The Social Life of Financial Bubbles*

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Financial bubbles remain a challenge for economic theory. Puzzlingly, bubbles occur not only in real-world markets, with their inherent uncertainty and noise, but also in highly controlled experimental markets, even when uncertainty is eliminated and calculating the expected returns should be a simple statistical exercise. We propose that bubbles can be understood as episodes of institutional logic. Such logic has been shown to play a pervasive role in the spread of beliefs, behavior, and practices among individuals and organizations, both in laboratory and field studies. We examine experimentally two alternative explanations for the appearance of bubbles: 1) that participants lack knowledge and eventually learn to price correctly and 2) that each participant overconfidently believes that her understanding of the situation is better than average. We find lack of support for either, and show that the appearance of bubbles is congruent with institutionalization processes, similar to those observed elsewhere in financial markets and organizations.

Markets sometimes develop price bubbles: trade in high volumes at prices that are considerably at variance from intrinsic values (Ronald R. King et al., 1993). Cases such as the South Sea Bubble of 1720 or the Dot-Com bubble of the late 1990s demonstrate the enormous effect of bubbles on individuals, firms, markets and even nations, and explain the interest they draw from economists as well as the general public (Charles P. Kindleberger, 1978, Charles MacKay, 1841). While important in their consequences, the causes of bubbles are not well understood. Theoreticians have suggested that bubbles are rational (J. Bradford De Long et al., 1990), intrinsic (Kenneth A. Froot and Maurice Obstfeld, 1991), and contagious (Richard Topol, 1991), but there is no widely accepted theory to explain their occurrence.

Bubbles in Behavioral Economics. The existence of a market bubbles seems at odds with common assumptions regarding the efficiency of financial markets. Even more puzzling is the finding that bubbles occur not only in real-world markets, with their inherent uncertainty and noise, but also in highly predictable experimental markets (e.g. Vernon L. Smith et al., 1988). In the laboratory, uncertainty is eliminated and calculating the expected returns should be a simple mathematical exercise, because participants are endowed with assets that are defined to have finite lifespan and known distribution probability of dividends. Participants should be able to use simple statistics to value the assets they trade according to the expected stream of dividends. Nevertheless, bubbles have been observed repeatedly in experimental markets, even with sophisticated participants such as business students, managers, and professional traders. Experimental bubbles have proven robust to a variety of conditions, including short-selling, margin buying, equal portfolio endowment, brokerage fees, the presence of informed insiders, dividend certainty, constant value, and limit price change rule (Ronald R. King, Vernon L. Smith, Arlington W. Williams and Mark V. van Boening, 1993, David P. Porter and Vernon L. Smith, 2003).

The academic literature on experimental bubbles has suggested that bubbles may be the result of bounded rationality. Only two conditions were found to reduce the occurrence of bubbles, and both seem to be related to difficulty in pricing or myopic focus on short-term gains. First, it was found that when the *same* group of participants traded in repeatedly occasions bubbles were less severe, although never completely eliminated. It has been shown that same-group experience is negatively correlated with the appearance of bubbles (Ronald R. King, Vernon L. Smith, Arlington W. Williams and Mark V. van Boening, 1993, Mark V. van Boening et al., 1993), which may suggest that participants learn how to price assets better. This finding may be explained by bounded rationality and learning by doing. Initially, people have difficulties applying a theoretical model to produce pricing (Herbert A. Simon, 1955) and that leads to mispricing. However, individual learning processes that take place among market participants should lead to rapid improvement in subsequent rounds as learning rates commonly follow a power law (Robert Gagne, 1985). The alleviating effect of delayed dividend payments, the second condition that was shown to reduce bubbles, was stronger when combined with shared group experience (Vernon L. Smith et al., 2000).

Finally, not commonly addressed in the academic literature but prevalent in popular thinking, the "Greater Fool" explanation posits that bubbles are fueled by individuals who knowingly purchase overpriced assets in the hope of selling them to naïve investors, i.e. "greater fools". If each participant in a market (or a sufficiently large number of them) holds the unrealistic believe that her financial acumen is better than everybody else's, all (or most) of the participants will readily acquire overpriced assets, even if each individual investor knows that the assets are overpriced. That is because each individual investor (wrongly) believes that the others do not realize that those assets are overpriced and that expects the others will be willing to buy them at a premium.

Such behavior is congruent with class of cognitive biases collectively known as the Lake Woebegone effect, where it was shown that most people assess themselves to be above average in various positive characteristics (Ola Svenson, 1981). Although a recent study has shown that bubbles developed even when speculation opportunities were eliminated (Vivian Lei et al., 2001), the Greater Fool explanation still looms large in popular sources (e.g. David Dreman, 1993, The Economist, 2003).

In sum, all the explanations we examine here involve arguments of individual bias, whether in pricing assets incorrectly or overestimating one's own acumen.

Method

We used an experimental double auction market (Vernon L. Smith, 1962), which is known to possess extremely competitive characteristics (Charles A. Holt, 1995). In such markets, each participant is endowed with experimental cash and assets, and he is free to post bid and ask prices to buy and sell assets at will. The experimental market was programmed and conducted in z-Tree (Urs Fischbacher, 1999), based on the seminal design of Vernon L. Smith, Gerry L. Suchanek and Arlington W. Williams (1988). To maintain consistency with prior work, we replicated the recent design of Martin Dufwenberg, Tobias Lindqvist, and Evan Moore (2005), including the distribution of dividend streams, asset life span, number and length of trading periods, number of traders, and initial endowment of experimental assets and cash. We also used the participant instruction sheet provided to us by Dufwenberg et. al with only slight stylistic modifications.

Participants were recruited for an experiment in "economic decision making" using a web-based recruiting system. We recruited a total of 62 participants for ten trading sessions. All of the participants were undergraduate students with no prior experience in such experiments.

Upon arrival to the experimental laboratory, they sat down in a meeting room and received the instruction sheet (see Appendix 1a). The participants were given as much time as needed to read the instructions carefully. They required 10 minutes on average. With the instruction sheets still in their possession, the participants received the Price Questionnaire (not titled as such) that required them to provide answers to trading scenarios. For instance, "In the fourth period, someone wants to sell you his stock. Write the maximum price you will be willing to pay for it" (see Appendix 1b). The price questionnaire included 10 questions, one for each trading session, in random order. The participants were told that they might consult the instruction sheet to answer the questions and were given 10 minutes to complete the questionnaire. All of them finished within the time allocated.

With the price questionnaires collected, the participants were asked to complete an Assessment Questionnaire (not titled as such) which included questions on three constructs related to the accuracy of the responses in price questionnaire. Each participant was asked to provide 1) an assessment of the accuracy of his or her own responses, 2) an assessment of the accuracy of the other participants' responses, and 3) an assessment of the other participants' assessment of his or her own responses ("try to imagine what the other people in the room think of you"; see Appendix 1c). Once the price questionnaires were collected, the participants were asked to complete a brief demographics questionnaire. It required about eight minutes on average.

Following that, the participants moved to the computer laboratory, where they sat in separate cubicles in front of networked personal computers. Each participant was randomly assigned to receive either two shares and 600 cents or six shares and 200 cents. They knew that their earnings would be paid to them in cash at the end of the experiment.

Once trading began, the participants could use the computer software to enter their minimum selling prices (ask) and their maximum offers to buy (bid). Those figures were visible to all of the participants and each one could initiate a transaction by accepting a buying or selling offer. The prices in each concluded transaction were also visible to everybody. All transactions were anonymous, and participants could communicate only by posting bid and ask offers. Each trading period lasted 120 seconds.

At the end of each round, a dividend of 20 cents per share was payable with a probability of 0.5, so that participants received a dividend about half of the time, on average. A summary screen presented the individual trading results of the round to the participants, as well as his or her income from dividend, if any. Once everybody read the summary, the next round began. The entire experimental session lasted for 10 trading periods. At the conclusion of the trading periods, the participants received their show-up fee and earnings in cash, were invited to a debriefing session, thanked, and dismissed. Earnings on average were $13.38 (s.d.=2.87; range=$5.30-$18.30).

Results

At the most basic level, our results replicate those obtained in prior work as we observed bubbles in most of the experimental sessions. We take it as an indication that our method constitutes a true replication of prior work. That is, even with the added price and self-assessment questionnaires, which plausibly could have affected behavior.

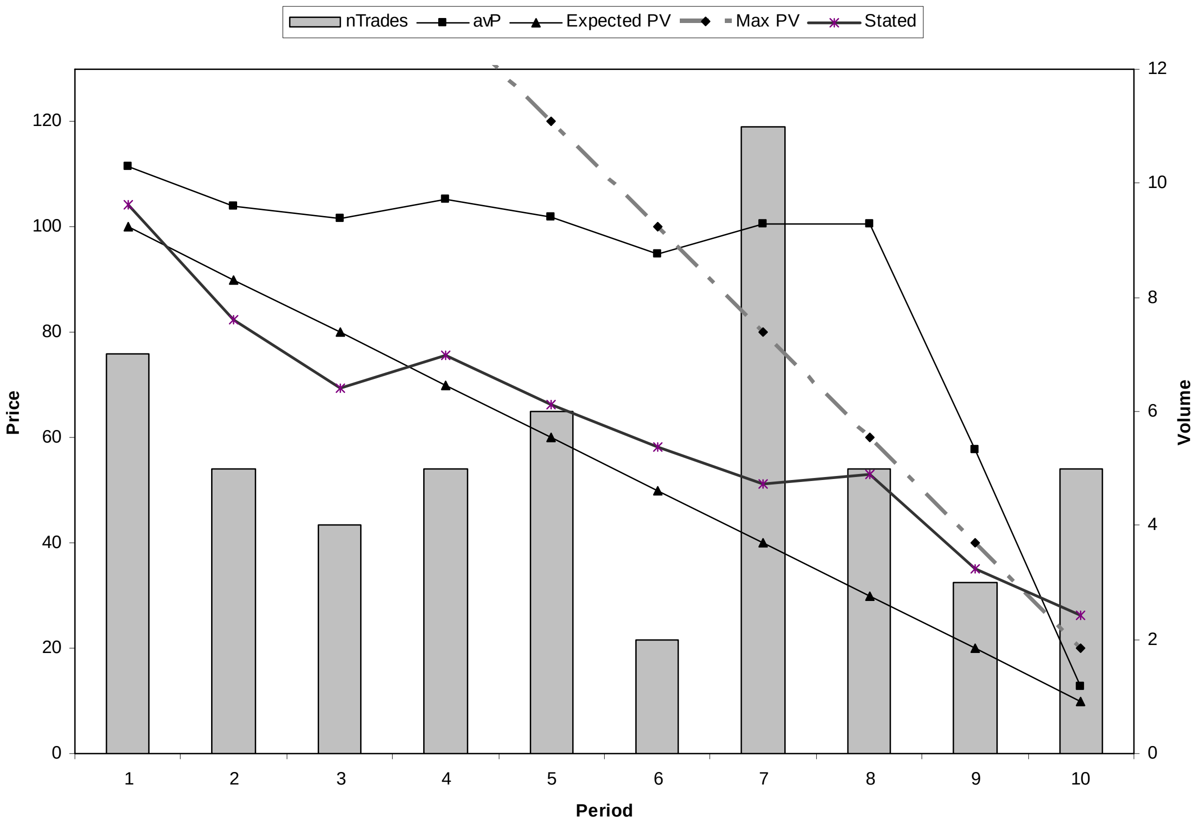

Figure 1**: Illustration of prices in theoretical model versus actual trading behavior in one experimental session.** Legend (left to right): trade volume; average trading price; average present value (fundamental); maximum present value (fundamental); average stated price.

We find that participants had a good understanding of the theoretical pricing model *ex ante*. A comparison of average prices stated in response to the Price Questionnaire with those obtained in actual trading reveals that the stated prices constituted a better fit to the theoretical pricing model. The Haessel R square, a measure of goodness of fit between the data and the fundamental model (Walter Haessel, 1978), was lower for trading prices in nine out of 10 sessions. Figure 1 shows an illustration of the discrepancy between the prices stated *ex ante* and the actual trading prices.

Similarly, prices in trading also had higher normalized average price deviation in nine out of 10 sessions. This statistic was calculated by summing the absolute deviation between mean trading prices and fundamental values for each of the ten periods, and dividing by the number of shares outstanding. Prices in trading also had wider price amplitude in ten out of 10 sessions. This statistic was calculated by finding the highest and the low discrepancies between fundamental value and trading prices, subtracting the lowest from the highest and dividing the 100 (the initial fundamental value). The three measures we use have been used frequently to assess the magnitude of bubbles (Martin Dufwenberg, Tobias Lindqvist and Evan Moore, 2005, Ronald R. King, Vernon L. Smith, Arlington W. Williams and Mark V. van Boening, 1993, David P. Porter and Vernon L. Smith, 2003, Mark V. van Boening, Arlington W. Williams and Shawn LaMaster, 1993).

	Session																	
	1A	2A	3A	4A	5A	6A	7A	8A	9A	10A	1B	2B	3B	4B	5B	6B	7B	8B
	Haessel R Square																	
Stated (S)	0.927	0.903	0.859	0.916	0.888	0.906	0.969	0.004	0.927	0.758	0.838	0.952	0.799	0.937	0.935	0.886	0.839	0.420
Trading (T)	0.552	0.962	0.691	0.698	0.069	0.747	0.896	0.000	0.810	0.525	0.841	0.900	0.404	0.886	0.675	0.523	0.418	0.660
T>S	No	Yes	No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	No	Yes
	Normalized Absolute Price Deviation																	
Stated (S)	0.356	0.279	0.779	0.675	0.454	0.392	0.288	0.793	0.452	0.456	0.793	1.119	0.215	0.477	1.559	0.725	0.671	1.708
Trading (T)	0.594	0.176	0.567	0.757	1.342	0.394	0.167	1.289	0.203	1.856	0.687	0.549	1.963	0.765	0.315	0.450	0.546	0.960
T>S	Yes	No	No	Yes	Yes	Yes	No	Yes	No	Yes	No	No	Yes	Yes	No	No	No	No
	Normalized Average Price Deviation																	
Stated (S)	0.016	0.036	0.083	0.067	0.044	0.041	0.083	0.113	0.057	0.052	0.077	0.147	0.023	0.073	0.187	0.147	0.045	0.249
Trading (T)	0.142	0.040	0.120	0.131	0.162	0.092	0.034	0.204	0.039	0.295	0.124	0.119	0.150	0.037	0.084	0.021	0.048	(0.010)
T>S	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes	No	Yes	No	No	No	Yes	No
	Price Amplitude																	
Stated (S)	0.119	0.123	0.317	0.367	0.195	0.133	0.142	0.602	0.200	0.398	0.378	1.258	0.112	0.300	0.953	0.495	0.300	1.083
Trading (T)	0.678	0.149	0.560	0.443	0.786	0.479	0.186	0.785	0.395	1.329	0.568	1.128	0.740	0.284	0.478	0.670	0.647	0.594
T>S	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No	Yes	Yes	No

Table 1: Measures of Goodness of Fit, Price Deviation, and Price Amplitude for Average Stated versus Trading Prices

Results obtained from the Assessment Questionnaire (Table 2) suggest that participants generally viewed their own price assessment to be as precise as the assessments of the other participants. The same is true about their assessment of others' perception of themselves – they assumed that the others had a correct assessment of their own capabilities – although the mean is slightly lower in that measure. Measures of Cronbach's alpha (Lee J. Cronbach, 1951) show high reliability for each group of questionnaire items.

Construct	No. of Items	Mean	Standard Deviation	Cronbach's Alpha
Participant's self-assessment	3	2.90	1.04	0.79
Participant's assessment of the other participants	6	3.00	0.79	0.69
Participant's assessment of the other participants' perception of him/her	3	2.95	0.77	0.83

Table 2: Items measured in Assessment Questionnaire

Discussion and Conclusion

The results suggest that the appearance of financial bubbles cannot be fully attributed to individual cognitive limitations or biases. From the survey of participants before trading began, it is clear that each participant individually had good understanding of the problem at hand and possessed the necessary knowledge to price in accordance with fundamental value *ex ante*. During trading, however, that knowledge was put to use only occasionally, resulting in worse fit to the fundamental model, higher price deviation, and higher amplitude. Because we have indication of knowledge *ex ante*, it is clear that cognitive limitation or lack of knowledge cannot fully explain the deviations from the fundamental model.

Further, as noted above, the questionnaires were completed within 10 minutes at the most. In contrast, during active trading, participants had a total of 20 minutes to make prices assessments. Hence, it does not seem that time pressure is responsible for the poorer performance during the trading session. We do not rule out, however, that the mere presence of other traders led to a perception of stress and resulted in institutionalized pricing strategies.

Surveying the perception of the participants about their own capability and that of the others allows ruling out the possibility that of a widespread Lake Woebegone Effect, where each agent (wrongly) believes that she possess abilities that are superior to everybody else's. Taken together with prior findings, which showed that bubbles appeared even when it was not possible to profit from speculation (Vivian Lei, Charles N. Noussair and Charles R. Plott, 2001), these findings suggest little validity in the Greater Fool Theory.

These results shed light on another potential cause for financial bubbles – social biases that lead to the emergence of weak norms, rather than just the result of individual cognitive bias of one type or another. It has been argued previously that individuals observe each other and base their decisions, at least partly, on imitation of others rather than on their own cognition (Christopher Avery and Peter Zemsky, 1998, Andrei Shleifer and Lawrence H. Summers, 1990). Theoretical arguments have been made to suggest that markets can deviate from fundamental values even if most of the agents act rationally (Ernst Fehr and Jean-Robert Tyran, 2005), and – more generally – that a small number of actors can disproportionally sway markets away from rational outcomes (Colin F. Camerer and Ernst Fehr, 2006).

Future research can identify whether herding process can happen even in efficient markets, such as the ones simulated in our experiments. Recent findings in the field of corporate governance suggest that the answer is in the affirmative. It has been documented that US stock markets have systematically responded favorably to (costless) announcements of stock buyback, although the announcing firms rarely acted on their announcements. Further, although the failure of the announcer to act was public information, market participants did not incorporate that into their pricing decisions, even over a span of several years (James D. Westphal and Edward J. Zajac, 2001, Edward J. Zajac and James D. Westphal, 2004).

Herding, we suggest, can be the result of institutionalization processes, where agents respond to external pressures, expectations, and the behavior of others by mimicking the behavior of others. This would explain why participants in our study acted according to theory individually, but not collectively. Institutionalization, long documented in groups and organizations, is particularly strong when common interpretation of facts is rewarded. This is the case in financial markets, where an individual agent's gain or loss is associated with a correct prediction of the *market* response to a new fact or event, rather than the correct economic interpretation of the fact or event (J. Bradford De Long, Andrei Shleifer, Lawrence H. Summers and Robert J. Waldmann, 1990, Andrei Shleifer and Lawrence H. Summers, 1990). Non-mainstream behavior can have detrimental financial and status consequences (Joel M. Podolny, 1993). That is, individual-level outcome is highly related to the behavior of others.

Institutionalization leads to the appearance of herding through individual internalization of beliefs and interpretation of facts, until they become taken for granted. Such processes have been shown to sustain practices across agents and over time, even when the practices are irrational or meaningless. In an early laboratory experiment, Zucker (1977) demonstrated how institutionalization facilitated the transmission of a practice that would have clearly appeared counter-factual to an outside observer, but to the agents involved, as in Andresen's The Emperor's New Clothes.

We suggest that a potentially fruitful path would be to investigate how social interaction leads to the spread and formation of shared beliefs in markets. As Douglas North suggested more than a decade ago: "We form mental models to explain and interpret the environment…[which] may be continually redefined with new experiences, include *contacts with others' ideas*" (1994:362-363).

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