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Uninformative Announcements and Asset Trading Behavior*

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Abstract

Financial markets are overwhelmed by daily announcements. We use experimental asset markets to assess the impact of uninformative communications on asset prices and trading volumes. We deliver uninformative messages in standard experimental asset markets and find that trading volumes and prices are impacted by these messages. In particular, the release of a pre-announced preset message to traders "The price is too high" in predetermined trading periods decreases the amplitude and duration of bubbles. Also, the release of the messages "The price is too high" or "The price is too low" reduces trading volume with inexperienced subjects.

Keywords: experimental asset markets, bubbles, market communications, bounded rationality.

JEL codes: C92, G12

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I. Introduction

"When you get this far away from a recession, invariably forces build up for the next recessions, and indeed we are beginning to see that sign."

Alan Greenspan, Hong Kong business conference, **February 26th, 2007**.

Why should words count? A cursory look at the functioning of stock markets tells us that words do count, and that there are lots of words (to be counted). The importance of words is highlighted by the market reaction to the statement made by Alan Greenspan in February 2007 after he stepped down as chairman of the Federal Reserve Bank. The aftermath of this speech was a worldwide fall of stock markets that started in China and reached the US stock markets by next morning. The morning after Greenspan's announcement the S&P fell by 3.4% on February 26. In fact, the remark had a domino effect resulting in fall of all major stock markets worldwide.

There are an enormous number of words that can be counted each trading day from the recommendations of stock analysts, brokers or pundits. A natural question to ask would be why markets react in this manner to Greenspan's remarks. Defenders of full rationality may argue that Greenspan's speech had an informative content on the possible evolution of US interest rates. Other commentators stress that Greenspan did not have credible information on which to base his assertions. More importantly, he did not have power to take action at the Fed anymore. However, the reaction of markets to Greenspan's message suggests that his words are powerful. The power of Greenspan's words may be attributed to the "guru" effect under which markets may be subject to manipulation by influential agents (Sperber, 2005). The following statements suggest that financial analysts appear to be concerned about the possibility that Greenspan's announcement generates effects that would destabilize financial markets.

"He's setting a very bad precedent." "I find it unusual that he's been talking so much."

Andrew Brenner, market analyst at **MAN Financial**

"Two words, Mr. Greenspan: shut up."
Gary Kaltbaum of **Kaltbaum Associates**

"But should we say everyone has freedom of speech except former chairmen of the central bank?"
Marc Chandler, senior currency strategist at **Brown Brothers Harriman** in New York

However, markets seem to learn and discount somewhat the introduction of uninformative messages. For example, subsequent remarks by Greenspan elicited little response. Business Week reporting on the effect of his remarks after the February market decline said,

"On May 24, China stock prices fell only marginally after Greenspan said —the previous day—he was concerned that equities in the world's fastest growing major economy might undergo a dramatic contraction; this despite the fact that the comments triggered a minor sell-off in the U.S."[1]

This episode stresses the need to understand the reaction of financial markets to messages that are apparently uninformative. In this paper we analyze the effect of deliberately benign messages in a controlled experimental market. We assess the effects of such announcements on market variables such as prices, bids, asks and trading volumes. Using real market data is rendered impossible by the multiplicity and simultaneity of the messages reaching the market. We use economic experiments to study the importance of communications on asset markets prices. Experiments allow us to control for the timing and the informativeness of messages. Using experimental markets we can disentangle the effects of informative and uninformative messages on asset prices. We release messages in standard experimental asset markets with bubbles first described in Smith, Suchanek and Williams (1988), hereafter SSW.

In this paper we find support for the hypothesis that apparently benign messages can have a significant impact on market variables. In particular, in the case of inexperienced subjects the release of the preset message *"The price is too high"* reduces the amplitude and duration of bubbles observed

[1] http://www.businessweek.com/globalbiz/content/jun2007/gb20070613_615822.htm?campaign_id=rss_daily

in experimental asset markets. Further, asset prices tend to change in the direction suggested by the message *"The price is too high"* even when the statement is false. Finally, the release of benign messages like *"The price is too high"* or *"The price is too low"* significantly reduces trading volumes.

II. Related literature

Evidence of bubbles in an experimental asset markets dates back to SSW. Prices in these markets tend to start below fundamental value (as determined by the expected dividend value of the asset) and quickly rise above the intrinsic value until a crash occurs. These bubbles have been found to be robust to many treatments such as short selling, capacity to buy on margin, brokerage fee, and a limit price change rule (King et al. 1993).

SSW stress upon the lack of common expectations as an explanation for the formation of bubbles. Porter and Smith (1995) introduce a futures market in experimental asset markets as a mechanism to promote common expectations among traders. The authors find that the introduction of a futures market significantly reduces bubble amplitude, although bubble duration is not significantly affected. A complete set of futures (one for each of the fifteen periods) seems to eliminate bubbles (Noussair and Tucker 2006). The lack of common expectations lead to the possibility of speculation as it is evoked in SSW. They explain bubbles by referring to the uncertainty about others' behaviors. Under this hypothesis agents buy at prices higher than fundamentals because they think that they will be able to resell the asset to possibly irrational traders at a higher price. However, as the end of the experimental market approaches, the probability of making speculative profits diminish and prices revert to fundamentals. This is what the authors refer to as the speculative hypothesis for explaining bubbles and crashes.

A critical variable in the development of experimental bubbles is the experience of subjects. Bubbles tend to vanish with twice-experienced subjects even in markets in which these traders are mixed with inexperienced traders (Dufwenberg, Lindqvist and Moore 2005). However, bubbles are still observed among twice-experienced traders when the market environment is modified by increasing liquidity and by adding dividend uncertainty (Hussam, Porter and Smith 2007).

It is clear that common information about the dividend probabilistic structure is not sufficient to ensure common expectations of the agents. With experience subjects tend to develop common expectations. Agents develop similar expectations where the unifying theory corresponds to rational expectations. The result is that agents with a long common experience trade at fundamental value.

Another possible explanation for the formation of bubbles is the irrationality of subjects (Lei, Noussair and Plott 2001). They consider an experimental design in which speculation is impossible. Subjects are either buyers or sellers but cannot purchase to resell. The lack of reselling should impede speculative behavior. The authors find that even in the absence of reselling, bubbles and crashes occur in experimental asset markets. Discarding the speculative hypothesis the authors emphasize the importance of individual irrationality in explaining asset price pattern. They find evidence of systematic errors in decision making accompanying bubbles. Traders engage in unprofitable transactions at prices above the maximum possible or below the minimum possible dividend stream.

In this paper, we analyze how the release of messages in experimental markets can affect the patterns of asset prices and trading volumes. There are two mechanisms by which messages can impact market variables. On one hand, messages can serve as advice to subjects that exhibit irrational behavior trading at extremely low or extremely high prices (see Lei, Noussair and Plott, 2001). For example, messages may help irrational traders to discover how to compute the fundamental value of the asset. On the other hand, messages can serve as a focal point to coordinate the expectations of rational and irrational traders. Rational traders that are able to compute the fundamental value of the

asset may anticipate that messages will induce potentially irrational subjects to trade closer to fundamental values. As a result, the magnitude of speculation and then the magnitude of bubbles would be reduced. In previous works, alternative strategies have been used to coordinate subjects' expectations as for example developing common traders' experience (SSW, Dufwenberg, Lindqvist and. Moore 2005) or introducing futures markets (Porter and Smith 1995, Noussair and Tucker 2006).

III. Hypotheses

The effect of a message on market variables will depend on its *content*, *reliability* and *timing*. A priori, a message coming from a credible source with (seemingly) reliable information should have a significant impact on market variables. Similarly, an unreliable message independent of the source should be ignored by rational agents.

A priori, one would expect informative messages (from a reliable source) to affect asset prices. Given this a more interesting question to ask would be as to how uninformative messages impact these prices. It is clear that an uninformative message would not influence asset prices under the full rationality hypothesis. Hence one would have to assume irrationality or lack of common knowledge on rationality on the part of traders for uninformative messages to have any effect. In that case one can consider one of the following situations:

i) Traders exhibit irrational behavior or,

ii) Rationality is not common knowledge.

Messages can affect trading patterns by facilitating the computation of the rational expectations equilibrium when traders exhibit irrational behavior (Lei, Noussair and Plott, 2001). Irrationality may also manifest itself through the inability of agents to use backward induction (Katok, Sefton and Yavas 2002, Johnson et al. 2007) in determining the equilibrium price (Tirole, 1982). Under these

circumstances, messages that refer to the fundamental value of the asset may help subjects in determining the intrinsic value of the stock.

Messages may also affect market variables when subjects are uncertain about the behavior of others. This uncertainty may result in speculation even on the part of traders that are able to determine the fundamental values of the asset. This may result in subjects trading at prices higher than fundamentals (SSW). On the other hand, messages may reduce speculative activity if rational subjects anticipate that the messages help irrational subjects to focus on the fundamental value of the asset. The release of messages can thus facilitate coordination of beliefs among traders with different levels of sophistication. Further, note that uninformative messages may appear to be informative if a proportion of traders are not able to determine the rational expectations equilibrium.

In this paper we study the effect of uninformative messages on asset prices, trading volumes, bids and, asks. We consider the weakest treatment possible by releasing an unreliable message with uninformative content at arbitrary points in time. Subjects are informed beforehand that a predetermined message will be released at given points of time during the experiment. Given this we test the following hypotheses.

Hypothesis 1: A priori, uninformative messages significantly impact the amplitude, the duration and the normalized price deviation.

Hypothesis 2: A priori, uninformative messages significantly impact trading volumes.

Hypothesis 3: A priori, uninformative messages significantly impact price changes and the number of bids and asks.

IV. Experimental Design

Subjects were recruited from the undergraduate population at George Mason University. The experiments lasted 2 and ½ hours and subjects earned an average of US $34 including a $7 show-up fee. All experiments were computerized using common interactive instructions.[2]

A standard experimental asset market in which 9 subjects trade a security with a finite life of 15 periods is used. At the end of each period, the asset pays a random dividend (in cents) drawn from a uniform distribution over four outcomes {0, 8, 28, 60} giving an expected dividend of 24 cents per period. The traders were also endowed with an initial portfolio of cash and shares. Five of the nine traders were endowed with 2 shares and 550 cents in cash, while the other four were given an initial portfolio of 4 shares and 180 cents in cash. Risk neutral agents using backward induction should trade at the fundamental value of 360 cents in period one with decrements of 24 cents in each period thereafter (Tirole 1982).

An experimental session involves two consecutive markets of fifteen periods with the same nine subjects. In the first market, each trading period lasts for 180 seconds while the duration is 160 seconds in the subsequent market. All other characteristics of the environment are the same for the two markets. In period 10 of each market all subjects receive an electronic announcement stating that there are only 5 periods remaining.

IV.1. The Message Treatment

Given the baseline experiments we created two message treatments. In each message treatment subjects received a predetermined message in periods 3, 7 and 12. Messages were released in these periods because from past asset market experiments one sees that bubbles usually form between periods 3 and 7. Further, crashes in these experiments occur towards the last few periods.

[2] Instructions for the experiments can be found at http://ices2.gmu.edu/Words2/page1.html.

Thus, a message in period 12 would tell us if it has any impact on the crash whereas, messages in periods 3 and 7 should inform us about their affect upon bubble formation.

The subjects are informed in the instructions about the predetermined message and the periods in which they receive it. In the two treatments the subjects receive the following preset messages.

In treatment **L** subjects received the message:

"THE PRICE IS TOO LOW".

In treatment **H** subjects received the message:

"THE PRICE IS TOO HIGH".

These messages are chosen for the following reasons. As mentioned above, we can classify messages based upon their *content*, *reliability* and *timing.* Then it is very likely that a message with *precise content* released at "*the right time*" from an *informed source* would make the markets react. The opposite would be true if messages *lacked content*, arrived at the *wrong time* and came from an *uninformed source*. If we are interested in studying the effect of messages in asset markets, i.e. the power of words, a natural place to start would be the release of a *benign* message. A *benign* message should, a priori, have no impact on market variables. If, however, it does impact market variables then this tells us that subject irrationality, or the lack of information about the common knowledge on rationality, may very result in trader reaction to uninformative message without content.

We do this by releasing a preset message with a vague content in periods 3, 7 and 12. This is the weakest possible treatment where messages are *predetermined* and released at predetermined periods that are known to market participants. We inform the subjects about the content and timing of a preset message before the experiment starts. The subjects receive the following instructions:

*"Before the session starts, a preset message will be selected that says either "The price is too high" or "The price is too low". The message will appear during the experiment, in the panel under Your Holdings**,** and it will only appear in periods **3**, 7, and **12**."*

The message appears on the right hand corner of the trading screen as follows.

Your Holdings

Cash	150
Shares	3

THE PRICE IS TOO HIGH

The dividend has equal chance of being 0, 8, 28, or 60 cents this period.

This message is then repeated in the instructions summary. At the end of the instructions the subjects are further asked about the message (as a part of a quiz they take). They answer the following question.

Question 6
In which period(s) will a predetermined message saying that "The price is too high" or "The price is too low" be released:

- A. Periods 3, 6 and 12
- B. Periods 3, 7 and 12
- C. Period 3
- D. Never

By doing so, we stress upon the subjects that the message is predetermined and that it appears in some known preselected periods. As a result, we ensure that the content and the timing of the message are common information.[3] The table below outlines the experimental design with the different treatments.

[3] The content and timing of the message are not common knowledge in the sense of SSW and Smith (2003) since subjects are not trained to use this piece of information. Subjects have common information ("knowledge that") about the content and timing of the message but do not have common knowledge ("knowledge how") until they have experienced the effect of the message.

Table 1

Summary of the experimental design

Treatment	Message	Number of Experiments
Baseline (Treatment N)	No messages	3 inexperienced sessions 3 experienced sessions
Treatment H	Predetermined message *"The price is too high"* Periods 3, 7 and 12	3 inexperienced sessions 3 experienced sessions
Treatment L	Predetermined Message *"The price is too low"* Periods 3, 7 and 12	3 inexperienced sessions 3 experienced sessions

The different treatments are based on a common market environment described as follows.

Table 2

Summary of the market environment

Trading mechanism	Asset	Traders
Computerized continuous double auction	15-period asset Uncertain dividends	9 traders

V. Experimental Results

We denote by ***ijk*** the experimental session *j* in which message *i*∈ {**H**, **L**, **N**} is released given level of experience *k*=1 (*k*=2) when subjects are inexperienced (once experienced). Message **L** is *"The price is too low"* and message **H** is *"The price is too high"*. The case in which no messages are released is denoted by *i*=**N**.

Previous studies consider *Amplitude, Duration, Normalized Average Price Deviation, Normalized Absolute Price Deviation and Turnover* as relevant measures of bubbles (see Dufwenberg, Lindqvist and Moore (2005). We further add *Upward Trend* and *Crash period* as complementary measures of the impact of messages on market variables.

1. Amplitude: Measures the trough-to-peak change in market asset value relative to fundamental value. This is measured as A = Max{(P_t-f_t)/E: t =1…15}-Min{(P_t-f_t)/E: t =1…15} where P_t is the average market price in period t, f_t is the fundamental value of the asset in period t**,** and E is the expected dividend value over the life of the asset.

2. Duration: Measures the length, in periods, in which there is an observed increase in market prices relative to the fundamental value of the asset. Formally, duration is defined as:

D = Max{m: P_t-f_t < P_{t+1}-f_{t+1} <…< P_{t+m}-f_{t+m}}.

3. Normalized Absolute Price Deviation: Measures the per-share aggregate overvaluation (or undervaluation), relative to the fundamental value of the asset in a given period and is defined as follows: $ND = \sum|P_{it}-f_t|/(100\times22)$, where P_{it} is the price of the i^{th} transaction in period t. The number 22 represents the total number of shares. Large values of *ND* reflect important deviations from fundamentals.

4. Normalized Average Price Deviation: Sums up the absolute deviation between the average price and the fundamental value for each of the fifteen periods. It is defined as follows: $NAD = \sum|P_t-f_t|/15$. This measure is similar to the *Normalized Absolute Price Deviation*. However, *NAD* also accounts for the magnitude of mispricing.

5. Turnover: Is a measure of trading activity and is defined as $T= \sum V_t /S,$ where, V is the volume of trades in period t and S(=22) is the total number of stocks in the experimental session.

6. Upward Trend: Measures the number of consecutive periods in which average prices (P_t) increase. By definition the *Upward Trend* is inferior to the *Duration* of the bubble since the bubble can grow

when stock prices go down given that the fundamental value of the asset decreases over time. Also, two experimental markets may have the same duration and still have very different trends. The messages released in our experiments refer to the level of asset prices. We are interested in analyzing not only the evolution of mispricing but also the pattern of asset prices. For our purpose it is important to assess whether the trend in asset prices is significantly affected by the release of messages.

7. Crash Period: This measure identifies the period in which prices start to revert to fundamentals. It is estimated by using Chow break points tests in a regression of average prices (P_t) with respect to a linear trend. This test is useful in determining when the bubble starts to deflate.

Below we present the results.

Result 1.

*(i) Relative to treatments **N** and **L,** the message "The price is too high" significantly reduces the Amplitude, Duration, Normalized Average Price Deviation and Normalized Absolute Price Deviation for inexperienced subjects. This effect is not significant for experienced subjects.*

*(ii) Relative to treatment **N** the measures are not significantly increased by the release of the message "The price is too low". This holds for both experienced and inexperienced subjects.*

Result 1 emphasizes that apparently uninformative messages affect the behavior of subjects that are exposed to it for the first time (see tables 5a and 5b below). However, these effects are eliminated as traders gain experience. This stresses that once exposed to irrelevant messages subjects learn to disregard them. These findings are consistent with the idea that asset markets are harder to manipulate in the long run.

The magnitude of bubbles is decreased by the release of the message *"The price is too high."* However, we find no evidence that the message "*The price is too low"* exacerbates bubbles. It seems that stabilizing prices appears to be easier than magnifying bubbles. This result may seem surprising given that there exists a natural tendency towards the formation of bubbles in these experimental

markets. However, the formation of bubbles usually implies that asset prices exhibit a persistent positive trend and, in that context, the release of the message "*The price is too low"* may call subjects' attention to the irrelevance of this announcement. In the case of inexperienced traders, a positive trend was observed in 8 out of the 9 cases in the period before the release of the message "*The price is too low"*. This implies that the possible destabilizing effect of financial gurus may be overestimated. That is, words are more effective when they are consistent with the fundamental value of the asset.

Result 2.

*(i) The release of the message "The price is too high" significantly reduces the Upward Trend in prices and precipitates the occurrence of a crash, relative to treatments **L** and **N**, for inexperienced subjects. These effects are not significant with experienced subjects.*

*(ii) The release of the message "The price is too low" does not significantly affect the Upward Trend in prices and the Crash Period relative to the baseline treatment **N** independent of the level of subject experience.*

Result 2 confirms the effect of the message *"The price is too high"* on asset prices and the absence of effect of the message "The price is too low" (see tables 5a and 5b below). Under treatment **H** the *Upward Trend* is practically eliminated (2.3 periods on average in the case of inexperienced traders). Under treatments **N** and **L**, the *Upward Trend* is on average more than twice longer than under treatment **H**. The difference in the patterns of crashes in the case of inexperienced subjects is also very different among treatments. Crashes occur on average between periods 7 and 8 for treatment **H** whereas crashes occur around period 11 in the other treatments. Results 1 and 2 are illustrated by the following figure.

We analyze the effect of messages on the different measures of bubbles by running Wilcoxon non-parametric tests that are summarized in tables 5a and 5b. Descriptive statistics of the measures of bubbles are provided for the different treatments in the appendix (tables 3 and 4). In table 5a, we display the p-values for the tests that a given measure of bubble has the same mean for *i*=**L** and for

$i \in \{\mathbf{N}, \mathbf{H}\}$. The alternative hypothesis is that a given measure of bubble has a greater mean for $i=\mathbf{L}$ than for $i \in \{\mathbf{N}, \mathbf{H}\}$. We provide within brackets the p-values for the same tests when comparing bubbles measures of treatment **L** with treatment **N** only.

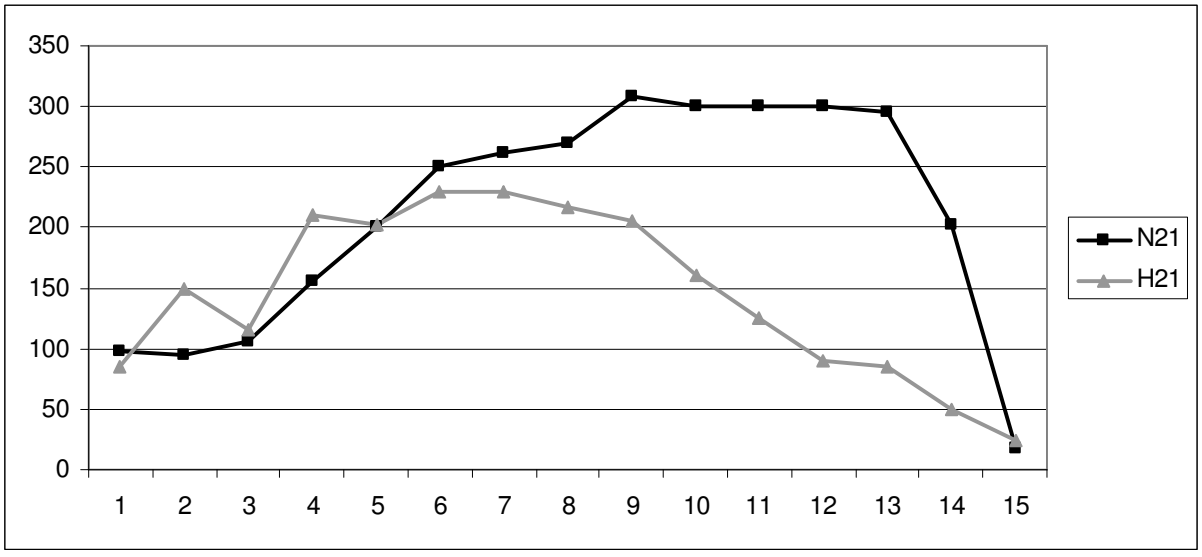
Tables 5a

P-values: Wilcoxon Rank Sum tests-Treatment **L**

	Amplitude	**Duration**	**Normalized Average Price Deviation**	**Normalized Absolute Price Deviation**	**Upward Trend**	**Crash Period**
Inexperienced Traders	0.1905 (0.5)	0.1468 (0.5889)	0.6429 (0.95)	0.1905 (0.65)	0.2548 (0.8232)	0.1217 (0.35)
Experienced Traders	0.1310 (0.2)	0.5 (0.5)	0.4484 (0.8121)	0.1310 (0.2)	0.1166 (0.4124)	0.5 (0.8121)

In table 5b, we provide the p-values for the tests that a given measure of bubble has the same mean for $i=\mathbf{H}$ and for $i \in \{\mathbf{L}, \mathbf{N}\}$. The alternative hypothesis is that a given measure of bubble has a lower mean for $i=\mathbf{H}$ than for $i \in \{\mathbf{L}, \mathbf{N}\}$.

Figure 1: Median prices per period for treatments **N21** and **H21**.



Tables 5b: P-values: Wilcoxon Rank Sum tests-Treatment **H**						
	Amplitude	**Duration**	**Normalized Average Price Deviation**	**Normalized Absolute Price Deviation**	**Upward Trend**	**Crash Period**
Inexperienced Traders	0.0476**	0.0576*	0.0476**	0.0119**	0.0125**	0.0886*
Experienced Traders	0.1905	0.6023	0.1310	0.2738	0.0560*	0.2174

Result 3.

The Amplitude, Duration, Normalized Average Price Deviation and Normalized Absolute Price Deviation are not significantly different between markets involving inexperienced subjects facing the message "The price is too high" and markets with experienced subjects in which this message is not released.

According to result 3 the stabilization in asset prices induced by the message "*The price is too high"* is of similar magnitude as the stabilization effects due to subjects' experience. The release of messages and trader's experience can be seen as two alternative mechanisms by which traders coordinate their expectations towards the fundamental value of the asset. The results are provided in table 6.

In table 6 we provide the p-values for the Wilcoxon Rank Sum test that a given measure of bubble has the same mean for treatments **H*j*1** and treatments ***ij*2**. The alternative hypothesis states that a given measure of bubbles has a different mean for treatments **H*j*1** and ***ij*2**, where $i \in \{\mathbf{L}, \mathbf{N}\}$ and $j \in \{1, 2, 3\}$.

Table 6 P-values: Wilcoxon Rank Sum test- Result 3			
Amplitude	**Duration**	**Normalized Average Price Deviation**	**Normalized Absolute Price Deviation**
0.9048	0.5169	0.381	0.2619

V.2. Trading Volumes.

Different values of *Turnover* are summarized in table 7. We present our results with those of other related studies.

Table 7 Average *Turnover* for the different treatments and for related studies	
	Turnover
No message treatment *Inexperienced [once-experienced] subjects*	6.00 [3.32]
Treatment **L** *Inexperienced [once-experienced] subjects*	4.31 [2.53]
Treatment **H** *Inexperienced [once-experienced] subjects*	4.14 [2.65]
Smith, Van Boening, and Wellford (2000)	5.18
Porter and Smith (1995)	5.49
King et al. (1993) (Short Selling) *Inexperienced subjects*	6.67
Smith, Suchanek and Williams (1988) *Inexperienced subjects*	5.37

In the following tests we compare *Turnover* in different treatments using the Wilcoxon Rank Sum test. The results are presented in table 8.

Test 1 [2]: The mean *Turnover* is the same for treatments **H** and **L** and for treatment **N** in the case of inexperienced **[experienced]** subjects. Under the alternative hypothesis the mean *Turnover* is lower for treatments **H** and **L** than for treatment **N**.

Test 3: The mean *Turnover* is the same for treatment **H** and for treatments **L** and **N** for inexperienced subjects. Under the alternative hypothesis the mean *Turnover* is lower for treatment **H** than for treatments **L** and **N**.

Result 4. *The release of the message "The price is too high" or "The price is too low" significantly reduces Turnover regardless of experience.*

Result 4 emphasizes that a message that does not significantly affect asset prices like "The price is too low" can still impact trading volumes. The effect of messages on *Turnover* may be explained by a semantic effect related to the adverb *too*. Messages like "*The price is too high"* or *"The price is too low"* may call subjects' attention to the possibility of mispricing. Subjects may thus become more cautious in their trading behavior as they take into account the possibility of making valuation mistakes. The results are summarized in table 8.

Table 8:
P-values: Wilcoxon Rank Sum test
Result 4

	P-value
Test 1	0.0238**
Test 2	0.0769*
Test 3	0.1905

V.3. Price Changes.

In this section we analyze the effects of messages (regardless of whether they are true or false) on relative prices changes for the periods in which a message is delivered, i.e. periods 3, 7 and 12. We classify the evolution of median prices as follows. If $\boldsymbol{P_t-P_{t-1}<0}$ **[**$\boldsymbol{P_t-P_{t-1}>0}$**]** for $t\in\{3, 7, 12\}$ then we classify the change in median prices in period t as consistent with treatment **H** [**L**], where $\boldsymbol{P}t$ is the median price in period t. In the following tests we study, given the message, when an increase (or decrease) in median prices is more likely. The results are presented in table 10.

Test 4 [5]: For inexperienced [experienced] subjects, a decrease in median prices is significantly more likely under treatment **H** than under treatments **L** and **N**, for t∈ {3, 7, 12}.

Test 6 [7]: For inexperienced [experienced] subjects, an increase in median prices is significantly more likely under treatment **L** than under treatment **N**, for t∈ {3, 7, 12}.

Result 5. *Relative price changes are highly consistent.*

*i) For inexperienced subjects, a decrease in median prices is significantly more likely under treatment **H** than under treatments **L** and **N**, for t∈{3, 7, 12}. This effect is not significant with experienced subjects.*

*ii) An increase in median prices is not significantly more likely under treatment **L** than under treatment **N**, for t∈{3, 7, 12} whether subjects are experienced or not.*

According to result 5, the impact of treatment **H** on asset prices is consistent with the timing of the message. This finding supports results 1 and 2 since it emphasizes that the impact of treatment **H** on the magnitude of the bubble does not follow a random pattern. The results are summarized in tables 9 and 10.

Table 9 Proportion of periods for which median prices increase			
	Treatment L	**Treatment N**	**Treatment H**
Inexperienced subjects	6 / 9	7 / 9	2 / 8
Experienced subjects	7 / 9	4 / 8	5 / 8

Table 10 Wilcoxon Rank Sum test- Result 5	
	P-value
Test 4	0.0149**
Test 5	0.4721
Test 6	0.7151
Test 7	0.1351

We now analyze whether messages have a stronger impact on asset prices *if they are actually true*. We consider that the message "The price is too high" ["The price is too low"] is true in period $t \in \{3, 7, 12\}$ if $\boldsymbol{P}_{t-1} < ft\text{-}1$ $[\boldsymbol{P}_{t-1} > \boldsymbol{f}_{t-1}]$ where *ft* is the fundamental value of the asset in period *t-1*. In table 11 one can see the proportion of periods for which the changes in the median price are consistent with a true message. Notice, that experienced subjects react are less likely to react when a message is false then when it is true (table 11). This is, however, not true for inexperienced subjects.

Below we test whether median prices are more likely to be consistent in cases in which the message is true.

Test 8 [9]: For inexperienced [experienced] subjects, the proportion of consistent median prices changes is significantly higher for true messages than for false messages, for $t \in \{3, 7, 12\}$.

Result 6. *For inexperienced subjects, the proportion of consistent price changes is not significantly different whether a true or a false message is released.*

However, for experienced subjects, the proportion of consistent price changes is significantly higher for true messages.

Result 6 sheds light on the mechanism that underlies the effect of the message *"The price is too high"* on asset prices. In the case of inexperienced traders, this message moves prices downwards even if prices are below the fundamental value of the asset. Result 6 stresses the possibility of manipulating a market in the periods in which a false announcement is released. However, we know from results 1 and 2 that general measures of bubbles are not affected by the release of a preset message (*"The price is too low"*) that is not consistent with the positive trend usually observed in these markets. As a result, false announcements appear to have a durable effect on asset prices only if they are consistent with the positive trend observed in these markets as it is the case for the message *"The price is too high"*.

Table 11
Proportion of periods for which median prices changes are consistent

	True messages	**False messages**
Inexperienced subjects	7 / 10	6 / 8
Experienced subjects	7 / 9	3 / 8

Table 12
Wilcoxon Rank Sum test-Result 6

	Test 8	**Test 9**
P-values	0.0573*	0.1794

V.4. Excess Bids

In this section we study the evolution of the difference between the number of Bids minus the number of Asks (*Excess Bids*) in periods 3, 7 and 12. The analysis of *Excess Bids* is motivated by the price adjustment model first described in SSW in which *Excess Bids* serves as a predictor for asset prices. The model is estimated as follows.

$$P_t - P_{t-1} = a + b(\text{Excess Bids in period } t\text{-}1)$$

SSW argue that the coefficient *b* should be strictly greater than zero given that *Excess Bids* is positively correlated to excess demand, and excess demand leads to an increase in future average prices. We confirm the role of *Excess Bids* as a predictor of average price changes by testing the following hypothesis: $b>0$. We summarize these results in the following table.

Table 13

Pooled regressions: Inexperienced subjects

$P_t - P_{t-1} = a + b(\text{Excess Bids in period } t\text{-}1)$

Treatment	***b*** **(p-value)**	R^2
Baseline	*1.02* *(0.1370)*	*0.054*
Treatment H	*2.51*** *(0.0316)*	*0.116*
Treatment L	*0.783**** *(0.0099)*	*0.162*

We then analyze the effect of messages on *Excess Bids* in periods 3, 7 and 12. We illustrate this effect in the following figures.

Figure 2: *Excess Bids* around periods 3, 7 and 12 for treatments L and H with inexperienced subjects

Figure 2.1: Excess Bids around the 3rd period

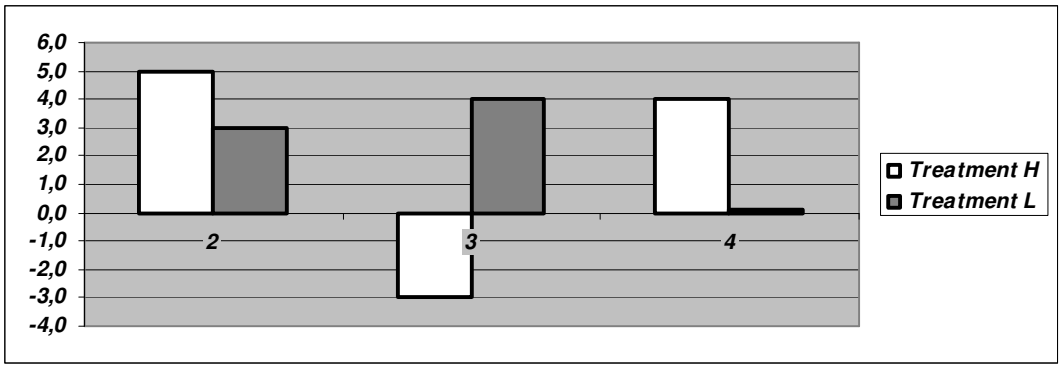


Figure 2.2: Excess Bids around the 7th period

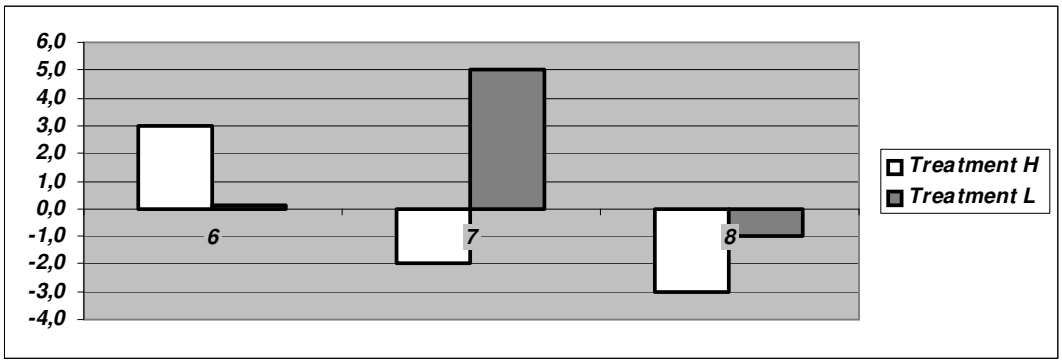
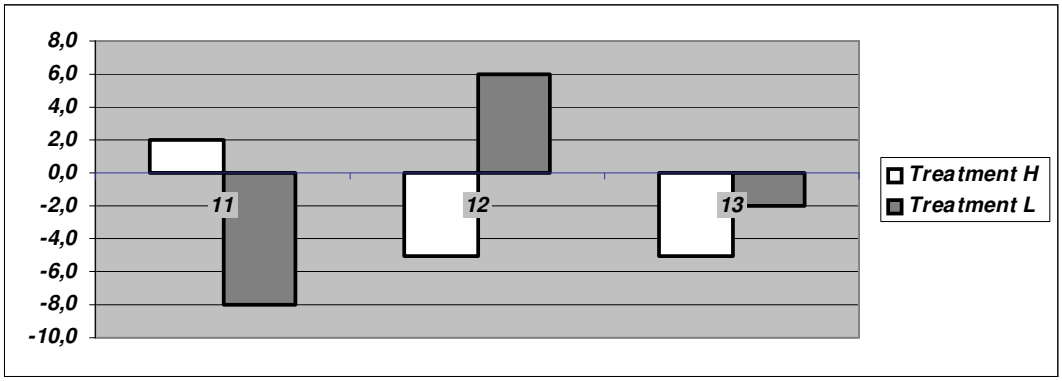


Figure 2.3: Excess Bids around the 12th period



Below we test for bid-ask differentials given trader experience under treatments **H, L** and **N**.

Test 10 [11]: For inexperienced [experienced] subjects, the proportion of strictly positive *Excess Bids* is significantly lower under treatment **H** than under treatment **N**, for $t \in \{3, 7, 12\}$.

Test 12 [13]: For inexperienced [experienced] subjects, the proportion of strictly positive *Excess Bids* is significantly higher under treatment **L** than under treatment **N**, for $t \in \{3, 7, 12\}$.

The results are summarized in Result 7.

Result 7. *i) For inexperienced subjects the proportion of strictly positive Excess Bids is significantly lower for treatment **H** than for treatment **N**. This effect is not significant for experienced subjects.*

*ii) Independent of experience the proportion of strictly positive Bid Excess Bids is not significantly different between treatments **L** and **N**.*

Given the role of *Excess Bids* on predicting prices changes, result 7 implies that treatment **H** affects asset price adjustments when subjects are inexperienced. It is not only that the message lowers asset prices in the periods in which it is released (result 5) but it also reduces prices in subsequent periods. Result 7 is consistent with results 1 and 2 since the effect of treatment **H** is not limited to periods 3, 7 and 12 but also translates to the duration and amplitude of bubbles. It is not surprising to find that treatment **L** has no effect on *Excess Bids* given that results 1 and 2 show that this treatment does not affect bubbles measures. Table 14 summarizes these results.

Table 14
Wilcoxon Rank Sum test- Result 7

	P-value
Test 8	0.0021***
Test 9	0.1794
Test 10	0.9456
Test 11	0.8475

VI. Conclusion

In this paper we explore the effects of apparently benign communications on asset markets. In particular, we found that releasing the preset message "The price is too high" at arbitrary points in time significantly reduces the magnitude of bubbles. The effect of this message on the different measures of bubbles appeared to be comparable to the effect of traders' experience. To the contrary, the message "The price is too low" did not affect the patterns of asset prices. This result emphasizes that it is easier to stabilize than to destabilize experimental markets with bubbles. Further, compared to the baseline treatment and independent of experience, trading volumes were significantly reduced by the release of either message.

Benign messages do affect prices, volumes, bids and asks in experimental asset markets. However, experienced subjects are not significantly affected by the release of such messages in our design. Overall, these results stress that traders learn to identify irrelevant information with experience. This supports the idea that maybe asset markets are subject to manipulation only in the very short run. Further, our work can help assess the extent to which asset markets can be manipulated by influential agents such as financial gurus or (retired) central bankers that deliver non-informative messages to the market.

Our findings on the impact of benign messages on market variables open new directions of research concerning the impact of non-arbitrary messages that would depend on the current situation of the market. For example, we could release messages that state the actual price deviation from the fundamental value of the asset. In that case, would it be possible to eliminate bubbles? Or, would it be possible to exacerbate bubbles? If so, would this effect be robust to traders' experience? These are some of the questions we are analyzing in further research.

VII. Appendix

Results 1 & 2 (Descriptive statistics)

Table 3

Average bubble measures for different treatments and related studies with the same number of periods (15) and traders (9)

Average measures	**Amplitude**	**Duration**	**Normalized Average Price Deviation**	**Normalized Absolute Price Deviation**
Baseline Treatment **N** *Inexperienced subjects*	1.26	10.33	11.16	130.08
Treatment **L** *Inexperienced subjects*	1.30	10.67	6.60	128.75
Treatment **H** *Inexperienced subjects*	0.98	5.67	4.31	58.51
Smith, Van Boening, and Wellford (2000)	1.39	-	5.5	-
Porter and Smith (1995)	1.53	10.15	-	-
King et al.(1993) Short Selling *Inexperienced subjects*	1.61	9.5	11.88	-
SSW *Inexperienced subjects*	1.24	10.2	5.68	-

Table 4

Average measures: Upward Trend and Crash Period

Average measures	Treatment **N** *Inexperienced subjects*	Treatment **L** *Inexperienced subjects*	Treatment **H** *Inexperienced subjects*
Upward Trend	6.33	5.33	2.33
Crash Period	10.67	11.00	7.66

Summary of bubbles measures for the different treatments

1) Statistics for sessions: Message- "The price is too high":

	H11	**H21**	**H31**	**H12**	**H22**	**H32**
Amplitude	**0.98**	**0.82**	**1.16**	**1.05**	**0.50**	**0.89**
Duration	**6**	**6**	**5**	**9**	**4**	**12**
Normalized Average Price Deviation	**3.56**	**3.86**	**5.52**	**2.20**	**0.98**	**3.16**
Normalized Absolute Price Deviation	**17**	**61.80**	**96.73**	**102.96**	**61.35**	**83.75**
Upward Trend	**3**	**2**	**2**	**2**	**3**	**2**
Turnover	**3.32**	**4.5**	**4.59**	**2.32**	**2.27**	**3.36**
Crash Period	**11*** **	**7*** **	**5** **	**9*** **	**7*** **	**13*** **

2) Statistics for sessions: Message-"The price is too low":

	L11	L21	L31	L12	L22	L32
Amplitude	**1.491**	**1.151**	**1.27**	**0.773**	**1.360**	**1.49**
Duration	**9**	**9**	**14**	**4**	**10**	**11**
Normalized Average Price Deviation	**10.52**	**3.94**	**5.33**	**3.58**	**3.58**	**2.16**
Normalized Absolute Price Deviation	**143.33**	**129.70**	**113.23**	**74.23**	**146.17**	**142.48**
Upward Trend	**5**	**4**	**7**	**3**	**6**	**4**
Turnover	**5.81**	**2.86**	**4.27**	**3.772**	**2.272**	**1.54**
Crash Period	**10*** **	**12** **	**No crash**	**11*** **	**12*** **	**13*** **

3) Statistics: No messages:

	N11	N21	N31	N12	N22	N32
Amplitude	**1.08**	**1.37**	**1.33**	**1.29**	**0.56**	**0.94**
Duration	**14**	**12**	**5**	**8**	**2**	**14**
Normalized Average Price Deviation	**10.85**	**9.49**	**13.15**	**5.05**	**1.19**	**3.83**
Normalized Absolute Price Deviation	**119.43**	**137.03**	**133.78**	**110.47**	**44.94**	**94.73**
Upward Trend	**5**	**9**	**5**	**5**	**2**	**4**
Turnover	**5.5**	**6**	**6.5**	**3.45**	**2.59**	**3.91**
Crash Period	**11*** **	**13*** **	**8*** **	**6*** **	**No crash**	**No crash**

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