 | 466 | 831 | 620 | 700 | 599 |
| Average insider's wealth during the experiment (with bonus) | 607 | 751 | 587 | 695 | 410 | 474 | 779 | 435 | 727 | 684 | 615 |
| Average insider's wealth during the experiment (without bonus) | 487 | 511 | 419 | 439 | 827 | 558 | 432 | 748 | 519 | 548 | 549 |
| Average outsider's wealth during the experiment | 553 | 589 | 401 | 561 | 435 | 386 | 608 | 396 | 703 | 637 | 527 |
| Average insider's wealth during the experiment (with bonus) | 549 | 584 | 397 | 557 | 432 | 381 | 600 | 394 | 697 | 630 | 522 |
| Average insider's wealth during the experiment (without bonus) | 322 | 356 | 341 | 367 | 441 | 456 | 368 | 540 | 427 | 458 | 407,6 |
| Average outsider's wealth during the experiment | 397 | 481 | 332 | 466 | 321 | 285 | 524 | 338 | 427 | 395 | 397 |
| Insider's stocks at the end | 317 | 371 | 342 | 400 | 512 | 357 | 344 | 499 | 376 | 397 | 392 |
| Outsider's average stocks at the end | 13 | 10 | 13 | 10 | 13 | 16 | 11 | 13 | 13 | 14 | 13 |
| Average insider's stocks during the experiment | 9 | 9 | 10 | 0 | 5 | 11 | 8 | 9 | 9 | 10 | 8 |
| Average outsider's stocks during the experiment | 8 | 8 | 9 | 9 | 5 | 9 | 8 | 9 | 6 | 7 | 8 |
| Insider's stocks at the end | 8 | 9 | 8 | 10 | 8 | 7 | 9 | 7 | 7 | 6 | 8 |
| Average insider's stocks during the experiment | 10 | 7 | 9 | 8 | 9 | 10 | 7 | 9 | 10 | 11 | 9 |
| Average outsider's stocks during the experiment | 7 | 7 | 8 | 4 | 6 | 9 | 8 | 9 | 7 | 8 | 7 |
| Price at the end | 7 | 7 | 7 | 8 | 6 | 7 | 7 | 8 | 5 | 6 | 7 |
| Average price during the experiment | 6 | 8 | 7 | 8 | 7 | 6 | 7 | 7 | 6 | 6 | 7 |
| Total number of purchases | 69 | 84 | 62 | 72 | 45 | 41 | 87 | 40 | 103 | 91 | 69 |
| Total number of sales | 56 | 50 | 40 | 40 | 94 | 63 | 40 | 82 | 66 | 68 | 60 |
| Average price during the experiment | 46 | 56 | 36 | 52 | 37 | 26 | 61 | 35 | 59 | 49 | 46 |
| Total number of purchases | 32 | 41 | 37 | 43 | 59 | 39 | 36 | 57 | 48 | 49 | 44 |
| Total number of sales | 42 | 52 | 52 | 38 | 53 | 51 | 47 | 61 | 49 | 52 | 497 |
| Total number of sales | 64 | 57 | 52 | 49 | 49 | 61 | 51 | 44 | 44 | 59 | 530 |
| Total number of sales | 26 | 37 | 33 | 22 | 44 | 28 | 33 | 42 | 38 | 38 | 341 |

| | 52 | 41 | 39 | 39 | 40 | 48 | 35 | 33 | 35 | 51 | 413 |
|--|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------------|
| Total number of non-trade situations | 92 | 71 | 75 | 100 | 63 | 81 | 80 | 57 | 73 | 70 | 762 |
| | 44 | 62 | 69 | 72 | 71 | 51 | 74 | 83 | 81 | 50 | 657 |
| Number of restrictions to purchases due to liquidity constraints | 5 | 23 | 10 | 22 | 9 | 3 | 14 | 12 | 3 | 43 | 144 |
| | 6 | 17 | 6 | 14 | 40 | 6 | 16 | 17 | 3 | 6 | 131 |
| Times where the insider reports earnings truthfully | 18 | 7 | 16 | 17 | 9 | 14 | 3 | 7 | 9 | 8 | 108 |
| | 4 | 6 | 5 | 8 | 6 | 5 | 18 | 6 | 8 | 9 | 75 |
| Times where the insider reports a 20% earnings increase | 16 | 21 | 21 | 12 | 16 | 14 | 17 | 7 | 35 | 20 | 179 |
| | 12 | 11 | 13 | 15 | 32 | 19 | 5 | 24 | 13 | 14 | 158 |
| Times where the insider reports a 20% earnings decrease | 3 | 1 | 13 | 2 | 7 | 18 | 0 | 9 | 4 | 4 | 61 |
| | 8 | 9 | 13 | 13 | 4 | 8 | 17 | 13 | 6 | 4 | 95 |

* The 10 first rows are the average across groups. The last 7 rows are the sum for the 10 groups.

** Values in bold (second row in each item) correspond to the treatment T0, i.e. no bonus is paid. The rest of the values in the table correspond to treatment T1.

Focusing on the data of T1, the average wealth of insider's is much higher (932 ECUs) than that of the outsiders (615 ECUs). This comparison does not include the gains corresponding to the extra bonus (hypothesis H4). These figures have increased considerably from treatment T0 as a consequence of the higher increase of the stock price (69 ECUs on average) (hypothesis H5). It is also revealing that in this case the insiders have on average more stocks (13) than the outsiders (8), while in the other treatment both had 8 stocks on average at the end of the experiment (this also explains the differences in profitability). It is also noteworthy that although the number of purchases has not increased in T1 (with respect to T0), the difference between purchases and sales is higher in this treatment. Furthermore, the misreporting behavior has been reduced from 82% of the cases to 73%, and also the leading message in T1 is a "20% earnings increase" (45% of all the cases). All of this is consistent with the optimal manipulation strategy in T1 (see hypothesis H6) directed to increase the stock price in order to maximize the bonus.

2.2. Reported earnings

Hypotheses H1, H2 and H3 focus on the insiders' manipulation of reported earnings. To study whether these hypotheses are supported by the data throughout the experiment we estimated two alternative random effects panel data models on the determinants of earnings management (Model 1) and purchase decision (Model 2).

Model 1:

$$\tilde{r}_{it} = \gamma_0 + \gamma_1 r_{it} + \gamma_2 \tilde{p}_{it} + \gamma_3 \Delta \omega_{it-1} + \gamma_4 b_{it-1} + \gamma_5 D_{it} + \eta_i + \varepsilon_{it} \quad (4)$$

$\forall i = 1, 2, \dots, 10$ and $\forall t = 1, 2, \dots, 40$, where \tilde{r}_{it} and r_{it} stand for the reported and real earnings (respectively) in the market i and period t , $\Delta \omega_{it-1}$ represents the variation of wealth in two consecutive periods performed by the insider in the previous period, b_{it-1} is the bonus that the insider received in the previous period (it is only different from zero in treatment T1 and only every 5 periods) and \tilde{p}_{it} and D_{it-1} are dummy

variables that take value 1 if the insider expected a price increase in the period and if a dividend was paid in the previous period, respectively, and zero otherwise. η_i is a random variable capturing individual effects for the insiders and ε_{it} is white noise, both satisfying the traditional random effects model assumptions.

Table 2 presents the results on the estimation of Model 1. It displays the generalized least squares (GLS) estimates for the parameters and their corresponding t-ratios for the entire sample (pool data) and for both treatments, T0 and T1. The Breusch-Pagan statistic for testing the validity of the random effects model is also displayed, as well as the R-squared of the (within, between and overall) model.

The estimates of Model 1 show that the hypothesis about the uncorrelated reported and real earnings for the pool data and in treatment T1 cannot be rejected. In treatment T0, however, the reported and real earnings are negatively correlated. Therefore, our data confirm hypothesis H1, since insiders systematically misreport information about earnings. This aspect is illustrated in Figure 1 that illustrates how insiders manipulate the data and how the messages tend to concentrate on the extremes (20 and -20) as conjectured in hypotheses H2 and H6 (for the sake of brevity we only display the pictures for T0). Furthermore, the data also reveal that manipulation is incentivized by the profitable insider trading operations in the previous period and that reported earnings have a positive relation to the expected price, i.e. if insiders expect that the price is going to increase/decrease they report high/low earnings figures in order to get the price to be as high/low as possible and a profitable sell/purchase (hypothesis H3). This assessment is also consistent with the negative relation among real and reported earnings found in T0.

Table 2. Estimates for Model 1

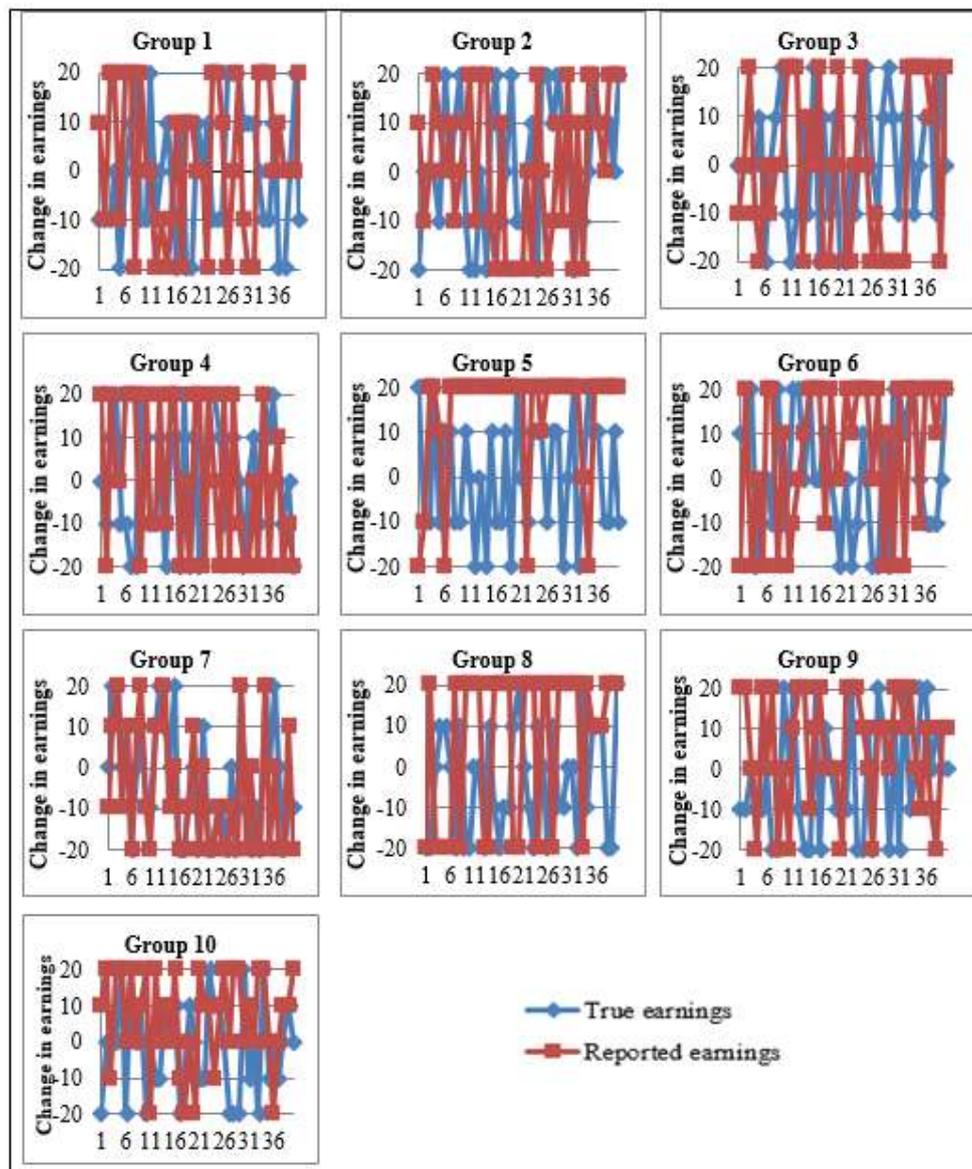
| <i>Model 1: Dependent variable reported earnings</i> | | | | | | |
|--|------------|----------|--------------|----------|--------------|----------|
| $\hat{r}_{it} = \gamma_0 + \gamma_1 r_{it} + \gamma_2 \tilde{p}_{it} + \gamma_3 \Delta\omega_{it-1} + \gamma_4 b_{it-1} + \gamma_5 D_{it} + \eta_i + \varepsilon_{it}$ | | | | | | |
| Variables | Pool data | | Treatment T0 | | Treatment T1 | |
| | Estimate | t-ratio | Estimate | t-ratio | Estimate | t-ratio |
| Real earnings (r_{it}) | -0.0190996 | -0.54 | -.0882066 | -1.73* | .0429379 | 0.86 |
| Price expectation (\tilde{p}_{it}) | 13.39044 | 12.73*** | 15.8414 | 10.93*** | 10.87339 | 6.94*** |
| Lag-profit ($\Delta\omega_{it-1}$) | .0086843 | 3.31*** | .010535 | 1.89* | .0105044 | 3.50*** |
| Lag-Bonus (b_{it-1}) | -.0840574 | -1.36 | ----- | ----- | -.1198706 | -1.64* |
| Dividend (D_{it}) | 1.204874 | 0.83 | -.7531367 | -0.42 | 3.574179 | 1.45 |
| Observations | | 3,200 | | 1,600 | | 1,600 |
| R^2 | within | 0.1786 | within | 0.2413 | within | 0.1250 |
| | between | 0.3727 | between | 0.3891 | between | 0.4666 |
| | overall | 0.2021 | overall | 0.2566 | overall | 0.1541 |
| Breusch and Pagan LM | | 73.87*** | | 24.84*** | | 41.39*** |

* 10% confidence; ** 5% confidence; *** 1% confidence; T-ratios two-sided tests and BP one-sided tests.

Finally, Model 1 also presents two interesting results. The first is that the bonus seems to have a significant impact on the earnings management in treatment T1. In this

treatment the lagged value of the bonus has a negative effect on reported earnings. This evidence is consistent with hypothesis H6, since the stock-based remuneration scheme implemented in the experiment gives clear incentives for reducing the stock price after being paid the bonus in the previous period (and increase it afterwards from the lowest level possible). The second result is the insignificance of the dividend policy with respect to the reported earnings strategy followed by the insiders.

Figure 1. True and Reported Earnings Earnings: Treatment T0 (without bonus)



2.3. Trading choice

In order to analyze the rational behavior of the subjects and the possible determinants on their trading operations that are behind our hypothesis H2 we estimated Model 2.

Model 2:

$$y_{jit} = \delta_0 + \delta_1 \tilde{r}_{it} + \delta_2 r_{it} + \delta_3 \tilde{r}_{jit}^* + \delta_4 \Delta p_{it-1} + \delta_5 \tilde{p}_{jit} + \delta_6 D_{jit} + \delta_7 T_{jit} + \alpha_j + \eta_i + \varepsilon_{it} \quad (5)$$

$\forall j = 1, \dots, 4$, $\forall i = 1, 2, \dots, 10$ and $\forall t = 1, 2, \dots, 40$, where y_{jit} is a variable that takes value 1 if subject j in market i purchased a stock in period t , \tilde{r}_{it} and r_{it} stand for the reported and real earnings (respectively) in the market i and period t , Δp_{it-1} is the price variation in the previous period and \tilde{r}_{jit}^* , \tilde{p}_{jit} , D_{jit} and T_{jit} are dummy variables. \tilde{r}_{jit}^* takes value 1 if the outsider believed that earnings are reported truthfully, \tilde{p}_{jit} takes value 1 if the insider expected a price increase in the period, D_{jit} takes value 1 whenever dividends are paid and T_{jit} takes value 1 for insiders (i.e. if $j = 1$). α_j and η_i are random variables capturing individual effects for each subject j and each market i and ε_{it} is white noise, all of them satisfying the traditional random effects model assumptions. We also assume a logit model and thus we model the probability of purchase according to a logistic function.

Table 3 incorporates the estimates for Model 2 parameters for the total sample and both treatments independently. Particularly, the logit model is estimated by maximum likelihood and the Likelihood-ratio (LR) statistic for testing the joint significance of the model and the pseudo R-squared is presented as well. It is noteworthy that in this model we study the probability of purchase.

This table confirms the rational speculative behavior of the agents when deciding about their trading operations, since the results are consistent with the determinants of the price formation in equation 2 and also with our hypothesis H2. This assessment is supported by the following results. First, reported earnings influence the price positively and then negatively incentivize purchases. Second, real earnings influence positively the probability of insiders' purchases (since it negatively affects the price). Obviously this effect is only tested for the insiders, since they are the only subjects that know the true earnings. This result, however, is not so clear when we disaggregate the two treatment subsamples reflecting that insiders' purchase pattern may differ across treatments. For example, in treatment T1 insiders' purchases might be more guided by the stock-based scheme than by the trading gains. Third, if outsiders believe the insider's earnings reports ($\tilde{r}_t = r_t$) they do not expect an impact on the price and then \tilde{r}_{jit}^* does not influence the purchase pattern. Fourth, the price variation is negatively correlated to purchases (i.e. subjects tend to sell with high prices in order to get capital gains). And fifth, if subjects believe that the price is going to increase, the probability of purchase decreases.

Furthermore, subjects' purchases do not seem to be affected by the dividend policy. Surprisingly, it seems that dividends are negatively correlated with purchases for the pool sample, although this effect is insignificant in both treatments. On the other hand, being an insider (Type) seems to affect positively the probability of purchase only in

T1, probably because to maximize the bonus they are incentivized to increase the stock price and they may achieve it by purchasing.

Table 3. Estimates for Model 2

| <i>Model 2: Dependent variable purchase decision</i> | | | | | | |
|--|------------|----------|--------------|----------|--------------|----------|
| $y_{jit} = \delta_0 + \delta_1 \tilde{r}_{it} + \delta_2 r_{it} + \delta_3 \tilde{r}_{jit}^* + \delta_4 \Delta p_{it-1} + \delta_5 \tilde{p}_{jit} + \delta_6 D_{jit} + \delta_7 T_{jit} + \alpha_j + \eta_i + \varepsilon_{it}$ | | | | | | |
| Variables | Pool data | | Treatment T0 | | Treatment T1 | |
| | Estimate | t-ratio | Estimate | t-ratio | Estimate | t-ratio |
| Reported earnings (\tilde{r}_{it}) | -0.0084827 | -3.16*** | -0.0075698 | -1.98** | -0.0099402 | -2.36** |
| Real earnings (r_{it}) | .01283 | 2.26** | .0119767 | 1.42 | .011162 | 1.43 |
| Earnings trust (\tilde{r}_{jit}^*) | .1006002 | 1.09 | .0988311 | 0.74 | .0434898 | 0.32 |
| Price variation (Δp_{it-1}) | -1.26772 | -3.17*** | -1.814336 | -3.11*** | -.7852321 | -1.41 |
| Price expectation (\tilde{p}_{jit}) | -.5089981 | -6.04*** | -.7739589 | -6.44*** | -.2796426 | -2.26** |
| Dividend (D_{jit}) | -.2071782 | -2.08** | -.2214314 | -1.56 | -.1848622 | -1.30 |
| Type (T_{jit}) | .1475005 | 1.42 | -.1572047 | -1.01 | .3729284 | 2.61*** |
| Observations | | 3,200 | | 1,600 | | 1,600 |
| Pseudo-R ² | | 0.0249 | | 0.0450 | | 0.0211 |
| LR | | 96.85*** | | 88.60*** | | 40.27*** |

* 10% confidence; ** 5% confidence; *** 1% confidence; T-ratios two-sided and LR one-sided tests.

2.4. Profits

Hypothesis H3 states that as a consequence of the earnings management practices, insiders maximize profits on their trading operations. Moreover, earnings management does negatively affect outsiders' profitability. In order to test this hypothesis we formulated the following random effects panel data model.

Model 3:

$$\Delta \omega_{jit} = \beta_0 + \beta_1 T_{jit} + \beta_2 T_{jit} (\tilde{r}_{it} - r_{it}) + \beta_3 (1 - T_{jit}) (\tilde{r}_{it} - r_{it}) + \beta_4 H_{jit} + \beta_5 p_{it} + \beta_6 bD_{jit} + \alpha_j + \eta_i + \varepsilon_{it} \quad (5)$$

$\forall j = 1, \dots, 4, \forall i = 1, 2, \dots, 10$ and $\forall t = 1, 2, \dots, 40$, where $\Delta \omega_{jit}$ represents the variation of wealth (profitability) performed by the subject j in market i between periods t and $t - 1$ (for the sake of comparability this wealth does not include the extra bonus received by insiders in T1), $(\tilde{r}_{it} - r_{it})$ accounts for the earnings manipulation by insiders, p_{it} is the stock price in market i and period t , bD_{it} stands for the dividends and bonuses received by subject j in market i and period t , and T_{jit} and H_{jit} are two dummy variables. The former captures the type of subject (1 for insiders and 2 for outsiders) and the latter the treatment effect (1 for treatment T0 and 0 for T1). Therefore, the interaction variables $T_{jit} \times (\tilde{r}_{it} - r_{it})$ and $(1 - T_{jit}) \times (\tilde{r}_{it} - r_{it})$ account

for the earnings manipulation for the insiders and outsiders, respectively. α_j and η_i are random variables capturing individual effects for every subject j and every market i and ε_{it} is white noise, all of them satisfying the traditional random effects model assumptions.

Table 4 displays the GLS estimates of the parameters of Model 3 for the whole sample (pool data) and for both treatment T0 and T1. The t-ratios and the Breusch-Pagan statistic for testing the significance of the parameters and the random effects model are included, as well as the R-squared statistic of the (within, between and overall) model.

The results in Table 4 show clear evidence supporting hypothesis H3 since variable *Type* (i.e. being an insider) has a positive impact on the profitability and also because of the different effect of earnings manipulation on it. In fact, insiders increase their profit by their earnings management practices but they induce a negative collateral effect on outsiders' profitability. This effect is particularly intense in treatment T1, which jointly with the positive significance of treatment effect, support hypothesis H4, i.e. stock-based remuneration policies positively affect insiders' returns even discounting the direct effect of the bonus extra payouts. In the model we include the price and the dividend (including bonuses) payouts as control variables, which obviously affect the profits positively.

Table 4. Estimates for Model 3

| <i>Model 3: Dependent variable profits (bonuses discounted)</i> | | | | | | |
|---|----------------|----------|----------------|----------|----------------|----------|
| $\Delta\omega_{jit} = \beta_0 + \beta_1 T_{jit} + \beta_2 T_{jit} \times (\tilde{r}_{it} - r_{it}) + \beta_3 (1 - T_{jit}) \times (\tilde{r}_{it} - r_{it}) + \beta_4 H_{jit} + \beta_5 p_{it} + \beta_6 Db_{jit} + \alpha_j + \eta_i + \varepsilon_{it}$ | | | | | | |
| Variables | Pool data | | Treatment T0 | | Treatment T1 | |
| | Coefficient | Estimate | Coefficient | Estimate | Coefficient | Estimate |
| <i>Type</i> (T_{jit}) | 61.4716 | 6.98*** | 16.35083 | 1.91* | 107.6427 | 7.86*** |
| <i>Manipulation insider</i> | .2447197 | 1.64* | -.1260288 | -1.03 | .5450628 | 2.06** |
| <i>Manipulation outsider</i> | -.2546271 | -2.93*** | -.0877282 | -1.23 | -.4862178 | -3.16*** |
| <i>Treatment</i> (H_{jit}) | 23.11113 | 3.22*** | ----- | ----- | ----- | ----- |
| <i>Price</i> (p_{it}) | 9.185343 | 137.16** | 8.586173 | 146.05** | 9.680141 | 85.27** |
| <i>Dividend Bonus</i> (Db_{jit}) | 1.058819 | 7.06*** | .7927805 | 6.31*** | 1.257154 | 4.84*** |
| R^2 | <i>within</i> | 0.8650 | <i>within</i> | 0.9346 | <i>within</i> | 0.8353 |
| | <i>between</i> | 0.6967 | <i>between</i> | 0.8249 | <i>between</i> | 0.7461 |
| | <i>overall</i> | 0.8096 | <i>overall</i> | 0.9063 | <i>overall</i> | 0.8061 |
| <i>Breusch and Pagan LM</i> | 14659.60*** | | 6763.07*** | | 5200.01*** | |

* 10% confidence; ** 5% confidence; *** 1% confidence; T-ratios two-sided and BP one-sided tests.

2.5. Stock-based compensation scheme

Hypothesis H4 may be also tested by means of non-parametric tests. Particularly, we implemented the Wilcoxon signed-rank test to test whether insiders' profits at the end

of the experiment are higher than (average) outsiders' profitability. The values for the Wilcoxon test are 1.478 and 2.803 in T0 and T1, respectively, and thus this hypothesis cannot be rejected at reasonable confidence levels in both T0 and T1. Nevertheless, the differences in profitability are more significant in T1 reflecting the fact that the higher profitability of the insiders is much stronger when the stock-based compensation scheme is implemented. On the other hand, the hypothesis that the insider profits (bonuses payout discounted) are higher in treatment T1 with respect to treatment T0 can be tested by means of the Mann-Whitney statistic. Such a hypothesis cannot be rejected at any confidence level (the value of the Mann-Whitney test is 3.553). Therefore, we conclude that stock-based remuneration policies positively affect insiders' returns.

The stock-based remuneration policies have an important collateral effect on the stock prices, which experiment a sharp rise as a consequence of the earnings management practices. This conjecture is stated in our hypothesis H5. To test this hypothesis we applied the Mann-Whitney test to compare price variation between both treatments. The value of this statistic is 34.5 and then the test strongly confirms our hypothesis and thus stock prices soar, the effect being more significant in the presence of this manager compensation scheme.

Consistently with the hypothesis H4 and H5, i.e. profit maximization by increasing stock prices, the stock-based compensation scheme imposes a particular earnings management strategy stated in hypothesis H6. This hypothesis has already been tested in Model 1, where we show that in treatment T1 insiders' earnings management depends positively not only on the price expectation and the successful profitability in the past, but it also reacts negatively to the bonus payout (in order to reduce the reference stock price to calculate the next bonus).

Conclusions

In this paper, we have designed a laboratory experiment to study the behavior of insiders in relation to their earnings management and trading practices. The experiment simulates a market where one insider and three outsiders trade on the stocks of a company. Their benefits come from the capital gains of their trading but also from the dividends and the increase in the price of their portfolio. We also assume that the stock price depends on the excess of supply/demand, but also on the difference between reported and real earnings of the firm (surprises). Under these basic assumptions if the insider reports the firm's earnings and the real earnings are not known by the outsiders (although ex post they may guess them from the realized prices) we show two main results. Firstly, insiders misreport the information for the purpose of affecting the price in the direction that allows them to increase their capital gains. Therefore, earnings management induces inefficiencies on the stock prices, but also the misleading information reduces the outsiders' profits, which are significantly lower than those of the insiders. Secondly, managerial stock-based compensation policies reinforce these results although the insiders' earnings management strategies are driven by bonuses rather than by capital gains maximization. This fact increases insiders' profits even discounting the effects of the bonuses but also significantly raises stock prices.

The results are obtained in a very simple scenario, but highlight how managers behave if earnings management practices, insider trading operations and stock-based compensation policies are not accurately regulated and supervised. The lack of transparency in earnings management practices and the wrongly incentivized managerial compensation policies have an important role on generating price inefficiencies, bubbles and financial crises. In fact, the current economic-financial crisis is also (and perhaps above all) a crisis of confidence in corporations and securities markets. Recovering that confidence will inevitably require corporate information to be more credible and all the agents involved in the financial reporting process to be subject to scrutiny.

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