University of Innsbruck

Working Papers in Economics and Statistics

Trading strategies and trading profits in experimental asset markets with cumulative information

Thomas Stöckl and Michael Kirchler

2010-09

Trading strategies and trading profits in experimental asset markets with cumulative information*

Thomas Stöckl† and Michael Kirchler‡

April 12, 2010

*We would like to thank Michael Hanke and Jürgen Huber for helpful comments on earlier versions of this paper and Emuanuel Böhler for his research assistance. Financial support by the University of Innsbruck is gratefully acknowledged (Nachwuchsfoerderung Michael Kirchler).

†Corresponding author. Innsbruck University School of Management, Department of Banking and Finance, Universitätsstrasse 15, 6020 Innsbruck, Austria. Phone 43-512-507-7588, Fax 43-512-507-2846, E-mail: thomas.stoeckl@uibk.ac.at

‡Innsbruck University School of Management, Department of Banking and Finance, Universitätsstrasse 15, 6020 Innsbruck, Austria and Center for Finance, University of Gothenburg, P.O. Box 600, 40530 Gothenburg, Sweden. e-mail: michael.kirchler@uibk.ac.at.

Abstract

We study the use of trading strategies and their profitability in experimental asset markets with asymmetrically informed traders. We find that insiders make most of their profits from trades which are initiated by their limit orders – especially at the beginning of a period and when the change in their fundamental information is large. The average informed lose most with market orders and their losses are highest at the beginning of a period when they can be exploited by insiders. Uninformed traders act as liquidity providers. They place the highest number of limit orders and end up with the market return.

JEL classification: G12, G14, D03.

Keywords: Asymmetric information, liquidity, trading strategies, limit order markets, experiment.

1 Introduction

The importance of limit order markets as the major trading mechanism on financial markets has increased enormously within the past decades.[1] Limit orders are offers made at some time to trade a certain quantity of a certain stock for a pre-specified price. Nevertheless "the economic interactions in limit order markets are complex because the associated state and action spaces are extremely large and because trading with limit orders is dynamic and generates non-linear profits" (Parlour and Seppi, 2008, p. 2).

[1] See Parlour and Seppi (2008) for a recent survey on limit order markets. Limit order markets are highly competitive, efficiently aggregate information and outperform other market mechanisms (Glosten, 1994). Hollifield et al. (2006) estimate that the gains from trade in LOM are 90 % of maximum possible gains-from-trade. Examples for limit order markets are: Euronext (Brussels, Amsterdam, Paris), London Stock Exchange, Stockholm Stock Exchange, Toronto Stock Exchange, and Archipelago Exchange. Examples for trading systems: INET, ArcaEx, Reuters D2000-2.

One central question within this complex interaction environment concerns the use of limit orders vs. market orders of asymmetrically informed traders who face the following trade-off. Market orders offer immediate execution at higher costs (e.g. bid-ask spread) whereas limit orders are executed at lower costs but execution is not guaranteed. Early models by Copeland and Galai (1983), Kyle (1985), Glosten and Milgrom (1985), and Glosten (1994) associate limit orders with uninformed traders and market orders with informed traders.[2] This assumption is questioned by more recent work. Chakravarty and Holden (1995) conclude that informed traders prefer to use market orders but strategically informed investors might use limit orders as insurance to bound the (random) price at which their market orders will be traded. In the models of Harris (1998) and Kaniel and Liu (2006) informed traders condition the use of limit vs. market orders on the "life-span" of the information. They use market orders if the information is short-lived and limit orders if information is persistent. Goettler et al. (2008) distinguish between informed traders who know the fundamental value of the stock and "uninformed" traders who know this information only one period later. They find that informed traders submit the bulk of limit orders to the market, and competition among informed traders results in private information often being reflected in the limit order book.[3]

Anand et al. (2005) provide some empirical evidence. They use detailed order and audit data from the NYSE and define institutional investors as informed traders. Their results show that informed traders act as liquidity takers in the first half of a trading day and become liquidity suppliers in the second half of the day.[4] Their empirical results are supported by findings of Bloomfield et al. (2005). They set up an experimental limit order market, which is populated by informed traders and liquidity traders, who do not receive any information but have to fulfill exogenous trading requirements. Their main finding is that

[2]Foucault (1999) investigates the choice between limit and market orders considering the basic trade-off between execution risk (winner's curse) and price advantages.

[3]Note that all models operate with two information levels.

[4]However, the categorization of institutional investors as informed traders (insiders) is ambiguous. Jensen (1968), Fama (1991), Malkiel (2005) document below average performance for this kind of investors. Thus, the value of their (superior) information is questionable.

informed traders are liquidity takers earlier in the market and liquidity suppliers later. Following this strategy, informed traders reveal their information and drive prices towards fundamental values. Liquidity traders, on the other hand, provide liquidity at the beginning and use market orders towards the end to meet their trading targets.[5]

In this paper we extend the research on trading strategies of asymmetrically informed traders. Instead of distinguishing between informed and uninformed traders, only we impose a cumulative information structure with five information levels. With this approach we are able to investigate the trading behavior and its economic consequences of traders who receive (slightly) outdated fundamental information. Additionally, there is one group of traders who do not receive any information on the fundamental value of the asset. Based on the literature we formulate two research questions. The first one concerns the trading strategies of traders conditional on their information level, the change in their fundamental information, and time. Research question two addresses the (fundamental) profits conditional on information level. Related to this we also check whether profits depend on the magnitude of the change in fundamental information and vary over time.

We find that insiders (I4) make most of their profits from trades which are initiated by their limit orders. Their profits are highest at the beginning of a period, particularly when the change in their fundamental information is large. The group of average informed traders perform worst, as they lose most of their money with market orders and do not gain money from trades which are initiated by their limit orders. Especially the worst performing traders with information level I1 often place market orders and hence lose a lot of money as they have to pay the bid-ask-spread. Their losses are highest at the beginning of a period when they are mainly exploited by the insiders. Uninformed traders act as liquidity providers since they place the highest (lowest) number of limit

[5]Bloomfield et al. (2009) study differences in trading behavior between liquidity traders, who do not possess information but have to fulfill trading requirements, and uninformed traders, who do not posses information but have no trading requirements.

(market) orders. They make little losses from their market orders, small but insignificant profits from their trades initiated by their limit orders and so end up with approximately the market return.

The paper is structured as follows: Section 2 provides details on the market model and the experimental implementation. Section 3 defines the research questions and method. Section 4 presents the results, and Section 5 summarizes and concludes the paper.

2 Model and Experimental Implementation

In each experimental market 10 traders interact in a continuous double auction for 24 periods. They trade stocks of a virtual company for virtual money (Taler). The markets investigated in this study are taken from Kirchler (2009).

2.1 *Fundamental Value of the Asset*

The fundamental value (FV) of the stock is a random walk process generated by a geometric Brownian motion:

$$FV_k = FV_{k-1} \cdot (1 + \epsilon_k), \tag{1}$$

where FV_k denotes the fundamental value of period k and ϵ is a normally distributed random variable with a mean of 0.5% and a standard deviation of 7.2%. The initial FV is 40 Taler. Figure 1 shows the eight fundamental value process realizations. Four are generated randomly, and for each its counterpart mirrored at the dotted line - the unconditional expected value of FV - is calculated.

2.2 *Information System*

Asymmetric information on the assets' FV is implemented by an approach of Hellwig (1982), which gives better informed traders a timing advantage in receiving information about the fundamental value of the stock. The idea be-

hind this information structure is that relevant fundamental information is first known by insiders (I4) and then trickles down over time to the broad public (I1). Moreover, uninformed traders I0 do not even collect this relatively old information.

Hence, only the best informed traders (I4) know the fundamental value of the current period k. Fundamental information provided to I4 in period k will be available to I3 in period k+1, to I2 in period k+2, etc. At the beginning of each period k, I4 is provided with the current FV_k, and the information level I(i-1) receives the information I(i) had one period earlier. This procedure is repeated for each period. As only I4 knows the true FV of the current period, all other traders I(i), i=1,2,3, have a conditional expectation CV_i. Basically, all informed traders receive the same information, but at different times. Traders with information level I0 get no information at all, they do not form a conditional expectation.

2.3 *Market Architecture*

Subjects trade in an (anonymous) continuous double auction market with open order books, i.e. all orders, specifying price and quantity, are visible to all subjects at the same time. Orders are being executed according to price and then time priority. Market orders have priority over limit orders and are always executed instantaneously. Any order size and the partial execution of limit orders is possible. Shorting stocks and borrowing money are not allowed. The stock does not pay any dividends, and no interest is paid on cash holdings. There are no transaction costs.

Each market consists of 24 periods of 100 seconds each. Subject know that the experiment will be randomly terminated between periods 20 and 30 to avoid end-of-experiment effects. Taler and stock holdings are carried over from one period to the next.

2.4 *Experimental Implementation*

At the beginning of each session traders are briefed using written instructions, which take about 25 minutes to go through.[6] Afterwards we run four trial periods to allow subjects to become familiar with the trading screen and the different order types. Then we conduct the main experiment, which lasts about 45 minutes. At the start of the experiment subjects are randomly assigned to one of the information levels and remain at this level for the whole session. In all markets each trader is initially endowed with 40 stocks and 1600 in cash. The information structure is also public knowledge, i.e., traders know how many information levels exist, how many traders are assigned to each information level, and they know their own information level. At the end of the session all stocks are bought back at the fundamental value FV_K (i.e., the information of the insider, I4) of the last period K. Thus, the final wealth of each trader j in Taler, $FW_{j,K}$, equals

$$FW_{j,K} = (S_{j,K} * FV_K) + C_{j,K} \tag{2}$$

where $S_{j,K}$ denotes the stock holdings of the final period K and $C_{j,K}$ equals the cash holdings at the end of the experiment. The final wealth is converted into EUR at the exchange rate of 1 EUR=175 Taler.

We conducted 8 markets in November and December 2006 at the University of Innsbruck with a total of 80 business students. Most subjects already took part in other experiments in economics, but none of them participated in more than one of the markets in this experimental series. Each session lasted about 80 to 90 minutes, and the average earnings were around 19 EUR. The market was programmed and conducted using z-Tree 3.0.6 (Fischbacher, 2007).

[6] The instructions are provided in Appendix A.

3 Research Questions and Method

Research question (RQ) 1 is concerned with trading strategies conditional on information level, how these strategies evolve depending on changes in the fundamental information and over time. In RQ 2 we study profits of the subjects' trading strategies and how they depend both on changes in their fundamental information and over time. Both research questions have been investigated before, but using a rather crude distinction between only two groups of traders, informed and uninformed (see e.g. Anand et al., 2005; Bloomfield et al., 2005, 2009; Kaniel and Liu, 2006; Goettler et al., 2008 for recent contributions). We extend the literature by investigating these questions for five information levels. A closer examination of previous studies in relation to the results presented here is provided in Section 4.

3.1 *RQ 1 - Order Choice and Trading Strategies*

3.1.1 *Order Choice*

To give an overview of the order choices of the different information levels I we run an OLS regression on information level dummies D_i of the dependent variables limit orders (LO), limit trades (LT, i.e. trades which are initiated by limit orders), and market orders (MO) for subject j and market m (N=80).[7]

$$\mathrm{Y}_{m,j} \quad = \quad \sum_{i=0}^{4} \beta_i D_i + \epsilon. \tag{3}$$

3.1.2 *Defining Trading Strategies*

We calculate the following three variables to identify trading strategies. *SR* (submission rate) measures subject $j's$ preference of posting limit orders compared to her total activity (LO and MO) in period k of market m. It divides the number of shares (volume) offered to trade (i.e. sum of LO) by the sum of

[7] We use OLS regression throughout the paper. We implement clustered standard error procedure to allow for varying standard errors in markets m and information level i therein.

the volumes of LO and MO.[8] Values range from 0 (no LO posted) to 1 (no use of MO).

$$\mathrm{SR}_{m,k,j} = \frac{\sum \mathrm{LO}_{m,k,j}}{\sum \mathrm{LO}_{m,k,j} + \sum \mathrm{MO}_{m,k,j}}, \tag{4}$$

$$\mathrm{ER}_{m,k,j} = \frac{\sum \mathrm{LT}_{m,k,j}}{\sum \mathrm{LO}_{m,k,j}} \tag{5}$$

$$\mathrm{TR}_{m,k,j} = \frac{\sum \mathrm{MO}_{m,k,j}}{\sum \mathrm{MO}_{m,k,j} + \sum \mathrm{LT}_{m,k,j}}. \tag{6}$$

ER (execution rate) measures the ratio of limit trades relative to total shares offered as bids and asks (LO). This variable is a proxy for the effectiveness of limit orders. The higher the value, the more effective and therefore the more aggressively priced are limit orders.[9] The third variable, *TR* (taking rate), is a measure for the willingness to take liquidity by using market orders. It divides the number of shares traded via market orders by the total number of shares traded, i.e. MO plus LT.[10]

3.1.3 *Trading Strategies Conditional on the Change in the Fundamental Information*

Contributions by Harris (1998), Bloomfield et al. (2005), and Kaniel and Liu (2006) highlight that insiders condition their strategies on the value of their fundamental information. To evaluate these findings with multiple information levels we calculate the variable $\Delta\mathrm{CV}_{m,k,j}$.

$$\Delta\mathrm{CV}_{m,k,j} = \left|\ln(CV_{m,k,j}/CV_{m,(k-1),j})\right|. \tag{7}$$

$\Delta\mathrm{CV}_{m,k,j}$ is the continuously compounded absolute percentage difference between subject j's fundamental information (CV) in period k of market m and

[8] All variables throughout the paper are volume-weighted.

[9] One might also interpret this variable as the probability of limit order execution.

[10] Computation of the submission-rate and the taking-rate are inspired by Bloomfield et al. (2005). Execution rate is sometimes reported as fill rate.

the fundamental information that subject j received in period $k-1$.

To analyze trading strategies conditional on changes in the CV of certain information levels we run the following OLS regression.

$$\mathrm{Y}_{m,k,j} \quad = \quad \sum_{i=0}^{4} \beta_i D_i + \sum_{i=1}^{4} \gamma_i D_i * \Delta\mathrm{CV}_{m,k,j}. \tag{8}$$

Here, D_i are binary dummies for I0-I4, and SR, ER, and TR serve as the dependent variables $\mathrm{Y}_{m,k,j}$. In a first step we run the regression solely on the first summand to analyze trading strategies across information levels. In a second step we run the full specification to additionally investigate the reaction of information levels on changes in their fundamental information.

3.1.4 *Trading Strategies Conditional on Time*

To study inter-period effects of trading strategies we subdivide each period of the experiment into five equally spaced time intervals of 20 sec each and compute SR, ER, and TR for each subject j and the corresponding time interval t. We regress trading strategies variables on dummies for each information level D_i and additionally interact these dummies with two time variables.

$$\mathrm{Y}_{j,t} \quad = \quad \sum_{i=0}^{4} \beta_i D_i + \sum_{i=0}^{4} \gamma_i (D_i * \mathrm{D}_{\mathrm{interval}_1}) + \sum_{i=0}^{4} \delta_i (D_i * \mathrm{trend}). \tag{9}$$

The first variable $\mathrm{D}_{\mathrm{interval}_1}$ controls for effects that are associated with the order book building that mainly takes place in the first time interval. $\mathrm{interval}_1$ is 1 for time interval 1 and zero otherwise. To capture patterns that consistently change over time we include the variable trend which takes values from one to five corresponding with time interval. $\mathrm{interval}_1$ and trend are interacted with information level dummy D_i to separate effects for each information level.

3.2 *RQ 2 - Profits*

3.2.1 *Defining Profits*

To analyze the profitability of each trade t we introduce the concept of "fundamental profit" (FP).[11] FP compares the price of each individual transaction to the fundamental value (FV) of the current period, which is known only by I4:

$$\mathrm{FP}^{buy}_{m,k,j,t} = \ln(\mathrm{FV}_{m,k}/\mathrm{PRICE}_{m,k,j,t}), \quad (10)$$

$$\mathrm{FP}^{sell}_{m,k,j,t} = \ln(\mathrm{PRICE}_{m,k,j,t}/\mathrm{FV}_{m,k}). \quad (11)$$

Here, t stands for the t^{th} transaction. $\mathrm{FP}^{buy}_{m,k,j,t}$ ($\mathrm{FP}^{sell}_{m,k,j,t}$) is the continuously compounded percentage difference between FV and the transaction price (PRICE). A buy (sell) transaction yields a positive profit if the asset is bought (sold) at a price below (above) FV.[12]

3.2.2 *Profits Conditional on the Change in Fundamental Information*

Similar to Section 3.1 we first run OLS regressions for all transactions, for limit trades, and market orders on information level dummies D_i (first summand in Equation 12). In a second step we investigate for each information level i how FP is influenced by changes in the fundamental information (ΔCV). The regression equation reads as follows:

$$\mathrm{Y}_{m,k,t} = \sum_{i=0}^{4} \beta_i D_i + \sum_{i=1}^{4} \gamma_i (D_i * \Delta\mathrm{CV}_{m,k,i}). \quad (12)$$

3.2.3 *Profits Conditional on Time*

To study the development of FP over time across information levels we run OLS regressions interacting a set of information level dummies (D_i) with time interval dummies for each of the five time intervals ($\mathrm{interval_t}$, 20 sec each). FP

[11] In their analysis Bloomfield et al. (2005) use a similar concept. They define the profit of a trade as the difference between the trading price and the true value of the security.

[12] FP is volume-weighted.

for all trades (Total), for LT, and MO serve as dependent variables $\mathrm{Y}_{m,k,t}$

$$\mathrm{Y}_{m,k,t} = \sum_{i=0}^{4}\sum_{t=1}^{5} \beta_{(5*i)+t} D_i * \mathrm{D}_{\mathrm{interval_t}}. \tag{13}$$

4 Results

4.1 *Core Results*

Before going into more detail we briefly present the main results of this paper in Table 1. The insiders (I4) make most of their profits from limit trades (LT). They have a high execution rate (ER) although they submit relatively few limit orders (LO). Their profits are highest at the beginning of a period and when their ΔCV is large due to their informational advantage.

Table 1 about here

In contrast, average informed traders perform worst. They lose most of their money from market orders (MO) and do not gain money from LT. Especially the worst performing traders with I1 have the highest taking rate (TR) indicating that they often place MO's and hence lose a lot of money as they pay the bid-ask-spread. Their losses are highest (especially with their MO's) at the beginning of a period when they are exploited by the insiders. Furthermore, there is no clear pattern observable when it comes to profit changes conditional on their ΔCV.

I0 act as liquidity providers since their submission rate (SR) is highest and their TR is lowest. Although their SR is highest across the information levels, uninformed traders only rank third in ER. They make little losses from their MO's, small but insignificant profits from LT and so end up with approximately the market return.

More detailed results regarding each research question are presented in the following sections.

4.2 *RQ 1a - Order Choice and Trading Strategies*

4.2.1 *Order Choice*

Columns 1–4 of Table 2 show that uninformed traders (I0) are the most active market participants. They provide significantly more liquidity than other information levels with their LOs (I1 p=0.024; I2 p=0.046; I4 p=0.085, Wald coefficient test). One reason may be that they simply cannot condition their trading behavior on information about the CV which limits their profit potential to exploiting the bid-ask spread. I0 also generate significantly more trades via LT than I1 (p=0.045) and I2 (I2 p=0.068, Wald coefficient test) and it is the only trader group for which LT exceeds MO. In contrast traders with I1 and I2 trade cautiously, exhibiting the lowest numbers of LO, LT, and MO compared to other information levels. Insiders (I4) rank second regarding LT and first regarding MO. They are actively participating and provide as well as consume liquidity. The latter result supports the findings of Harris (1998), Bloomfield et al. (2005), Kaniel and Liu (2006), and Goettler et al. (2008).

Table 2 about here

4.2.2 *Trading Strategies*

Table 2 reports the results on trading strategies in columns SR 1, ER 1 and TR 1. Regarding SR uninformed traders rank first (I1 p=0.005; I3 p=0.026; I4 p=0.012, Wald coefficient test) confirming their strong focus on providing liquidity to the market. Consequently uninformed traders rank lowest with respect to their TR. The opposite picture emerges for insiders. I4 show the lowest SR but place aggressive limit orders that are well priced and so their ER is highest at 29.4%. Not surprisingly, they also exhibit one of the highest values for TR, indicating that insiders feel a need to make trades immediately at some time during the market. In contrast, traders at I1 and I2 have low ERs indicating that their orders are badly priced and do not result in many transactions. In addition I1 turn out to have the highest TR with the disadvantage of paying

the bid-ask spread.

4.2.3 *Order Strategies Conditional on the Change in the Fundamental Information*

Results for SR, ER, and TR conditional on changes in the fundamental value are reported in Table 2, columns SR 2, ER 2, and TR 2. When focussing on traders' reactions towards fundamental information changes, we find that it is especially the insiders who condition their trading strategies on their fundamental information. When the information change is large and hence the profit potential is high, insiders significantly increase their TR to cash in their informational advantage and consequently decrease their SR (see the coefficient values of Δ CV I4). While reducing limit orders, however, their execution rate (although insignificantly) increases, indicating that the aggressiveness of their limit orders is higher than for small information changes. This result supports the finding of Bloomfield et al. (2005) that insiders imply time dependent order strategies where they switch from MO to LO depending on the profit potential of their fundamental information. Subjects with outdated information hardly do so, since most of the $\beta_i(D_i * \Delta\text{CV}_{m,k,i})$-coefficients for SR, ER, and TR of I1 and I2 are insignificant.

4.2.4 *Trading Strategies Conditional on Time*

In the literature there is strong support for time dependencies in order strategies of heterogeneously informed traders.[13]

Table 3 about here

The results for the use of trading strategies over time are presented in Table 3. When focussing on ER, one can see that insiders generate by far the highest average execution rate of 42.9%. Except for low execution in interval 1, their

[13]See e.g. Harris (1998); Kaniel and Liu (2006); Goettler et al. (2008) for theoretical support, Bloomfield et al. (2005) for experimental support and Anand et al. (2005) for empirical evidence.

execution rate remains at that level. TR of the insiders, after a peak at the initial interval, significantly increases over the course of the period. This result partly contradicts findings of Bloomfield et al. (2005); Anand et al. (2005) but may be explained by the insiders trying to exploit the ultimate parts of their informational advantage as quickly as possible with MO's. Average informed traders act more aggressively in the course of a period and hence increase their ER.

4.3 *RQ 2 - Profits*

Table 4 about here

On aggregate (see column Total 1 of Table 4) I0, I1, and I2 earn negative returns, with I1 losing most, which is statistically and economically significant. I0, the liquidity providers in the experiment, earn slightly negative returns and are able to outperform I1 and I2 (I1 p=0,005; I2 p=0,539; Wald coefficient test). I3 earn marginally positive returns and I4 earn statistically significantly positive returns with respect to the market average.[14] Decomposing total FP into profits generated by limit trades (column LT 1) and market orders (column MO 1) reveals that limit trades are on average more profitable than market orders as traders pay the bid-ask spread for immediacy in the latter. LT are highly profitable for the insiders, who earn 4.8% per share transacted. Market orders are highly unprofitable for I0–I2 and are responsible for the overall negative returns for these traders. More surprisingly, I3 and I4 earn only marginally positive returns with this order type on average.

Table 5 about here

In Table 5 we explore the origins of traders' profits. To do so we split up the volume-weighted sum of FP of LTs (upper panel) and MOs (lower panel) by information level i (columns). Positive (negative) numbers indicate that the

[14]Huber (2007) and Huber et al. (2008) report similar results, showing that the average informed traders may earn below-average market returns while uninformed traders end up earning approximately the market return.

information levels in the columns gained positive (negative) FPs from trades with the information levels in the rows. Insiders earn profits from their LTs at the expense of all other information levels (see column I4 in the upper panel). These profits are highest when uninformed traders and traders with I1 and I2 pick up the insiders' LOs. Average informed traders also lose money to better informed traders (I3 and I4), with their LTs indicating that their limit orders are very badly priced. Furthermore, I1 and I2 consistently lose money to all other information levels, especially to insiders, when posting MOs (see columns I1 and I2 in the lower panel). The uninformed traders gain profits from LTs mainly at the expense of I1 and heavily lose to insiders with their MOs.

4.3.1 *Profits Conditional on the Change in the Fundamental Information*

Including changes in CV in the regression of Table 4 reveals that I4 gain from LT when their information change is large, and they even make an average profit of 1.8% per trade (see column LT 2). Traders at I3 face significantly negative returns for all transactions (Total 2), LT (LT 2) and MO (MO 2). Only when their information indicates large changes in the CV are they able to compensate these losses with high returns. There is no clear pattern for I1 and I2.

4.3.2 *Profits Conditional on Time*

Focusing on total profits (Total) over time we find that I0–I2 mainly lose money in the first three intervals of a period, while especially I4 start earning significant profits (see Table 6). Returns of I0 are higher than those of I1 and I2 during these intervals. These results indicate that the insiders mainly profit at the expense of I1 and I2 at the beginning of a period by exploiting their informational advantage. Furthermore, only insiders are able to generate significantly positive returns up to interval 4 with their LTs, but at a decreasing magnitude. Market orders are less profitable, and even insiders manage to earn significantly positive returns via MO only in the first interval.

Table 6 about here

5 Conclusion

In this paper we investigated trading strategies of asymmetrically informed traders. To extend the line of prior research we did not restrict ourselves to two information levels (informed and uninformed traders) but imposed a richer, cumulative information structure with five information levels. This allows us to investigate the behavior of average informed traders who get (slightly) outdated fundamental information.

We find that insiders make most of their profits from trades which are triggered by their limit orders. Their profits are highest at the beginning of a period and/or when the change in their fundamental information is large. The average informed traders perform worst, as they lose most of their money with market orders and do not gain money from trades which are initiated by their limit orders. Especially the worst performing traders at I1 often place MO's and hence lose a lot of money as they have to pay the bid-ask-spread. Their losses are highest (especially those from their MO's) at the beginning of a period when they are prone to being exploited by the insiders. I0 act as liquidity providers since they place the highest (lowest) number of limit (market) orders. They make little losses from their market orders, small but insignificant profits from their trades initiated by limit orders, and so end up with approximately the market return.

In prior studies with two information levels the informed traders exploited the uninformed liquidity providers due to their informational advantage (e.g., Bloomfield et al., 2005, 2009). We find that once average informed traders are added, the formerly exploited uninformed traders underperform the market only slightly and instead the average-informed traders perform worst. Especially when submitting market orders they are easily exploited by the insiders due to the latter's informational advantage.

References

Anand, A., Chakravarty, S. and Martell, T. (2005) Empirical evidence on the evolution of liquidity, *Journal of Financial Markets* **8**, 289–309.

Bloomfield, R., O'hara, M. and Saar, G. (2009) How noise trading affects markets: an experimental analysis, *The Review of Financial Studies* **22**, 2275–2301.

Bloomfield, R., O'hara, M. and Saar, G. (2005) The "make or take" decision in an electronic market: Evidence on the evolution of liquidity, *Journal of Financial Economics* **75**, 165–199.

Chakravarty, S. and Holden, C.W. (1995) An integrated model of market and limit orders, *Journal of Finanical Intermediation* **4**, 213–241.

Copeland, T.E., Galai, D. (1983) Information effects on the bid-ask spread, *Journal of Finance* **38**, 1457–1469.

Fama, E.F. (1991) Efficient capital markets 2, *The Journal of Finance* **66**, 1575–1616.

Fischbacher, U. (2007) z-tree: Zurich toolbox for ready-made economic experiments, *Experimental Economics* **10**, 171–178.

Foucault, T. (1999) Order flow composition and trading costs in a dynamic limit order market, *Journal of Financial Markets* **2**, 99–134.

Glosten, L.R. (1994) Is the electronic open limit order book inevitable? *The Journal of Finance* **49**, 1127–1161.

Glosten, L,R. and Milgrom, P. (1985) Bid, ask, and transaction prices in a specialist market with heterogenously informed traders, *Journal of Financial Economics* **14**, 71–100.

Goettler, R.L., Parlour, C.A. and Rajan, U. (2008) Informed traders and limit order markets, unpublished working paper.

Harris, L. (1998) Optimal dynamic order submission strategies in some stylized trading problems, *Financial Markets, Institutions & Instruments* **7**, 1–76.

Hellwig, M. (1982) Rational expectation equilibrium with conditioning on past prices, a mean-variance example, *Journal of Economic Theory* **26**, 279–312.

Hollifield, B., Miller, R.A. Sandas, P. and Slive, J. (2006) Estimating the gains from trade in limit-order markets, *The Journal of Finance* **61**, 2753–2804.

Huber, J. (2007) 'J'-shaped returns to timing advantage in access to information - experimental evidence and a tentative explanation, *Journal of Economic Dynamics & Control* **31**, 2536–2572.

Huber, J., Kirchler, M. and Sutter, M. (2008) Is more information always better? Experimental financial markets with cumulative information. *Journal of Economic Behavior & Organization* **65**, 86–104.

Jensen, M.C. (1968) The performance of mutual funds in the period 1945-1964, *The Journal of Finance* **23**, 389–416.

Kaniel, R. and Liu, H. (2006) So what orders do informed traders use? *Journal of Business* **79**, 1867–1913.

Kirchler, M. (2009) Underreaction to fundamental information and asymmetry in mispricing between bullish and bearish markets. An experimental study, *Journal of Economic Dynamics and Control* **33**, 491–506.

Kyle, R.A. (1985) Continuous auctions and insider trading, *Econometrica* **53**, 1315–1335.

Malkiel, B.G. (2005) Reflections on the efficient market hypothesis: 30 years later, *The Financial Review* **40**, 1–9.

Parlour, C.A. and Seppi, D.J. (2008). *Handbook of Financial Intermediation and Banking*, chap. Limit order markets: A survey. Elsevier Science, pp. 63–96.

Tables

Table 1: Core results: ordinal rankings of order choice (limit orders (LO), limit trades (LT), market orders (MO)), trading strategies (submission rate (SR), execution rate (ER), taking rate (TR)), and profits for information level i. I4 (I0) stands for the information level of the insiders (uninformed). "+" ("–") indicates significantly positive (negative) values – at least at the 5%-level.

	Order choice			Trading strategies			Profits		
	LO	LT	MO	SR	ER	TR	Total	LT	MO
I0	1	1	4	1	3	5			–
I1	5	5	5	4	5	1	–		–
I2	4	4	3	2	4	4			–
I3	2	3	2	3	2	3			
I4	3	2	1	5	1	2	+	+	

Table 2: Order choice and trading strategies for each information level I0–I4 and trading strategies conditional on ΔCV (the change in the conditional estimation of the fundamental value of information level i). Standard errors are provided in parenthesis. *, ** and *** denote the 10%, 5% and the 1% significance levels.

	LO[a]	LT[a]	MO[a]	SR 1	SR 2	ER 1	ER 2	TR 1	TR 2
I0	579.000	165.188	104.250	0.822***	0.829***	0.264***	0.260***	0.373***	0.370***
	(114.047)	(38.541)	(28.307)	(0.024)	(0.023)	(0.038)	(0.036)	(0.056)	(0.057)
I1	284.000	80.250	98.688	0.641***	0.691***	0.249***	0.229***	0.492***	0.445***
	(51.476)	(14.143)	(16.387)	(0.055)	(0.071)	(0.037)	(0.049)	(0.053)	(0.081)
I2	326.188	87.625	107.375	0.740***	0.715***	0.252***	0.230***	0.387***	0.417***
	(44.389)	(14.697)	(26.792)	(0.048)	(0.057)	(0.036)	(0.048)	(0.061)	(0.076)
I3	385.063	114.625	126.375	0.695***	0.681***	0.273***	0.298***	0.421***	0.496***
	(40.366)	(19.062)	(37.590)	(0.050)	(0.065)	(0.042)	(0.057)	(0.064)	(0.074)
I4	336.750	122.000	133.000	0.631***	0.729***	0.294***	0.269***	0.483***	0.388***
	(75.888)	(32.609)	(21.142)	(0.068)	(0.045)	(0.035)	(0.062)	(0.076)	(0.058)
Δ CV I1					−0.593		0.336		0.536
					(0.357)		(0.492)		(0.463)
Δ CV I2					0.383*		0.248		−0.423
					(0.205)		(0.235)		(0.312)
Δ CV I3					0.190		−0.457		−1.017*
					(0.438)		(0.428)		(0.596)
Δ CV I4					−1.452**		0.390		1.375*
					(0.570)		(0.696)		(0.698)
N	80	80	80	1920	1840[b]	1920	1840[b]	1920	1840[b]
R^2	0.72	0.64	0.59	0.81	0.82	0.41	0.41	0.50	0.51
F	44.18	27.25	23.35	373.05	278.45	50.79	35.02	51.26	60.79
p	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Notes:
[a] *, **, *** are omitted.
[b] Period 1 of each market is excluded from the analysis as subjects receive no information on the CV in period 0.

Table 3: Trading strategies conditional on time. SR, ER, and TR are provided for each information level conditional on time interval within a trading period. interval_1 is 1 for time interval 1 and zero otherwise. To capture patterns that consistently change over time, trend is included which takes values from one to five corresponding with time interval. *, ** and *** denote the 10%, 5% and the 1% significance levels.

		SR	ER	TR
I0	mean	0.807***	0.214***	0.488***
		(0.060)	(0.070)	(0.073)
	interval 1	0.124*	−0.154**	−0.064
		(0.063)	(0.060)	(0.089)
	trend	−0.013	0.058**	−0.018
		(0.014)	(0.026)	(0.015)
I1	mean	0.796***	0.187***	0.491***
		(0.074)	(0.060)	(0.081)
	interval 1	0.026	−0.067	−0.073
		(0.029)	(0.089)	(0.077)
	trend	−0.060**	0.064***	0.029*
		(0.023)	(0.023)	(0.015)
I2	mean	0.833***	0.232**	0.310***
		(0.070)	(0.087)	(0.086)
	interval 1	−0.039	−0.108	0.104
		(0.088)	(0.118)	(0.076)
	trend	−0.040	0.056**	0.034
		(0.030)	(0.025)	(0.026)
I3	mean	0.710***	0.237**	0.548***
		(0.062)	(0.088)	(0.093)
	interval 1	0.113***	−0.146	−0.110*
		(0.041)	(0.090)	(0.060)
	trend	−0.016	0.072**	−0.018
		(0.010)	(0.027)	(0.012)
I4	mean	0.800***	0.429***	0.360***
		(0.074)	(0.144)	(0.066)
	interval 1	0.029	−0.278***	0.148*
		(0.039)	(0.102)	(0.080)
	trend	−0.052***	0.017	0.046***
		(0.014)	(0.043)	(0.014)
N		400	400	400
R^2		0.87	0.62	0.70
F		177.55	30.03	19.08
p		0.000	0.000	0.000

Table 4: Aggregate return analysis. Volume-weighted profits for limit and market orders for each information level. *, ** and *** denote the 10%, 5% and the 1% significance levels. Δ CV indicates the change in the conditional estimation of the fundamental value of information level i.

	Total 1	Total 2	LT 1	LT 2	MO 1	MO 2
I0	−0.005	−0.004	0.007	0.006	−0.023**	−0.021***
	(0.004)	(0.005)	(0.007)	(0.007)	(0.008)	(0.008)
I1	−0.021***	−0.018**	−0.004	0.005	−0.035***	−0.038***
	(0.004)	(0.007)	(0.009)	(0.012)	(0.010)	(0.011)
I2	−0.010	−0.004	0.006	0.004	−0.023***	−0.013
	(0.008)	(0.008)	(0.011)	(0.011)	(0.007)	(0.008)
I3	0.003	−0.024***	0.004	−0.029**	0.003	−0.020*
	(0.007)	(0.008)	(0.012)	(0.014)	(0.005)	(0.011)
I4	0.024***	0.016	0.048***	0.018	0.003	0.002
	(0.009)	(0.012)	(0.007)	(0.012)	(0.010)	(0.012)
Δ CV I1		−0.020		−0.125		0.076
		(0.079)		(0.114)		(0.082)
Δ CV I2		−0.077		0.043		−0.145***
		(0.062)		(0.122)		(0.046)
Δ CV I3		0.437***		0.496**		0.378*
		(0.149)		(0.189)		(0.188)
Δ CV I4		0.090		0.441***		−0.024
		(0.131)		(0.140)		(0.042)
N	18230	17032[a]	9115	8516[a]	9115	8516[a]
R^2	0.02	0.02	0.04	0.06	0.03	0.04
F	8.86	6.52	11.02	7.96	6.08	4.92
p	0.000	0.000	0.000	0.000	0.000	0.000

[a] Period 1 of each market is excluded from the analysis as subjects receive no information on the CV in period 0.

Table 5: Who gains from whom? Cumulative volume-weighted profits (FP) for limit trades (upper panel) and market orders (lower panel) of information level i (columns). Positive (negative) numbers in the upper (lower) panel indicate that the information levels in the columns gained positive (negative) FPs from their LTs (MOs) with the information levels in the rows.

LT	I0	I1	I2	I3	I4
I0	2.28	−0.66	6.55	1.55	27.86
I1	18.64	4.93	9.71	2.43	19.43
I2	3.80	5.47	0.11	9.90	20.28
I3	−7.75	−4.75	−3.20	−4.03	13.73
I4	0.34	−10.74	−4.90	−2.61	12.07

MO	I0	I1	I2	I3	I4
I0	−2.28	−18.64	−3.80	7.75	−0.34
I1	0.66	−4.93	−5.47	4.75	10.74
I2	−6.55	−9.71	−0.11	3.20	4.90
I3	−1.55	−2.43	−9.90	4.03	2.61
I4	−27.86	−19.43	−20.28	−13.73	−12.07

Table 6: Volume-weighted profits conditional on information level and time interval within a period in total, for LT and MO. *, ** and *** denote the 10%, 5% and the 1% significance levels. Standard errors are omitted.

IN	interval	Total	LT	MO
I0	1	−0.017	−0.013	−0.021
	2	−0.019***	0.000	−0.044***
	3	−0.013	−0.001	−0.028
	4	0.012***	0.021***	−0.008
	5	0.014	0.021	0.001
I1	1	−0.046***	−0.021	−0.066***
	2	−0.032***	−0.034***	−0.030***
	3	−0.006	0.012	−0.024**
	4	−0.012	0.020	−0.033**
	5	−0.018**	−0.002	−0.030
I2	1	−0.037***	−0.045*	−0.032*
	2	0.003	0.009	−0.003
	3	−0.017*	0.013	−0.038***
	4	−0.010	0.009	−0.027***
	5	0.012	0.033	−0.010
I3	1	0.023	0.019	0.028
	2	0.001	−0.006	0.006
	3	0.004	0.006	0.003
	4	−0.000	0.004	−0.005
	5	−0.005	−0.001	−0.009
I4	1	0.055***	0.067***	0.045**
	2	0.036***	0.043***	0.027
	3	0.025	0.068***	−0.021
	4	0.007	0.030***	−0.013
	5	−0.006	0.023	−0.024
N		18230	9115	9115
R^2		0.04	0.07	0.06
F		8.36	21.37	12.59
p		0.000	0.000	0.000

Figures

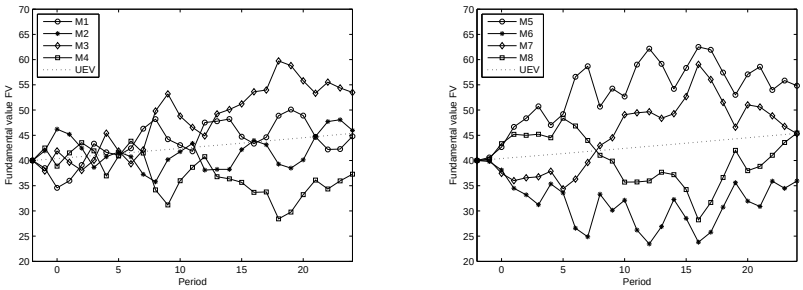

Figure 1: Fundamental value paths, FV_k, as a function of period for the eight markets. Four are generated randomly, and for each its counterpart mirrored at the dotted line - the unconditional expected value of FV - is calculated.

Appendix

Appendix A: Experimental Instructions

We welcome you to this experimental session and ask you to refrain from talking to each other for the duration of the experiment

Background of the experiment

This experiment consists of a market in which ten traders trade the shares of a fictitious company for 20-30 consecutive periods (months).

Market procedure

The market is characterized by an asymmetric information structure. The best informed (I4) receive all relevant information on the company. The second best informed (I3) receive the same information one period later. This process continues until the worst informed, I1, receive the information, who have an informational disadvantage of 3 periods compared to the insiders.

Trading will occur with a double auction market mechanism. The price of the shares is determined by your and the other traders' actions in the market. You are free to submit as many bids and asks (in the range of 10 to 200 with up to two decimal places) as you wish.

Total wealth

Your wealth is the sum of your money balance and the market value of your shares (the number of shares you hold multiplied with the current price). Your wealth will change during a period as the market price changes, even if you do not trade; the most recent trading price will be used to value your shares.

Fundamental value and CV

All relevant information on the future development of the company are included in the variable "fundamental value", which stands for the fundamentally justified valuation of the company at any time. The fundamental value starts at 40 and will change randomly each period. The random change each period is +0.5% with a standard deviation of 7.2%. Examples:

- The probability of the fundamental value increasing by more than 14.9% = 2.3%
- The probability of the fundamental value decreasing by more than 13.9% = 2.3%

- The probability for the fundamental value increasing by more than 7.7% =16%
- The probability for the fundamental value decreasing decrease by more than 6.7% =16%.

The fundamental value is especially relevant at the end of the experiment, since all shares will be bought back by the experimenter from you at that time at this value. Each period you (as well as every other participant with exception of I0) receive an estimate (CV) of the fundamental value. Traders with information level 4 (I4) get the most up-to-date information, i.e. the fundamental value of the stock in the current period. Traders with information level 3 receive the same information with one period delay. Traders with information level 2 get the same information as I4, just two periods later. Finally, investors with information level I1 receive the same fundamental information as I4 with three periods delay. As mentioned before, traders with I0 don't get any information on the fundamentals of the company.

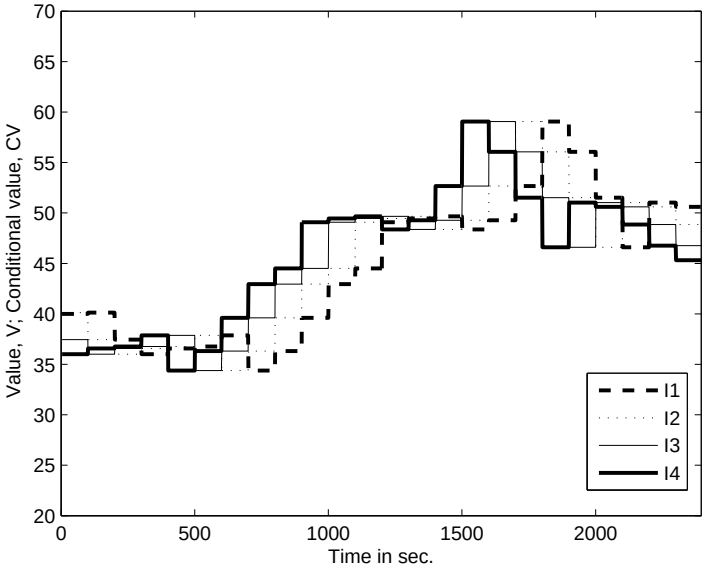

Figure E1: Example of a realization of fundamental value/CV as a function of information level

The following table gives a brief overview on the number of traders per information level and their initial endowments:

At the end of each period a history screen will give a short summary on your endowments, past prices and trading activity on the market.

Information level	Stocks	Money	No. traders	Lag to fundamental value
I0	40	1,600	2	no information
I1	40	1,600	2	3
I2	40	1,600	2	2
I3	40	1,600	2	1
I4	40	1,600	2	0

Table E1: Overview of initial endowments and traders per information level.

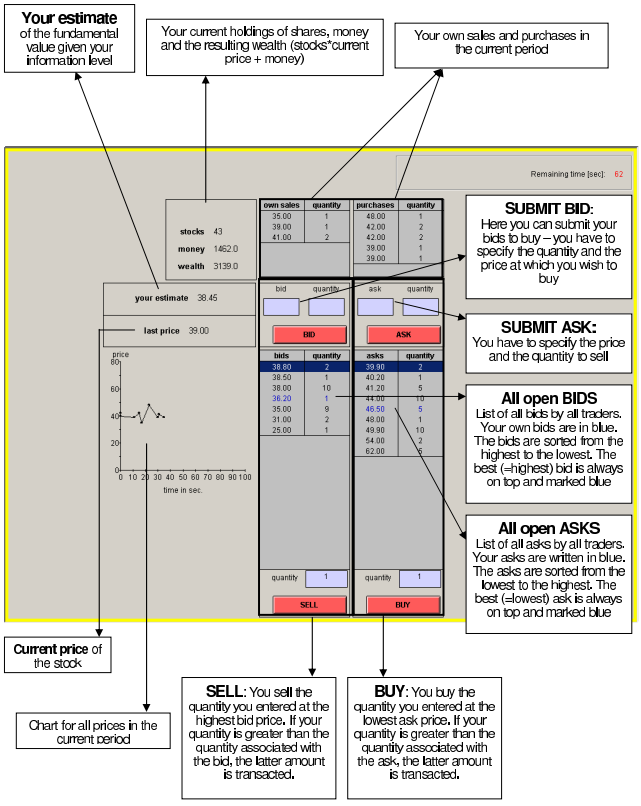

Figure E2: Trading screen

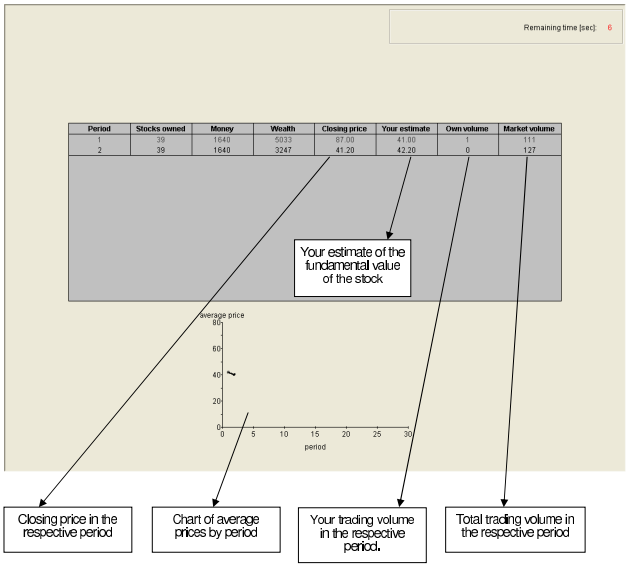

Figure E3: History screen

Some important details

- Each period lasts 100 seconds. The experiment will be terminated between periods 20 and 30, with equal probability at each termination date.
- Final payment: At the end of the experiment you will be paid in EUR. At this time all your stocks will be bought back at the fundamental value (equal to the estimate of I4 in the final period). Your money will be added to the value of your stocks and this amount will be converted into EUR at the rate of 1 EUR = 175 Taler. So, at the end of the experiment only I4 are perfectly informed on the fundamental value of the stocks. The worse your information level, the imprecise your estimate (CV) will be.

  Example: If your final wealth is 3860 units of money you earn 3860/175 = 22.10

Appendix B: Additional material

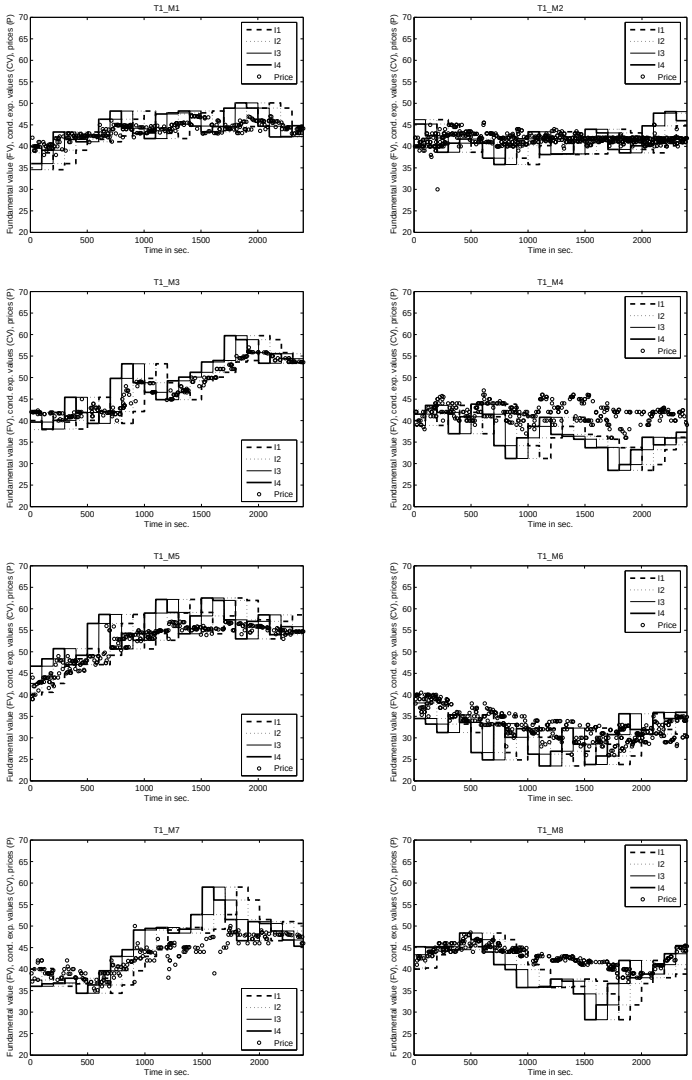

Figure E4: Fundamental value (FV), conditional expectation (CV) and prices as a function of time for markets 1 to 8.

University of Innsbruck – Working Papers in Economics and Statistics
Recent papers

2010-09 **Thomas Stöckl and Michael Kirchler:** Trading strategies and trading profits in experimental asset markets with cumulative information

2010-08 **Martin G. Kocher, Marc V. Lenz and Matthias Sutter:** Psychological pressure in competitive environments: Evidence from a randomized natural experiment: Comment

2010-07 **Michael Hanke and Michael Kirchler:** Football Championships and Jersey Sponsors' Stock Prices: An Empirical Investigation

2010-06 **Adrian Beck, Rudolf Kerschbamer, Jianying Qiu and Matthias Sutter:** Guilt from Promise-Breaking and Trust in Markets for Expert Services - Theory and Experiment

2010-05 **Martin Gächter, David A. Savage and Benno Torgler:** Retaining the Thin Blue Line: What Shapes Workers' Intentions not to Quit the Current Work Environment

2010-04 **Martin Gächter, David A. Savage and Benno Torgler:** The relationship between Stress, Strain and Social Capital

2010-03 **Paul A. Raschky, Reimund Schwarze, Manijeh Schwindt and Ferdinand Zahn:** Uncertainty of Governmental Relief and the Crowding out of Insurance

2010-02 **Matthias Sutter, Simon Czermak and Francesco Feri:** Strategic sophistication of individuals and teams in experimental normal-form games

2010-01 **Stefan Lang and Nikolaus Umlauf:** Applications of Multilevel Structured Additive Regression Models to Insurance Data

---

2009-29 **Loukas Balafoutas:** How much income redistribution? An explanation based on vote-buying and corruption. *Revised version forthcoming in Public Choice.*

2009-28 **Rudolf Kerschbamer, Matthias Sutter and Uwe Dulleck:** The Impact of Distributional Preferences on (Experimental) Markets for Expert Services

2009-27 **Adrian Beck, Rudolf Kerschbamer, Jianying Qiu and Matthias Sutter:** Car Mechanics in the Lab - Investigating the Behavior of Real Experts on Experimental Markets for Credence Goods

2009-26 **Michael Kirchler, Jürgen Huber and Thomas Stöckl:** Bubble or no Bubble - The Impact of Market Model on the Formation of Price Bubbles in Experimental Asset Markets

2009-25 **Rupert Sausgruber and Jean-Robert Tyran:** Tax Salience, Voting, and Deliberation

2009-24 **Gerald J. Pruckner and Rupert Sausgruber:** Honesty on the Streets - A Natural Field Experiment on Newspaper Purchasing

2009-23 **Gerlinde Fellner, Rupert Sausgruber and Christian Traxler:** Testing Enforcement Strategies in the Field: Legal Threat, Moral Appeal and Social Information

2009-22 **Ralph-C. Bayer, Elke Renner and Rupert Sausgruber:** Confusion and Reinforcement Learning in Experimental Public Goods Games

2009-21 **Sven P. Jost:** Transfer Pricing Risk Awareness of Multinational Corporations - Evidence from a Global Survey

2009-20 **Andrea M. Leiter and Engelbert Theurl:** The Convergence of Health Care Financing Structures: Empirical Evidence from OECD-Countries

2009-19 **Francesco Feri and Miguel A. Meléndez-Jiménez:** Coordination in Evolving Networks with Endogenous Decay

2009-18 **Harald Oberhofer:** Firm growth, European industry dynamics and domestic business cycles

2009-17 **Jesus Crespo Cuaresma and Martin Feldkircher:** Spatial Filtering, Model Uncertainty and the Speed of Income Convergence in Europe

2009-16 **Paul A. Raschky and Manijeh Schwindt:** On the Channel and Type of International Disaster Aid

2009-15 **Jianying Qiu:** Loss aversion and mental accounting: The favorite-longshot bias in parimutuel betting

2009-14 **Siegfried Berninghaus, Werner Güth, M. Vittoria Levati and Jianying Qiu:** Satisficing in sales competition: experimental evidence

2009-13 **Tobias Bruenner, Rene Levinský and Jianying Qiu:** Skewness preferences and asset selection: An experimental study

2009-12 **Jianying Qiu and Prashanth Mahagaonkar:** Testing the Modigliani-Miller theorem directly in the lab: a general equilibrium approach

2009-11 **Jianying Qiu and Eva-Maria Steiger:** Understanding Risk Attitudes in two Dimensions: An Experimental Analysis

2009-10 **Erwann Michel-Kerjan, Paul A. Raschky and Howard C. Kunreuther:** Corporate Demand for Insurance: An Empirical Analysis of the U.S. Market for Catastrophe and Non-Catastrophe Risks

2009-09 **Fredrik Carlsson, Peter Martinsson, Ping Qin and Matthias Sutter:** Household decision making and the influence of spouses' income, education, and communist party membership: A field experiment in rural China

2009-08 **Matthias Sutter, Peter Lindner and Daniela Platsch:** Social norms, third-party observation and third-party reward

2009-07 **Michael Pfaffermayr:** Spatial Convergence of Regions Revisited: A Spatial Maximum Likelihood Systems Approach

2009-06 **Reimund Schwarze and Gert G. Wagner:** Natural Hazards Insurance in Europe – Tailored Responses to Climate Change Needed

2009-05 **Robert Jiro Netzer and Matthias Sutter:** Intercultural trust. An experiment in Austria and Japan

2009-04 **Andrea M. Leiter, Arno Parolini and Hannes Winner:** Environmental Regulation and Investment: Evidence from European Industries

2009-03 **Uwe Dulleck, Rudolf Kerschbamer and Matthias Sutter:** The Economics of Credence Goods: On the Role of Liability, Verifiability, Reputation and Competition. *Revised version forthcoming in American Economic Review.*

2009-02 **Harald Oberhofer and Michael Pfaffermayr:** Fractional Response Models - A Replication Exercise of Papke and Wooldridge (1996)

2009-01 **Loukas Balafoutas:** How do third parties matter? Theory and evidence in a dynamic psychological game.

2008-27 **Matthias Sutter, Ronald Bosman, Martin Kocher and Frans van Winden:** Gender pairing and bargaining – Beware the same sex! *Revised version published in Experimental Economics, Vol. 12 (2009): 318-331.*

2008-26 **Jesus Crespo Cuaresma, Gernot Doppelhofer and Martin Feldkircher:** The Determinants of Economic Growth in European Regions.

2008-25 **Maria Fernanda Rivas and Matthias Sutter:** The dos and don'ts of leadership in sequential public goods experiments.

2008-24 **Jesus Crespo Cuaresma, Harald Oberhofer and Paul Raschky:** Oil and the duration of dictatorships.

2008-23 **Matthias Sutter:** Individual behavior and group membership: Comment. *Revised Version published in American Economic Review, Vol.99 (2009): 2247-2257.*

2008-22 **Francesco Feri, Bernd Irlenbusch and Matthias Sutter:** Efficiency Gains from Team-Based Coordination – Large-Scale Experimental Evidence. *Revised and extended version forthcoming in American Economic Review.*

2008-21 **Francesco Feri, Miguel A. Meléndez-Jiménez, Giovanni Ponti and Fernando Vega Redondo:** Error Cascades in Observational Learning: An Experiment on the Chinos Game.

2008-20 **Matthias Sutter, Jürgen Huber and Michael Kirchler:** Bubbles and information: An experiment.

2008-19 **Michael Kirchler:** Curse of Mediocrity - On the Value of Asymmetric Fundamental Information in Asset Markets.

2008-18 **Jürgen Huber and Michael Kirchler:** Corporate Campaign Contributions as a Predictor for Abnormal Stock Returns after Presidential Elections.

2008-17 **Wolfgang Brunauer, Stefan Lang, Peter Wechselberger and Sven Bienert:** Additive Hedonic Regression Models with Spatial Scaling Factors: An Application for Rents in Vienna.

2008-16 **Harald Oberhofer, Tassilo Philippovich:** Distance Matters! Evidence from Professional Team Sports. *Extended and revised version forthcoming in Journal of Economic Psychology.*

2008-15 **Maria Fernanda Rivas and Matthias Sutter:** Wage dispersion and workers' effort.

2008-14 **Stefan Borsky and Paul A. Raschky:** Estimating the Option Value of Exercising Risk-taking Behavior with the Hedonic Market Approach. *Revised version forthcoming in Kyklos.*

2008-13 **Sergio Currarini and Francesco Feri:** Information Sharing Networks in Oligopoly.

2008-12 **Andrea M. Leiter:** Age effects in monetary valuation of mortality risks - The relevance of individual risk exposure.

2008-11 **Andrea M. Leiter and Gerald J. Pruckner:** Dying in an Avalanche: Current Risks and their Valuation.

2008-10 **Harald Oberhofer and Michael Pfaffermayr:** Firm Growth in Multinational Corporate Groups.

2008-09 **Michael Pfaffermayr, Matthias Stöckl and Hannes Winner:** Capital Structure, Corporate Taxation and Firm Age.

2008-08 **Jesus Crespo Cuaresma and Andreas Breitenfellner:** Crude Oil Prices and the Euro-Dollar Exchange Rate: A Forecasting Exercise.

2008-07 **Matthias Sutter, Stefan Haigner and Martin Kocher:** Choosing the carrot or the stick? – Endogenous institutional choice in social dilemma situations. Revised version forthcoming in *Review of Economic Studies*.

2008-06 **Paul A. Raschky and Manijeh Schwindt:** Aid, Catastrophes and the Samaritan's Dilemma.

2008-05 **Marcela Ibanez, Simon Czermak and Matthias Sutter:** Searching for a better deal – On the influence of group decision making, time pressure and gender in a search experiment. *Revised version published in Journal of Economic Psychology, Vol. 30 (2009): 1-10.*

2008-04 **Martin G. Kocher, Ganna Pogrebna and Matthias Sutter:** The Determinants of Managerial Decisions Under Risk.

2008-03 **Jesus Crespo Cuaresma and Tomas Slacik:** On the determinants of currency crises: The role of model uncertainty. *Revised version accepted for publication in Journal of Macroeconomics.*

2008-02 **Francesco Feri:** Information, Social Mobility and the Demand for Redistribution.

2008-01 **Gerlinde Fellner and Matthias Sutter:** Causes, consequences, and cures of myopic loss aversion - An experimental investigation. *Revised version published in The Economic Journal, Vol. 119 (2009), 900-916.*

2007-31 **Andreas Exenberger and Simon Hartmann:** The Dark Side of Globalization. The Vicious Cycle of Exploitation from World Market Integration: Lesson from the Congo.

2007-30 **Andrea M. Leiter and Gerald J. Pruckner:** Proportionality of willingness to pay to small changes in risk - The impact of attitudinal factors in scope tests. *Revised version forthcoming in Environmental and Resource Economics.*

2007-29 **Paul Raschky and Hannelore Weck-Hannemann:** Who is going to save us now? Bureaucrats, Politicians and Risky Tasks.

2007-28 **Harald Oberhofer and Michael Pfaffermayr:** FDI versus Exports. Substitutes or Complements? A Three Nation Model and Empirical Evidence.

2007-27 **Peter Wechselberger, Stefan Lang and Winfried J. Steiner:** Additive models with random scaling factors: applications to modeling price response functions.

2007-26 **Matthias Sutter:** Deception through telling the truth?! Experimental evidence from individuals and teams*. Revised version published in The Economic Journal, Vol. 119 (2009), 47-60.*

2007-25 **Andrea M. Leiter, Harald Oberhofer and Paul A. Raschky:** Productive disasters? Evidence from European firm level data. *Revised version forthcoming in Environmental and Resource Economics.*

2007-24 **Jesus Crespo Cuaresma:** Forecasting euro exchange rates: How much does model averaging help?

2007-23 **Matthias Sutter, Martin Kocher and Sabine Strauß:** Individuals and teams in UMTS-license auctions. *Revised version with new title "Individuals and teams in auctions" published in Oxford Economic Papers, Vol. 61 (2009): 380-394**).***

2007-22 **Jesus Crespo Cuaresma, Adusei Jumah and Sohbet Karbuz:** Modelling and Forecasting Oil Prices: The Role of Asymmetric Cycles. *Revised version accepted for publication in The Energy Journal.*

2007-21 **Uwe Dulleck and Rudolf Kerschbamer:** Experts vs. discounters: Consumer free riding and experts withholding advice in markets for credence goods. *Revised version published in International Journal of Industrial Organization, Vol. 27, Issue 1 (2009): 15-23.*

2007-20 **Christiane Schwieren and Matthias Sutter:** Trust in cooperation or ability? An experimental study on gender differences*. Revised version published in Economics Letters, Vol. 99 (2008): 494-497.*

2007-19 **Matthias Sutter and Christina Strassmair:** Communication, cooperation and collusion in team tournaments – An experimental study. *Revised version published in: Games and Economic Behavior, Vol.66 (2009), 506-525.*

2007-18 **Michael Hanke, Jürgen Huber, Michael Kirchler and Matthias Sutter:** The economic consequences of a Tobin-tax – An experimental analysis. *Revised version forthcoming in Journal of Economic Behavior and Organization.*

2007-17 **Michael Pfaffermayr:** Conditional beta- and sigma-convergence in space: A maximum likelihood approach. *Revised version forthcoming in Regional Science and Urban Economics.*

2007-16 **Anita Gantner:** Bargaining, search, and outside options. *Published in: Games and Economic Behavior, Vol. 62 (2008), pp. 417-435.*

2007-15 **Sergio Currarini and Francesco Feri:** Bilateral information sharing in oligopoly.

2007-14 **Francesco Feri:** Network formation with endogenous decay.

2007-13 **James B. Davies, Martin Kocher and Matthias Sutter:** Economics research in Canada: A long-run assessment of journal publications. *Revised version published in: Canadian Journal of Economics, Vol. 41 (2008), 22-45.*

2007-12 **Wolfgang Luhan, Martin Kocher and Matthias Sutter:** Group polarization in the team dictator game reconsidered. *Revised version published in: Experimental Economics, Vol. 12 (2009), 26-41.*

2007-11 **Onno Hoffmeister and Reimund Schwarze:** The winding road to industrial safety. Evidence on the effects of environmental liability on accident prevention in Germany.

2007-10 **Jesus Crespo Cuaresma and Tomas Slacik:** An “almost-too-late” warning mechanism for currency crises. *(Revised version accepted for publication in Economics of Transition)*

2007-09 **Jesus Crespo Cuaresma, Neil Foster and Johann Scharler:** Barriers to technology adoption, international R&D spillovers and growth.

2007-08 **Andreas Brezger and Stefan Lang:** Simultaneous probability statements for Bayesian P-splines.

2007-07 **Georg Meran and Reimund Schwarze:** Can minimum prices assure the quality of professional services? (*Accepted for publication in European Journal of Law and Economics*)

2007-06 **Michal Brzoza-Brzezina and Jesus Crespo Cuaresma:** Mr. Wicksell and the global economy: What drives real interest rates?.

2007-05 **Paul Raschky:** Estimating the effects of risk transfer mechanisms against floods in Europe and U.S.A.: A dynamic panel approach.

2007-04 **Paul Raschky and Hannelore Weck-Hannemann:** Charity hazard - A real hazard to natural disaster insurance. *Revised version forthcoming in: Environmental Hazards.*

2007-03 **Paul Raschky:** The overprotective parent - Bureaucratic agencies and natural hazard management.

2007-02 **Martin Kocher, Todd Cherry, Stephan Kroll, Robert J. Netzer and Matthias Sutter:** Conditional cooperation on three continents. *Revised version published in: Economics Letters, Vol. 101 (2008): 175-178.*

2007-01 **Martin Kocher, Matthias Sutter and Florian Wakolbinger:** The impact of naïve advice and observational learning in beauty-contest games.

University of Innsbruck

Working Papers in Economics and Statistics

2010-09

Thomas Stöckl and Michael Kirchler

Trading strategies and trading profits in experimental asset markets with cumulative information

Abstract

We study the use of trading strategies and their profitability in experimental asset markets with asymmetrically informed traders. We find that insiders make most of their profits from trades which are initiated by their limit orders -- especially at the beginning of a period and when the change in their fundamental information is large. The average informed lose most with market orders and their losses are highest at the beginning of a period when they can be exploited by insiders. Uninformed traders act as liquidity providers. They place the highest number of limit orders and end up with the market return.

ISSN 1993-4378 (Print)
ISSN 1993-6885 (Online)