UNIVERSITY OF SIENA
DEPARTMENT OF ECONOMICS

EXPERIMENTAL ECONOMICS LABORATORY

Brice Corgnet

Angela Sutan

Arvind Ashta

The power of words in financial markets: soft versus hard communication, a strategy method experiment

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Abstract: The main objective of this paper is to analyze the impact of non-informative communications on asset prices. An experimental approach allows us to control for the release of non-relevant messages. We introduce the release of messages in standard experimental asset markets with bubbles (Smith, Suchanek and Williams 1988) through a strategy method experiment. We conjecture that *a priori uninformative messages can significantly impact the level of asset prices.* Uninformative communications may be used by boundedly rational subjects to compute the fundamental value of the asset. In addition, rational agents may anticipate such an effect and adapt their strategy to the messages received. We asked 182 subjects to construct strategies about their action in a standard experimental asset market environment. Our analysis sheds light on the possibility of manipulation and stabilization of financial markets by influential agents such as financial *"gurus"* or central bankers.

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Brice Corgnet, Universidad Carlos III, Madrid, bcorgnet@est-econ.uc3m.es
Angela Sutan, CEREN, ESC Dijon, and BETA, Strasbourg, asutan@escdijon.com
Arvind Ashta, CEREN, ESC Dijon, aasthta@escdijon.com

"…how do we know when irrational exuberance has unduly escalated asset values, which then become subject to unexpected and prolonged contractions as they have in Japan over the past decade?" (Alan Greenspan, black-tie dinner speech: "The Challenge of Central Banking in a Democratic Society" before the American Enterprise Institute at the Washington Hilton Hotel December 5, 1996)

1. Introduction: why words matter?

As pointed out by Sperber (2005), obscurity of expression is considered as a language and communication imperfection, except in a *maîtres à penser* or guru's speech. Greenspan's seemingly harmless quotation implied a strong reaction in the markets. The Tokyo stock market that opened at the time of his speech, felt sharply, and closed down 3%. Similarly, stock markets in Frankfurt and London felt by 4%. The US stock market felt 2% immediately after its opening (Shiller, 2001). Although the term "irrational exuberance" reached a definition status and is now used as a synonym for a heightened state of speculative fervour, it seems disproportionate that markets react all over the world to a question casually thrown out in the middle of a dinner speech (Shiller, 2001). Defenders of full rationality may argue that Greenspan’s speech had an informative content since it leads traders to revise upwards the probability of an increase in US interest rates. Experimental markets allow us to disentangle the effects of informative and uninformative messages on asset prices since then we can control for the level of informativeness of messages. Under the full rationality hypothesis, an uninformative communication should not have any impact on asset prices. However, if we consider one of the following situations: i) traders are boundedly rational or ii) rationality is not common knowledge, uninformative messages are likely to influence prices. First, uninformative communications may be used by boundedly rational subjects to compute the fundamental value of the asset. Second, rational agents that do not believe in others’ full rationality may anticipate such an effect and adapt their strategy to the messages received.

As a result, we have to stress that messages that are uninformative under the common knowledge of rationality assumption may appear to be informative if traders are not fully rational.

We therefore address in this paper the question of the sensitiveness of financial market prices to uninformative communications. We build our analysis within a *cold* experimental financial market, i.e. we construct a strategy method experiment (Selten, 1967). Assessing the importance of communications on financial markets prices using real markets data is rendered impossible by the multiplicity and simultaneity of the messages reaching the market. This is why we consider an experimental approach allowing us to control for the release of non-relevant messages. We introduce the possibility of communications in standard experimental asset markets with bubbles described in Smith, Suchanek and Williams (1988). We consider the case in which a message about the price of the experimental asset is sent at the end of a trading period. We decide to use a strategy method experiment in the spirit of Selten, Mitzkewitz and Uhlich (1997), or Sonnemans et al.(2004). In a strategy method experiment, subjects are asked to formulate a complete strategy, which is a description of their decisions in all possible states of the world. Decisions in this type of experiment are not immediate; subjects have time to construct their decisions and to "look forward" for their implications. In *hot* experiments, subjects make relatively few decisions in a short period of time. It is then difficult to detect the type of beliefs taken into account by traders when making their decisions.

Our decision has been to test our main hypothesis that *uninformative messages influence asset prices* in a context a priori unfavorable. Indeed, in a strategy method experiment, as subjects have more time to make decisions, they are less likely to exhibit boundedly rational behaviors. As a result, the non-relevant message delivered on the market should not modify subjects' beliefs about the fundamental value of the asset. In addition, compared to a *hot* experiment, traders should anticipate that everybody has more time to make decisions so that the common knowledge of rationality hypothesis is more likely to hold. In summary, in a strategy method experiment, asset prices should be less sensitive to uninformative messages than in a *hot* experiment. Therefore, the strategy method experiment will be our stress treatment. If prices are influenced by messages in that context, this will provide a strong support for our research hypothesis. Our research hypothesis is stated below jointly with four complementary hypotheses.

Hypothesis: *A priori uninformative messages have a significant impact on asset prices.*

The argument is that messages can serve as a focal point for the convergence of beliefs among subjects. If we agree that experimental bubbles occur partly as a result of a divergence in traders' beliefs (as argued for example in Smith, Suchanek and Williams, 1988), the introduction of messages in the experimental design should significantly reduce bubbles by facilitating the coordination of beliefs. We test our main hypothesis by using the experimental design presented in the next section. Our contribution can help analyze the extent to which asset markets can be manipulated by influential agents such as financial *"gurus"* or central bankers through the delivery of non-informative messages.

Hypothesis a: *The effect of uninformative messages on asset prices is higher in the case of hard signals than in the case of soft signals* **(Content dimension)**.

A recent strand of literature proposes to distinguish hard versus soft information (Petersen, 2004). Hard information is quantitative, verifiable and explicit. Soft information is qualitative, non verifiable and implicit. It is strongly contingent on cognitive factors and subjective judgments. This distinction has been recently used as an alternative explanation of risk decision of financial intermediaries (Stein, 2002). However, evidence that the type of information impacts financial markets prices remains scarce. In this paper we set up an experimental environment in which subjects have full information (they may not use it fully rationally but they are perfectly informed) so that any messages that we are releasing are a priori uninformative. As a result, we will refer to hard / soft messages or communications rather than to hard / soft information. The difference between hard and soft messages can be seen as a way to distinguish messages according to their *content*. We argue (Hypothesis a) that hard messages, compared to soft messages, are likely to facilitate the coordination of beliefs among traders implying that such messages have a greater influence on asset prices. This should be the case since the interpretation of such messages is more homogenous. Indeed, traders may not agree on a unique interpretation of soft messages.

Kirschenheiter (2002) proposes the following distinction between hard and soft information: "Hard information (…) is when everyone agrees on its meaning. (…) Honest disagreements arise when two people perfectly observe information yet interpret this information differently (i.e. soft information)".

Hypothesis b: *The effect of uninformative messages on asset prices is higher the higher is the reliability of the message sender* **(Reliability dimension)**.

Reasons to *hear* a message released in the market and to accept to *interpret* it (the first two steps by which the power of words can be characterized) may be internal (related to its content) or external (related to its source) (Sperber, 2005). In this paper we show how messages and communications *are* relevant in financial markets, and this can be a rational way to achieve coordination and stabilization. The relevance (in our case closely related to the reliability of the sender) of a message is an indicator of its '*power*'.[1] The power of a message depends on the tradeoff between the informational gains associated with processing the message and the processing effort. As a result, deliberately opaque and short formulations, released by authorial sources (*maîtres à faire*), replacing complicated statements, can have a significant influence of individuals' behavior (Sperber, 2005). Reliability facilitates information processing since then traders do not have to fully examine the steps and reasons underlying the official statement.

Hypothesis c: *The effect of uninformative messages on asset prices is higher the more frequently messages are released* **(Frequency dimension)**.

As emphasized by Mullainathan (2002), one can understand individuals' bounded rationality by memory limitations. As a result, mechanisms facilitating the work of memory should help boundedly rational traders to compute the fundamental value of the experimental asset. The frequency with which the message is released is then expected to affect the valuation of the asset by non-fully rational traders.

Hypothesis d: *As traders' experience increases the effect of uninformative messages on asset prices decreases.* **(Experience dimension)**

There is another question that may be of interest: the difference between market manipulation and market stabilization. Are uninformative messages more effective in stabilizing the market (avoiding bubbles in our experimental design) than in destabilizing the market (exacerbating bubbles)? A priori, we may think that stabilization of the market is easier since a rational equilibrium to which subjects may coordinate their expectations exists there.

The introduction of communication is not the first mechanism considered in order to reduce the magnitude of experimental bubbles. Experience of subjects (King et al., 1992, Dufwenberg, Lindqvist and Moore, 2005) and the introduction of future markets (Porter and Smith, 1994) in the experimental design have been found to be particularly effective to limit the occurrence of experimental bubbles. However, the solution proposed here is particularly attractive since much less costly than the introduction of a new institution like a future market and much faster than training subjects.

[1] Market circumstances may influence the relevance and the *power* of the message. A message is likely to be highly relevant in a period of bubble or crash.

2. Experimental methods: an asset market strategy experiment

2.1. Experimental treatments

We propose to use the design presented by Smith, Suchanek and Williams (1988) while considering the parameter values used in Dufwenberg, Lindqvist and Moore (2005).[2] In these experimental asset markets, a unique asset is traded. The asset releases a dividend at the beginning of each of the 15 or 30 trading periods. The dividend is drawn from a probability distribution known by experimental traders. Subjects are given an endowment in cash and assets at the beginning of the experiment. The market is not "reinitialized" at the beginning of each period, so that trading periods only differ in the realization of the dividend process. The trading procedure is a computerized double-auction mechanism. Subjects are trading continuously the experimental asset by entering bid and ask prices on a computer screen. A unit of the asset is traded once an ask or bid price previously entered is accepted by a subject.
The experimental markets are usually characterized by a "boom" phase (a period where prices are higher than the fundamental value of the asset) followed by a "crash" period.[3] This is a surprising result, since according to backward induction, risk neutral agents should trade at the fundamental value.[4]

There are two differences between our design and the the design used by Smith, Suchanek and Williams (1988). First of all, our experiment is a strategy method experiment (*cold* experiment), i.e. participants have to propose actions for all the periods and the states of the world and to justify their choices. Their strategies are then programmed and simulated and they are paid according to the relative performance of their strategy. The second difference is that we allow for the release of messages along the experiment. We characterize messages using three dimensions:

1. ***reliability*** of the sender,
2. ***content*** of the message,
3. ***frequency*** of the message.

We believe that these three dimensions may influence experimental asset prices. Reliability of the person sending the message will influence the degree to which the message is "focal" to the agent (the agent is sensitive to the reception of the message). Reliability is maximal when subjects know that the message is delivered by the experimenter. In Table 1, we propose different alternatives in which the reliability of the sender is likely to be lower, as for example the case of a student sending the message, or as in the case of a random message. We denote ***B(i,j,k)*** a treatment in which the message has reliability ***i***, content ***j*** and frequency ***k***, where ***i,j,k*** can be low (***L***) or high(***H***).The content of the message is as well important, a vague statement *("the average price is too low or too high")* as described in treatment ***B(L,L,H)*** may have a more reduced impact on subjects' beliefs than a precise statement like: *"the average price is x cents of euro too low or x cents of euro too high"* (see treatment ***B(L,H,H)***

[2] The authors consider 6 subjects trading for 10 periods. We propose to use similar endowment classes as well.
[3] The fundamental value of the asset is computed as the expected value of future dividends delivered by the asset.
[4] Risk averse agents should trade at a price lower than the fundamental value.

and ***B(H,H,H)***). Finally, the frequency of the messages is an important variable, we believe that the more frequent is a message, the higher is its impact on traders' beliefs and then on experimental prices.

Table 1: Examples of messages types and experimental designs

Treatment/ Message type	***B(L,L,H)***	***B(L,H,H)***	***B(H,L,H)***	***B(H,H,H)***
Reliability	*Low* An observer	*Low* An observer	*High* Message released by the experimenter	*High* Message released by the experimenter
Content	*Imprecise* Average prices of the last period are too low/high	*Precise* Deviations from fundamental values in c€	*Imprecise* Average prices of the last period are too low/high	*Precise* Deviations from fundamental values in c€
Frequency	*Very frequent* At the end of periods 5 to 9	*Very frequent* At the end of periods 5 to 9	*Very frequent* At the end of periods 5 to 9	*Very frequent* At the end of periods 5 to 9

We considered the 4 treatments specified in Table 1. Evidently, several other configurations for ***i,j,k*** can be considered: different types of message, we can modify the frequency of the message or release a random message.

We conjecture that the impact of messages on experimental asset prices will be higher the higher the reliability of the sender, the more precise is the signal and the more frequent are the messages. We consider for the moment only the configuration in which the message is very frequent (***k=H***). We expect to observe some effects of the messages in treatments ***B(L,L,H),*** ***B(H,L,H)*** and ***B(L,H,H)*** and more perceptible effects in treatment ***B(H,H,H)***. We also run a benchmark treatment in which no messages are delivered, as in Dufwenberg, Lindqvist and Moore (2005). Our treatments are summarized in Table 2.

Table 2: Summary of the experimental design

Treatment 0	**- No messages are delivered.** Same design as in Dufwenberg, Lindqvist and Moore (2005)
Treatments *B(i,j,k)*	- **Messages are delivered at the end of periods 5 to 9.** The content of the message is either precise or vague, and the reliability of the sender of the message is either high or low.

Our experimental design allows us to assess how influential agents can impact the level of prices in financial markets. If we find no effects for the treatments ***B(i,j,k)*** presented in Table 1, we can conclude that the impact of financial "*gurus*" on the market is limited (through their influence on media). If message treatments have a significant impact on experimental prices we may conclude that manipulation of prices by financial *"gurus"* is possible and relatively easy: we can conclude that stabilization of prices can be obtained by announcements delivered by financial authorities.[5]

2.2. Subjects and procedures

This experiment has been conducted in November 2005 at the Burgundy School of Business in Dijon, France. Altogether 182 students were recruited on a voluntary basis in an introduction to Psychology undergraduate course in which there are 272 students aged between 19 and 22. Students in this course usually have an intensive 2 years post-secondary background, and pass an entrance exam to join the school. Subjects received instructions with full information about the market and procedures and had one week to submit their strategies and comments. Up to 50 subjects participated in each of the five treatments corresponding to treatments ***0*** and ***B(i,j,k).*** They were asked not to communicate about the experiment during the week and asked to describe their strategies and motivations as accurately as possible.

Subjects were involved in trading an asset with a finite life of ten periods. In each period the asset pay a dividend of 0 or 20 cents, with equal probability. Therefore the expected monetary benefit of holding an asset is 10 cents for each remaining period. They were told that each market will involve 6 traders, who could buy and sell assets. Half of the subjects (3) started with a cash endowment of 200 cents and six assets and the other half (3) with a cash endowment of 600 cents and 2 assets. A trader's cash holding at any point in time differed from his or her cash endowment by accumulated capital gains or losses via market trading, and accumulated dividend earnings via asset units held in inventory at the end of each trading period. All information was common knowledge.

Assuming risk neutrality and zero time preference, the fundamental value of the asset, by backward induction, is equal to *10t* where *t is the number of* remaining periods.

Subjects had to describe their trading actions and to anticipate the market price for the 10 trading periods. Several simulation schemes were than implemented on each strategy, by incorporating it in homogenous or heterogeneous 6 traders markets, as we explain in the next section. Subjects were paid on the basis of the results of one randomly selected strategy. The earnings in points were ranked, the best strategy was paid 15 euros and the others proportionally decreasing according to their rank.

3. Results

In this section, we use the data of our strategy experiments in order to test the hypotheses stated in the introduction. We provide statistical tests to assess how uninformative messages do affect expected asset prices, bids, asks and simulated asset prices.

3.1 Analysis of expected prices: *'when words really matter'*

3.1.1 Break tests on expected asset prices

We are interested in knowing if there exists a shift in prices expectations in period 5 when messages start to be delivered. We test for a shift in expected prices using panel

[5] Interventions of Alan Greenspan are examples of such attempts to stabilize asset prices.

data regression methods. We run the following regression for the different treatments considered in our strategy experiments (i.e. *B*(*H*,*H*,*H*), *B*(*L*,*H*,*H*), *B*(*L*,*L*,*H*), *B*(*H*,*L*,*H*), and treatment *0*):

$$f(t) = c(0) + c(1)*t$$

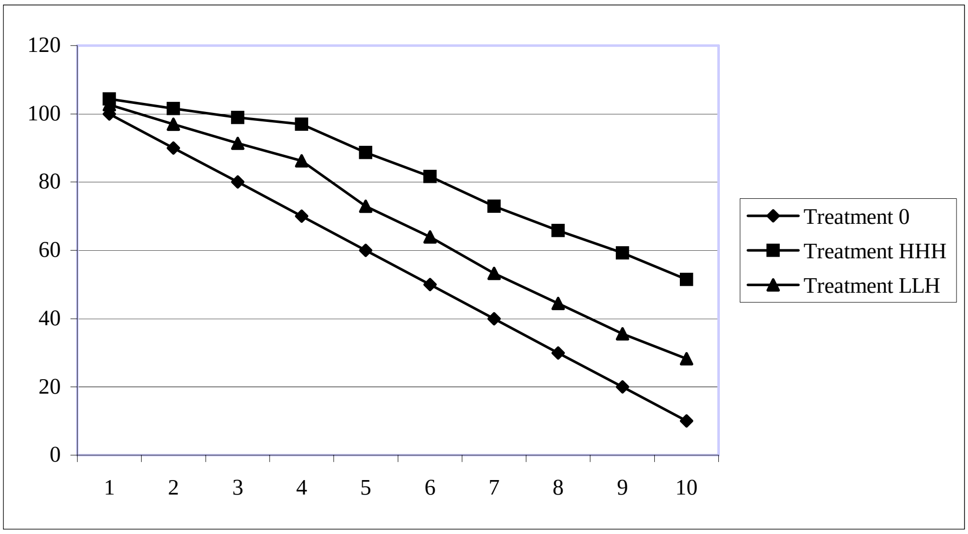
where $f(t)$ is the price forecast for period t and $c(0)$ or $c(1)$ are the regression coefficients.

We compare the trend coefficient $c(1)$ for $1 \leq t \leq 4$ and for $5 \leq t \leq 10$.
We display in the appendix the output for the panel data regression on the full sample ($1 \leq t \leq 10$) and the test for the stability of the coefficient $c(1)$. We first observe that, in the full sample, $c(1)$ is highly significant for the different treatments. This means that agents are correctly assessing the decreasing patterns of fundamental values. We then test for the stability of the trend parameter by running a Wald-test where the null hypothesis is that the coefficient $c(1)$ is the same in the two subsamples (the subsample without messages: $1 \leq t \leq 4$ and the subsample with messages: $5 \leq t \leq 10$). We are unable to reject the stability of the trend coefficient in treatment *0*, whereas we strongly reject coefficient stability in treatment *HHH*. This finding is consistent with an alternative version of our main hypothesis stating that the release of uninformative messages has an impact on expected prices. This effect is observed at a lesser extent for treatment *LLH*.

Result 1: The release of uninformative messages significantly influence expected asset prices in treatments *HHH* and *LLH*.

According to Result 1, our subjects anticipate that uninformative messages released at the end of the fifth period are going to affect asset prices. The break observed in asset prices is stronger for treatment *HHH* in agreement with the assumption. As a result, even in a strategy method experiment for which individuals' bounded rationality is limited, uninformative communication may affect prices. This occurs even in treatment *LLH*, where the sender has low reliability and the uninformative message is imprecise. However, we are unable to find such message effects in treatments *LHH* and *HLH*. In figure 1, we draw the average expected prices for each period and treatments *O*, *HHH* and *LLH*. We notice the presence of a break in treatments *HHH* and *LLH*.

Figure 1: Average estimated prices in treatments *B(H,H,H)*, *B(L,L,H)* and *0*



Result 1': The impact of uninformative messages on expected asset prices is strongest when the message sender is highly reliable *and* the message is very precise.

According to the stability test provided in the appendix, the existence of a break is more significant in the case of treatment *HHH* since there we can reject the stability of the trend coefficient at a 1% level of significance. The stability of the coefficient *c*(1) is not rejected at this level of significance in any of the treatments *LLH*, *LHH* and *HLH*. Result 1' implies that our complementary assumptions on the role of the reliability of the message sender and on the content of the message are only partially verified. We cannot conclude that the reliability of the message sender or the content of the message *alone* explain the effect of uninformative messages on expected asset prices. Indeed, treatments *HLH* and *LHH*, which are characterized by a more reliable message and more precise content of the message respectively than treatment LLH lead to a much lower effect of uninformative messages on expected asset prices.

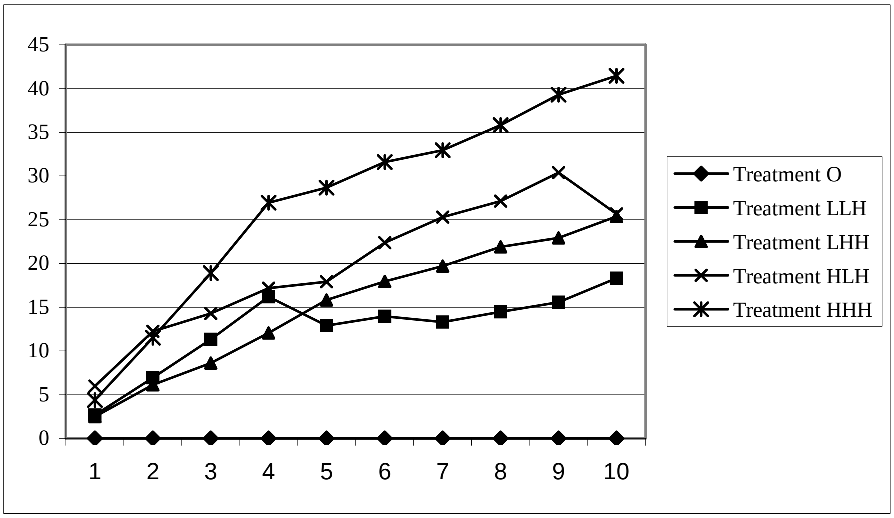
3.1.2 Bubbles and expected asset prices: *'don't play with words'*

In the next figure, we represent the average expected bubble for each of the ten periods of the experiment and for each of the treatments.

Result 2: Our messages treatments are associated with large bubbles in asset prices.

We observe that asset prices are higher than the fundamentals for any of the messages treatments considered whereas no bubbles are observed in the absence of messages (treatment *0*). This result may seem surprising if we take into account that our message stresses that the prices observed in the market are too high. Our initial objective has been to stabilize prices in the market by warning traders that they may overvalue the experimental asset. However, our message seems to have the opposite effect on asset prices since then bubbles appear in the market. As we have stressed in the introduction, bubbles can arise either because subjects are not rational or because they do not believe in others' rationality. As a result, our messages may positively influence the formation of bubbles by making agents aware of the possibility that others are irrational. Indeed, our message mentions explicitly the possibility of a bubble from period 5 onwards. In agreement with this hypothesis, volatility in asst prices tends to increase as messages reach the experimental markets (see appendix). If messages would serve to stabilize market prices by making traders' beliefs homogenous we would expect asset prices volatility to decrease with the release of messages. Given that non-rational behaviors are complex messages may not always have the expected effects. This implies that one may destabilize the market by attempting to stabilize it. Our second result provides support for avoiding possible interventions of financial authorities that attempt to regulate the market. In addition, special attention should be given to the possibility of destabilization of asset markets by influential 'gurus'. Such communications should be reduced as much as possible. As a consequence of results 1 and 2, asset prices do react to uninformative communications but in a direction that is difficult to predict.

Figure 2: Expected bubbles for each treatment



Result 2': The more reliable and the more precise is the message released from period 5 onwards, the larger is the expected bubble in prices.

We can observe that expected asset bubbles are stronger in treatments HHH and HLH than in treatments LLH and LHH suggesting that the reliability of the message sender positively impacts the magnitude of expected bubbles. Similarly, bubbles are expected to be higher in treatment HHH (LHH) than in treatment HLH (LLH) so that the precision of the message sent from period 5 onwards seems to increase expected asset prices bubbles.

We evaluate the goodness-of-fit between the estimated and fundamental values using the Haessel-R^2 statistic; this statistic takes values between 0 and 1 (1 is a perfect fit) and its average, standard deviation, minimum and maximum values are reported in table 3 for treatments *B(H,H,H)*, *B(L,L,H)* and *0*. The more prices conform to the fundamental value, the more the statistic approaches 1.

Table 3: Goodness-of-fit for treatments *B(H,H,H)*, *B(L,L,H)* and *0*

	B(H,H,H)			*B(L,L,H)*			*0*		
	bid	*ask*	*estimated price*	*bid*	*ask*	*estimated price*	*Bid*	*ask*	*estimated price*
average	**0.76**	**0.77**	**0.61**	**0.86**	**0.88**	**0.71**	**0.28**	**0.33**	**1.00**
SD	0.33	0.25	0.40	0.25	0.20	0.40	0.48	0.38	0.00
min	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	1.00
max	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.90	1.00

4. Conclusions (partial)

Results 1 and 1' suggest that asset prices strongly react to uninformative communications even if the reliability of the message sender is low or the statement is imprecise. However, it appears very difficult to predict the direction in which prices are going to be affected by messages (Result 2).

5. Appendix

5.1. Panel data regressions for the different treatments

- Treatment O

Dependent Variable: Expected asset prices
Method: Pooled Least Squares
Sample: 1 10
Included observations: 10
Number of cross-sections used: 4
Total panel (balanced) observations: 40
Cross sections without valid observations dropped

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	100.00	9.22E-15	1.08E+16	0.00
@TREND	-10.000	1.73E-15	-5.79E+15	0.00

R-squared	1.000000	Mean dependent var	55.00000
Adjusted R-squared	1.000000	S.D. dependent var	29.08872
S.E. of regression	3.14E-14	Sum squared resid	3.74E-26
Log likelihood	1187.970	F-statistic	3.35E+31
Durbin-Watson stat	0.082038	Prob(F-statistic)	0.000000

- Treatment HHH

Dependent Variable: Expected asset prices
Method: Pooled Least Squares
Sample: 1 10
Included observations: 10
Number of cross-sections used: 19
Total panel (balanced) observations: 190
Cross sections without valid observations dropped

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	108.3633	3.597931	30.11821	0.0000
@TREND	-6.047624	0.673954	-8.973344	0.0000

R-squared	0.299868	Mean dependent var	81.14895
Adjusted R-squared	0.296144	S.D. dependent var	31.80478
S.E. of regression	26.68297	Sum squared resid	133852.4
F-statistic	80.52091	Durbin-Watson stat	0.077123
Prob(F-statistic)	0.000000		

- Treatment LLH

Dependent Variable: Expected asset prices				
Method: Pooled Least Squares				
Sample: 1 10				
Included observations: 10				
Number of cross-sections used: 30				
Total panel (balanced) observations: 300				
Cross sections without valid observations dropped				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	104.5351	2.579182	40.53035	0.0000
@TREND	-8.601166	0.483125	-17.80319	0.0000
R-squared	0.515411	Mean dependent var		65.82990
Adjusted R-squared	0.513784	S.D. dependent var		34.46932
S.E. of regression	24.03517	Sum squared resid		172151.4
F-statistic	316.9535	Durbin-Watson stat		0.099089
Prob(F-statistic)	0.000000			

- Treatment LHH

Dependent Variable: Expected asset prices				
Method: Pooled Least Squares				
Date: 03/13/06 Time: 19:51				
Sample: 5 10				
Included observations: 6				
Number of cross-sections used: 19				
Total panel (balanced) observations: 114				
Cross sections without valid observations dropped				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	105.1673	11.19614	9.393178	0.0000
@TREND	-7.954887	1.665939	-4.775017	0.0000
R-squared	0.169144	Mean dependent var		53.46053
Adjusted R-squared	0.161726	S.D. dependent var		33.17890
S.E. of regression	30.37770	Sum squared resid		103354.1
F-statistic	22.80079	Durbin-Watson stat		0.027815
Prob(F-statistic)	0.000005			

- Treatment HLH

Dependent Variable: Expected asset prices				
Method: Pooled Least Squares				
Date: 03/13/06 Time: 19:58				
Sample: 1901 1910				
Included observations: 10				
Number of cross-sections used: 22				
Total panel (balanced) observations: 220				
Cross sections without valid observations dropped				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	107.7893	5.180095	20.80835	0.0000
@TREND	-7.634986	0.970321	-7.868518	0.0000
R-squared	0.221188	Mean dependent var		73.43182
Adjusted R-squared	0.217616	S.D. dependent var		46.73514
S.E. of regression	41.33840	Sum squared resid		372532.2
F-statistic	61.91357	Durbin-Watson stat		0.125888
Prob(F-statistic)	0.000000			

5.2. Stability tests

- Treatment HHH

We test (Wald coefficient test) if $C(2)$ - the coefficient of the trend is stable- To do so we test if the trend coefficient in the regression for periods 5 to 10 is equal to –2.38. Here is the result:

Wald Test:			
Equation: POOLALL			
Null Hypothesis:	C(2)=-2.38		
F-statistic	8.842090	Probability	0.003605
Chi-square	8.842090	Probability	0.002944

We have to REJECT the absence of breaks. This implies that estimated prices are not stable. There is a break in period 5 (we would obtain similar result for a break in period 6).

- Treatment LLH

Wald Test:			
Equation: POOALL			
Null Hypothesis:	C(2)=-6.41		
F-statistic	3.860354	Probability	0.050996
Chi-square	3.860354	Probability	0.049440

We CANNOT REJECT the absence of breaks at a 5% level of significance. However at a 10% level we REJECT the absence of a break at *t*=5. This implies that estimated prices are more stable than under treatment HHH (what we should expect). However, there is evidence of a break in period 5 (we would obtain similar result for a break in period 6).

- Treatment LHH

Wald Test:			
Equation: POOLALL			
Null Hypothesis:	C(2)=-7.07		
F-statistic	0.282135	Probability	0.596357
Chi-square	0.282135	Probability	0.595305

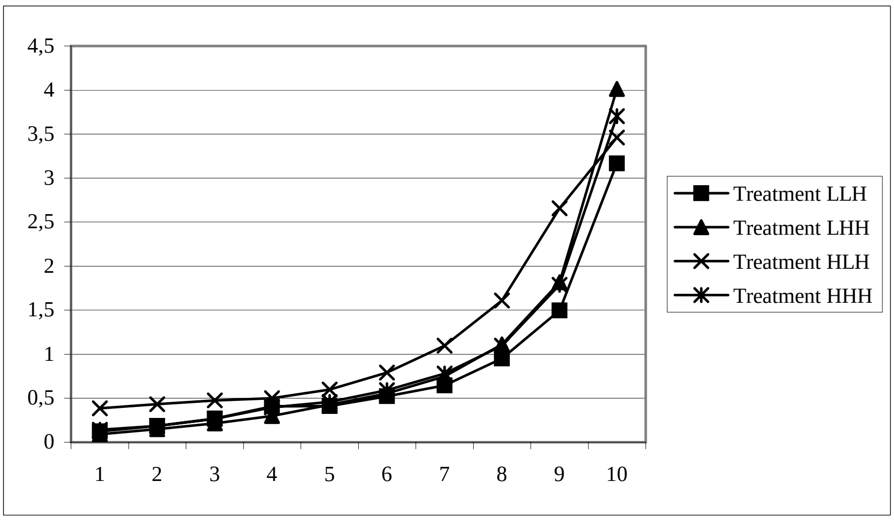
- Treatment HLH

Wald Test:			
Equation: POOLALL			
Null Hypothesis:	C(2)=-6.54		
F-statistic	0.547079	Probability	0.460847
Chi-square	0.547079	Probability	0.459514

5.3. Volatility of expected asset prices

We draw the evolution of the standardized volatility of expected asset prices from the first to the tenth period of our strategy experiment. The standardized volatility for treatment *T* and period *t* is computed as the standard deviation for expected prices for treatment *T* and period *t* divided by the fundamental value of the asset in that period.

Figure 3: Evolution of the standardized volatility of expected asset prices.



<u>5.4. Instructions</u>: as an example, these are the instructions for one of the participants in treatment *HHH* (in French)

Ce jeu consiste en une expérience sur la prise de décision. Les instructions sont simples, si vous les suivez et si vous prenez les bonnes décisions, vous pouvez gagner un nombre de points considérable. L'expérience consiste en une série de périodes dans lesquelles vous avez l'opportunité d'acheter ou de vendre dans un marché. Toutes les opérations d'achat ou vente se font en points.
Je vous prie de ne pas communiquer entre vous sur ce jeu avant la remise de vos stratégies. Normalement vous devriez pouvoir construire une stratégie complète à ce jeu en 2 heures. Je vous prie de lire une fois en entier les instructions pour prendre connaissance du déroulement du jeu et procéder ensuite à la construction de la stratégie.
Sur ce jeu, vous devez formuler une stratégie. Une stratégie est un plan complet d'actions. Si vous donnez par exemple votre stratégie à une autre personne, elle devrait être capable de faire exactement la même chose que vous auriez faite.
Une stratégie doit être : complète (elle doit prévoir une action dans tous les cas possibles), pas ambiguë (elle doit prévoir un choix seulement pour une situation) et correcte de point de vue informationnel (les informations utilisées sont celles basées sur ce document).
Exemple de stratégie incomplète: dans la première période je prévois un prix de 40. Dans les périodes suivantes ma prévision est 70 si le prix est plus grand que 50 et 40 si le prix est plus petit que 50. Cette stratégie est incomplète parce qu'elle ne prévoir rien si le prix est exactement à 50.
Exemple de stratégie ambiguë: dans la première période ma prévision est de 70. Dans les périodes suivantes je vais augmenter ma prévision de 10 si ma prévision précédente était plus petite que le prix réalisé, je vais la baisser de 10 si ma prévision précédente était plus grande que le prix réalisé et je vais maintenir ma prévision si mon erreur de prévision dans la période précédente était plus petite que 5.
Cette stratégie est ambiguë parce qu'il n'est pas clair quelle serait la prévision si la prévision précédente était par exemple de 3 points en dessous du prix réalisé : devrait la prévision être maintenue ou diminuée de 10? Quelle est la règle prioritaire?
Exemple de stratégie incorrecte de point de vue informationnel: dans la première période ma prévision est 45. Dans les périodes suivantes, ma prévision dépend du prix réalisé en période 5. Si en période 5 le prix est plus grand que 50, j'augmente, sinon je baisse. Cette stratégie est incorrecte puisqu'elle ne dis pas comment on fait pour prédire entre la période 2 et la période 5.

Description du marché:

Chaque marché est compose de 6 participants. Au début du marché, 3 des participants ont une dotation de 6 biens X et de 200 points et 3 participants ont une dotation de 2 biens X et de 600 points.

Vous avez une dotation de 2 biens X et de 600 points.

Le jeu dure 10 périodes.

A chaque période, vous devez vendre ou acheter des unités du bien X. X peut être considéré comme un actif avec une vie de 10 périodes, et votre stock de X est reporté de période en période. A la fin de chaque période, chaque unité de X vous paie un

dividende. Les dividendes sont soit de 0, soit de 20 points, avec une chance de 50% chacun. Donc, le dividende moyen par période est de 10.
Vos profits sur le marché seront égaux au total des dividendes que vous recevez pour vos unités de X que vous avez en stock à la fin de chaque période, plus le cash que vous avez à la fin du marché.

Vous pouvez utiliser le tableau 2 suivant pour prendre vos décisions. Il y a 5 colonnes dans ce tableau. La première colonne, qui porte le nom "nombre de périodes" vous rappelle la durée du marché. La deuxième colonne, qui porte le nom "période courante", vous indique la période en cours. La troisième colonne donne le nombre de périodes pendant lesquelles vous détenez le stock à partir de la période courante incluse. La quatrième colonne vous donne la valeur moyenne du dividende pour chaque unité de X. La cinquième colonne vous donne l'espérance de dividende total pour le restant de la période pour chaque unité de X en stock : pour chaque unité de X en stock jusqu'à la fin du marché, vous avez une espérance de recevoir le montant listé en colonne 5. Les nombres listés en colonne 5 est obtenu en multipliant les nombres en colonne 3 et 4.

Imaginez par exemple qu'il reste 4 périodes. Puisque le dividende payé pour une unité a une chance de 50% d'être 0 et 50% d'être 20, le dividende a une espérance de 10 par période pour chaque unité de X. Si par exemple vous avez une seule unité, le dividende total payé sur les 4 périodes restantes a une espérance de 4 ×10 = 40.

L'activité sur le marché:

Votre activité sur le marché consiste à vendre et à acheter des unités de X. Ainsi, à chaque période, vous devez prendre les décisions suivantes :
-communiquer un prix auquel vous seriez prêt à vendre une unité de X
-communiquer un prix auquel vous seriez prêt à acheter une unité de X
-décider de vendre en fonction du prix qui est établi sur le marché (oui/non)
-décider d'acheter en fonction du prix établi sur le marché. (oui/non)
Ainsi, vous pouvez vous aider du tableau suivant qui retrace les 10 périodes :

Période	Offre d'achat	Offre de vente	Prix estimé pour les transactions	Je vends (oui /non)	J'achète (oui /non)	Nombre unités en début de période et dividende espéré associé	Nombre unités en fin de période et dividende espéré associé	Cash en début de période	Cash en fin de période
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									

Tableau 1

Le prix réel sur le marché (auquel se feront les transactions) dépendra effectivement de toutes les offres de vente et de toutes les offres d'achat dans votre groupe, et des décisions réelles d'achat ou vente.

Comment calculer vos gains:

Pour une période :

GAIN POUR UNE PERIODE =
DIVIDENDE PAR UNITE × NOMBRE D'UNITES EN STOCK A LA FIN DE CETTE PERIODE
 - MONTANT DU PRIX PAYE POUR ACHETER UN X (si achat)
+ MONTANT DU PRIX RECU POUR LA VENTE D'UN X (si vente)

Gain total :

GAIN TOTAL = GAIN PERIODE 1 + GAIN PERIODE 2 + GAIN PERIODE 3 + GAIN PERIODE 4 + GAIN PERIODE 5 + GAIN PERIODE 6 + GAIN PERIODE 7 + GAIN PERIODE 8+ GAIN PERIODE 9 + GAIN PERIODE 10

Ending Period	Current Period	Number of holding Periods	×	Average Dividend Value Per Period	=	Average Holding Value Per Unit of Inventory
10	1	10		10		100
10	2	9		10		90
10	3	8		10		80
10	4	7		10		70
10	5	6		10		60
10	6	5		10		50
10	7	4		10		40
10	8	3		10		30
10	9	2		10		20
10	10	1		10		10

Tableau 2

Pendant les 4 premières périodes, le marché se déroule comme décrit et vous pouvez remplir le tableau jusqu'à la période 4 incluse.
Vous devez aussi remplir le tableau pour le restant des périodes. A partir de la période 5, à la fin de chaque période, l'expérimentateur vous annonce publiquement que le prix établi sur votre marché pour une unité de X à cette période est trop haut de 5% par rapport aux fondamentaux de l'économie.

Merci de remplir le tableau et d'expliquer vos choix.

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